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STRATEGIC PLANNING FOR NATIONAL AGRICULTURAL RESEARCH SYSTEMS: AN OVERVIEW

Marie-Hélène COLLION

isnar

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.

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GLOSSARY

Critical Mass: The critical mass is the level of resources needed either per research activity or per research station in order to achieve the desired objectives. The critical mass required for a particular research activity will be influenced by the type of other research activities in the system, if "economies of scope" are possible. The level of resources is determined first by the human resources required, which then fixes the other resources needed to match them.

Goal and objectives: The goal is the end towards which actions are directed. It is the state to be brought about through a course of actions. A goal is general and fairly broad. It must be specified by objectives. The objectives are specific intermediate ends to be achieved, in the process of striving for the overall goal.

National Agricultural Research System (NARS): Many organizations may be involved in agricultural research: departments of various ministries, parastatal organizations, departments of the universities, private institutions. Whether an organization is included or not in the NARS depends on whether it has developed well-structured and specified linkages with other research institutions in the system.

Organization: A coalition of interest groups sharing a common resource base and depending on a larger context for its legitimacy and development. It has an internal structure, is goal directed, and exchanges resources with its external environment.

Organizational structure or organization structure: It describes an organization's framework: it is the way work is divided into different tasks, and is then coordinated to achieve stable patterns of behavior and output. The organizational structure regulates the flow and exchange of various kinds of resources; i.e., products, services, information, power. Another way to look at organizational structure is the formal division of responsibilities.

Policy: A set of decisions and measures necessary to carry out a chosen course of action to meet specific goals and objectives.

Program: A program is a coherent set of projects and activities (such as training, special studies, etc.) in one specific area of research. The program is defined by a goal, a set of objectives, a research strategy and resources to achieve these objectives. Program scope, size and complexity may vary considerably according to the level of disaggregation and specificity of objectives. Complex programs can group several sub-programs in different regions or involving interlinked projects. They can also cut across institutions.

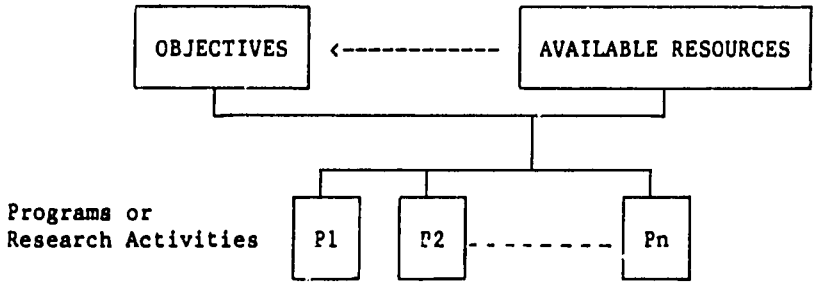
Programming or program formulation: Programming is the actual design of a program and its components. It implies the definition of a coherent set of projects with their research activities, studies, and experiments.

Project: A project is a coherent set of activities with a rationale, a goal, specified by a set of objectives, a plan of action to achieve these objectives, specific outputs and beneficiaries, a limited time frame for execution, and a budget defining resources needed.

Research Stakeholders: The groups whose activities are likely to affect the research system, or conversely, the activities of which will be affected by the output of the research system. They are not the direct users of research. They are: 1) the financers of research (government and donors); 2) the groups that make up the environment of agricultural research, such as, for example, the rural banks (their credit scheme will influence the adoption of a technology); the agriculture-based industries and import-export firms (their absorptive capacity of agricultural output will also be a determining factor); and all agriculture-related services; 3) the consumers.

Scenario: A scenario is a description of a vision of the future state of a system. It is based on an assessment of its environment, of the forces for change at work and the likely interactions between system variables in the progression from current conditions to a future state.

Scope of a System: The scope of a system is an operative combination of the readily available resources into a set of research activities in order to achieve the objectives set for the system. The research activities are defined by their content, the type of research (applied, adaptive and testing, maintenance) and the critical mass of resources (qualitative and quantitative).



Strategy: A course of action, selected among alternatives in the light of a given set of conditions to meet specific goals and objectives; it includes the internally consistent way in which resources will be mobilized to carry out the course of action and give it the maximum support.

Structure: The elements or components of an entity and the position of such elements or components in relation to each other. The way in which the elements are put together or organized.

Sustainable Research System: A sustainable agricultural research system is one in which the contribution from external sources does not bring the overall funding level above the one a country would be prepared to reach progressively within a definite schedule.

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1. INTRODUCTION

1.1 Purpose

The purpose of this paper is to contribute to improving the effectiveness of policy elaboration and planning by laying out a systematic and normative process using a long-term strategic approach. Presented is a model, that is, an abstraction from reality, a reflection of it. A model can neither reflect reality perfectly nor completely: particular country circumstances have to be left out in its elaboration. As such, it cannot be applied in any given situation without first being adapted to the specific situation.

1.2 Structure and Content

Chapter 2 presents a definition and rationale for planning. What can be achieved through planning? What are the inefficiencies it addresses? The paper adopts a specific approach to planning termed strategic, defined in chapter 3. The advantages of drawing from the principles of strategic planning over the classical, projection-based method are discussed. Though developed for the private sector in the West, the principles and process of strategic planning can be quite relevant for agricultural research in developing countries. The specificity of such an approach is highlighted.

One of the particularities of agricultural research planning is that it takes place within a "system" encompassing various organizational entities, with or without a centralized structure for decision-making and/or coordination at the top, generally referred to as the "apex". The planning mechanisms will differ according to the type of structure and organization within which it is carried out. However, whatever the structure, two levels of planning are present: a national or system level, discussed in chapter 4, and an institute one, in chapter 5. At each of these levels, the object of planning is obviously different: respectively the whole system and only the institute. However, the planning process goes through the same steps.

The output of planning at the system level is a national agricultural research policy for the long term which serves as an input for the planning process at the institute level.[1] The output at the institute level is an institute strategic plan for the same long term, including a description of the institute policies, its programs' objectives and strategy, and the long-term plan for the

1) Long term should be lengthy enough for the agricultural research system to achieve control over the future. The actual number of years will vary according to several factors, mainly the scope of the ambitions for the system.

development of the resources in support of its programs. The institute long-term strategic plan is translated into a plan of action for implementation. The time span corresponds to the period for which resources are known and environment changes are predictable (generally not more than three to seven years).

Chapter 6 introduces the issue of the organizational devices and planning mechanisms necessary to perform the planning functions. An example is given, based on the strategic planning principles: at the same time bottom/up and top/down, emphasizing participation of all concerned (i.e., planning should not be left to so-called planners alone). However, the description remains fairly general, as the mechanisms and organizational devices that are required for the purpose of planning vary greatly according to the type of organizational structure and the socio-political environment of each NARS.

1.3 Necessary Further Work

It is hoped that the framework will be of use to NARS leaders. In order to facilitate the adaptation of the model to the particular circumstances of each NARS, it would be useful to illustrate it through case studies of the planning process; that is, what type of planning approach, and in particular, what planning mechanisms and organizational devices have been taken in different contexts, characterized by the type of organizational structure of the NARS, the socio-political and cultural environment, and the level of institutional development.

The paper emphasizes the approach (i.e., strategic rather than projection-based planning) and the process of strategic planning when applied to NARS. It also addresses the issues at each step of the process but does not go into the information to be gathered and analyzed. Both the illustration through case studies and the information to be gathered would be useful when implementing the model. This, however, deserves further work.

2. RATIONALE FOR PLANNING

> "A successful planning process does not end with a formal document that is then put aside, but rather it taps the lifeblood of the organization in a way that permanently changes the way its members think and act."
>
> Pfeiffer (1987:27)

2.1 How Much Should Research be Planned?

A number of people do not feel comfortable with the idea of planning, especially insofar as research is concerned. The word planning often rings bells of Eastern-block central-planning systems, of bulldozing the researchers' necessary creativity and insight into the straight-jackets of a top/down and rigid blueprint. In the minds of others it brings out images of "experts", using valuable resources while cranking out numbers and toying with sophisticated models in the secrecy of their planning units; producing plans, which are destined to gather dust on shelves. These unfortunate views often result from the lack of participation by people concerned in the planning process; lack of understanding of the models and confidence in their outputs, as they are often perceived as non-adaptable to real situations; and using data of dubious quality.

Agricultural research planning need not be stultifying. On the contrary, planning can increase the effectiveness of individuals and organizations by sharpening the focus of research activities on the most relevant areas for agricultural development, through developing a sense of mission and commitment, and improving the flow of information between the various actors concerned with agricultural research. Nor should the understanding of the planning process be reduced to the use of economic models for allocation of resources. Planning goes beyond the use of models which are only tools that may (or may not) be utilized as part of a larger process.

The answer to the question "How much should research be planned?" depends on whether planning, in the particular circumstances of a country, can fulfil its purpose, which is to improve the productivity (i.e., the effectiveness and efficiency) of agricultural research. Before embarking on a planning process, what needs to be clarified is whether better planning is the correct and only remedy for the identified problem. Thus, in order to make the final decision to go ahead with planning, it is necessary to define its objectives, content and scope, and the approach that will be taken (in particular who is going to be involved, what planning mechanisms will be put in place).

2.2 Definition of Agricultural Research Planning and Policy-Making

Through agricultural research planning and policy-making, a country translates its development objectives into research objectives, priorities, and strategies with various time horizons. It allocates its resources to major program thrusts reflecting these objectives, priorities and strategies. The planning process considers two sets of issues in parallel:

1) What are the country's social, economic and agricultural development objectives and what can and should be the contribution of research towards the achievement of those objectives? This leads to determining the ideal objectives of agricultural research.

2) What are the capacities and resources that can be applied to this end? A realistic set of research objectives and the expected research output is determined through an iterative matching process between the two.

   A strategy to achieve this end result is then specified in operational terms (activities and timing; human, physical and financial resources to be used; organizational structure required). (See Fig. 1.)

2.3 Context of Planning and Policy-Making

Planning is concerned with the national agricultural research system as a whole, and parts within the system. There are many entities that can be engaged in agricultural research in a country. At the core lie public institutes/ministerial departments created for the primary purpose of agricultural research. They may have developed specific links with universities, parastatals, private research foundations or companies, and research-development projects.

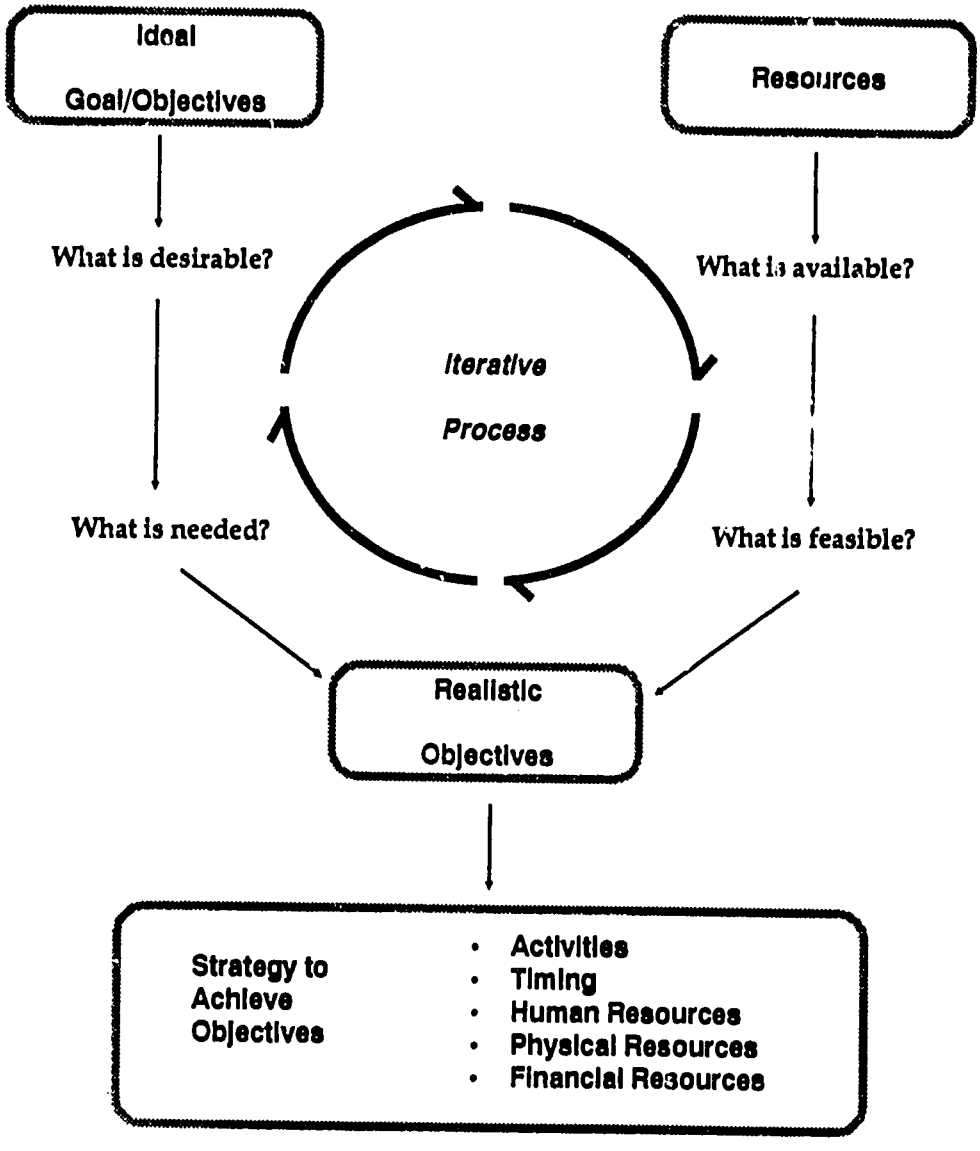
Whether the latter are considered as part of the agricultural research system or only constitute part of its environment depends on whether the relations are specified and structured and not merely ad hoc; that is, for an entity to be considered as part of the agricultural research system, it is not sufficient that it conducts research relevant to agricultural development: it should also "behave" as if it is in the system.[2] The linkages are part of the system: 1) between the institutions themselves; 2) with the extension services; 3) with policy-making bodies; 4) with external sources of knowledge.

