

CRU 630 T828a 1987

INTER-AMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE (IICA)

TECHNOLOGY GENERATION AND TRANSFER PROGRAM

AGRICULTURA RESEARCH IN SMALL COUNTRIES: SOME ORGANIZATIONAL ALTERNATIVES

Eduardo J. Trigo

IICA CH CR 630 T828a 1987

San José, Costa Rica
October, 1987

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1987

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AGRICULTURAL RESEARCH IN SMALL COUNTRIES;
SOME ORGANIZATIONAL ALTERNATIVES 1/ 2/

I. INTRODUCTION

How to effectively organize agricultural technology generation and transfer in a small country is a big challenge. In most cases resources are just not nearly enough to appropriately fund a minimum scale of activities, demands on the other side are not totally determined by the size of the country. There are, however, a number of ways in which the impact of this restriction can be lessened if not completely eliminated. This paper discusses some of the available alternatives giving particular attention to the potentials of networking as an organizational solution for providing for the small countries' technological needs. In so doing the different factors affecting the effectiveness of different types of networks are discussed and some of the experiences available in Latin America and the Caribbean are analyzed.

1/ Some parts of this document draw heavily on previous work by the author and the paper "Establishing Agricultural Research Policy: Problems and Alternatives for Small Countries" by W.K. Gamble and E.J. Trigo presented at Agricultural Research Policy and Organization in Small Countries Workshop, Wageningen, The Netherlands, 11 to 14 September 1984.

2/ The author wants to recognize the comments and contributions of Jorge Ardila and Eduardo Lindarte particularly in reference to the development of the analytical framework used to present Latin America and the Caribbean networking experiences.

II: THE SMALL-COUNTRY PROBLEM: CONFLICT BETWEEN RESOURCES AND NEEDS

The main problem facing the development of an effective agricultural research system in a small country is the potential conflict between research needs and the amount of resources available to meet those needs.

A country's research needs are related to the country's size, but the relationship is not a direct one. Given the characteristics and location specificity of agricultural production, some research capacity is essential in support of agricultural development, no matter how small the country may be. Smaller countries do not necessarily have a smaller variety of crops in their agricultural production mix than larger countries. Quantities produced will of course be less, but not necessarily the number of production alternatives that should be included in the agricultural research mix.

This problem can be confirmed by a cursory look at the situation in a few countries of widely different size, such as the Dominican Republic, Costa Rica, and Colombia in Latin America, and Sri Lanka, Bangladesh, and India in Asia. There may be differences in the total numbers of products they include in their research mix but there is not much variation in the major components of their research programs other than that coming from agroecological differences. Even when going into the smallest countries such as the island states, in the Caribbean, we find that the number of crops for which research is required is likely to be 10 or more.

Another important consideration is the relative indivisibility of research below a certain minimum critical mass effort. This is a difficult issue to discuss in general terms, but, it can be safely stated that there is a minimum size research effort below which no relevant results can be expected. This effort, which can be equated to a fixed-cost concept, will be approximately the same throughout a wide range of variation in the area planted to any particular crop. The work and costs required to develop a new variety or a new cultural practice would be about the same, whether a crop is planted on 10,000 or 100,000 hectares. In both cases, the basic core of activities and expertise required will be the same, and includes information on the country's natural resources -soil and water surveys, etc.- plus some capacity on a minimum number of areas such as agronomy, plant breeding, pest and disease control, physiology, soils and socioeconomics.

The size of a country's core research effort is also influenced by its climate and other environmental characteristics. Tropical agriculture tends to be more diversified than temperate agriculture, and as diversity increases, research needs will also increase, if for no other reason than the need to replicate experiments and to test results in a greater number of different production environments. So environment exacerbates the conflict between research needs and available resources; most small countries in the developing world are located in the tropics.

Consumer demands also have an important impact on research needs, and they are not directly related to country size. Income and climatic factors will affect diets, but whether a country is large or small will have little bearing on the numbers and types of products included in its diet. The need to reduce balance-of-payment deficits and the political importance of food self-sufficiency have made meeting food demand through local production high priority in many, if not most, developing countries. This increases the pressure on the number of products a national research system must include in its program whether a country is large or small.

