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planning in the STPI countries

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Science and Technology for Development:

Planning in the STPI Countries

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Contents

12. Methods Used to Design a Scientific and Technological Policy with Respect to Research and Development Activities

Fernando Chaparro

Designing an R&D Policy or Plan at the National Level

The methods used by different countries in designing an R&D policy or plan are of two dominant types: the deductive method and the successive approximations method. Because the methods are complementary, some countries combine elements of both, but the degree to which each country stresses one of the two approaches varies, so that different limitations are faced. I will discuss each of these methods in its ideal or pure form.

Deductive Method

The point of departure of this approach is the identification of the problems, needs, and priorities of the country, as well as the overall objectives of its process of national development. These factors are usually derived from three sources: the national development plan or policy of the government, the image or characteristics of the future society one wishes to have, and direct personal knowledge of the country's problems and needs.

The first source reflects the fact that policymaking and planning in S&T are part of the overall planning for the development of any country and cannot be considered an isolated process. Therefore, the objectives and priorities established in the government's national development plan or policy have to be taken into consideration, especially in the short term.

The second and third sources give S&T planning a certain flexibility, so that it, in turn, can influence the direction and future characteristics of the country in the medium and the long term. These two sources have been used in two ways: for unilateral identification of objectives, needs, and priorities by the policymaking body or through the assistance of advisory committees or working groups set up for this purpose; and for a systematic effort to develop a consensus among different groups and sectors of the society.

Once the socioeconomic problems and needs of the country have been identified, they must be expressed in terms of questions and problems suitable for S&T treatment. Thus, the potential demand for R&D activities is translated into an explicit one through identification of contributions R&D can make to the solution of the country's problems.

The most common pattern has been to set up advisory committees to analyze the problems identified. The committees address themselves to the question of what S&T can do to solve or help solve those problems.

Traditionally, these committees have been largely composed of members of the scientific community. Nevertheless, their composition is being drastically redefined by some national science councils so as to have greater representation from the production sector and from other potential users of S&T knowledge. This change is part of the evolution from a scientific view of S&T development to an integrated view of this process.

The result of these efforts is the formation of an indicative plan at either the national or the sectorial level related to specific issues or problem areas. The plan identifies possible R&D or technological development programs and projects that should be carried out because they are closely related to national problems and needs.

Some planning efforts have stopped at this stage. The limitation of an indicative plan is that it does not consider the following: the feasibility of the proposed projects, what specific activities will be carried out during a given period (the "duration" of the plan), what institution is going to carry them out, and with what funds and scientific personnel they are going to be carried out.

An indicative plan may provide a useful framework within which decision-making (for example, the allocation of research funds) may take place, but it is not really a plan. If the deductive method is carried to its logical conclusion, funds and other types of resources should be allocated to the different programs and projects identified in the previous stage; this would convert an indicative plan into an action plan. The deductive method has basically been limited to the design of indicative plans. Attempts to form specific action plans have incorporated, to various degrees, elements of the successive approximations method.

The deductive approach to policymaking and planning has several potential limitations:

- The first stage of the process may fail to identify certain basic needs of the country because of, among other things, implicit views of socioeconomic development and of the role S&T may play in it. A case in point is the concentration of R&D in the "modern" sector of the society as opposed to the "traditional" one, where many of the problems are.
- In setting up the advisory committees that analyze each issue or problem too much weight may be given to the scientific community, so that there is little representation of the production sector and other users of S&T knowledge. Thus, the indicative plans or action plans drawn up by these committees may have a strong academic orientation and pay little attention to the solution of existing problems or to the application of S&T knowledge to production.
- This method follows a strictly deductive approach that goes from general development objectives and national needs to specific R&D or technological development projects. Although this approach is intellectually coherent and theoretically integrated, it may have serious practical weaknesses if one wishes to go beyond a mere indicative plan to an action plan. One of these weaknesses is that it is hard to imagine how a

detailed research program could be imposed "from above" on the existing research institutions unless the sociopolitical system were highly centralized. The priorities and research programs thus derived do not take into consideration the research and other S&T activities being carried out by the existing institutions, as well as their future programs of work. Because there is a substantial discrepancy between the theoretical programs and priorities derived through the deductive method and those that are actually being carried out, the problem of implementing the former may be great, depending on the implementing power of the policymaking body.

The first two limitations are not inherent to the deductive method. They are, rather, due to problems in the use or application of the method and therefore can, in principle, be corrected once they are identified. On the other hand, the third limitation is much more basic since it is a consequence of the deductive nature of the approach. As such it is a more serious limitation to the overall process and its results.

An important question is raised by the second limitation: What social sectors or groups should be represented in the policymaking process? Technological development affects not only the scientific community and the production sector but also other interest groups and classes in the society (such as industrial workers, peasants, etc.). Therefore one must consider what groups should be represented in the policymaking process, and through what means this participation can be achieved.

This issue places the S&T policy of a country in the sociopolitical context in which it is designed and implemented, for it takes into consideration the effects of technological development on different groups in the society as well as the relations between these groups.

Successive Approximations Method

This approach does not take as a point of departure the identification of national objectives, problems, and needs, nor does it attempt to deduce systematically an indicative plan or an action plan for R&D at the national or the sectorial level. On the contrary, the point of departure is the R&D and other scientific activities that are presently being carried out or are expected to be carried out by specific institutions. This information is usually collected in one of two ways: through specific requests for funds to carry out certain R&D projects or other scientific activities that are presented by research institutions to the policymaking body; or through systematic collection of information on R&D and other scientific activities that are being carried out by different ministries or governmental agencies, as well as the programs and projects they expect to carry out in the next financial year.

