International Service for National Agricultural Research
The International Service for National Agricultural Research (ISNAR) began operating at its headquarters in The Hague, Netherlands, on September 1, 1980. It was established by the Consultative Group on International Agricultural Research (CGIAR), on the basis of recommendations from an international task force, for the purpose of assisting governments of developing countries to strengthen their agricultural research. It is a non-profit autonomous agency, international in character, and non-political in management, staffing, and operations.

Of the thirteen centers in the CGIAR network, ISNAR is the only one that focuses primarily on national agricultural research issues. It provides advice to governments, upon request, on research policy, organization, and management issues, thus complementing the activities of other assistance agencies.

ISNAR has active advisory service, research, and training programs.

ISNAR is supported by a number of the members of CGIAR, an informal group of approximately 43 donors, including countries, development banks, international organizations, and foundations.
The use of *curi* and *curies* in the text is in error. The correct term should be *cuy* (plural *cuyes*), which is the Spanish word for guinea pig (*Cavia cobaya*).
The Impact of Improved Institutional Coordination on Agricultural Performance:
The Case of the Nariño Highlands in Colombia

by

Paul Engel

January 1990
INTRODUCTION TO THE ISNAR STUDY ON THE LINKS BETWEEN AGRICULTURAL RESEARCH AND TECHNOLOGY TRANSFER IN DEVELOPING COUNTRIES

David Kaimowitz
Study Leader

In 1987, the International Service for National Agricultural Research (ISNAR) initiated a major international comparative study on the links between agricultural research and technology transfer in developing countries. Like other ISNAR studies, this study was developed in response to requests from agricultural research managers for advice in this area. It is being carried out with the support of the Governments of Italy and the Federal Republic of Germany and the Rockefeller Foundation.

The objective of the study is to identify ways to strengthen the links between agricultural research and technology transfer systems in order to improve the following:

(a) the relevance of research efforts through a better flow of information about farmers' needs for the research systems;
(b) the transfer of technology to agricultural producers and other users of agricultural technologies.

Why the Study Was Initiated

Many sources have noted the problem of poor links between research and technology transfer in developing countries:

"Bridging the gap between research and extension is the most serious institutional problem in developing an effective research and extension system" (World Bank 1985).

"Weak linkages between the research and extension functions were identified as constraints to using the research in 16 (out of 20) of the projects evaluated" (United States Agency for International Development 1982).

"All the 12 countries (in which research projects were evaluated) had difficulties of communication between research institutions and extension agencies" (Food and Agriculture Organization 1984).

The serious consequences of this problem are effectively summed up by a leading expert in the field, Monteze Snyder: "The poor interorganizational relations between the extension agency and the research organization almost guarantee that research results will not reach farmers, and if they do, farmers will not be able to use them" (A Framework for the Analysis of Agricultural Research Organization and Extension Linkages in West Africa, PhD dissertation, George Washington University, 1986).

Despite this situation, no major international study has been dedicated specifically to this issue. While there are some good evaluation reports and academic studies in individual countries, much of what has been written on the issue has been general or anecdotal. The results of practical attempts made to improve links have been disappointing.

A systematic study is needed to provide a set of simple, but not simplistic, suggestions on how research-technology transfer links can be improved in different situations.

Operational Strategy and Products

The study is being conducted over a four-year period and has been divided into three stages. The first stage consists of a literature review, the development of a conceptual framework and case study guidelines, the production of 'theme papers' (see page iii), and pilot case study activities in Colombia. The second stage involves carrying out case studies in six additional countries—Costa Rica, Côte d'Ivoire, the Dominican Republic, Nigeria, the Philippines and Tanzania. In each of these countries the studies will concentrate on specific subsets of the national research and
technology transfer systems. They will also document the links which were involved in the generation and transfer of a small number of specific new agricultural technologies. In the third stage, the various materials which have been developed will be synthesized into one set of concrete applicable guidelines.

Ultimately, four types of documents will be published as part of this special series of papers on research-technology transfer links:

1. **Theme papers** on key linkage-related topics. These have been written by specially commissioned international experts in the field.

2. **Discussion papers** which analyze one or a few major issues emanating from the case studies. About 15 such papers are expected to be produced, written by the case study researchers. They will focus on the most outstanding features of the links observed in the cases and draw clear conclusions about them for practical use by managers.

3. **Synthesis papers** which present the lessons emerging from the case studies. These are being written by ISNAR staff, together with selected study group members.

4. **Guidelines** on how to design and manage the links between agricultural research and technology transfer for policy makers and managers concerned with the two activities. These will also be written by ISNAR staff, with input from the case study researchers, managers of national systems, and others.

The theme papers were published in 1989 and most of the discussion papers will be published in 1990. The synthesis papers and guidelines will probably be published in early 1991. Copies of these papers will be available from ISNAR upon request, at the discretion of ISNAR.
LIST OF THEME PAPERS
IN THE SPECIAL ISNAR LINKAGE SERIES
(published in 1989)

A Conceptual Framework for Studying the Links between Agricultural Research and Technology Transfer in Developing Countries
D. Kaimowitz, M. Snyder and P. Engel

The Agricultural Research-Technology Transfer Interface:
A Knowledge Systems Perspective
N. Röling

Private Sector Agricultural Research and Technology Transfer Links in Developing Countries
C. Pray and R. Echeverría

The Political Economy of the Development and Transfer of Agricultural Technologies
H. Sims and D. Leonard

The Implications of On-Farm Client-Oriented Research for the Relationships between Research and Extension
P. Ewell

Intergroup Relationships in Institutional Agricultural Technology Systems
P. Bennell

The Effect of Changes in State Policy and Organization on Agricultural Research and Extension Links: A Latin American Perspective
R. Martínez Nogueira
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What is that extra piece of dynamism within agricultural institutions which makes the difference between success and failure in terms of their impact upon agricultural performance? Within the major international comparative research project initiated by the International Service for National Agricultural Research (ISNAR) on the links between agricultural research and technology transfer in developing countries, we have been trying to put our finger on it. This paper is my attempt to identify and understand some of the elements which form the basis of successful institutional impact on agricultural performance.