Among other things, policy-making and planning purports to determine:

1. the size, scope and mission of the research system, the overall level of resource allocation and the criteria for major technological and societal choices;

2) Dagg and Eyzaguirre (1989:8).

Figure 1: What is Planning?



2. agricultural research objectives in function of 1) the overall development objectives; 2) the agricultural Science and Technology policy; 3) the available resources;

3. the research programs and the criteria on which to base priorities between them; and for each research program, the strategies that appear best suited to achieve the research objectives; within each research area, the constraints that should be addressed in priority;

4. the planning methods and tools, to prioritize between research areas and to allocate scarce resources accordingly; this will serve as the framework for the elaboration of research programs;

5. the necessary adjustments in the organizational structure of the research system in order to ensure adequacy between the mandate assigned to research and its structural support system;

6. the mechanisms and organizational devices for planning, communication, and coordination, reporting, monitoring and evaluation, such that: a) farmers' needs and constraints be at the core of program design; b) feedback linkages between the various actors concerned (i.e., policymakers, research leaders in various institutions, extension agents, farmers, private entrepreneurs, etc.) function efficiently.

2.4 Issues to be Addressed through Planning

Since ISNAR started in 1981, it has been involved in 40 reviews of agricultural research systems. A number of issues were found to be common to many systems; issues that can be referred to as planning and policy issues. This does not necessarily mean that better planning will be sufficient to address these issues successfully: most of the time, they will require a combination of tools, that is not only planning tools but also management and organizational ones. In what follows, a number of these issues which can be addressed through planning will be discussed.

Resource allocation issues

Appropriate overall funding. Funding levels are usually measured as a proportion of the value of the agricultural product (AgGDP). According to this measure, developing countries spend substantially less on agricultural research (0.5% and even less of their AgGDP) than the developed ones (2%).

On the human resources side, the number of scientists per unit of agricultural GDP is three times higher in developed countries than in developing ones.[3] These figures are often quoted to highlight the insufficient funding of agricultural research in developing countries and to argue for investment targets of 2% of AgGDP.[4]

The conceptual basis for such recommendations is far from established. However, it is fair to say that social gains could have been higher had more funds been invested in agricultural research, as demonstrated by ex-post analysis of return on investments.[5] It has been argued that the insufficient research support partly reflects the lack of political influence of research users in developing countries, in particular farmers.[6] In addition, many decision makers and development planners are unaware of the potential contribution of effective and efficient research to agricultural development.

To their defense, it is fair to say that in many instances, agricultural research, suffering as it has been from a number of illnessess, has had less impact than could have been expected. In addition, research output is only a potential for increased production. There are so many intervening factors before a technology is adopted that its impact on agricultural output is far from being secured. Therefore, policymakers are often tempted to make alternative investments with a more immediate pay off.

3) Using figures from 130 countries, the weighted average of public investment in national agricultural research, including donor funding, was 0.39% of the agricultural GDP during the period 1975-79, and 0.42% during the period 1980-85. Figures from the same period for 22 developed countries show rates of investment of 1.58% and 2.01% respectively. The number of scientists per billion agricultural GDP was 61 in developing countries and 194 in developed countries for the period 1975-79. The figures were 74 and 231 respectively for 1980-85. Expenditures as a percentage of AgGDP have been calculated on the basis of agricultural research expenditures taken from Pardey and Roseboom (forthcoming 1989) and AgGDP data provided by the UN Statistical Office, New York.

4) World Bank (1981:8). ISNAR has also been using these figures to argue for higher investments in agricultural research.

5) For an exhaustive overview of the studies on economic return to research investments, see in particular, Echeverria, Ferreira and Dabezies, (Forthcoming), which updates for Latin America the study done by Ruttan (1987:Chap.6). Echeverria points out the fact that not all costs were included in the various analyses, thereby biaising the results upwards. In particular the costs of public extension, additional inputs, private research and extension are commonly left out. Even taking these costs into account, the figures would remain quite high, as he demonstrates using the case of rice in Uruguay.

6) This point has been made in particular by Ruttan (1987:180-1).

The low level of support may well lie with the overall limited investments in agriculture, as a result of financial and political constraints.[7] Whatever the cause may be, there is a need to determine the appropriate level of funding for the particular circumstances of a country, taking into account the potential agricultural research contribution as well as the financial capacities of the country.

Imbalance in the funding allocation between research infrastructure, operating funds and human resources. In the last three decades, the number of scientists in developing countries has quadrupled. However, the expenditure per scientist shows a steady decline from a peak in 1970.[8] This decline is threatening both the productivity and the commitment of scientists to conduct research. Donor intervention has also tended to be biased in favor of facility development, but, if parallel investments in human resources and program support are insufficient, it creates a burden on recurrent research costs rather than being a source of productivity.[9]

One of the tasks of planning is to determine the proper funding balance. In India, well-balanced donor assistance to agricultural research played a key role in the development of an effective research system. The emphasis was not so much on large expenditures on "bricks and mortar" but rather on the long-term commitment to human resources development and institution building.[10]

Research critical mass. A recurrent problem to be found in almost all systems is the dispersion and fragmentation of scarce resources (human as well as financial) among all possible researchable areas, and often among too many research stations. Since resources are limited, this dispersion results in a very weak resource-support for each research area; similarly, the number of scientists per research station may not be sufficient to efficiently provide them with the needed logistical support, and for them to form a group large and diversified enough to be intellectually stimulating. When a minimum level of investment is not reached, scientists can hardly be expected to be productive. Thus the notion of critical mass (i.e. the minimum level of resources needed per program or research station) is a very important one. Obviously, it will vary depending on the characteristics of the program and on the type of activities of the research station; planning is expected to provide firm guidance on minimum levels of investment per research area and per program.

7) Agricultural research expenditures calculated as a share of total public expenditure on agriculture, show levels of funding as equally high in developing countries as in developed ones (Pardey, Kang and Elliott, forthcoming 1989).

8) See Elliott and Roseboom, (1988:18).

9) This point has been particularly argued by Ruttan (1986, 1987:49).

10) Lele, U. and A.A. Goldsmith (1989).

Sustainability. The issue of sustainability is also becoming critical, at least for certain systems in which external funding provides for a large part of operating expenses. A sustainable agricultural system can be defined as one in which the contribution from external sources does not bring the overall funding level above what the country would be prepared to reach progressively within a definite schedule.

Unfortunately, most countries, stranded as they are in the webs of financial difficulties, tend to accept offers of external assistance without much discrimination as long as it is a subsidy. If the assistance is withdrawn, the country has to let programs or facilities wither away, or else chase other donors for continuing support.[11] Planning should help a country define what level of external assistance it should accept, based on the overall level of funding it is prepared to put into its agricultural research.

Agricultural research policies.

In many cases, decision makers have not been giving much attention to the definition of a national agricultural research policy. As a result, the necessary choices regarding the scope of the research system, its mission, the strategies to fulfil the mission have not been made, and broad guidelines to determine the most appropriate allocation of resources are lacking.

In addition, communication mechanisms between researchers and policymakers are often ineffective or even non-existent, leading to research and development objectives being conceived in isolation. On the one hand, the overall development and agricultural objectives of a country are poorly translated into agricultural research objectives, resulting in research programs being elaborated without the necessary reference to them. On the other hand, decision makers are often unaware that the economic policies to which they contribute may create an unfavorable environment for the adoption of research results.

Relevance of research programs.

Poor research program design, in terms of their relevance for the needs and adoption capabilities of the research users has been recurrently noted as one of the weaknesses. As a result, technologies with little value to the farmers have been generated, while scarce resources have been expanded for their generation. Here, a number of factors are at play, including the organization of research, often along single

11) C. Eicher's concern that the huge transfer of funds into African NARS planned for the next five years (approx. US$300 million a year) may overload research systems is well taken. These systems, he argues, are still at an early stage of institutional development and should be developing their own domestic political support (Eicher 1989). Contrary to these massive inflows of funds, it may have been a blessing for the agricultural research system in India that external assistance was parsimonious, allowing it the time to develop institutionally (Lele and Goldsmith 1989).

discipline lines. Such an organization encourages a mono-disciplinary and technical approach to the multi-faceted problems confronting the farmers, while a farmer-centered management approach would be necessary in many cases. Moreover, in the absence of clear national guidelines, researchers have tended to pursue scientific objectives for recognition in their discipline, an objective that has deterred them from being responsive first to the needs of the farmers.

Part of the problem confronting researchers when designing programs arises from the fact that in many developing countries, farmers, especially small farmers, do not have the political power necessary to influence the design of research programs; nor are they able to articulate their technology needs, because of institutional and social barriers. One way of overcoming this problem is through a systematic process of information gathering on farm-level circumstances, coupled with on-farm research activities, as a basis for research program design; or else, to structure programming mechanisms in such a way as to substitute for direct user participation in program definition.

Unfortunately, collecting and processing information also constitutes one of the weak points of the research systems. On-farm research or farming system research should provide the on-station researchers with the necessary information to design their research activities. An analysis of some on-farm research programs shows that it has been difficult to implement the feedback function.[12] The existing planning and programming mechanisms are usually not designed for the purpose of compensating for the communication problems between researchers and research users.

Coordinating mechanisms.

Research tends to be carried out by different ministeries and multiple institutions, including universities and the private sector. While the dispersion of research activity should not be a problem in itself, ineffective coordination and communication mechanisms often result in researchable problems left unattended, the development of parallel research projects on topics of dubious relevance and, in general, a less than optimum use of the scarce resources allocated to research.

Public and private research/International, regional and national research institutions.

There is a natural division of responsibility between private and public sector and between the national and international research centers. Many countries fail to recognize and take full advantage of the complementarity between public- and private-sector research, and between international research centers and the national ones.

12) On the role of client-oriented research, more often referred to as farming systems research or on-farm research, in fostering farmers' needs for the design of research program, see in particular the analysis of nine cases synthesized by Merrill-Sands and McAllister (1988).

As a result, public-sector research does what the private sector could be doing, and policies tend to discourage the private sector from entering the research and technology transfer domain. All of this leads to the allocation of the already scarce public resources to programs or areas within programs that should be left to the international centers or the private sector.[13]

Research infrastructure and orientation.

Some African countries inherited the costly colonial infrastructure as well as the research orientation that had been established to respond to the requirements of the colonial economy. The pre-independence orientations are no longer appropriate for the technology needs of the agricultural sector in today's independent countries. Reorganizations and adjustments have occurred, but often haphazardly, following demands from pressure groups; or inspired by the organization and the research orientations of research systems in developed countries with different needs and resources altogether.

2.5 Potential Contribution of Planning

The above issues should be addressed from different angles: planning but also organization and management. Used together these tools can increase the efficiency and effectiveness of agricultural research, and enable it to contribute to its full potential to the development of the agricultural sector. When complemented by organizational and management measures and if followed by implementation, research policy-making and effective mechanisms for planning, programming and resource allocation could go a long way towards improving the productivity of the research systems.

13) On the role of private sector research, see Ruttan and Pray (1987:4).

3. PLANNING APPROACH

3.1 Strategic Rather than Projection-Based Planning

In the previous section, some of the recurrent issues that could be addressed through planning were highlighted. However, planning is certainly no panacea. Indeed, if the idea of planning is so often met with skepticism, it might be for having failed too many times to achieve its purpose. Perhaps one of the reasons for planning's poor performance lies in the approach used and in not fully recognizing that the process of planning can be as important as the output, i.e. the plans. In what follows, an alternative planning approach to the more "traditional" one will be proposed.

In most national agricultural research systems, central planning, at least at the level of the research institutes, has been given an increased importance through the 1960s and 1970s, often in response to pressures from financial and planning bodies. The concern was primarily a budgetary one, an ex ante justification of the use of financial resources. Techniques linking budget to activities, such as Planning, Programming and Budgeting System (PPBS), and zero-based budgeting, were therefore favored.