Quite apart from research needs, the amount of resources a nation can devote to agricultural research is determined by its size and the importance of agricultural production within its economy. The profitability of investments in agricultural research are clearly related to the actual or potential area planted to a crop. Consequently, the larger the area over which the new technologies resulting from research can be diffused, the larger the economic returns and the larger the economic base to support the research effort.

The quantitative dimension of the small-country conflict between resources and needs is difficult to assess in general terms, because each country is unique. The required minimum capacity will vary depending on both institutional and technical issues. The type of problems in need of research and the possibility of using information generated for other purposes or available internationally will be important factors to consider. This level of analysis is well beyond the scope of this paper. However, a broad estimate of the magnitude of the conflict between research needs and potential resources is possible. This is through comparing the costs of a hypothetical research module for one product against the actual value of production of major food crops in a number of developing countries.

Table No.1 presents the results of this comparison for the Caribbean countries on the basis of two alternative minimum research modules, one defined at the country level and other for the region as a whole and for four different percentages of the value of production of the most important crops being allocated to agricultural research .5%, 1.0%, and 2.0%. The details of the cost structures of each minimum research module are presented in Annexes I and II.

The results of this comparison are quite revealing and highlight the magnitude of the conflict we made reference above, in as far as in most cases not even key food crops such as rice are large enough to sustain a minimum research effort.

TABLE N° 1

CARIBBEAN COUNTRIES: COUNTRY-PRODUCT COMBINATIONS GENERATING ENOUGH ECONOMIC VALUE TO SUPPORT A MINIMUM RESEARCH MODULE

REGION	RICE	POTATOES	SWEET POTATOES	CASSAVA	YAMS	BANANA	SUGAR	COCOA BEANS	TOMATOES
	0,5% 1% 2%	0,5% 1% 2%	0,5% 1% 2%	0,5% 1% 2%	0,5% 1% 2%	0,5% 1% 2%	0,5% 1% 2%	0,5% 1% 2%	0,5% 1% 2%
Antigua	0	0	0	0	0	0	0	0	0
Bahamas									
Barbados									
Bermuda									
Dominica									
Grenada									
Jamaica					X X	X X	X X		
Saint Lucia						X			
Trinidad & Tobago									
St. Vincent									
St. Chris. Nev.									
Surinam	X	X	X						
Guyana	X	X	X					X X	

Where X denotes if value greater than US\$191.00 (for country)
 Where 0 denotes if value greater than US\$515.714 (for region)

III: SOME POLICY ALTERNATIVES

Even though there may be no adequate solution to the conflict between resources and research needs, there are a number of policy alternatives that can reduce its impact substantially. Through them, a country can effectively increase the resources available for its research effort and can affect the nature of the research needs it must attend to.

Before turning to the discussion of some of these alternatives, it is important emphasize that none of them will be relevant in all cases. Although small countries share a number of very important common characteristics, they cannot be considered to be homogeneous. Many factors, such as level of economic development, climate, geographical location, and historical and cultural factors will differentiate one country from another and in turn the relevancy of any particular policy option. A number of important general considerations can be made however.

A. Concentration of Efforts to Maximize the Impact of Available Resources

Program dispersion, duplication, and research projects not addressing relevant production constraints are the most frequent causes of resource wastage. These problems are present in both small and large countries, but their impact is much more severe in the smaller ones. Any research alternative requires a certain minimum critical mass of resources if it is to produce results. With fewer total resources to invest in research, priority-setting becomes the cornerstone of a small-country research policy. Program coordination mechanisms and research problem identification in close contact with the clients of research are two other important elements for maximizing the impact of available resources.

At the priority-setting level, the issue is concentration of effort, recognizing that with limited resources only a limited number of needs can be addressed effectively. Which alternatives to include should be selected following the country's overall national and agricultural development policy objectives. This, however, is not a simple decision-making process, as frequently the appropriate organizational framework is lacking and the criteria for setting priorities are unclear. Under these circumstances, it is important for the research system to take the initiative and present the policy decision-making levels with program alternatives for the use of presently available resources, including clear indication of what is being left out and what projects will be brought into program implementation if extra resources become available.