Many people contributed in one way or another to the creation of this paper. I am particularly indebted to Niels Röling, David Kaimowitz, Larry Zuidema, Deborah Merrill-Sands, Willem Stoop, Robin Bourgois and Peter van Beek, and to my colleagues in Pasto in the Nariño Highlands, Belén Arcilla and Germán Arteaga.
The Impact of Improved Institutional Coordination on Agricultural Performance: The Case of the Nariño Highlands in Colombia

INTRODUCTION

Poor institutional performance in the provision of agricultural technology to farmers is often attributed to weak inter-institutional coordination. The message is that a higher level of coordination, collaboration and communication leads to improved institutional performance (Kainowitz et al., 1989), and the list of linkage mechanisms being put forward as a means of enhancing institutional coordination is growing fast.

However, the empirical evidence supporting this message leaves much to be desired. Is there indeed a direct connection between inter-institutional coordination and agricultural performance? What contextual factors are the key to such coordination? Which specific linkage mechanisms can be identified that do not merely enhance coordination but make a direct contribution to improved agricultural performance? This paper uses evidence from the Nariño Highlands, the Andean region in the extreme south of Colombia, to address these questions.

The paper opens with an outline of agricultural performance among peasant farmers in the Nariño Highlands from the 1970s to the mid-1980s. It shows that, after the implementation of the Integrated Rural Development Programme in the mid-1970s, and particularly in the 1980-85 period, there was a significant increase in production in some agricultural domains, whereas in other domains production remained stagnant. The second section looks at the core institutions which were involved in the development and transfer of agricultural technologies in the region during the period under review. In the third section, the level of integration between these institutions is outlined; the role played by linkage mechanisms in facilitating integration is examined in relation to their impact upon certain agricultural domains; and the external factors which contributed institutional integration are discussed. The final section looks at the issue of sustainability of institutional performance in the post-1985 period.

The evidence from Colombia's Nariño Highlands suggests that increased agricultural productivity was directly related to a high level of institutional coordination in developing and transferring the agricultural technologies to peasant farmers. This supports the basic hypothesis of this paper, that strong linkages between agricultural institutions involved in introducing new technologies are key to improved agricultural performance.

Summary

In the late 1970s and early 1980s, agricultural institutions contributed to a considerable increase in productivity amongst peasant farmers in the Nariño Highlands of Colombia. Although national agricultural policies were stable and financial and human resources adequate during this period, this was not the sole reason for institutional success. Specific linkage mechanisms which boosted institutional integration were necessary to ensure high impact on agricultural performance.

Recent shifts in national policy have resulted in a reduction in financial resources, and integration is deteriorating. Local small-farmer organizations seem unable to make effective claims upon the institutions to continue their support for the peasant sector. Some agro-industries may fill the gaps in certain agricultural domains, but overall it appears likely that agricultural productivity amongst peasant farmers in Nariño will decrease.
AGRICULTURAL PERFORMANCE

Small, mixed farms, 85% of which are under 5 hectares, are the predominant source of agricultural production in the Nariño Highlands (URPA, 1987); there are a limited number of large, commercial farms in the region. The main crops grown by Nariño's peasant farmers are potatoes, maize, beans, wheat and barley; the two other main agricultural activities are dairy farming and the production of curies, a species of guinea pig. Potatoes and barley do not form part of the analysis in this paper because certain factors, including unfavorable market conditions during the period under review, make it difficult to interpret the production trends.

Agricultural Performance Prior to the Mid-1970s

Until the mid-1970s, the Nariño Highlands played only a marginal role in the national economy in terms of food crop production. The region did not produce commercial food crops, such as rice, sugar cane and soybeans, all of which had shown dynamic production increases nationally. Over 50% of the region's population depended upon agriculture for its livelihood, compared to 20% nationally, and agriculture accounted for about 30% of the region's output. In all agricultural domains, apart from potatoes, yields were stagnant.

Development of the predominantly peasant economy in the Nariño Highlands was hampered by a lack of capital and expertise. These factors contributed to low levels of labor productivity, poor yields per hectare, and inadequate facilities for marketing agricultural produce elsewhere in Colombia. Thus the region was characterized by stagnant agricultural production, an economy geared towards satisfying local demand and few opportunities for the peasant farmers to improve their situation.

Implementation of the Integrated Rural Development Program

In the mid-1970s, Colombia abandoned large-scale land reform as the main focus of agricultural development in the country and developed a policy aimed at increasing state involvement in the modernization of peasant agriculture. It defined peasant farmers as farmers who owned less than 20 hectares of land, who did not have considerable capital resources and whose major source of income was agricultural production. The two main vehicles for this policy were the Integrated Rural Development Programme (DR!) and the National Food and Nutrition Plan (PAN).

The objectives of these programs were to enhance the role of the peasant farming sector in the national economy and to improve the living standards of Colombia's rural population. To achieve these objectives, emphasis was placed on introducing new food production technologies, improving marketing facilities and providing the necessary rural infrastructure. Within the scope of the DRI program, the responsibility for developing and introducing new technologies was assigned to the Colombia Agricultural Research and Extension Institute (ICA).

The program was initiated in 1974-75. In Nariño, the ICA took up its task in cooperation with other government institutions, including the Agricultural Bank (Caja Agraria), and with the Dutch/Colombian bilateral program, Convenio Colombo Holandes-ICA (ICA-CCH).

Agricultural Performance Between the Late 1970s and Mid-1980s

The level of agricultural production in Nariño during the ensuing decade can be taken as a reliable indicator of the effectiveness of agricultural institutions in bringing about technological change. All new agricultural technologies made available to Nariño's peasant farmers were developed and introduced by or in close cooperation with ICA; most peasant farmers relied on government credit to incorporate new technologies into their systems; and independent evidence suggests that government institutions achieved considerable coverage of the total peasant population.
Figure 1. Productivity trends in Nariño, 1980-1986 (1980 = 100)

The production and yield figures given in this section are derived mainly from two studies carried out by the Regional Agricultural Planning Unit (URPA) in 1983 and 1987. Although there may be some disagreement about the details of these studies, experts agree that the figures accurately reflect the general trends in the Nariño Highlands (CCH Evaluation Mission Reports; ICA-CCH, 1984).