An exclusive reliance on budget-based resource allocation techniques, though satisfying for the financial institutions, proved to have serious flaws for the development of the research systems: a longer-term horizon for committing resources to research activities was required. In a number of cases, long-range planning, based on a multi-year forecast of resources and on projection of past trends in terms of research activities and allocation of resources was therefore adopted.

But long-range planning, too, has limitations, designed as it has been for a world characterized by stability, continuity and predictable changes. In contrast, today's environment (both in LDCs and worldwide) features high interdependence, uncertainty, rapid technological change leading to substantial and frequent shifts in comparative advantage, and evolving external conditions. Projecting the vision of the past into the future, long-range planning cannot accommodate fundamental environmental changes; it is a static approach to planning; it tends to discourage the generation of creative solutions and to lead to a routine extension of existing activities.

In response to the inadequacy of long-range planning under changing circumstances, the private sector developed a new approach, termed "strategic planning". Strategic planning focuses on an understanding of the environment and of the forces causing changes; it promotes creative thinking for the generation and evaluation of strategic choices leading to the design of alternative scenarios and the identification of a preferred one among them.[14] This is more than attempting to anticipate the future and preparing accordingly. Behind strategic planning is the belief that the future can be influenced by what is done in the present.

14) For a discussion on the benefits of strategic planning over more traditional methods, see Hanna (1985:8-13).

3.2 Definition and Characteristics of Strategic Planning

The issue is the same as with the more traditional planning approaches: matching objectives to available resources and defining ways to achieve the objectives, given the available resources; and this, through an iterative process. Strategic planning enables an organization to do this, through emphasizing the development of the most desirable vision of its future, evolved from a clear identification of its mandate and analysis of its environment, and resting upon an assessment of its internal strengths and weaknesses. Then, the strategy (i.e., the necessary decisions and actions) to achieve this desirable situation is elaborated and converted into an action plan.

The main characteristics of strategic planning are as follows:[15]

(a) The approach helps an organization create its future, not just plan for it. Instead of a mere projection of past trends, it centers upon the design of alternative scenarios for the future state of the research system and the choice of a preferred one. The analysis of the differences between the current and desired situation, called gap analysis, gives a measure of the changes that have to occur.
(b) The environment is a key element. One of the basic principles is to ensure that research is responsive to the needs of its clients, is sensitive to the interests and expectations of major stakeholders and is driven by the characteristics of the environment, in particular the markets.
(c) It emphasizes action. Strategies to achieve goals are clearly specified and converted into an action plan. Why a particular course of action is selected from among many is clearly stated.
(d) The organizational changes or adjustments necessary for the implementation of the plan are examined and specified as part of the planning content.

Most important, perhaps, is to understand the 'philosophy' of strategic planning, because it has important implications for the conditions required for its effectiveness:[16]

(e) The primary benefit of strategic planning may be less the production of a plan than bringing participants to thinking strategically about the future and creating a measure of consensus on future priorities; the emphasis is more on issues, less on data collection.
(f) Strategic planning cannot be the task of planners only. It is a social process of communication, negotiation and learning between planners, decision makers, NARS leaders, senior scientists and stakeholders. The planners' role is to enhance these processes through the preparation of base materials and the gathering and synthesizing of information and ideas for the elaboration of pilot strategies.

15) Pfeiffer (1986) and Hanna (1985, 1987) provide a good analysis of strategic planning. Ozgediz (1988) and Rocheteau (1989) have applied these principles to the specificity of agricultural research for developing countries.

16) Gray (1986), Mintzberg (1987) and Hanna (1985, 1987) analyze the 'philosophy' of strategic planning.

(g) Key actors within the NARS, as well as outside, participate in its preparation in order to enhance the legitimacy of the decisions taken, foster political support and a sense of involvement from all concerned. It is thus a political process that involves the realignment of interest groups into a coalition for strategic change; this, in order to increase the chance of successful implementation of the plan at a later stage.

(h) It is a top/down as well as a bottom/up exercise: top management must lead and be committed to the planning process, clearly communicating and engendering a sense of a direction and a mission to all staff. At the same time, participation from all concerned is emphasized, in order to produce insightful and creative scenarios and fostering commitment to the plan's implementation. Feedback and iterations between top and bottom are built into the process.

(i) Unlike long-range planning, flexibility is built into strategic planning. It is a continuous process. A strategic plan may be revised to take into account changing circumstances.

(j) Strategic planning will lead to recommendations for strategic changes which can be sustained only if they are supported by appropriate changes in organizational structures and reinforcing management processes. Indeed, strategic planning is only one aspect of a more comprehensive approach to running an organization: strategic management.[17]

3.3 Relevance of the approach for agricultural research systems

Developed as it was for the needs of the private sector, strategic planning has received only limited attention from the public sector. However, the environments of public and non-profit organizations have also changed drastically in the last decade.[18] Would a strategic approach to planning be relevant, given the specific circumstances of agricultural research in developing countries?

In many developing countries, stagnant or declining per capita agricultural production and natural resources degradation are prevailing features. Agricultural research is being hard pressed to produce results that will likely have an impact in terms of solving the problems at hand.

In addition, such major technological breakthroughs, like biotechnology, are profoundly modifying the decision-making framework. Such situations deserve some innovative thinking for the

17) For a discussion of strategic planning as part of strategic management, see Hanna (1985) and Gray (1986).

18) The applicability of strategic planning to the public sector has been the subject of a number of recent articles. See Bryson (1987), Bryson and Roering (1986 and 1988), Bryson, Freeman and Roering (1985).

elaboration of research strategies beyond a mere continuation of the present. It calls for a critical diagnosis of the present research objectives and strategies, usually taken for granted in long-range planning.

As pointed out previously, being responsive to the needs of farmers is one of the difficulties in program design. Strategic planning precisely emphasizes the analysis of the operating conditions and the needs of the clients and the evolving market opportunities (domestic and international).

The participative aspect of the approach appears particularly relevant. The specificity of agricultural research lies in the nature of research itself which requires long-term investment of the scientists in their subject matter, and presupposes independent thinkers. Unlike any other business, orders passed from top to bottom, particularly those dealing with reallocation of scientists' efforts, are unlikely to be easily implemented without prior agreement having been reached with those concerned. Similarly, plans elaborated without the scientists' involvement run the risk of being seriously distorted at the implementation stage. Thus, promoting the involvement of all concerned with a view to reach a consensus on main issues, which seems a key requisite for the success of agricultural research planning in general, is well served by the strategic planning approach.

3.4 A Word of Caution

The above points to the difficulties of implementing a strategic planning approach. Since the process is deliberately designed to respond to the need for change, it may be resisted by various groups in an organization where interests may be threatened.[19] Its implementation requires a combination of centralization/ decentralization and a participatory approach which can be inherently foreign to the organization's culture. It calls for specific leadership skills for top managers in order to master a finely tuned combination of management practices: top/down and bottom/up; all of which may be incompatible with a country's social, political and cultural environment. Without the above, though, strategic planning would lose its power as a change agent.

Another main problem is that planning is usually seen as a separate function from other managerial functions, as an ad hoc activity in time, and is carried out by specialists. Hence strategic planning, when adopted, falls into the same trap. Quite to the contrary, strategic planning should be understood as one of the strategic management functions; strategic thinking becomes a pervasive approach to running an organization, and strategic planning, one of the instruments to run the organization, integrated with others: budgeting, information management, reporting and organizational behavior. Short of this, as with other planning approaches, implementation will again be the stumbling block.

19) Rocheteau (1989:18), Hanna (1987:32), Gray (1986), and Bryson and Roering (1988), have warned about the difficulties of implementing strategic planning and its misuses.

Since strategic planning is becoming very popular, there is a tendency that the term gets applied to anything that may vaguely resemble it. When it goes wrong or is ineffective, strategic planning itself may get blamed, rather than considering whether the conditions necessary for its effectiveness were ever present; or whether the approach used was indeed strategic planning. Because of the importance of the preconditions for its success, strategic planning is not relevant for all situations. Some socio-political and cultural environments simply preclude its use.

Paradoxically, strategic planning is probably most needed where it is the least likely to work. It "would appear to work best in units that have effective policy-making boards, strong and supportive process sponsors, superb process champions, good strategic planning teams, enough slack to handle potentially disruptive crises, experience in coping with major disruptions, and a desire to address what is truly important for the organization. Instead most organizations tend to "muddle through" in a disjointedly incremental way from one situation (often a crisis) to the next. The introduction of strategic planning to such organizations may be doomed to failure" (Bryson and Roering 1988:19.)

In such situations, creating the preconditions for effective planning, or "planning to plan" should be the focus first, an important step that will determine the success of the planning process later.

3.5 Planning to Plan[20)]

Commitment to strategic planning. In order to be effective, strategic planning should start with a clear national political commitment to the process as well as to its implementation. Commitment from the various organizations involved should also be secured, in particular from managers and boards of governors. Staff should get a sense that they are part of the process from the beginning, through oral and written communication from management.

Actors in the process. As pointed out above, strategic planning is a process of consensus-reaching among different actors who will influence or be influenced by the output of the research system. Thus it is important that all the people who should be involved be identified carefully, as well as their specific function in the planning process.

Steps, approach, expected output and timing. Agreement should be reached on what the planning process will -and will not- involve, and what the output is expected to be; the steps that should be taken, the approach, the expected intermediary products and the timing should be decided upon before embarking into the planning process.

20) See Pfeiffer (1986:3-6, 49-50); Rocheteau (1989: 2-4).

4. STRATEGIC PLANNING AT THE NATIONAL LEVEL

Strategic planning at the national level concerns itself with the elaboration of a national agricultural research policy and strategy for the whole research system. First, some strategic decisions regarding the mission, the size and scope of the research system have to be made; this includes 1) the overall level of resources (financial and human) that should be devoted to agricultural research; and 2) some basic decisions regarding the scope of the research itself.

The decision concerning the scope of the research will, in part, depend upon the country's economic and agricultural development objectives. An important task of planning at the national level is to translate the country's economic and agricultural sector development objectives into a set of agricultural research goals and objectives.

Figure 2 proposes a model for the process of strategic planning.[21] The increasing interest in strategic planning, demonstrated by the abundant literature on the theme, has resulted in a number of models being proposed. A careful review of these models in an attempt to adapt them to agricultural research management shows that they amount to essentially the same, simply differing as to the level of disaggregation of the steps. The order of the steps may also differ slightly, but the essential point is more the issues than the order in which they are addressed, since the process is inherently iterative.

The process begins with an assessment of the present situation of the agricultural research system (i.e., its current objectives and strategy), an evaluation of its strengths and weaknesses and an analysis of its environment. The output is a review or diagnostic of the system.

From there, an ideal scenario for the research system is designed. In analyzing the difference between the 'present' and the 'desirable' future, one gets a measure of the needed changes (gap analysis), in particular the resources and capabilities that are required to bridge the gap, as well as any organizational adjustments. Comparing this with the resources the country can realistically mobilize may lead to a redefinition of the preferred scenario and of a desirable scope for the system. The output of this iterative process is a goal statement which defines the mission, the size and scope of the system, and its objectives.

The goal statement becomes an input in the process of policy elaboration which produces a national agricultural policy and strategy. Such a document specifies the resources that are available to reach the objectives and the required organizational adjustments. Then comes the implementation which is monitored and evaluated. The monitoring and evaluation reports serve as an input for the planning process.

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21) The model proposed here owes a great deal to that of Stoner and Wankel, (1986:124-5). Sachdeva (1988b), inspired by a number of authors writing on strategic planning, also developed a model for agricultural research planning, elements of which were used here.

4.1 Assessing the Current Status of the NARS; Determining Strengths and Weaknesses

The situation of the NARS can be assessed along four major lines: 1) the actual mission of the research system; 2) the consistency between the goals and objectives of the research system and those of national economic development; 3) the organizational structure of the system, and the various mechanisms, organizational devices and linkages are they in accordance with and do they further the goals and objectives of the system? 4) the level and complementarity between resources (financial, physical and human): do they enable the system to fulfil its objectives and operate efficiently?

The Mission of the System

There is often a gap between the stated, or expected mission for the system, and the actual mission pursued by its scientists. While the research stakeholders may expect the system to be at the service of agricultural development, researchers may pursue scientific objectives within their disciplines and may aim at contributing to international advancement of knowledge. Thus program contents need to be evaluated as to their relevance for the country's circumstances.

Consistency Between Research Objectives and National Development Objectives

This is a crucial moment in the evaluation of the current situation of the research system. Agricultural research objectives, as expressed in the various programs of the institutes, are checked for consistency with national development objectives. All too often research objectives are elaborated in isolation from national development goals.