This approach can be an effective tool for improving the links of agricultural research policy-making to economic development planning and budget determination. At the same time, it can generate important information for program monitoring and evaluation and can put the research system in a much stronger position to seek additional resources from both domestic and external sources.

B. Better Coordination of Research and Technology Transfer Activities

Together with the concentration of effort, the coordination of all potential providers of research and a close relationship between research and technology transfer activities can greatly increase the impact of limited resources. Universities, development projects, and commodity organizations are often overlooked as important potential providers of research support. In many cases, no one of them on its own has the resources required to address given research problems; or, as is often the case with universities, they lack the linkages necessary to give their research efforts a production-problem orientation. Coordinated research projects forcing scientists from different institutions to work together to plan and carry out experiments and other research activities can help in these situations. Close interactions between research, extension, and clients is essential for focusing research projects on significant production problems. On-farm testing as an integral component of the research process can enhance this interaction and can facilitate a rapid diffusion of research results. A successful example of how this can be achieved is the case of the Instituto de Ciencia y Tecnologías Agrícolas (ICTA) in Guatemala where, through close collaboration with cooperating farmers, the research system has been able to have a major impact on the country's food production.

C. Increasing National Research Capacities through Donor Assistance

Donor assistance is one of the most important resources available to a small-country research effort. External resources can contribute not only by directly adding to national research budgets but also indirectly through the need to generate counterpart funding and by broadening the base of political support for agricultural research. In many cases, the possibility of generating much needed foreign exchange resources through agricultural research projects will bring the support of groups and sectors of government that otherwise would not see the importance of or be interested in agricultural research. There are, however, some hazards in the extensive use of external and donor assistance to support national research programs. Small countries are particularly at risk because of the greater relative importance of external sources in the total available resources.

One problem is the impact of overreliance on external assistance on program orientation and the long-term stability of the research effort. External sources tend to rely too heavily on the project approach. Well-defined projects can be very effective in bringing concentration of efforts and high impact results but, at the same time, the project system lends itself to program fragmentation when many individual projects are independently negotiated with different assistance sources. This is especially so under the weak management conditions of many of the developing countries' research systems. Under these circumstances, there is a strong chance that the result will be a collection of loosely linked efforts and no coherent national strategy.

The effects of abrupt adjustments resulting from changes in donors' priorities are also important for program continuity and long-term system development, especially since domestic support is in many cases highly unstable.

Taking initiative for the development of a donor coordination mechanism appears to be an essential element of the agricultural research policy of a small developing country. An alternative in this sense is the creation of a country-level research support group bringing together all donor sources interested in assisting the country, with emphasis on long-term needs and goals and on the incremental steps required for implementation. The development of such a group and plan may prove to be a high-pay-off move, both for receiving countries and donors. For the recipient, it can be a very effective way of achieving the needed concentration of efforts, continuity of support, and reducing administrative costs and management of external-resource workload. For the donor, it can reduce the costs of project searching and increase the return on their investments by complementing and supplementing one another and the national program, rather than wastefully competing for "good investment opportunities".

D. Multiplying National Research Capacities through Networking and International Cooperation

Applied agricultural research is highly location specific. But no country need undertake on its own all of the research needed for meeting the requirements of its agricultural development. Generally, as we move from applied to basic research, location specificity diminishes and, consequently, transferability increases, opening the possibility for a country to benefit from research conducted in others or at the international level. Every national agricultural research system should be viewed as part of a world complex of research institutions and activities all contributing to and benefitting from a common pool of information and knowledge.

The transferability of research results does not imply that a country can do away with all of its research needs. At the very least, a country must have the ability to screen and interpret information from other sources and adapt imported knowledge to its local conditions. But transferability does open a number of opportunities for reducing research needs through information exchange and cooperative research schemes. The potential, however, is not the same for all countries. Countries in temperate regions will have a larger pool of knowledge and technologies to draw upon than those located in the tropics. At the same time, small countries sharing characteristics with larger neighbors, or that are part of relatively homogeneous regions, will benefit more from borrowing and will have better opportunities for information sharing and cooperation than those in relatively isolated situations.