Maize and beans. The acreage under maize decreased in the 1970s, and then stabilized in the early 1980s. The beans acreage increased significantly between 1980 and 1986. In both cases, however, there was a low level of adoption of improved technologies and yields stagnated. Maize continued to be grown mainly for local consumption.

Wheat. Wheat yields declined in the 1970s. However, in the 1980-86 period a 60% increase in yield, combined with a 45% increase in planted area, more than doubled output. A large part of the new area under wheat may have resulted from a substitution of wheat for barley (URPA, 1983).

Dairy. Milk production rose slowly in the 1970s, and then increased considerably in the early 1980s. This trend can be attributed partly to an increase in the number of productive animals (about 30% between 1973 and 1983), and partly to increased production per head (about 60% over the same period).

There were several reasons for this growth. Favorable government credit schemes made it attractive for peasants to enter dairy farming. Milk collection, transport and processing were taken up locally by a regional dairy cooperative, COOPROLACTEOS, which increased its daily raw milk intake from about 10,000 liters in 1980 to over 35,000 in 1986. The gate price for raw milk increased steadily between 1977 and 1984, making milk a stable source of family income. And finally, improved pasture seeds were introduced. Institutional sales of seeds rose steadily after 1980; between 1981 and 1984, some 1000 peasant farmers sowed an estimated 800 hectares of improved pastures (ICA-CCH Annual Reports).

Curis. The development of improved technology for curi breeding and husbandry had a significant impact on the region’s curi producers, many of whom were women. In 1980, only a few curi producers in the Nariño Highlands used improved technologies. After 1985, however,
according to figures produced by the Financial Corporation in Support of Cooperatives (CORFAS) — a non-profit-making private organization established to provide credit for curi production — 236 peasant women obtained credit to enable them to adopt improved technologies; 40 male farmers obtained credit through the DRI/Caja Agraria.

Conclusion

Whereas the pre-1978 period was characterized by stagnation in all domains apart from potatoes, during the 1978-86 period, a significant increase in agricultural production was achieved in three domains — wheat, dairy and curies — whereas in two domains — maize and beans — production stagnated. Given that there is a close correlation between agricultural production and institutional intervention in the region, this would suggest that dairy, wheat and curi production were cases where the institutional development and transfer of technology to peasant farmers was effective, whereas in the case of maize and beans it was not.

The difference in production trends between the 'high impact domains' and the 'low impact domains' is particularly clear in the 1980-86 period, as shown in Figure 1. Although curi production does not feature in the figure, it also falls within the 'high impact domain', as indicated above.
The entities which played a leading role in the development and transfer of technology to peasant farmers in the Nariño Highlands during the 1970s and early 1980s were:

- **ICA/Research**: the Regional Centre for Agricultural Research was established in Obonuco in 1966 and since 1963 has been responsible for ICA research activities in Nariño.

- **ICA/Extension**: during the period under review, there were two ICA District Extension offices in the region, one in Ipiales and the other in the regional capital, Pasto; both offices maintained field offices in various municipalities.

- **Regional DRI Office**: located in Pasto, this office was responsible for implementing the Integrated Rural Development Programme in Nariño.

- **Caja Agraria**: through its regional office in Pasto and its subsidiary offices in all the municipalities of the region, this bank was the main supplier of agricultural credit in the region; in addition, all DRI agricultural loans were channeled through the Caja Agraria.

- **Dutch-Colombian project, ICA-CCH**: this bilateral technical cooperation project, based initially in Obonuco but later in Pasto, operated from 1974 to 1985.

Several other entities were involved in technology development and transfer in the region during this period but they played only facilitating or minor roles in terms of institutional coordination. The contribution made by the National Service for Vocational Training, SENA, was limited to training farmer leaders, farmers and operators, without much follow-up. The ICA-UNICEF program collaborated with CORFAS in organizing curi breeding and production among peasant women. The Colombian Agrarian Reform Institute, INCORA, provided organizational and some technical support to a few farm cooperatives. The University of Nariño supported programs in certain domains.

Below we discuss the core entities in terms of their involvement in research, technology transfer, on-farm research and resource provision; some reference will be made to activities other than those directly concerned with dairy, wheat, curies, maize and beans, in order to give a more comprehensive picture.

Research

The research programs carried out by ICA/Research at the Obonuco station between 1966 and 1987 are shown in Table 1 (overleaf). All of them were associated with national ICA research programs, and some were replications of research carried out at ICA's National Research Centre at Tibaitata (ICA, 1966).

In an evaluation carried out by a visiting Dutch team in 1973, the dairy research program being conducted at the station scored high in terms of on-station performance but low in terms of technology transfer to peasant farmers (Oosterberg and van der Kuip, 1973).

Later, although the station continued to conduct research on the problems faced by medium- and large-scale producers as part of the national ICA dairy research program, it placed more emphasis on adapting research results to meet the needs of small-scale producers in Nariño. With the support of ICA-CCH, an intensive small dairy farming unit was established in 1975.

The efforts undertaken by ICA/Research in wheat, beans and maize focused mainly on breeding and selecting varieties. A large number of varieties have been introduced since the 1960s, many of which have been accepted by Nariño's farmers.

Research on potatoes has been conducted since 1966, and a number of more productive varieties were introduced in the period under review. The ICA-Nariño variety which was developed at the regional station became one of the most widely used varieties in the Nariño Highlands. ICA/Research was also actively involved in producing seed potatoes, both on-station and with selected peasant producers.

In response to both regional and national demands for new technologies, ICA/Research embarked upon several new programs in the early 1980s, including grain legumes, intercropping, horticulture and fruticulture. The agricultural economics research program was implemented in 1985, to enhance the practical applicability of research recommendations through farm budget evaluations. The disciplinary programs on soils, farm machinery, entomology and phytopathology concentrate on specific problem areas.
Table 1. Research programs carried out at the ICA Regional Centre for Agricultural Research since 1966

<table>
<thead>
<tr>
<th>Program</th>
<th>1966</th>
<th>1982</th>
<th>1987</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Maize</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Dairy production</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Pastures and fodder crops</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Potatoes</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Grain legumes</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Intercropping</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Horticulture</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Fruticulture</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Soils</td>
<td></td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Agricultural machinery</td>
<td></td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Entomology</td>
<td></td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>Phytopathology</td>
<td></td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>Agricultural economics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Technology Transfer

During the early 1970s, ICA/Extension operated as part of the Regional Rural Development Project, and focused on organizing farmers’ groups for transferring technology. This approach was abandoned in 1975 and the extension service reverted to undertaking individual farm visits and providing credit assistance, backed by DRI; inevitably, this resulted in reduced coverage.