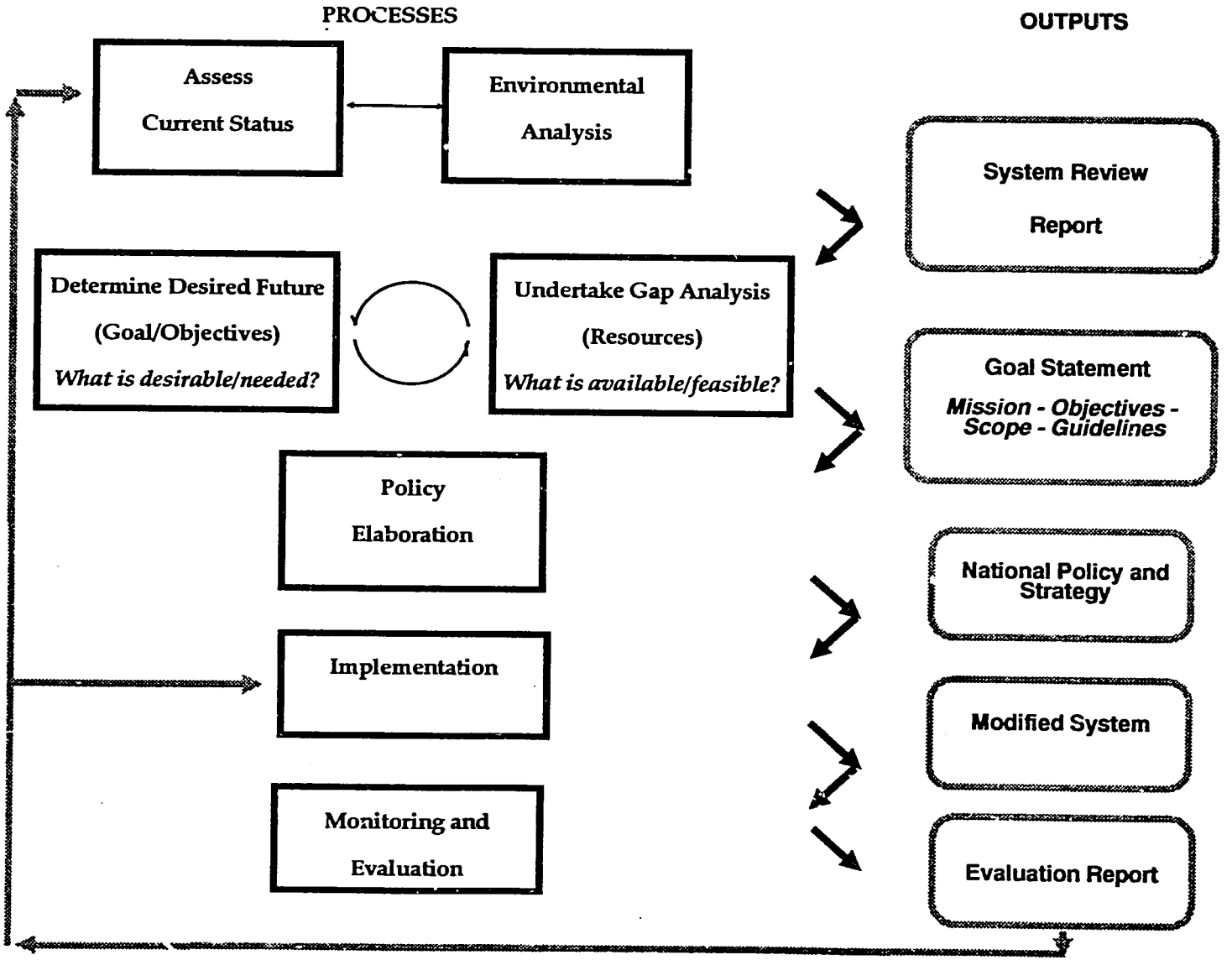
This leads to evaluating the process of formulating agricultural research objectives. It involves assessing for efficiency: 1) the linkages between research and policy-making; 2) the methodologies and, particularly, the assumptions behind the models that have been used (if any) for priority setting; 3) the functioning of the mechanisms that have been put in place for planning, as well as mechanisms that are part of the management control system and are useful to the planning process (see infra.).

Effective communication between policymakers and researchers can also affect the extent to which research policies are in tune with national development objectives. The informal interactions, as well as the more formal linkages, need to be assessed.

Structure and Organization of the Research System

These will determine the system's capacity to achieve its designated objectives. The main issues evolve around the number of institutes

Figure 2: Strategic planning model and outputs at the national level.



or departments, which entity they will be placed under, their degree of autonomy (or control), the degree of centralization or decentralization of the system (administratively as well as geographically) and the degree of unification or coordination within the system.

Other questions deal with the organization within the system necessary for the performance of planning, monitoring and evaluation and inter-institutional coordination functions. Monitoring refers to the periodic reporting and analysis of data on key research indicators. The performance of the system is thereby measured against the objectives set and the intermediary output expected in relation to a plan. Thus it provides the necessary information for corrective action. Evaluation is concerned with issues of relevance and quality of research process and impact of research outputs. Both generate information useful for management purposes and for future planning.

Sound planning, monitoring and evaluation rest first and foremost upon a good information system on the research programs and projects, the resources allocated to them, and their results. Ineffective information management results in duplication of efforts, lack of continuity in building knowledge bases and inefficiencies that limited-resource systems cannot afford.

Well-functioning linkages between the institutes within the system are important to avoid duplication and a gap in research coverage, and to capitalize on the complementarity of research efforts. These are particularly difficult to manage in the case of autonomous or semi-autonomous institutes or, in the case of departments, under different ministries. The most difficult linkages may be between the private and the public sector and between the universities and the research institutes, as these may operate with different value systems and a different mission.

Thus, the various mechanisms and organizational devices (bodies or committees) that are put together for these specific tasks need to be assessed. To what extent are these coherent with, and do they further the goal of the system? The composition, mandate, functions, and degree of authority of the various bodies need to be reviewed for strengths and weaknesses.

Level and Complementarity of Resources

Is the level of resources for the actual scope of research adequate? Equally important is the appropriate balance between personnel, operating funds and facilities, and within personnel, between scientists and support staff. There are too many facilities without programs, too many researchers with insufficient funding to adequately carrying out their research. Does the system have enough scientists with an adequate level of training?

4.2 Environmental Analysis

Environmental analysis has three purposes: 1) to understand the economic, socio-cultural and political characteristics of the environment as it affects the functioning of the NARS and its ability to meet the designed objectives; 2) to know and understand its stakeholders and its clients; 3) to evaluate the present and future markets (domestic and international) for the country's agricultural products.

The Economic, and Socio-Political Environment

Agricultural research will ultimately be evaluated by the adoption rate of new or improved technologies and the impact of the adoption on the economic development of the country. Adoption rates are determined by the relevance of the technology for farmers' needs and constraints, and further, by national economic and agricultural policies.

In particular, farmers' decision to adopt a technology will be based in part on the costs of using the technology in relation to its likely profit. But producer prices for a commodity (level and stability) in relation to the prices of other products and to consumer goods, will also be decisive. Policies in areas beyond the agricultural sector, such as import-export, fiscal, monetary and foreign exchange will determine the relative price levels. These are often affected by political decisions to favor urban consumers, or to protect the industrial sector, thereby turning the terms of trade against producers and the agricultural sector.

Other determinant factors in the technological diffusion and adoption rate are an effective extension system, in turn affected by its linkages with research, by the reliability of input delivery and services (whether performed by the public or the private sector) and by an appropriate infrastructure. Reviewing the performance of these sectors should be part of planning at the national level, because there is little sense in promoting the generation of new technologies if rural infrastructure will not support their adoption.

Entering into the details of an action plan for an adequate agricultural research environment would be much beyond the scope of planning for agricultural research. Nevertheless, the deficiencies that stand in the way of research contributing to its full potential to agricultural development should be brought to the attention of the policymakers who are dealing with issues in the realm of economics and finance, agricultural and rural development, and trade.

The Clients

The environmental analysis is also concerned with the ultimate clients of agricultural research, the producers, and their

characteristics. The disparities between socioeconomic categories in rural communities are such that technology adoption capabilities can vary substantially, depending on the input content of a technology. For example, new or improved technologies requiring high level of inputs are not likely to be adopted by resource-poor farmers. Thus farmers should be identified according to their relative endowments (land, water, labor, and capital), and their access to inputs, markets and services such as credit; this in order to tailor research program objectives to the needs and constraints of the research users.

The Stakeholders

An analysis of the stakeholders of agricultural research is also necessary in order to identify their interests and expectations. By stakeholders is meant the groups whose activities are likely to affect the research system, or conversely, the activities of which will be affected by the output of the research system. They are not the direct users of research. They are: 1) the financers of research (government and donors); 2) the groups that make up the environment of agricultural research, such as, for example, the rural banks (their credit scheme will influence the adoption of a technology); the agriculture-based industries and import-export firms (their absorptive capacity of agricultural output will also be a determining factor); and all agriculture-related services; 3) the consumers.

Given their role in allocating resources to research, governments and donors are important stakeholders. Hence, part of the analysis is to identify the information that would enhance the commitment of policymakers and provide them with the necessary justification to increase resources for agricultural research. Another part would be to detect the policy-making activities for which policymakers would need and welcome the input from research, thereby giving research a higher profile and demonstrating its value. As for donors, a solid understanding of their priorities and requirements for research funding will help to develop a strategy to attract the available external funds.

The generation of technologies that will lead to a production increase for export or for processing, or to the development of new products, should only be envisioned if:

- rural services can be expected to handle the surpluses or new products adequately and deliver the additional inputs;

- import firms and/or local manufacturers can produce the necessary inputs;

- banks can increase their lending scope in support of higher activity levels.

Thus, identification of the actions in the system and close consultation with them is essential before envisioning the development of new technologies.

Finally, consumers will be affected by technological innovations, either through a change in relative prices for agricultural products or their quantity, quality and diversity. Different consumer groups will be affected differently, depending upon their purchasing power and patterns. An estimate of demand elasticities is needed to evaluate the likely effect of a supply increase on prices.[22)]

Domestic and International Markets

The agricultural research policy and strategy are also built upon the results of market prospects, both domestic and international. Normally, such studies should have been undertaken as part of the process of elaborating the country's economic development policies, prior to the elaboration of the agricultural research policies. For each present and potential speculation, market growth, as well as market share and the country's comparative advantage need to be evaluated, so as to take advantage of changing demands and opportunities.

When new products are being considered, consumer preferences and their purchasing patterns and constraints need to be understood and analyzed carefully in order to determine the necessary characteristics of the products. Too often, so-called "good" products have been developed only to be found unacceptable by the consumers. These data and information are then used to evaluate the potential return to research investments.[23)]

Private-Sector and IARC Contribution to Agricultural Research

The issue is to evaluate the actual and potential contribution of the private sector to agricultural research, either in-country or through the importation of ready-made foreign technology (such as improved seed produced by multinational corporations). Equally important is the possibility of borrowing technology from the IARCs. The purpose is to define the best mix of public and private research, and how much foreign technology should be imported. From there the appropriate niche for public-sector research can be determined, as well as the policies which will best encourage private-sector research and technology transfer.

22) By price elasticity of demand is meant how much the demand for a product will change as a result of a change in price. If a product is price inelastic, the demand for it will tend to be stable with respect to price; conversely, if a product is price elastic, the demand will respond to price change. How responsive the demand is with respect to prices is measured by the elasticity.

23) In their system approach to research resource allocation, Pinstrup-Andersen and Franklin (1977:422-3) are discussing market data requirements.

4.3 Determining the Desired Future: Mission and Objectives

Mission of the system.

"Mission" is understood to mean what the country is expecting from its agricultural research. A NARS's mission can be either 1) to support the development of the country's agricultural sector; 2) to contribute to the advancement of agricultural science; or 3) to provide the basis for the elaboration of agricultural development policies and development projects; that is, to be a service to policy-making. The mission assigned to the system will determine many of its functions: obviously, it determines, in part, the content of the research programs. Beyond that it will determine the criteria for rewards and promotion of the scientists and the organizational structure of the system, in particular the kind of mechanisms that will be put in place for planning, monitoring and evaluation, and reporting.

Societal Choices and Agricultural Research Objectives

Agricultural research policies are intended to influence the direction of technical change and the characteristics of technological development in the agricultural sector, so that they are compatible with social goals. Determining agricultural research objectives is a process that merges the overall socioeconomic and agricultural development objectives of a country with the agricultural science and technology policy, taking into account the availability of resources and their relative costs.

The process of defining research objectives for the agricultural research system incorporates some major societal choices.[24] These are usually made in a much wider development context than the elaboration of a national agricultural research policy. Some of the choices that are likely to be relevant for agricultural research are the following.

i. Target Groups. Should agricultural research have as its primary clients: 1) the poorest, most marginal farmers, for whom increasing production is a matter of survival; 2) the intermediate farmers, who are perhaps more likely to be able to improve their productivity; 3) the agro-industrial/large-scale producers, whose production may be crucial to improving the country's balance of payments; or 4) an appropriate combination of all three, depending on the availability of resources and commodities?

ii. Priorities Among Differing Agro-Ecological Zones. Should research concentrate on high-potential or marginal regions, the colonization of unused land or the development of densely populated agricultural areas? Decisions on these issues are not independent

24) Societal choices are also discussed by Rocheteau (1989). One of the most comprehensive models for tying agricultural research objectives to social goals such as growth, equity and security has been proposed by Pinstrup-Andersen and Franklin (1977).

of the agricultural sector's expected contribution to the overall development objectives, nor of the decisions concerning target social groups.

iii. Distributional Issues among Producers. The adoption of new technologies is likely to have important side effects on the social structures, depending upon the characteristics of the technology and on the socioeconomic and institutional environment in which it is introduced. Thus, choices made on the ways to release production constraints and increase agricultural productivity are critical. Obviously, choices concerning the preferred characteristics of technological change will be determined in part by the priorities among target groups and target regions (1&2 above).