The nature of the agricultural product mix will also affect the extent to which a country can benefit from borrowing. In products such as the cereals or those tropical crops, such as Casanova, that are studied by the international centers, borrowing will be a more relevant strategy than in the case of those products that have received little attention from the international systems, such as plantain, taro, or tropical fruits.

In this context networking and horizontal cooperation are two very important alternatives to increase the scope of national agricultural research systems, either through the exchange of information and/or the coordination and promotion of certain types of research. Bringing together countries with common problems and characteristics, these mechanisms help avoid wasteful duplication and allow the specialization of resources and a greater economic base to support certain types of research that no participating country on its own could afford. By pooling the strengths of each national program, they may be able to develop a research program of considerable strength.

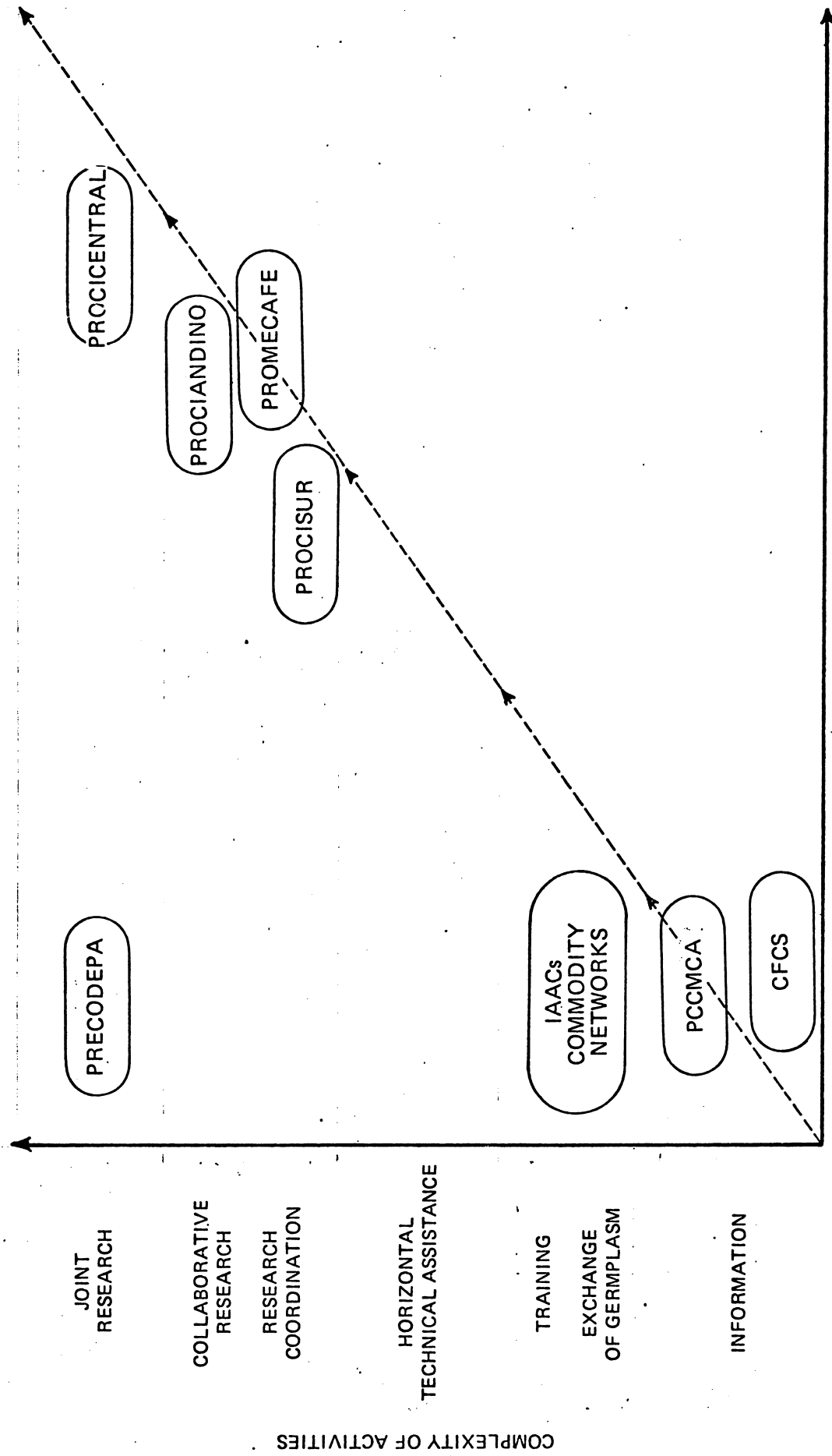
In terms of selecting the most appropriate networking and horizontal cooperation mechanisms the critical issues are what research to do domestically and for what research to rely on knowing or cooperation, or in other term the degree of integration among the cooperating parties. At the same time, the coverage in terms of products and activities and the level of institutional participation in the network's decisions are also critical issues affecting the effectiveness of different cooperating mechanisms and the ways in which they contribute to national research capacities and to meet a small country's technological needs.