In 1981, the ICA Communication Department developed a methodology which was aimed at improving the efficiency and effectiveness of technology transfer to small farmers. Known as the Communication Plans for Technology Transfer (PCTT) methodology, it focused on the adequate planning, preparation and implementation of multi-media extension programs and provided the means to clearly define the objectives, target groups and content of these programs. A key element was the systematic planning of extension events with groups of farmers in a village; individual technical assistance and credit services continued to be important.

Between 1981 and 1983, nine PCTT plans were implemented. They were designed by the field workers in collaboration with the ICA Communication Department, and covered the main peasant agricultural activities in the areas concerned. Improved planning and preparation, and the involvement of subject-matter specialists, permitted the plans to be backed up by a continuous production of high-quality extension materials, such as slide shows, booklets, brochures, posters, an ICA newsletter and, since 1983, agricultural news programs on the radio. These materials were professionally produced to ensure easy access by peasant producers, women and school-age children.

By 1985, the implementation of PCTT plans resulted in ICA-DRI coverage of about 10% of small farmers, a significant increase over the coverage achieved previously. The numbers of municipalities, villages and users involved in PCTT operations in the Pasto District in 1983 are given in Table 2; the table also provides figures on the number of extension booklets/brochures produced.

On-Farm Research

In the late 1970s, ICA/Extension began to place far greater emphasis on the adaptation of research recommendations to local conditions through on-farm trials. A Coordinator for Technology Adjustment (that is, on-farm adaptive research) was assigned to the District Office to help extension staff design the trials and process the results. The trials concentrated on varieties and fertilization.
Table 2. Communication Plans for Technology Transfer (PCTT) in operation in the Pasto District during 1983

<table>
<thead>
<tr>
<th>PCTT</th>
<th>Municipalities</th>
<th>Villages</th>
<th>Users</th>
<th>Booklets/brochures*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy</td>
<td>7</td>
<td>18</td>
<td>190</td>
<td>820</td>
</tr>
<tr>
<td>Wheat</td>
<td>2</td>
<td>9</td>
<td>250</td>
<td>550</td>
</tr>
<tr>
<td>Curies</td>
<td>3</td>
<td>6</td>
<td>96</td>
<td>4700</td>
</tr>
<tr>
<td>Maize</td>
<td>5</td>
<td>8</td>
<td>235</td>
<td>0</td>
</tr>
<tr>
<td>Beans</td>
<td>4</td>
<td>7</td>
<td>270</td>
<td>120</td>
</tr>
<tr>
<td>Potatoes</td>
<td>3</td>
<td>12</td>
<td>280</td>
<td>720</td>
</tr>
<tr>
<td>Fruits</td>
<td>7</td>
<td>14</td>
<td>270</td>
<td>1550</td>
</tr>
</tbody>
</table>

Note: * Number of booklets/brochures produced, usually one publication per topic; not all of these were used immediately or within the plan.

Adaptive research in dairy, pastures and horticulture was implemented and evaluated jointly by ICA/Research, ICA/Extension and subject-matter specialists provided by ICA-CCH. From 1978 onwards, extension staff maintained continuous on-farm trials in improved pastures, fodder crops and wheat at about 15 locations; on-farm trials were also conducted for horticultural commodities, and the research programs on potatoes and various other field crops incorporated the extensive use of on-farm demonstrations.

The linear programming studies, farm budget evaluations and economic evaluations of pilot farm operations carried out by ICA-CCH provided valuable insights into alternative technical opportunities for peasant farmers. After the economics section of ICA/Extension was established in 1978, both research and extension incorporated a farm management perspective into the application of research recommendations.

Adaptive research on commercial curi production was taken up by ICA/Extension and ICA-CCH in collaboration with the University of Nariño and the ICA Veterinary Centre in Pasto. In this research, a peasant cooperative (supported by INCORA) and individual peasant farmers played a leading role as innovators; they kept detailed records of their operations and participated in the interpretation and analysis of the research results.

Resource Provision

The Nariño Highlands was one of the first regions in Colombia in which DRI became operational. DRI quickly became the sole source of finance for ICA/Extension's personnel and operational costs, and through the Caja Agraria, financed most of the credit made available to peasant farmers. This gave DRI considerable influence. It used its pivotal position to formulate a strategy for developing Nariño's peasant sector and to reinforce this strategy through the selective allocation of financial resources.

Apart from its support for ICA/Extension's adaptive research programs, however, DRI did not finance research.

This was consistent with the trend in Colombian agricultural policy at the time to place more emphasis on a 'go straight to the farmer' approach and concentrate less on research. National agricultural research expenditure dropped from 0.42% of the agricultural Gross Domestic Product in 1970 to 0.18% in 1978; since 1985, with the help of external finance, this figure has now approached the 1970 level again (Montes Llamas, 1987).

Because of the lack of financial support from DRI, the regional research center faced serious financial constraints during the late 1970s and early 1980s. However, support
from ICA-CCH enabled the center to set up collaborative programs with ICA/Extension on potatoes, dairy, pastures, horticulture and fruticulture. The ICA-CCH project provided for a number of key subject-matter specialists, both Colombian and Dutch, to be specifically assigned to developing extension packages in their fields of expertise. These subject-matter specialists played a vital role in the collaborative programs; they collected and adapted research recommendations, implemented on-farm research projects, assisted in the development of technical extension materials and trained extension staff.