Distributional effects are the result of: 1) technological innovations being adopted soon after their release or later; 2) relative land, water, capital and labor endowments; and 3) different access to inputs, markets and services.[25] Early adopters will benefit from a new technology before increased production leads to a fall in producer price which will be the case if prices are not sustained by an increase in demand for the product.

New technologies will affect the unequal distribution of productive assets and income, by changing the returns to factors of production. For example, with unequal land distribution, labor-saving and land-using technologies will lead, other things being equal, to the displacement of agricultural laborers, to the subsequent impoverishment of the most marginal farmers and to the increase in rural-urban migration. In such situations, if the clients of the agricultural research system are the small farmers, the generation of labor-using and land-saving technical innovations may be preferable. In addition, low-income farmers have less capacity to withstand risk: they will choose a lower-profit but more secure technology over a high-profit but risky one. This may affect adoption rate and introduce further income inequalities.

Agricultural research is not the most efficient way to address social inequalities as compared to other policy measures. Indeed, "to attempt to meet distributional objectives through research allocation rather than redistributing of the land is analogous to moving the piano to the piano stool" (Mellor 1977:482.) However, it is almost inevitable that it will have an impact on social differentiation. In formulating choices for a technological path, the biases implied due to the particular socioeconomic circumstances have to be highlighted; not only for their impact on the adoption rate, but also for the potentially undesirable effects on the distribution of income, employment, rural differentiation and the socio-political unrest they could trigger off, so that appropriate complementary policies be instituted.

25) The literature on the distributional effects of technological change, is huge and controversial; Barker, Herdt and Rose (1985) review the literature on the income effect of modern varieties technology in Asia. See also Hayami and Ruttan (1985: chapter 11). For the implications for research resource allocation, see Binswanger, and Ryan (1977:224-226); Mellor (1977); and Schuh and Tollini (1979).

iv. Distributional Issues between Producers and Consumers.[26] A new or improved agricultural technology should lead to increased production at lower costs per unit. Therefore, depending upon the price elasticity of demand for the product, both consumers' and producers' welfare should be increased: this through consumption of larger quantities at lower prices per unit for the former; the selling of larger quantities and/or lower production costs for the latter that can more than offset the fall in prices.

However, in the case of inelastic demand for a product, the decline in producer prices, when supply increases, will not be offset by increased demand. Except for the early adopters, producers' income will be reduced, and consumers will reap the benefits generated by falling prices. The poorest consumers are the ones who will gain the most, since poor people spend a larger proportion of their income on food.

The agricultural research objectives thus may be quite different depending on whether the objective is to maximize producer income and/or employment in the agricultural sector, or if it is to increase the welfare of the poorest consumers. The possible conflict between lowering prices to consumers and increasing farmers welfare has to be acknowledged in elaborating research objectives. Concentrating on products for which the demand is likely to go up when prices decrease or on products with export potentialities in addition to the domestic market may be a solution if the objective is to increase farmers' welfare. However, these may not be the produce that the poor consumers need the most nor the ones they can afford to buy. In low income countries, however, there is less potential conflict as to the distribution of benefits between consumers and producers: most producers are consumers as well.

The above discussion does not pretend to analyze all the potential distributional effects of technological change under various circumstances. The intention is only to bring to the attention of policymakers some of these, so that they be aware that adequate policy measures (price policies, fiscal and monetary policies) be taken accordingly.

v. Environmental Considerations.[27] Should the control of environmental degradation and the stabilization of agro-ecological systems take precedence over an immediate increase in agricultural production? Given the degradation of natural resources, in the past often exploited without much concern for their reproducibility, the sustainability of production systems is becoming increasingly important. Certain technologies, if used inappropriately, may destabilize fragile systems. It is likely that concern for sustainability will have increasing research implications, both directly and indirectly, in the future.

26) On this issue, see Binswanger and Ryan (1977) and Hayami and Ruttan (1985: chapter 11).

27) See Treitz and Narain (1988).

Translation of Agricultural Development Objectives into Research Objectives

National development goals and agricultural sector objectives are normally spelled out in development plans. Agriculture has commonly been expected to contribute to the overall development objectives in several ways:

a) to increase consumer welfare through increased supplies of food and to improve the nutritional status of the disadvantaged;

b) to contribute to foreign exchange earnings through production for exports and to support the development of the domestic industrial sector by providing raw materials and a market for the domestically manufactured goods;

c) to increase income and employment in the agricultural sector;

d) to conserve the environment and the country's natural resources;

There are two problems with this set of objectives when it comes to basing the elaboration of agricultural research objectives on them. First they may be in conflict with each other. For example, under some circumstances the objective of increasing domestic food supplies may compete with the objective of increasing production for exports. As highlighted above, increasing food supplies through productivity improvements may lead to declining producer prices and a reduction in farmers' incomes; conversely, the objective of rural employment can lead to the adoption of less efficient production techniques and an increase in the cost of food to consumers.

Another problem is that these goals are so broad that they can accommodate any research activity. It is impossible, from the above to decide the extent to which research should emphasize:[28)]

1) increasing production for import substitution or for export; for food or industrial crops;

2) the diversification of production or development of current products;

3) improving the quality of products;

4) the savings of inputs;

5) the improvements in transportation, storage,and processing;

6) economic policy and institutional development.

28) For a discussion of this issue, see for example Schuh and Tollini (1979:14-22).

i. Increasing Agricultural Production. Though increasing output is generally the primary goal of agricultural research, resource allocation will be quite different if the focus is on products for exports, for import substitution or raw material for the industrial sector. Most countries stress the importance of increasing food availability, but this can be achieved through various ways in addition to research on food crops: 1) increased production for exports, which can finance the import of food products; 2) research on non-food crops, which by increasing resource productivity would release land and labor for the production of food crops.

ii. Diversification of Production. Similarly, research efforts could be directed at developing new products to exploit emerging market potentials (either domestic or external); or decisions can be made to scale down research on those crops, the marketing potentials of which are dwindling, either as a result of new competitors or the development of substituting products.

iii. Improving the Quality of Products. Research on the improvement of product quality also aims at capturing a potential market and increasing rural incomes.

iv. Input Saving and Resource Conservation. Input costs to improve agricultural production are becoming a matter of concern for many developing countries. Increased input costs in relation to product prices make it difficult for farmers to adopt new technologies. Faced with financial difficulties, most governments can no longer afford to subsidize inputs. Finally, the high foreign exchange component of inputs is a problem for countries already faced with balance-of-payments deficits. Hence, the challenge to agricultural research might become to develop varieties that are more responsive to fertilizer application or that can make better use of soil or air (nitrogen fixation) nutrients.

Another issue is the one of saving resources, in particular soil and water. Varieties that make more efficient use of water, either under rainfed or irrigated conditions, need to be developed. Though the ultimate result from resource savings may also be agricultural growth, the research content is quite different, whether the emphasis is on increasing agricultural output as the prime objective or whether it is to make more efficient use of resources.

v. Improvements in Transportation, Storage and Processing. Here, again, research on these issues may result in a reduction of waste and spoilage, and a more efficient distribution system, with the result that more produce reaches the consumers, the export markets or the industries.

vi. Institutional Environment and Economic Policies. As noted earlier, the economic and institutional environment plays a key role in the adoption of technological innovations. Thus

research on appropriate institutions and policies for the development of agriculture can go a long way towards the ultimate goal of increasing agricultural production, especially when undertaken in complementarity with biological research.

Thus it is essential that the various agricultural development objectives be detailed and priorities be set in order to resolve the potential conflicts between them. As much as possible, objectives should be quantified to give them operational meaning. In particular, the targets for food and export production and raw material supply to industries should be specified before agricultural development objectives can be translated into research objectives.

Determining research objectives adds another dimension. It answers the question: What is the potential contribution of national public research to the attainment of each agricultural development objective? This may lead to research objectives being somewhat different from agricultural development objectives. For example, a country may well have as its most important objective the increase of basic food, say rice, without the development of rice technologies being the major agricultural research objective; this, due to the fact that technologies may already be well known and that the major bottleneck is extension or delivery of inputs or transportation; or else, technologies may already exist, developed by institutions other than the national research system.[29]

4.4 Gap Analysis; Resources, Capabilities and Organization Required

Based on the mission and objectives assigned to agricultural research, the evaluation of the current situation of the research system, with its strengths and weaknesses, and the analysis of its environment, it is possible to proceed with a comparison between the actual and the desired situation. The gap between present and desired achievements (outputs and services), followed by the added resources required (physical, financial and human), as well as the weaknesses that need to be addressed in order to arrive at the desired situation, are all identified. Needs for organizational adjustments and cultural change are also included in gap analysis.

Resources and Capabilities: Determining the Size and Scope of the System

Given the desirable output of the system, the resources that would be needed are specified. This ideal situation is compared to the level of resources the country is prepared to allocate to its agricultural research. When discrepancies occur, either some additional funding needs to be secured or the objectives need to be revised.

29) Such is the case of the Philippines: for its rice research, it complements the rice program at IRRI with mainly adaptive research. (Personal communications: Emil Javier and Oely Gapasin).

Determining the optimal level of sustainable effort for agricultural research for the particular circumstances of a country is a thorny exercise. Because of the long time span required for generating definite research results, the sustainability of investments is more important than obtaining high funding levels that cannot be sustained over time. It is therefore important to determine the level of funding, including external funding, that the country is prepared to support, at least in the medium term.

As discussed in chapter two, the rationale for funding levels that mirror the levels of developed countries is far from having been established. An appropriate funding level will by and large depend upon the particular circumstances of a country, including its overall financial capabilities, its level of institutional development and the availability of qualified scientists. Therefore, a comparison with countries experiencing 'similar' circumstances is a better starting point.[30)]

Where there are presumptions of underinvestment, past return to investment in agricultural research can be measured to argue for higher and more appropriate levels of funding.[31)]

Beyond the overall level of funding, the concern should be the appropriate balance between expenditures on equipment and facilities, personnel and operating funds. An appropriate balance between scientists and support staff is also needed. Several measures of resource allocation can be used:

Number of scientists. It is usually expressed per billion of Ag. GDP or per million ha of arable land;[32)]

Operating funds per scientist. This defines the minimum operating funds (including recurrent costs on facilities and equipment) that are needed per scientist to carry out research work. Obviously, this will depend according on the type of research. However, each country needs to determine an average minimum funding level, as this will be one of the bases for arriving at a well-balanced level of funding between salaries and operations.

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30) For a discussion of public support to agricultural research, see Elliott and Pardey (1988); Pardey, Kang and Elliott (Forthcoming). Ruttan (1987) presents the various sources of financial support and ways to mobilize them. Rocheteau (1989) discusses some of the considerations other than Ag.GDP percentages to be taken into account to determine the level of funding.

31) A number of methods are used to evaluate research investments. They have been classified under: 1) the inputs saved approach; 2) consumer and producer surplus; 3) production function; 4) impact on national income; and 5) nutritional impact. The economic surplus approach, often known as rate-of-return analysis, compares the reduction (in unit costs) that comes about as a result of a technological innovation, with the costs of adopting the innovation. The share of benefits between consumers and producers is estimated. The production function approach estimates the farm output as a function of various factors, including research expenditure. Statistical procedures are used to separate out the impact of research effort on output and to control for other variables that may be affecting either the research output or agricultural production. For a detailed analysis of these methods, their advantages and disadvantages, and where most appropriate, see Schuh and Tollini (1979) and Shumway (1977).

32) Figures for adequate level of human resources are scanty. Using the developed-country figures could be as misleading as the figures for the level of funding.

Organizational Structure

The existing organizational structure may not be the most appropriate one for the implementation of the new research objectives. In such situations, organizational adjustments may become necessary, and can include changing the entities to which institutes are responsible, modifying the degree of control over the institutes towards more or less autonomy, changing the degree of centralization or decentralization, merging or splitting institutes, creating new institutes, reinforcing research at the universities, and privatizing parts of the research system. Various scenarios for reorganization may be envisioned.

Linkages Within the System and Between the System and Policymakers

Existing linkages may also be inefficient. Ways to improve the functioning of theses linkages will be designed as part of system planning.

4.5 Elaboration of a National Agricultural Research Policy and Strategy

Once the level of funding has been brought into balance with the objectives assigned to the system, the national agricultural research policy and strategy can be put together. It includes a well-defined mission for the system, a set of research objectives and broad priorities for the design of research programs, and the resources that will be applied to them: financing, staffing, physical facilities, and the adjustments in organizational structure and linkages deemed necessary.