Figure 1 summarizes in a graphical way how the degree of complexity of the activities undertaken and the coverage and level of institutional participation interact in defining different types of networks and horizontal cooperation schemes and places some of the experiences available in Latin America and the Caribbean in a continuation of ever increasing integration and institutional complexity. The vertical axis runs from the exchange of information the most simple form of cooperation implying the lowest level of involvement and commitment to joint research where the parties agree to a pulling together their resources for the solution of a common problem. The horizontal scale measures the level of institutional control over network activities. At the origin participation and decision making is essentially in the hands of participating researchers, as we move away from the origin there is an increasing level of institutional control and participation; usually product coverage also increases with institutional control but that is not always the case (PCCMCA, CFCS, and PROMECAFE).

The commodity networks of the IARC's represent probably the typical researcher based cooperation mechanisms. These schemes are essentially directed to germplasm and information exchange under the Centers coordination, they have a low level of intensity of activities and a minimum of formalization but represent an important resource for a small country active participation in the IARCs' networking activities and effective use of the centers' national research support services represent practical alternatives for allowing national programs to concentrate their limited resources on the technology application end of the research chain. A policy of active interaction of national scientists with international centers' personnel, in the countries themselves and at the centers through their training programs, can greatly contribute to the flow of relevant information.

PRECODEPA (Programa Cooperativo de la Papa) is a significantly different mechanism. Although as in the case of the Centers networks it concentrates on just one product -potatoes- and full program coordination and promotion of research is the main strategy of the program. Participants are Panama, Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, Mexico, Cuba, the Dominican Republic, and the International Potato Center (CIP). The program is financed by the Swiss Development Cooperation Program and the participating countries. Administrative responsibilities lie with CIP and the countries themselves. Of the group, only Mexico has the ability to support a full research program. Through a common program and selective leadership, with each country assuming responsibility for a particular research area, the handicap of size has been removed, and progress has been made in crucial area, such as seed production and plant protection.

FIGURE 1: TYPES OF NETWORKS ACCORDING TO COMPLEXITY OF ACTIVITIES AND LEVEL OF INSTITUTIONAL PARTICIPATION.



PROCISUR (Programa Cooperativo de Investigacion Agricola del Cono Sur), PROCIANDINO (Programa Cooperativo de Investigacion Agricola para la Subregion Andina), and PROCICENTRAL (Programa Cooperativo de Investigacion para la Region Central) 1/ represent additional levels of networking complexity as then are multiply product mechanisms based on full institutional participation.

As one moves from larger to smaller countries the nature and characteristics of cooperative programs and of the networking efforts involved differ. The main consideration is that in smaller countries the common or core component of the cooperative program becomes larger. This happens because single country capabilities for both funding research and apprehending a significant share of its benefits decrease. In turn this produces two consequences. First, the networking design assumes a more complex nature in small than in larger countries. Second and related to the above, the necessary integration of efforts also expands in the same direction with a tighter coupling of network components imposing enhanced planning, balancing and coordinating requirements.