The resources provided by ICA-CCH also had a considerable impact upon PCTT operations. ICA-CCH communication specialists assisted in strengthening the methodology, and introduced a number of measures which complemented the methodology. These measures included: participatory diagnosis, which increased farmer participation in decision-making in extension; the use of peasant vocabulary for technical words in written materials, such as leaflets, which made these materials more accessible to peasants with limited formal education; and a 5-minute radio program, broadcast twice daily, which contained up-to-the-minute news on such items as meetings, demonstrations and research recommendations. These radio programs were very successful among the peasant farmers (Engel, 1984; ICA Communication Department 1984; Guérón and Verbaken 1985).
In this section, we look first at the level of integration between the core institutions in Nariño’s agricultural technology system prior to and during the 1978-85 period. We then identify specific linkage mechanisms which contributed to the high level of integration in the 1978-85 period, and discuss the correlation between the existence of these mechanisms and domain impact. Finally, we examine the external factors which affected integration.

System Integration

The level of integration in Nariño’s agricultural technology system was assessed according to the strength of both formal and informal links between the core institutions; integration within the core institutions did not form part of the study.

Our definition of strong formal links includes such mechanisms as coordinated plans of action, regular coordination meetings, collaborative task groups, and the regular exchange of information and materials. It also includes the provision of resources by DRI (financing operational and staff costs) and ICA-CCH (financing key activities and assigning additional staff, transport and/or materials to priority areas). Informal links are broadly defined as the personal contacts between colleagues and incidental exchanges of information; they are rarely concerned with staff or materials.

In the 1975-78 period, strong links existed between DRI, ICA/Extension and Caja Agraria (see Figure 2 overleaf). As mentioned earlier, all three institutions had offices in the regional capital, Pasto, whereas ICA/Research and ICA-CCH were located some miles away, at Obonuco. In 1978, however, ICA-CCH became a pilot program within ICA/Extension, was provided with additional subject-matter specialists, and moved to Pasto. Nevertheless, it maintained many of its ties with ICA/Research and continued to be involved in on-station research programs at the Obonuco research center.

This proved to be crucial to the level of integration between research and technology transfer. Whereas research-technology transfer links were very weak in the early 1970s, the 1978-85 period was characterized by a high level of coordination between these two activities. After a period of mutual adjustment between 1978 and 1980, ICA/Extension and ICA-CCH played the role of ‘integrators’ within the system, facilitating the links between all the core institutions, including research (see Figure 3 overleaf).

Before 1978, ICA/Extension had started to promote DRI credit to peasant farmers but its impact was limited. The main reason for this was that it focused on individuals rather than groups, without the back-up of group or mass communication media; in addition, priorities were not clearly defined and, with the possible exception of the potato program, technical messages were poorly articulated. In the early 1980s, however, particularly after the group approach incorporated in the PCIT methodology had been introduced, it received assistance from ICA-CCH subject-matter specialists in setting priorities, formulating extension content and developing extension materials. Mass media back-up — printed, audiovisual and radio — was provided. Technical issues were often discussed at regional and national coordinating committees. After 1982, DRI, along with ICA/Extension and ICA/Research representatives, formally took part in the ICA-CCH national coordinating committee meetings.

Linkage Mechanisms

The analysis here centers on the two types of linkage mechanisms which were established in the 1978-85 period: those connected with the development of institutional leadership and strategic consensus; and those related to carrying out development and transfer tasks.

Institutional leadership and strategic consensus. Technical leadership was in the hands of ICA, the institution with the necessary knowledge and experience to successfully develop and introduce improved technologies to peasant producers. Political leadership was in hands of the DRI, as the implementing agency of the Integrated Rural Development Programme.

ICA/Research had been present in Nariño since 1946, and had research programs on most of the important crops and
Figure 2. Integration between the core institutions serving peasant farmers in Nariño, 1975-1978

<table>
<thead>
<tr>
<th>ICA/Extension</th>
<th>DRI/Nariño</th>
<th>Caja Agraria</th>
<th>ICA-CCH</th>
<th>ICA/Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICA/Extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRI/Nariño</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caja Agraria</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICA-CCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICA/Research</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- intra-institutional integration (not considered in this paper)
- limited informal inter-institutional linkages
- strong formal and informal inter-institutional linkages
- no linkages

Figure 3. Integration between the core institutions serving peasant farmers in Nariño, 1978-1985

<table>
<thead>
<tr>
<th>ICA/Extension</th>
<th>DRI/Nariño</th>
<th>Caja Agraria</th>
<th>ICA-CCH</th>
<th>ICA/Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICA/Extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRI/Nariño</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caja Agraria</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICA-CCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICA/Research</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- intra-institutional integration (not considered in this paper)
- limited informal inter-institutional linkages
- strong formal and informal inter-institutional linkages
- no linkages

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animal husbandry activities associated with small farmers in the region. The expertise within the ICA-CCH team complemented the technical capacity of ICA/Research in dairy, horticulture and fruiticulture, and was instrumental in developing awareness about the technical possibilities of curi production. ICA/Extension had long experience in extension among the highland peasants. Its most significant contribution to technology transfer was undoubtedly the introduction of the PCTT methodology, which provided the tools to systematically plan and implement multi-media extension campaigns, directed at groups of peasant farmers at the village level.

After a slow start, DRI asserted its political leadership in Nariño in 1978; by then, DRI was financing all the peasant-oriented operations of ICA/Extension and Caja Agraria. After the ICA-CCH move to Pasto in 1980, DRI played an active role in developing strong links with the project. Its leadership role was further strengthened in 1983 when DRI District Planning Seminars formulated the priorities that were to guide the disbursement of loans to peasant farmers. The priorities were carefully chosen to coincide as far as possible with ICA’s on-going programs, in order to make the best use of technical expertise already present in the region. DRI’s links with research would have remained poor, however, if ICA and ICA-CCH had not exerted considerable pressure on DRI to finance on-farm trials and subject-matter specialists.

The eventual result was a considerable strategic consensus among the core institutions. During the 1978-85 period, they shared a common goal — to improve the well-being of the peasants through the introduction of improved agricultural technologies — and directed their activities to a specific client group, as defined by the DRI program. The data in Table 3 (overleaf) make it clear that DRI set its priorities according to those areas covered by ICA/Extension and ICA/Research programs.

A number of specific linkage mechanisms contributed to the development of leadership and strategic consensus.