The research objectives and the socioeconomic development objectives of the country also serve as the basis for allocating resources among research programs. Making choices between different patterns of resource allocation is a thorny exercise, which requires experience, intuition and a solid knowledge of agricultural research and agricultural development. To complement informal expertise and improve the resource allocation procedure, a number of priority-setting methods have been developed. They include:[33)]

congruence, which allocates research funds to commodities in the same proportion as their existing contribution to the AgGDP;

domestic resource cost ratio: it calculates a country's comparative advantage over other producers in the world market;

33) It would be beyond the scope of this paper to enter into the details of each of the priority-setting techniques, their advantages and disadvantages, and which ones to choose, depending on the situation and the purpose. Among the voluminous literature that has been written on the subject, I refer the reader to Schuh and Tollini (1979); Anderson and Parton (1983), Norton and Davis (1981), Norton and Pardey (1987) and Contant and Bottomley (1988). The list presented in the text leaves out mathematical programing and simulation models, as they appear to be the most difficult to implement at this stage. ISNAR is presently working on developing priority setting tools based on benefit-cost analysis with and without an economic surplus perspective, and on scoring models.

checklists and scoring models: they establish a list of multiple criteria (and weights between them in the case of scoring models) for ranking research objectives, commodities or research areas;

benefit-cost analysis, including consumer-producer surplus analysis. These calculate a benefit-cost ratio, an internal rate of return and net present value for alternative patterns of research investments. They are based on researchers' opinions to determine an estimate of research impact, the probability of research success, the expected rate of research adoption and the distributional implications of technological adoption.

Priorities between objectives and programs serve as the basis for resource allocation among institutes. For example, if the highest priority has been given to reducing the balance-of-trade deficit through agricultural export revenues, resources will be allocated with priority to the institutes carrying out research on export crops. Conversely, if priority is given to achieving basic food security, the resources will be directed to research areas of relevance to this issue, from research to increase local staple food production to improve storage, marketing and/or constitution of security funds. This also applies to political and social motives: e.g., developing a particular region, or giving particular attention to a specific ethnic group. For example, a Latin American country may decide to give priority to the development of the Altiplanos and, therefore, may allocate a corresponding budget share to highland agricultural research.

4.6 Implementation of the Strategy

A distinctive characteristic of planning at the national level is that the actual implementation is passed on to the institute level. The national policy and strategy serves as an input to the planning process at that level.

Beyond providing guidelines for the institutes, the national agricultural research policy and strategy includes documented recommendations for policies to foster the adoption of the expected new technologies: price, import-export, monetary, marketing and extension policies. It also contains recommendations as needed for organizational readjustments and linkage improvements at the national level.

For the ministries of planning, or economics and finance, it provides information useful when elaborating national development plans, sectoral policies and allocating resource. For donors, it is also a reference for proposing special projects and for their own allocation of funds. It is thus the basic document for negotiation purposes with donors. Finally, for implementing ministries in the agriculture sector, it becomes one of the inputs for the elaboration of their own strategy.

4.7 Monitoring and Evaluation

The extent to which the implementation process at the level of the institute will be monitored from the national level depends on the structure of the research system. For a centralized system with a well-defined apex, the monitoring will begin with the review of the institutes' strategic plan, checking conformity with national policies and strategies. Once the plans are approved, achievements will be reviewed periodically in relation to intermediate targets, with the extent, nature and reasons for deviations documented and, when necessary, corrective actions decided upon.

In the case of a system without an apex, monitoring may be reduced to only a flow of information between the research system and its stakeholders. However, even with a loose structure, some feed-back mechanisms should be institutionalized to inform policymakers of the research results, progress or difficulties at determined intervals.

5. STRATEGIC PLANNING AT THE INSTITUTE LEVEL

Strategic planning at the institute level will vary considerably depending on the particular organizational structure of agricultural research in the country. In centralized and monolithic systems it is likely that most of the decisions will have been taken at the national level, leaving very little leverage to the institutes, other than straightforward implementation. By contrast, in extremely decentralized systems, with a multiplicity of intervening institutions and a loose policy-making process at the national or system level, the agricultural research policy may amount to little more than very broad guidelines; in such a situation, most of the planning will take place at the institute level. Hence, in reality, the institute planning exercise could encompass more (or less) than what is presented hereafter, depending on the specific circumstances of the country.

The strategic planning for the institute that has been adopted here places the formulation of long-term programs within the institute. Thus, it presupposes that most of the activities within the program will be carried out at the institute, or at least that the leadership of the program is clearly the mandate of the institute. However, this does not preclude that other institutions in the country may carry out parts of the program. To the contrary, one can envision situations where long-term programs are formulated at the national rather than the institute level. For example, if many institutions are undertaking research, with none carrying out the bulk of it, it may be necessary to formulate programs at the national level in order to coordinate activities between the various institutions and allocate resources accordingly.

The sequence of steps for elaborating the plan at the institute level is quite similar to that at the macro level. Major distinctions are to be found only at the two ends of the process (see Fig. 3). First, the research goals and mission of the institute are already defined by the national agricultural research policy and strategy. These are therefore discussed within environmental analysis. Second, the institute is concerned with the actual implementation of the policy and strategy; a detailed action plan has to be prepared over a period for which resources are fixed, and the major trends in the environment are known.

A further difference is that at the institute level, each step of the process starts from the results of the same step at the national level and proceeds from there into the specific circumstances of the institute, with an added degree of detail. For example, the environmental analysis at the institute level assumes the results of the environmental analysis at the system level, and focuses on the part of the environment which is of direct concern for the institute. Similarly for the research stakeholders.

5.1 Analysis of Current Status

The current objectives, strategies and performance (scientific output) are assessed in order to identify the institute's strengths

and weaknesses. In particular, the resources (physical, human and financial) and the scientific potential need to be assessed. One of the critical issues is the balance of resources allocated to each program, and the level of these resources. Different activities require different minimum levels of investment and support to ensure that research activities will have the expected impact. Investments, below that critical level, risk being unproductive, although it is often the case that, in the absence of priorities being set, research is being carried out in all required areas, even if it is with very limited resources for each.

Also belonging to this sequence is the evaluation of the effectiveness of the current structure to carry out the various functions the organization is supposed to perform. The following management functions need to be evaluated: planning, coordination, communication, information collection and processing, monitoring and evaluation, annual programming and budgeting, reporting and accounting.

Another important component of the evaluation is to determine how effective the present program organization is in terms of achieving the expected objectives. To what extent should research activities be organized along 1) product-lines; 2) resource/factors of production (soil and water resources, mechanization, labor, and management); 3) stages or levels in the production-to-marketing sequence (i.e., inputs, farm production, post-harvest technology, markets, and community services); 4) disciplines; 5) production systems; 6) themes; 7) problems; etc... ?

An organization strictly along discipline lines, for example, will tend to emphasize production of research results for the advancement of science. And yet, some regrouping of scientists by discipline in a kind of support department may be necessary, as not every program can afford a full-time specialist in all required scientific areas.

Programs by product lines tend to ignore the complex and heterogeneous natural and socioeconomic conditions in which many farmers operate. Such an organization may bias the selection of research activities towards providing technologies that only the farmers who have the capability to make the necessary adjustments can adopt. Introducing an organization based on production system to substitute for production lines as the basis for assigning research priorities has been suggested. However, such an organisation, if it facilitates the transfer process by generating technologies tailored to the needs and constraints of farmer groups and agro-ecological zones may be prohibitive in terms of financial, scientific and organizational resources.[34)]

The solution seems to lie with an integration of the two types of program organization; i.e., the production lines and the production system. It would involve maintaining an organization based on programs by product lines and disciplines for technology

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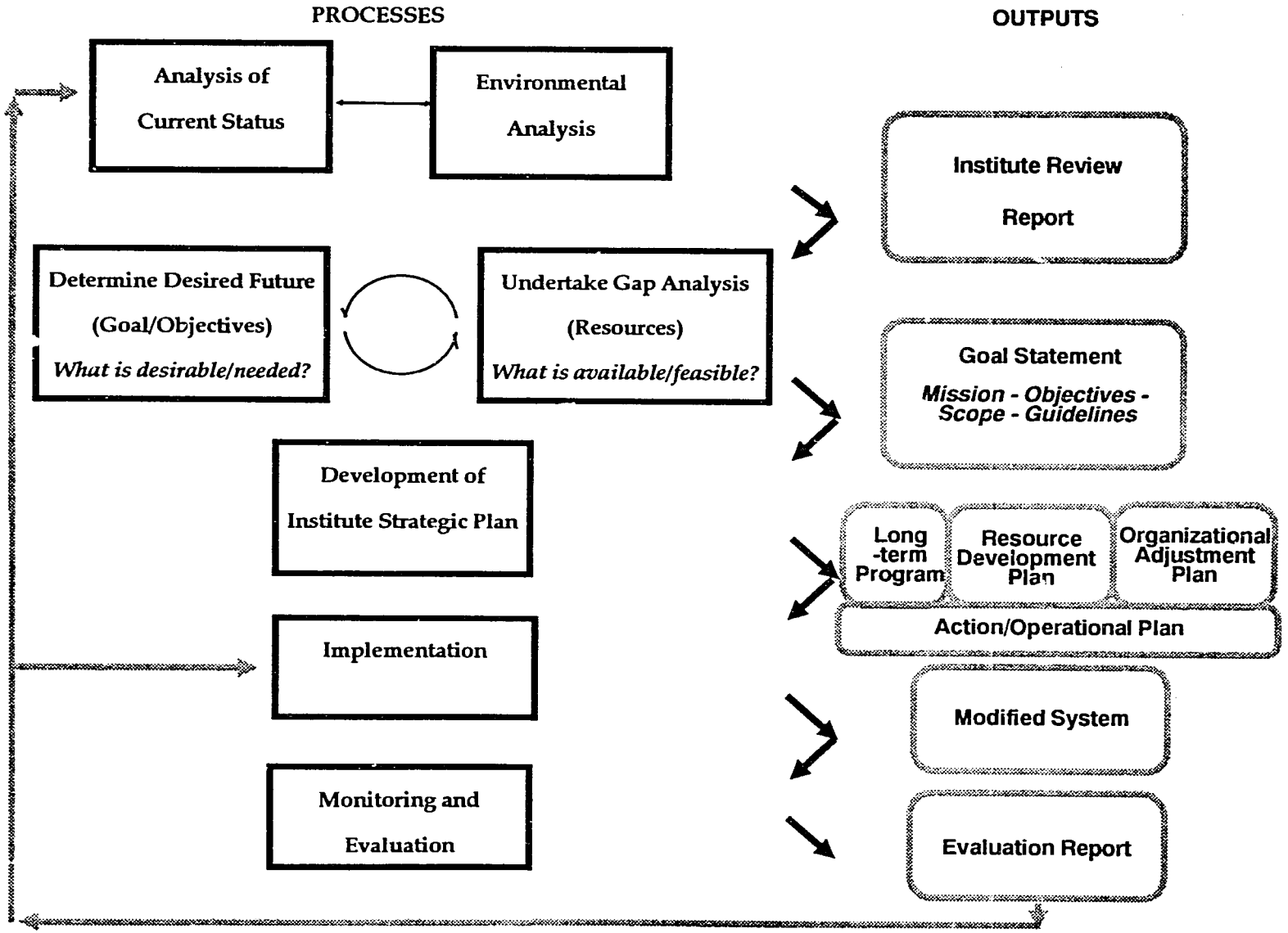
34) Trigo, Pineiro and Chapman (1982) discuss the advantages and problems of the two approaches to organization; i.e., the product-line or the production system approach.

Figure 3: Strategic planning model and outputs at the institute level.



development, but incorporating a production system approach for the selection of research activities and for technology adaptation.[35] This may be obtained through the effective integration of on-station and on-farm activities: though feedback mechanisms between on station and on farm activities, information concerning 1) the needs and constraints of specific groups of farmers and 2) performance of technologies under varying management conditions, can serve as the basis for selection of on-station research activities.

However, this close integration is particularly difficult to establish; in particular, the effective feed-back of information into the planning and priority-setting process for on-station work. On-farm or production systems research often remains isolated in a program parallel to product-line research, due to various institutional management and socio-cultural factors.[36]

5.2 Environmental Analysis

This step begins with a thorough in-house review and discussion of the national agricultural research policy and strategy. The goals and mission that are assigned to the institute need to be discussed, understood and agreed upon. This is an important aspect of elaborating the institute plan, organizationally and politically: it helps bridge the national and institute levels in the planning process; it serves the purpose of gathering consensus in-house around a common set of objectives and of giving staff a sense of participation in a national mission.

Environmental analysis at the institute level deals with:

(a) the economic policies that are relevant to the research mandate of the institute;

(b) the specific linkage mechanisms with extension services for the diffusion of the technologies developed by the institute;

(c) the particulars of the socioeconomic and political environment of the agro-ecological zones for which the institute has a mandate;

(d) the socioeconomic setting of the institute's clients; a typology of the institute's clients needs to be elaborated;

(e) the stakeholders, including the external donors, with their specific interests, concerns and priorities;

(f) the linkages with external sources of knowledge and international collaboration.