PROCISUR, a cooperative program among essentially large countries, each having a fairly developed and autonomous agricultural research system, has focused mostly on complementary exchanges of research information, results and germplasm. The principle involved here has been mainly one of sharing among peers in areas of common interest. The fact that several of the participating countries are notoriously weaker in their scientific and technological capabilities does not invalidate the above. Networks build on a commodity or multicommodity orientation with loose coupling of components and efforts carried out mostly on a national basis.

1/ PROCISUR is a cooperative networking program focussed on five commodities: wheat, maize, sorghum, soybean, and beef cattle covering the six countries in the southern tip of South America: Chile, Argentina, Uruguay, Brazil, Paraguay, and Bolivia. Its main components are a crop research information system, training, and staff exchange. Leadership for the different program components is divided among the countries, according to their relative strengths. Budget support comes from the countries and the Interamerican Development Bank (IDB). Administrative responsibilities lie with the Interamerican Institute for Cooperation on Agriculture (IICA). The program has completed a first phase of operation and has been renewed for a second term.

PROCIANDINO is a program of similar characteristics covering potatoes, oil crops, food legumes and maize for the five countries in the Andean Zone: Bolivia, Peru, Ecuador, Colombia and Venezuela. The program has just started its implementation in 1976.

PROCICENTRAL is still in its planning stage and is expected to operate in the countries of Central America, Panama, and the Dominican Republic. Product coverage is still undecided but it will most likely cover the basic grains plus some of the most important export crops such as cocoa, bananas, and plantains. It is expected to start operation in 1988.

PRODIANDINO, brings together research efforts of a range of medium sized countries at an intermediate state of development of both their agriculture and research facilities. In this cooperative program, networking involves system or collective goals which, however, are subject to independent implementation by each participating country. These system or regional goals distinguish the program here vis a vis PROCISUR. Likewise, such goals recognize the difficulty for each country "going it alone" as well as the need for joint coordination and goal setting. This increases both the complexity of the whole networking effort and its integration and planning requirements.

PROCICENTRAL represents still another variation. It relates to countries essentially too small to sustain on their own a critical mass of resources for research on the key crops but which, nevertheless, maintain capabilities for the adaptive research component. Research efforts here would no longer rest predominantly on each country providing singlehanded a coverage of its problems. rather the weakness of participating countries and the relative costs of necessary efforts call for a regional identification of problems and the formulation of joint research bearing on them. This would involve a division of labor among countries on all activities not strictly at the adaptive level. Implementation of efforts, however, would still remain a country responsibility within the framework of regional planning. At this level, research focuses begin to acquire a more flexible and diverse nature--not restricted only to specific crops.

An important differentiating element between PROCODEPA and the cases of PROCISUR, PROCIANDINO, and PROCICENTRAL is that of the existence in the later of an overall coordinating committee integrated by the countries Directors of Research which acts as the program maximum authority with responsibility for promptly setting among and within commodities as well as overall program monitoring follow up and evaluation. This characteristic is of particular importance in networking efforts involving collaborative or joint research activities and more than one product in the smaller countries. Researcher based networks lacking of the broader institutional context and checks have a strong potential to distort national priorities. In the situation of highly restricted budgets for operating expenses usually confronting the smaller countries, relatively small amounts of resources can have big impacts on the selection of research projects. If network participation is at the researcher level there is a great chance that the scientific interests of the participating individual will carry more weight than overall priorities in defining in-country network activities. In the case of PROCODEPA one could rise the question whether the level of human resources --probably the most

limiting factor to successful research in the central american countries-- being allocated to potatoes is fully justified given the relatively small importance of the crop in the participation countries. In the cases of PROCISUR, PROCIANDINO and PROCICENTRAL the participation of the Directors of Research in the networks' decision making process assure that product selection and resource allocation fully reflect national priorities.

IV. SUMMARY AND FINAL CONSIDERATIONS

We have attempted to describe the principal components of a national agricultural research policy and relate them to the situation of the small developing countries. In doing so, the importance of properly defined objectives, the nature of the issues, the process behind determining how much to invest in research, and the research system's institutional setting planning mechanism were discussed in their role as agricultural research policy instruments. Wherever relevant, alternative approaches and the factors affecting them were also presented.