- To carry out its tasks of planning, budgeting, financing and monitoring activities in the region, the DRI regional office established strong links with the national DRI office and with a number of quasi-government organizations operating in Nariño. Targeting credit, staff and other resources related to these activities was agreed upon at regular meetings attended by policy makers and representatives from extension, training, marketing, input distribution and, to some degree, farmers.

- The DRI Technical Committee responsible for Nariño met monthly and involved the directors of all relevant agricultural institutions in the region. These meetings were intended to provide coordination rather than control; they reinforced institutional targeting and strengthened the links, mostly informal, between the technical institutions. Decisions concerning the allocation of resources were taken at higher levels.

- The quarterly ICA-CCHI national and regional coordinating committee meetings, reinforced by bi-annual joint evaluation missions, strengthened international, national and regional coordination. They focused on agricultural development in Nariño, government policy and technical opportunities for peasant farmers and, in response to identified constraints and technical opportunities, re-allocated ICA-CCHI project funds.

The DRI Departmental Committee generally assigned priorities on the basis of national policy and the current contribution of the planted area to regional and/or national agricultural output. The ICA-CCHI coordinating committees placed more emphasis on identifying future high-potential domains of peasant production, hence the priority attached to horticulture, curi and fruiticulture. This resulted in a situation which, in terms of targeting resources, the DRI and ICA-CCHI efforts complemented each other to a large degree, as shown in Table 4 (overleaf). While the general coincidence between integration and joint targeting is apparent in the table, no direct correlation was found between the domains targeted by DRI and ICA-CCHI and the high and low impact domains.

**Performance of technology development and transfer tasks.** A number of formal linkage mechanisms were established within the Nariño agricultural technology system to perform such tasks as adaptive research, extension and training. The most frequently used mechanisms are given here.

- Collaborative task groups of technicians were established at district level to jointly perform a specific task, such as a multi-disciplinary survey report, a multi-media extension campaign, the design and implementation of an on-farm or on-station experiment or the production of a training manual or an extension brochure. For example, a multi-disciplinary task group, comprising two ICA researchers (dairy and horticulture) and three subject-matter specialists (dairy, pasture management and agro-economics) drawn from ICA and ICA-CCHI, was set up to supervise, evaluate and report on the trials carried out by the intensive mixed farming unit at the regional research station; over a period of four years, the group met at least once a month.

- Subject-matter specialists (technical, economic and communication) assumed responsibility for coordinating adaptive research, staff training, extension programs and the production of extension materials according to their particular field of expertise. They needed to have both technical and communication skills, and maintained close links with farmers, extension workers and...
Table 3. Program coverage by the core institutions in the Narifio Highlands, 1982 to 1986

<table>
<thead>
<tr>
<th>Program</th>
<th>1982</th>
<th>1984</th>
<th>1986</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy</td>
<td># + *</td>
<td># + * §</td>
<td># + §</td>
</tr>
<tr>
<td>Curies</td>
<td># *</td>
<td># *</td>
<td>#</td>
</tr>
<tr>
<td>Pastures and fodder crops</td>
<td># + *</td>
<td># + * §</td>
<td># + §</td>
</tr>
<tr>
<td>Wheat/barley</td>
<td># +</td>
<td># + §</td>
<td># + §</td>
</tr>
<tr>
<td>Potatoes</td>
<td># +</td>
<td># + §</td>
<td># + §</td>
</tr>
<tr>
<td>Maize</td>
<td># +</td>
<td># + §</td>
<td># + §</td>
</tr>
<tr>
<td>Beans</td>
<td># +</td>
<td># + §</td>
<td># + §</td>
</tr>
<tr>
<td>Intercropping</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Vegetables</td>
<td># + *</td>
<td># +</td>
<td>+</td>
</tr>
<tr>
<td>Fruits</td>
<td># *</td>
<td># + *</td>
<td>+</td>
</tr>
<tr>
<td>Agricultural economics</td>
<td># *</td>
<td># *</td>
<td>+</td>
</tr>
<tr>
<td>Rural communications</td>
<td># *</td>
<td># *</td>
<td>#</td>
</tr>
<tr>
<td>Soils</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Agricultural machinery</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Entomology</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Phytopathology</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Veterinary services</td>
<td># *</td>
<td># *</td>
<td>#</td>
</tr>
</tbody>
</table>

Note: # ICA/Extension; + ICA/Research; * ICA-CCH; § DRI priorities

Table 4. Domain targeting by DRI and ICA in relation to impact, 1984

<table>
<thead>
<tr>
<th>High Impact domains</th>
<th>Low Impact domains</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dairy</td>
</tr>
<tr>
<td>DRI targeting</td>
<td>yes</td>
</tr>
<tr>
<td>ICA-CCH targeting</td>
<td>yes</td>
</tr>
</tbody>
</table>
researchers. As shown in Table 5, the sharp increase in the number and coverage of subject-matter specialists in 1978-80 coincided with the ICA CCH move to ICA/Extension and with the subsequent shift of emphasis towards impact and dissemination. This suggests that the use of subject-matter specialists was a crucial factor in the impact made by the agricultural institutions from 1980 onwards.

- Systematic programs of on-farm trials and experiments were performed by research or extension staff in collaboration with farmers to adapt technologies to the specific conditions of a community or zone. Generally, these trials involved formal agreements between the farmer and the implementing institution, including subsidized inputs and, in the case of high risk operations, compensation.

- To implement the PCTT methodology developed by ICA's Communication Department, it was necessary to establish two sets of links. Firstly, extension field supervisors, subject-matter specialists and researchers had to work together to design the plan. Secondly, they were all involved in the implementation of the plan, thus bringing them into contact with a considerable number of farmers.

Table 5. Number of subject-matter specialists assigned to the Narino Highlands, 1974 to 1984

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy production</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Pastures and fodder crops</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Curies</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Milk processing</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Horticulture/fruticulture</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Socio-economics</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Extension/communication</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5</strong></td>
<td><strong>6</strong></td>
<td><strong>11</strong></td>
<td><strong>13</strong></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>


The relationship between the use of certain task-related linkage mechanisms within specific agricultural domains in Narino in 1981 and institutional impact in these domains is shown in Table 6 (overleaf). The table suggests that collaborative task groups, subject-matter specialists and on-farm trials were the mechanisms most clearly associated with high impact.