35) Trigo, Pineiro and Chapman (1982:32-33).

36) The importance of an effective integration between on-farm and on-station work is highlighted in the study of the nine cases of "on-farm, client-oriented research" undertaken by ISNAR. One of the main issues under study in this project is the appropriate organization for an effective integration. See Merrill-Sands and McAllister (1988); and Ewell (1988).

This last aspect of environmental analysis at the institute level is often neglected. Potential collaboration with research institutions outside the country involves determining: 1) the extent to which technologies produced by the international or regional research centers are appropriate for the particular circumstances of the country and could be borrowed with only some adaptive work needed; 2) the activities that could be undertaken by each party with mutual benefit.

The institute may find it advantageous for certain research areas to focus on testing and adaptive research, in vertical cooperation with international and regional institutions, while concentrating its resources for applied research in areas where technology cannot be directly borrowed. If a commodity is of strategic importance to a country and if basic research in that area is not readily available, an institute may decide to allocate a relatively larger share of its resources to developing fundamental research in that area. Such a strategic decision would have to be supported by decisions at the national level.

Possibilities of horizontal cooperation should also be investigated: institutions from several countries can cooperate towards the advancement of a jointly designed program, each taking part in the scientific responsibilities according to its relative advantage. Careful evaluation of these opportunities will have important implications for the design of program strategies and allocation of resources between programs.

5.3 Determining the Desired Future

It includes determining the mission for the institute, which will by and large be determined by the mission assigned by the national level, the institutes' clients and the research objectives that will be pursued.

5.4 Undertaking Gap Analysis: Resources, Capabilities and Organization Required

Gap analysis entails a comparison between the current and the desired status of the institute, taking into account environmental conditions. The resources and scientific capabilities necessary to achieve the new or revised objectives, and the organizational and managerial adjustments required to reach efficiency and effectiveness are determined.

The level of resources thus defined is compared to the level allocated by the national agricultural research policy and strategy. The resources allocated to the institute at the national level may not be sufficient with respect to the objectives assigned and the expected outputs. A dialogue then takes place between the institute and the national level; either the objectives assigned to the institute, or the amount of resources allocated, have to be revised.

5.5 Elaboration of the Institute's Strategic Plan: Long-Term Program Formulation

The institute strategic plan comprises three components:

1. the formulation of a long-term research program and its translation into an action plan for the short term;
2. the elaboration of a resource-development long-term plan (human, physical, financial);
3. organizational structural adjustment.

Program formulation is the process by which the goals and objectives assigned to the institute are translated into specific programs. An institute's programs will be quite different if the national priorities are, say, the diversification of agriculture, irrigated farming and medium-size farmers than if they are food security, rainfed agriculture, the poorest farmers, and marginal areas.

The process of designing the program involves answering the following questions:[37)]

i. What are the objectives to be achieved (given at the national level)?
What are the major problems that stand in the way of achieving those objectives (stemming from an analysis of the agro-ecological and socioeconomic conditions of production)?
To what extent are these technical and researchable; i.e., to what extent can they be tackled efficiently through research rather, than through development or policy measures?

ii. If the problems are researchable, can the constraints be removed by using present knowledge and materials?
How much further could research contribute towards solving the problem?

iii. In order to achieve the objectives, what should be the researchable problems to address in priority? That is, what should be the research "path" (for example: soil and water management, agronomy, plant breeding or plant pathology/entomology)?

iv. For each of the identified problems, are there appropriate technologies that can be borrowed and adapted to the diversity of agricultural situations in the country?
If no technology can be borrowed, what should be the research strategy; i.e., a) how much applied, or even basic research should be envisioned; to what extent is collaboration with other national or regional institutes, the universities or the private sector an option; b) how much laboratory-based, station-based and on-farm research is needed?

37) Answers to these questions will be provided by and large by the information obtained from the analysis of the current situation and environment.

v. What is the likelihood of research success?
How long will it likely take to produce usable results?
What is the likely adoption rate of research results?
If adopted, what can be the expected contribution of the technology towards the attainment of the objectives? This provides a timetable for monitoring, evaluation, corrective action, and differentiation between short- and long-term approaches.

vi. Given the strategy and the technological path chosen, what is the critical mass of resources (staff, material and financial) needed? Are they available? This will provide a framework for matching resources and program objectives, for identifying future training needs, etc.

It should be noted that the order of the above questions is somewhat arbitrary: giving them answers is an iterative process. For example, determining what should be the researchable problems to address in priority (point iii) will be modified by the answer to point iv, i.e., the possibility of borrowing technology and by the answer to point v.; that is, the likelihood of obtaining research results and of technological adoption.

The strategy for achieving the objectives begins to be specified here. Resource allocation to the program rests on it. Within each program, to permit the maximum output and given the amount of resources allocated, a division of labor, vertical and horizontal, as mentioned above, can be envisioned with other research institutions, domestic and abroad, as well as the universities and the private sector.

Another part of the strategy is the research approach taken: how much 'vertical' research (centered on the development of particular commodities or factors of production) vs. systems research (centered on the development of production systems)? Related to this issue is the question of the extent to which multidisciplinary vs. monodisciplinary research is going to prevail, and how much laboratory-based, station-based, or on-farm research is going to take place. A choice of multidisciplinary research implies higher costs of coordination and new attention to team building, but offers potentially higher pay-off in generating technologies relevant to the users needs. An emphasis on on-farm research, also, always will be more costly in operating funds and scientists' time. Thus these choices have direct implications for the level and type of resources required.

The strategy includes a spatial dimension; decisions must be made as to where the program should be based (i.e., what will be the main research stations, and what other research stations should be involved). This will lead to considerations of physical facilities-upgrading, construction, or phasing out.

Once the researchable problems to be addressed in priority have been decided upon and the strategy defined, the research critical mass for each program can be determined. By research critical mass is

meant the minimum level of resources (financial and human) needed per program or research area within programs to be able to expect meaningful research results. It is a crucial moment of program formulation: as mentioned earlier, all too often this minimum level of investment is not achieved, resulting in unproductive research activities and inefficient use of scarce resources.

If, as calculated from the aggregation of all critical masses, the required resources do not match the available resources, it will be necessary to select the research lines that should have priority for resource allocation.

5.6 Translating the Long-Term Program into an Action Plan

Once a strategic plan has been designed, with its research program and resources allocated accordingly, the next step in the planning process is to translate those commitments into a detailed plan of action; that is, the specific research activities to be carried out over a period for which the resources are known and the environment is predictable; generally not more than three to seven years. This also corresponds to the time span required for research activities to begin yielding results.[38)]

While the impulse for the elaboration of the strategic plan is with the institute managers, designing the action plan begins with the researchers at the level of the research station. The process of formulating a short-term plan falls between the research station and the headquarters level, depending on the size of the research organization. It is generally conceived and planned under national program coordinators, but the process starts at the research station where projects should be reviewed under the program coordinator's leadership.

Within the framework given by the program specifications, each researcher, or group of researchers, presents a research project. A research project can be considered the basic planning unit at the operational level. It is often a multi-disciplinary undertaking involving a number of scientists and technicians, trained in different disciplines, working within the same workplan, and under the leadership of one of the project members. A project is a coherent set of operations, with a rationale, a goal, a clearly defined set of objectives, a plan of action for achieving those objectives, a limited time frame for execution, specific outputs which can be measured against initial objectives, and a budget defining human resource inputs and direct operation costs (including all inputs required for project implementation).

The review process for the projects is extremely important, to ensure the preparation of a sound action plan. It should be set up so as to ensure that: (1) researchers have clear project objectives, in accordance with the overall program goals and objectives; (2) the

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38) The process of program formulation has been given special attention by Dagg and Haworth (1988). This section borrows from their text. See also Jain (1989:6, 28-31).

experiments and treatments chosen are expected to produce outputs relevant to the clients' needs and adoption capabilities; (3) these are quality experiments that will penetrate to the core of the problem with minimal effort; and (4) they are designed with scientific and statistical care so that solid conclusions can be drawn. The researchers should have these criteria in mind when designing their projects.

Once the projects have been approved at the level of the research station, they are aggregated by programs at the institute level for final review and approval. Priorities have been set between programs, at the strategic planning level. However, within a program there is still a wide range of themes or research areas and their associated activities and experiments, from which the most relevant and effective ones must be chosen and assigned priorities.

Some of these choices are made by the researchers, with the assistance of a review committee, at the level of the station (see Chapter 6). However, when projects have been aggregated by programs, and after they have been checked for congruence with the program objectives and strategy, choices still have to be made among them at the institute level, to be certain resources are sufficient to fund all proposed projects.

Hence, similar to the national level, where priorities had to be set among research objectives, and between product lines or research areas, priorities also need to be set at the program level, but this time between projects. Among the models that can be used to prioritize between commodities or research areas, only the checklists or scoring models, and the benefit-cost analyses techniques are appropriate for prioritization within programs.[39]

The Annual Program of Work and Budget

The preparation of the program of work and budget is not part of planning per se: it is an update of the action plan. The results of current research activities will often dictate the need for modifications for the future ones. Furthermore, even when there is agreement at the policy level to committing resources to a three- or five-year plan, the reality in most countries is that budgets are formulated on an annual basis, and that allocated funds fluctuate. Part of the annual program of work and budget is the preparation of a detailed program budget, linking each activity to the resources required and available: operational costs, staff time (including all support staff), the use of land, equipment and facilities. Information recorded by project is aggregated by program. The annual program of work and budget is then reviewed in relation to the action plan and is finally approved at the program level.

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39) Here again, mathematical programming could be used. It is probably more adaptable to resource allocation between projects than between commodities and research areas. However, as for the national level, this approach has not been researched as much as benefit-cost or scoring techniques.

5.7 Long-Term Resource Development Plan

The information concerning resources (human, financial, and physical) under each program, once aggregated, serves as the input for the next step, which is the elaboration of a strategy for the development of the resources: financial, staff, equipment and infrastructure. A strong link between program and resource planning is essential for developing effective research programs that relate resources to program goals. The process is again iterative, with adjustments between the overall level of the resources given to the institute and the objectives of the various programs. A program may be too ambitious, given the overall resources; its objectives may have to be revised and its scope scaled down, unless additional resources can be generated.

Financial Resource Mobilization Strategy and Planning

There are two aspects to financial resource planning; the first deals with the strategy to be pursued by the institute to obtain the funding it needs. The level of funding for the institute, from national as well as foreign donors, is indicated in the national agricultural research policy and strategy. The short-term plan may reveal that further funding is needed. The institute can develop a strategy to generate additional revenues, from the marketing of its production, the sales of its services, or by attracting funding from extra external sources.

The second aspect is the institute financial plan. It includes the aggregation of the use of funds under each program, as well as expenditures that cannot be related to specific programs, such as the development of land and buildings, certain human resource development expenditures, communication and public relations expenditures.

Human Resource Development Plan

The input is also the institute strategic plan, with the human resource requirements for its implementation, as specified in the action plan. Human resource planning involves the analysis and determination of the types, amounts, and availability of personnel required for the efficient and effective attainment of organizational and program objectives. The output of this planning activity at the level of the institute is a long-term strategic plan for the development of human resources.[40]

The process of developing such a plan includes three interrelated activities which can be greatly facilitated by an effective human

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40) This section draws from the work on this subject by Bennell and Zuidema (1988).

resource information system:[41]

- analysis of human resource requirements (demand);
- assessment of the available human resources (supply);
- matching requirements to availability.

(a) Analysis of Human Resource Requirements. First, the optimal skill and discipline composition of scientific, technical, and support personnel for each program is determined. This is the basis for deriving approximate human resource requirements by category of personnel, location, discipline, and program areas. The next step is to review the availability (supply) of personnel and match human resource requirements to availability.

(b) Assessment of Human Resource Availability: A quantitative and qualitative inventory of current staff is the point of departure for assessing the availability of human resources. Information on each staff person regarding: 1) qualifications, including highest degree obtained, special training undertaken, and professional work experience; 2) allocation in terms of research program, discipline, function, and position; and 3) location is collected and analyzed.

The analysis of human resources also includes:

i. evaluation of the qualification of present personnel returning from training;

ii. determination of the rate of attrition, due to retirements, deaths, resignations, and dismissals.

(c) Matching Requirements to Availability. The final stage of the human resource planning process involves matching the estimates of skill requirements with probable skill availabilities from both internal and external sources. The planning process ultimately yields detailed information on the desired number of staff by skill level (experience) and specialization. Comparison of the desired staff with the existing staff determines the net addition to personnel which, when estimates of attrition are taken into account, determines desired recruitment levels.