The small developing country's conflict between needs and available resources was brought into focus, the basis point being that research needs in general area not directly related to country size, while resources usually are. Pressure on resources comes from two sources: the diversity of needs the research system must consider and the minimum critical mass requirements of research.

Because of the nature of agricultural production, environmental characteristics, consumer demands, and political considerations, small countries face research needs quite similar to those of larger countries. But, if research is to be successful, certain minimum standards of professional expertise must be met. Without them, useful results are unlikely and resources are wasted.

Finally, several policy alternatives were discussed. Small countries must make the best use of national and international resources. Research efforts must be brought into focus and more closely tied to extension, to increase relevance and applicability of research results. Donor assistance must be coordinated. But the most significant and potentially useful alternative for small countries is better and more effective use of international cooperation.

Bringing countries together enlarges the economic support base, offers hope for otherwise insoluble problems, and makes the most of each small nation's particular research strength.

The policy alternatives mentioned above have been presented in general terms. The issues discussed do not represent an exhaustive rediscuss their validity under the characteristics of each particular situations, it would be necessary to rediscuss their validity under the . In this sense, how to concentrate efforts without losing political support; the viability of establishing donor coordination schemes; and how to prevent international cooperation from distorting national priorities appear to be relevant areas of inquiry.

ESTIMATED COSTS OF A MINIMUM RESEARCH MODULE FOR ONE PRODUCT AT THE COUNTRY LEVEL 1/ (IN \$US)

DIRECT COSTS		134.000
A. Personnel		108.000
1. 1 Principal Researcher, M.S. or Ph.D. (plant breeding on agronomy) Total cost per person/year US\$30.000	30.000	
2. 4 specialists, university graduates Total cost per person/year US\$18.000	72.000	
3. Training (annual)	6.000	
B. Services and materials Calculated as 12.5% of direct costs		16.000
C. Equipment Calculated as 7,5% of direct costs		10.000
II. COSTOS GENERALES Y ADMINISTRATIVOS		57.300
A. Personnel 60% of general and administrative costs	34.380	
B. Services and materials 25% of general and administrative costs	14.325	
C. Investments and equipment 15% of general administrative costs	8.595	
TOTAL BUDGET		191.000

Percent summary by broad budgetary items:

A. Personnel	74.54%
B. Services and materials	15,87%
C. Equipment	9,73%

Estimated using the budgetary structure of the International Agricultural Research Centers as a guideline for determining the percentage of each item of expenditures.

ANNEX II

ESTIMATED COST OF A MINIMUM RESEARCH MODULE FOR ONE PRODUCT FOR THE WHOLE REGION

I	DIRECT COST		361.000
	A. Personnel		289.000
	1. 4 chief researchers, M.S. or Ph.D. 3 person/years in plant breeding, agronomy, and pest & disease control, and 1 person/year equivalent in socioeconomics and other specializations, according to requirements (soils, physiology, etc.) Total cost per person/year US\$30.000	120.000	
	2. 8 specialists, university graduates. Total cost per person/year US\$18.000	144.000	
	3. Training calculated on the basis of 2x1 rate of retention; total rotation every 20 years: cost of US\$70.000 per Ph.D. 8(M.S.60%). Total annual cost for a permanent team of 2 Ph.D. and 2 M.S. (approximately). Also includes short-term training.	25.000	
	B. Services and materials Calculated as 12.5% of direct costs.		45.000
	C. Equipment Calculated as 7.5% of direct costs.		27.000
II	General Costs and Administration (30% of total budget) Includes direction, support and services (administration, laboratories, library, communications, field, etc.)		154.714
	A. Personnel 60% of general and administrative costs.	92.828,4	
	B. Services and materials 25% of general and administrative costs.	38.678,1	
	C. Investments and equipment 15% of general administrative costs.	23.207,1	
TOTAL	BUDGET		515.714

Percent summary by broad budgetary items:

A. Personnel	74,03%
B. Services and materials	16,22
C. Equipment	9,73%

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