The data on PCTT are less unequivocal. PCTT programs in wheat did not begin until 1983, but prior to that date systematic extension programming and implementation was being carried out. Our qualified conclusion is that the PCTT methodology was also associated with high impact.

Training, measured by the existence of training manuals in 1981, apparently had no relation to impact. The data suggest that although impact cannot be achieved without training field workers, training alone is not sufficient when other linkages fail.

Scarce Input Support (the name given to an ICA-CCH revolving fund) played a complementary role, particularly where commercial linkages for input supplies to peasant farmers were inadequate. This was the case, for example, with the supplies of improved grass seeds; the improved seeds were sold commercially in 60-kilo bags but, with the support of the revolving fund, they were re-packed in 3- or 5-kilo bags for those peasants who were interested in trying out smaller quantities. This service was important in both the dairy and curi programs, but less so in the wheat program as all inputs were readily available locally.
Table 6. Domain Impact In relation to the existence of specific task-related linkage mechanisms within the domain, 1981

<table>
<thead>
<tr>
<th>Linkage mechanism</th>
<th>High Impact domains</th>
<th>Low Impact domains</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dairy*</td>
<td>Curies</td>
</tr>
<tr>
<td>Collaborative task groups</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Subject-matter specialists</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>On-farm trials</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>PCTT program</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Training manuals</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Scarce Input Support</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

Note: * 'Dairy' includes pasture management; the two cases are identical  
** Demonstrations were bold but on-farm evaluations were not as widespread and systematic as in the case of wheat  
*** Those PCTT programs were not started until 1983, and were implemented less widely than in the case of dairy

External Factors

A number of external factors had a positive effect on system integration and performance among the core agricultural institutions in Nariño.

- Agricultural policy towards peasant farmers was relatively stable in the 1975-85 period, giving institutions enough time to develop inter-institutional relationships. The experience in Nariño suggests that even if adequate formal and informal linkage mechanisms are in place, as was the case in 1978, impact will be visible only after a considerable time lag, during which the institutions work out their rules, reach a degree of consensus on priorities and start implementing programs. The data suggest that in Nariño this adjustment period took about two years.

- Adequate financial and human resources were available throughout this period. The DRI financed field staff, operational expenses and credit; ICA-CCH provided finance for additional specialist support, training, contingency funds and some operational costs. ICA-CCH finance was particularly helpful in exploratory research and extension activities and in overcoming temporary administrative barriers which were hindering the implementation of already agreed upon programs.

- Adequate marketing opportunities were available in most domains, particularly in the case of dairy. Rising farm gate prices and the establishment of new milk collection and processing industries made dairy farming attractive for many peasant farmers in Nariño.

An external factor which had a negative effect on the performance of all the core institutions was centralized decision-making. The experience in Nariño suggests that centralized decision-making is not associated with high system performance. We will provide some examples to support this contention.

ICA/Research programs in Nariño tended to follow national priorities. Thus, although FAO had recommended as early as 1952 that the regional research station should initiate research on curi production, this recommendation was not taken up (Munoz, 1952). These protein-rich animals are eaten only in certain parts of Colombia and were therefore not regarded as a national priority. The decision to undertake research into curi production was taken at district level by ICA-CCH, without the involvement of the regional ICA/Research and was later approved by the regional and national ICA-CCH committees.

Another example concerns the PCTT methodology. Although it was an effective planning and programming tool, it did not incorporate the use of farmer participation in setting extension priorities. Having identified this gap, ICA-CCH set out to fill it by introducing the participatory diagnosis method (Engel 1984). However, although this method proved to be efficient in the field, was tested by ICA staff in a second region and was adopted by the ICA-UNICEF project and CORFAS, it did not become a formal part of the national PCTT methodology.

A final example concerns ICA's publications policy. ICA encourages research and extension staff to write technical
publications by offering salary increments for any materials published officially. However, for work to be accepted for official publication, it has to be approved by the Publications Council at the national headquarters, PUBLAICA; this approval process involves people from eight different ICA units and a minimum of 47 actions. Inevitably, many titles are either published too late for extension purposes or remain unofficial. In 1981, only one title was published officially. Over the following few years, publications procedures in Nariño were decentralized; local printing and audio-visual facilities were established under a Dutch grant, and provisional editions of all extension publications emanating from the Nariño region were printed before they were submitted for official screening and approval. This resulted in a sharp increase in the production and use of extension materials; in 1984, 11 titles were published.

Conclusion

Against the background of the review of agricultural performance among the peasant sector in Nariño, a number of conclusions can be drawn from the above analysis of system integration and the linkage mechanisms and external factors which influenced integration levels.

- The period during which system integration in Nariño was at its highest coincides with the period of increased impact in agricultural performance. It seems likely, therefore, that there is a direct link between institutional coordination and the impact of the relevant institutions on agricultural performance.

- The period during which strong institutional leadership and strategic consensus developed among the core institutions coincides with the period during which there was a high level of system integration, measured in terms of the level of resources exchanged between institutions. It is likely, therefore, that there is a direct correlation between these two sets of factors.

- A number of task-related linkage mechanisms, in particular collaborative task groups, subject-matter specialists and on-farm trials, and, to a lesser extent, the PCTT methodology can be directly related to high institutional performance and impact. It was found that high impact domains were supported by such mechanisms, but that this was not the case in low impact domains. This leads to the conclusion that different degrees of integration result in differences in performance and impact.

- It seems clear that stable agricultural policies, adequate financial and human resources, and incentives for agricultural development at the farm level are necessary conditions for effective performance of agricultural institutions. A degree of decentralization in decision-making is probably also associated with high performance; centralized decision-making blocks effective institutional performance and integration at the district and field level.
SUSTAINABILITY OF INSTITUTIONAL PERFORMANCE

Will the high degree of institutional coordination and performance achieved in 1978–85 be maintained? Will the institutions involved been able to sustain their impact on peasant agriculture in the Nariño Highlands? To address these questions, developments since 1985 and the prospects of solving the problems identified are outlined below.