The strategy to match existing with required resources is likely to combine to varying degrees the following three strategic options:

i. Upgrading of existing staff and personnel, including short-term and degree training, as well as professional development. The extent of the training programs to be envisioned depends upon the availability of financial support (particularly for international activities), the

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41) ISNAR has been working on the development and implementation in various countries of a management information system (MIS) for the three types of resources (human, financial and physical). The financial part of a MIS is usually referred to as a program budgeting system (PBS). See Hook (1988).

ability to launch appropriate training activities within the country, and overall staff workloads.

ii. Recruitment and involvement of expatriate expertise. Recruitment depends upon the availability of resources for recruiting additional staff and on the availability of appropriately trained and experienced personnel in the labor market. Expatriate expertise is a possibility when the local labor market is not able to meet the staffing requirements.

iii. Staff deployment. Deployment is another strategy which can be considered in meeting staffing requirements within the organization. When envisioning it, a number of issues have to be taken into account, such as maintaining a critical mass of researchers in terms of specification, program size, and geographic location.

Physical Resource Development Strategy

The physical resource plan brings together the programs (defined by the objectives to be achieved), the physical resources required, and the financial resources available. The availability of financial resources is examined not only for initial investments, but also for the servicing, maintenance, and repairs of facilities and equipment.[42)]

Physical resource planning deals with buildings, land, utilities, equipment, and other components of the institute's physical resources. It concerns itself with the establishment of new stations, and the consolidation or the phasing down of existing ones. When elaborating such a plan, the following steps should be taken:

i. evaluation of the physical resources needed for the implementation of the research program;

ii. assessment (quantity, quality, appropriateness, location, etc.) of the existing resources. The assessment can be greatly facilitated by the existence of a resource data base;

iii. elaboration of strategies for site and building development, equipment, and expendable supplies, purchasing and servicing, maintenance and repair;

5.8 Organizational Structure Readjustment

Managers should not only be concerned about achieving the appropriate organizational structure for planning, but also for implementation. Organizational restructuring is an important part of an institute's plan to foster the implementation of the

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42) See Hariri (1987).

institution's strategy and improve its productivity. The research programs provide the basis for designing or adjusting the internal structure of the institution.

In so doing, planners and managers need to identify the key managerial functions that must be carried out. Next comes the issue of where they are carried out (organizational levels); by whom (organizational devices); and how (mechanisms, means). (See fig 4.)

Management functions can be divided into various tasks which will be assigned to various bodies/individuals and at various levels of the organization. Thus, mechanisms for coordination between the divided tasks become important. Furthermore, management functions are interrelated by nature: well functioning, appropriate linkages, and channels of communication become crucial.

The issue of delegating authority and responsibility for research and administrative tasks comes next. Also, appropriate reporting mechanisms for monitoring and evaluation, annual programming and mechanisms for ensuring accountability for resource utilization and generation of results, need to be determined.

5.9 Monitoring and Evaluation

This component of an institute's strategic plan is often overlooked by planners and managers. However, not only the mechanisms, but the content of the monitoring and evaluation process, should be specified at the time the Action Plan is elaborated. A research project should specify not only the expected final outputs of the activities, but also the intermediate ones. It should also specify what resources are needed and when. This provides the basis for monitoring research projects and programs.

Figure 4: AN EXAMPLE OF ORGANIZATION FOR KEY MANAGEMENT FUNCTIONS AT THE INSTITUTE LEVEL[43])

MANAGEMENT FUNCTIONS	METHODOLOGICAL MEANS/MECHANISMS	PEOPLE/UNITS INVOLVED
ORGANIZING RESEARCH	• Assigning responsibilities for implementation	• Director of research
	• Coordinating between implementing units	• Multi-disciplinary teams of researchers and/or • Program leaders
	• Approving annual programs	• Program committee • Director of research
SUPERVISING IMPLEMENTATION	• Reporting mechanisms for monitoring and evaluation	• Director of research • Program leaders
	• Accounting for resource utilization	• Director of research • Program leaders • Station directors
	• Collecting and processing information	• Financial unit • Management information unit • Planning unit
ORGANIZING RESEARCH SUPPORT	• Managing human resources	• Human resources department head
	• Managing physical resources	• Administrative unit
	• Accounting and budgeting	• Financial unit

43) This example of organization has been inspired by Sachdeva (1988a).

6. PLANNING MECHANISMS AND ORGANIZATIONAL DEVICES

The focus so far has been on the sequential steps of planning, without any reference to how and by whom it is going to be done. Putting in place the appropriate mechanisms and organizational devices is the first task to be performed at the national level after a government has made the political commitment to embark upon a planning activity for the whole NARS. Similarly, at the institute level, senior management has to ensure that appropriate and well-functioning mechanisms and organizational devices for planning are in place.

This chapter presents an example of such devices and mechanisms in the context of a strategic approach to planning. The purpose is not to advocate a specific model, but rather to provide food for thought. Admittedly, the optimal mechanisms need to be suited to the country's specific socio-political and cultural environment.

Whatever the individual context, mechanisms for strategic planning need to provide the conditions necessary for it to be effective. As discussed earlier, the process is a dialectical one: bottom/up and top/down. Participation of all concerned is a key ingredient: strategic planning cannot be the exclusive task of specialists appointed for that sole objective.

6.1 Division of Planning Activities Between System and Institute Levels

The structure of the NARS can vary from a single ministry department to a very complex configuration involving departments of ministeries, universities, autonomous institutes and commodity-financed organizations.

A research system is usually composed of one or more of the following organizations:

a) A department under the ministry of agriculture of rural development.
b) A department under the ministry of scientific research and/or higher education.
c) Two or more departments, each under a different ministry, with, for example, crops research in the ministry of agriculture, livestock and veterinary research in the ministry of animal production, forestry research in the ministry of environment, etc...
d) Parastatal semi-autonomous or autonomous organizations, with a board of trustees, and a scientific advisory committee. As government funded, the institute still reports to a ministry. The board and the scientific advisory committee have representatives from the main interested parties.
e) Commodity-financed and controlled research groups with consequently, total control over its activities.
f) Departments in faculties of agriculture or universities.[44)]

44) On this topic, see in particular Trigo (1987); ISNAR/SPAAR (1987); Jain (1989) and Sachdeva (1987).

In many cases the system does not have any apex. A national agricultural research policy and strategy can still be elaborated, if a political commitment for it exists. However, because of the fragmentation of the system, and in the absence of an apex, the national plan will remain fairly general and only indicative: detailed planning starts at the level of the institutes, which enjoy a great deal of latitude to elaborate their own plan.

Even when an apex does exist, many planning functions are still delegated to the institute level. The extent of the delegation depends by-and-large on the degree of control that the national entity can exert on the institutes, which will be determined by the structure of the research service, and the governing organization of the country as a whole, influenced by traditions, political factors, and level of institutional development.

6.2 The National Level

A number of principles need to be followed for the elaboration of an agricultural research policy. To stand a chance to be implemented, the process should involve:

1. the policymakers, because they can bring the objectives for agricultural development to the level of detail needed for their translation into research objectives; they can be made aware that the policies they are contributing to may affect research through the technology transfer system;

2. the research practitioners, because they can determine the constraints for each agricultural development objective, which can be alleviated through research, the time span required to produce any results, the likelihood of research success, the critical resource mass needed, and the possibility of borrowing technology;

3. the research users, because they can specify their needs and constraints, and the type of research results in which they are interested; some research users, in particular the farmers, will be represented through the extension services of the user ministries;

4. the research stakeholders.

Thus, the views of the ministries, either directly concerned with agricultural research and agricultural development, or indirectly, insofar as agricultural development will be influenced by decisions made in that ministry (such as economy and finance, commerce, planning, etc.) should be taken into account. The private sector (banks, agriculture-based industries, import-export firms, agriculture-related services) should also have the opportunity to make suggestions and comments.

One approach is to form an ad hoc committee made up of representatives from some of the above organizations, with a heavier

representation of research users than research practitioners.[45] The choice will flow from the specific circumstances of the country (i.e., what are the most relevant organizations for agricultural research). Specific individuals will be assigned for their political weight. The formula for this committee, its position in the overall organizational structure, and the extent of its mandate will differ greatly from one type of organizational structure to the next.

However, it is necessary that such a committee have authority to reach decisions and give authoritative advice to the various entities carrying out research. Thus it should be placed at a sufficiently high level in the government structure so that its decisions will have political weight and guarantee political commitment. It should also be in a neutral position vis a vis the research users and research practitioners.

The work of the national committee will be prepared by technical task forces composed of senior scientists, managers and technical experts. The heads of each research institute/research department from the university/private research organization participate in the task force. Their presence guarantees that: 1) the planning approach is not only a top/down one; 2) research results serve as an input for the elaboration of the policy and strategy; and 3) the necessary link between the national and the institute level is made.

6.3 The Institute Level

As for the national level, one approach to guarantee the participation of all concerned would be to set up a committee supported by the work of technical task forces, such as a program committee. It should be headed by either the institute director, in the case of a semi-autonomous institute, or in the case of a non-autonomous department, by the department head. Alternatively, there could be a planning unit which would have the responsibility of leading and coordinating the work of the committee. Several research managers are involved: the research director (when such a position exists) for program formulation; the administrative and financial director for physical and financial resources component planning; and the director for human resources. Representatives of a selected sample of the organization's "stakeholders" or clients of the institute should also participate.

A program committee can be envisaged under the director for research. It should be multi-disciplinary and be composed of the program leaders and representatives of key interested organizations. Their participation is intended to foster the relevance of the programs in terms of users' needs. This committee prepares the long-term programs for the elaboration of the strategic plan. For the preparation of the action plan, its role is to aggregate by program the projects presented by the research station, to review them and to check for consistency with the institute's strategic plan.

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45) Planning committees have been discussed by Arnon (1975; 1985); at the institute level, see also Dagg and Haworth (1988).

6.4 The Operational Level

In addition to a program committee, a technical committee can be set up at the level of the research station. The selection of activities and experiments under each project cannot be left to scientists only. When reviewing projects, the scientists are well suited to discuss the relative quality of different experiments and studies and will guarantee the scientific value of the research activities. However, assessing their relevance for the development of the agricultural sector requires identifying the technological innovations that will meet the users' needs and constraints - something research users are in a better position to appreciate than the scientists. Thus representatives of a sample of concerned groups such as farmers, extension agents, local administrators and/or entrepreneurs, should be involved in the project selection. A review committee needs also to have multidisciplinary membership reflecting the many facets of practical production problems in a commodity, including the socioeconomic limitations of farming systems.

Although the participation of farmers' organizations appears to be highly desirable, the difficulties are obvious: the number of developing countries with active and representative farmers' organizations is quite small. When organizations exist, they are likely to represent well-endowed export-crop farmers, who cannot be relied upon to speak for the more resource-poor subsistence-oriented and marginal farmers. Finally, even if farmer representation can be obtained, it is not certain that it is the most reliable way to ensure that the choice of projects and experiments under each project takes into account farmers' needs and constraints: various cultural and social barriers are likely to hinder farmer participation in committee meetings.

In such circumstances, on-farm research or client-oriented research which has been designed to help research meet the needs of specific clients, most commonly resource-poor farmers, could be a very effective planning tool.[46] Under such an approach, research activities are carried out at the farm level with the active involvement of farmers at various stages in the process. Through working with farmers under their conditions, researchers are able to gather relevant information on production systems and socioeconomic constraints. This information can then be fed back into the design of programs more responsive to farmers' needs.

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46) Merrill-Sands and McAllister (1988).

7. SUMMARY AND CONCLUSIONS

This paper has attempted to systematically lay out the process of agricultural research planning at three levels: the national/system, the institute, and the station/researcher level. It identified the output of the process at each of these levels: a national agricultural research policy at the system level; a long-term strategic plan at the institute level, and an Action Plan for the short to the medium term elaborated in a bottom-up fashion, starting from the researcher/station level.

The approach taken was a strategic one, emphasizing the idea of creating the future rather than merely planning for it, taking into account the needs of clients, the interests of stakeholders, the potentialities of the market and the constraints of the socioeconomic environment. The specificity of strategic planning, as well as the difficulty of its implementation was highlighted, since it fosters the involvement of all concerned in thinking creatively about the issues at stake. A strategic planning model with various steps was proposed, both at the national and the institute level.

A number of issues that planning for agricultural research faces were discussed, in particular the need to determine an appropriate and sustainable level of funding; the need to concentrate resources in priority areas, and therefore, the need to establish criteria for allocating resources and to determine a research critical mass. Research strategies were also discussed, that is the extent to which research should remain at the level of testing and adapting, essentially borrowing its technology or wherever more applied or even fundamental research is needed; and finally, various issues concerning the organizational structure for setting up programs and for planning, and monitoring and evaluation.

No specific model can be advocated for the mechanisms and organizational devices to be put in place for the purpose of planning and policy-making. These will depend upon the particular organizational structure of the agricultural research system, and upon the socioeconomic and political specificity of a country. An example of such mechanisms and organizational devices was presented as an illustration.

The overview that was presented here might seem too orderly, too neat for policymakers and research managers, tangled in the complexities of real-life situations. Many times, institutes have to elaborate their plans without any guidelines from the national level. Rarely does planning start from a clean slate which would enable following each step of the model in a logical fashion. Research managers are seldom faced with allocating anew an entire research budget; but more often with marginal allocation decisions. Using the model presented here should help deal with the complexities of the real-life situations; this, provided that it is adapted first to the particular circumstances of each situation.

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