Policy Shifts

Agricultural policies have shifted rapidly since 1985, from focusing on the highland peasant-farming areas of Colombia to developing the country’s lowland agricultural frontier areas. As a result, the DRI budget has been cut considerably, and the DRI has concentrated its efforts on marketing and infrastructural projects. DRI funding for agricultural technology programs has been reduced to the minimum and, although credits are still provided, there is little finance available for extension services.

ICA extension policy has also changed. Some efforts have been redirected into setting up a new information system for rural areas through the establishment of District Information Centres. One such center was to have been established in Pasto. However, the initiative has suffered from lack of funds and has added little to the already existing human resources, infrastructure or practices in Nariño. In 1987, ICA announced yet another extension policy, termed the ‘integrated model for regional development’ and implemented through Regional Training and Technology Diffusion Centers (CRECEDs). The CRECEDs are designed to integrate research and extension services within each agro-ecological zone and, through Advisory Boards, plan the type and extent of producer participation in the technology generation and transfer process (ICA, 1987). It is still unclear whether this initiative will be backed with the resources required for successful implementation. In the meantime, financial resources for extension have become extremely limited.

The ICA-CCII project was terminated in June 1985. As a result, ICA/Extension lost most of its subject-matter specialists; some were transferred to ICA/Research’s regional station at Obonuco.

In 1983, ICA succeeded in obtaining external funding for research. This went some way towards reducing the financial constraints faced by the Obonuco research station; it was formally designated the national research station for Colombia’s peasant producers, and also became the headquarters of the national cereals research program. By 1988, however, the financial situation had deteriorated considerably; the station was faced with budget cuts of up to 60% for some programs, and operational expenses were stripped to the bare minimum. Operational expenses for on-farm research are now met only if external funds, either from the private sector or foreign donors, are available.

Decline of System Integration

The decline in DRI’s resources has been accompanied by a decline in the institutional leadership provided by DRI, particularly with regard to technology development. In addition to their normal programming and administrative tasks, extension area managers are now also expected to assume specialists’ tasks. They have continued to organize adaptive trials, but have been able to devote very little time to adapting new technologies or developing new extension materials.

Most PCTT plans in operation in 1987 had been designed in 1983; little time is available to design new ones, or even improve existing ones. In the 1984-87 period, emphasis was placed on increasing coverage by repetition, and the number of farmers reached doubled; in the meantime, however, the development of new subject-matter content stagnated. The production of written extension materials also decreased, from 15 titles in 1983 to five in 1987, of which two were reprints and two were one-page leaflets.

The reduction in the number of subject-matter specialists had a serious effect on research-extension links in that it led to the demise of collaborative task groups.

As shown in Figure 4 (overleaf), inter-institutional coordination declined considerably after 1985, with collaboration between research and extension reverting to predominantly informal links.
**Organized User Control**

It is possible that some of the problems which have arisen as a result of the policy shifts and the decline in system integration in the Nariño Highlands since 1985 can be addressed by organized user control. However, the establishment of strong user organizations is a comparatively recent development and it is still unclear as to what degree they can influence technology development and transfer in Nariño.

The milk cooperative, COOPROLACTEOS, and the cereal growers’ association, FENALCE, are both strong and articulate enough to take on a leadership role and to demand services from the relevant institutions. In some areas, COOPROLACTEOS has played a leading role, and it is likely that it will strengthen its involvement in technology development for dairy producers. Established in 1977 with Dutch assistance, it has grown into a multi-million pesos organization producing a wide range of dairy products for Nariño and other regions. Its membership consists mainly of small and medium producers, whose interests it represents at both regional and national levels.

FENALCE might play a more influential role in setting technology development and transfer priorities for small producers, but it is less firmly rooted in Nariño than COOPROLACTEOS.

The curi producers’ association, ASOCUY, has not yet established itself as a strong regional organization.

The regional brewery, Bavaria, has a strong position in Nariño. It has recently started to finance ICA’s adaptive research on barley.

DRI has established a National Association for DRI users, ANDRI, with a regional chapter in Nariño. However, it is unlikely that ANDRI will have much influence on institutional policies.

In 1986, ICA’s regional research center at Obono established an Advisory Council; the council meetings are attended by commercial farmers, agricultural professionals and a peasant farmers’ representative. Prior to this, there was no mechanism whereby peasant farmers could exert a direct influence on the center’s research policy. However, the effective participation of the peasant farmers’ representative seems strongly limited by socio-cultural factors.
Conclusion

From the analysis of the relationship between institutional coordination and agricultural performance among the peasant sector in Colombia's Nariño Highlands in the 1975-78, 1978-85 and post-1985 periods, it seems clear that strong linkages between the relevant agricultural institutions are crucial in improving agricultural performance.

The pre-1978 period was characterized by weak links between research and technology transfer and stagnant production in most domains. The development of strong research-technology transfer links in some domains in the 1978-85 period resulted in a noticeable increase in institutional impact on agricultural performance. With the post-1985 decrease in extensions' resources, the disappearance of effective linkage mechanisms and declining integration between the core agricultural institutions in the Nariño Highlands, it would appear that system performance in the region is currently in jeopardy. Although impact is still visible, it depends upon repetition rather than new developments; at some point, the reservoir will run dry.

The correlation between institutional coordination and institutional impact on wheat, dairy and curies — the high impact domains — and maize and beans — the low impact domains — is summarized in Figure 5.

**Figure 5. The correlation between institutional coordination and impact**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High INSTITUTIONAL IMPACT AND COORDINATION</td>
<td>Dairy, Curi, Wheat, Maize, Beans</td>
<td>Dairy, Curi, Wheat</td>
</tr>
<tr>
<td>Low</td>
<td>Maize, Beans</td>
<td>Maize, Beans</td>
</tr>
</tbody>
</table>

The prospects are particularly poor for peasant farmers. National priorities have shifted away from meeting their needs, and the agricultural institutions cannot but follow these. Farmer and agro-industrial organizations may fill the gap in certain domains, particularly in the cereal and dairy sectors, but apart from this no effective user organizations exist which could take up the interests of peasant farmers within Nariño's agricultural technology system.
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