Once this information is collected or made available, an attempt is made to "progressively adjust" the R&D and other scientific activities that are being carried out, or are supposed to be carried out in the near future, to the priorities and needs of the country. This adjustment is carried out through an evaluation that may have successive stages at different institutional levels. The evaluation has two important functions: it eliminates overlapping and repetition of projects; and it confronts the intended programs and projects with the needs of the country and on this

basis suggests modifications that should be introduced to make the R&D effort more compatible with national needs.

The evaluation is usually related to some funding mechanism or to a formal process of drawing up and approving the governmental S&T budget. Some countries have established an interministerial or interinstitutional mechanism to draw up the governmental S&T budget. Generally this involves a central policymaking body or an interinstitutional committee that evaluates and approves the R&D programs and other S&T activities that are being or will be carried out by government agencies.

In contrast to the deductive method, in which one starts with what should be done, the successive approximations method starts with what is being done and tries to progressively adjust this to the needs of the country. Thus, this approach does not have the same type of limitations as the deductive method. However, the limitations that this process does have are no less important. Because of its pragmatic character, this approach is more concerned with defining the mechanism by which funds are allocated or approved, as well as with designing limited strategies for improving what is being done. There is, therefore, the risk of not defining clearly the national objectives, needs, and priorities that provide the guidelines necessary to orient R&D activities toward the needs of the country.

Simplifying to a great extent, we may say that with the deductive method one runs the risk of designing a coherent policy or general view of the problem without creating the instruments to implement it, so that the plan remains theoretical. With the successive approximations method, however, one runs the risk of creating a series of mechanisms and instruments without having an overall policy that defines the problems and objectives toward which R&D efforts should be directed.

The two methods are not mutually exclusive; on the contrary, they may be complementary. The simultaneous use of the two methods for policymaking may help to avoid to a great extent their respective limitations. Nevertheless, countries differ in the degree to which they emphasize one of the two approaches. Colombia and Venezuela have emphasized the deductive approach, whereas Brazil has emphasized the successive approximations approach.

Designing an R&D Policy or Plan at the Sectorial Level: a Case Study

Technical advisory committees have been mentioned as one of the principal mechanisms or institutional instruments that have been used to identify and define research priorities at a sectorial level or at the level of certain problems of importance for national development. In the case of Colombia, COLCIENCIAS has created a series of special programs structured around these areas or problems of national interest. At present, special programs are being carried out in the following areas: national system of information; normalization, metrology, and quality control; national program of metallurgy; retention and return of scientists; food technology and nutrition; marine and continental waters research; improvement in the teaching of science; housing and building materials; technical assistance to small and medium-sized industry; and population and environment.

In these programs an effort has been made to define the priorities in the respective area through the use of the technical advisory committees. These committees have two basic characteristics: they have wide interinstitutional and interdisciplinary participation; and representatives of the scientific community, the production sector, and the government participate in them.

To illustrate the process, I will now analyze the methods used to define research priorities in the special program of food technology and nutrition.

Background to the Program

Studies carried out by various institutions had underlined that the main problems of nutrition in Colombia were protein and energy in infants, malnutrition and undernourishment and anemia through lack of iron in adults. The low income of the population and the lack of access to food were the outstanding causes of malnutrition. A study carried out by the Technological Research Institute found that nearly 40% of urban families did not have a sufficient total income to acquire the minimum diet. In addition, the balance sheet on food of the nutrition board of the Colombian Institute of Family Welfare showed that the local production of food was insufficient to satisfy the minimum requirements of the population.

Therefore the objective of the R&D program in this sector was basically to increase the availability of food for people of low income. This meant the generation and adaptation of production technologies that could provide a balanced diet at a low cost.

Elaboration of the Program

Planning of the program included the following stages, which will be discussed in detail:

- Choice of objectives.
- Study of the restrictions within which the possible solutions must be chosen.
- Choice of means to reach the objectives.
- Identification of the problems related to application of the means.
- Identification of the main problems that could be tackled by research programs, and their breakdown into specific projects.
- Establishment of priorities through the application of previously set criteria.

Objectives

On the basis of the overall socioeconomic objective — increasing the availability of food for people of low income — the program was directed toward the development of protein-rich foods of high nutritional content. Foods derived from cereals, especially wheat, were given a high priority.

Restrictions

When looking for solutions to the food problem through the application of food technology, one must take into account not only the

availability of nutritionally adequate food but also other factors, such as the low income, the current level and the possibility for development of the food industry, the impact that industrialization has on the cost of the product to the consumer, the educational level and food consumption patterns of the groups toward which the program is directed, the resources available, the existing government programs, and the degree of development of the R&D system in technology.

Means of reaching the objectives

Taking into consideration that there is no single solution to the problem of protein deficiency, various options were considered simultaneously:

- Adequate production, preservation, distribution, and industrialization of conventional sources of protein (meat, milk, fish, vegetables, oleaginous products, and cereals). Colombia must make the most of its capacity to produce protein of animal and vegetable origin. However, despite all its efforts, it is believed that the supply of animal protein and its consumption by the groups in need will not be sufficient. For this reason, balanced products containing vegetable protein and substitute animal protein should be designed and their consumption promoted.
- Production of processed food with higher protein quality and low cost.
- Selection, adaptation, and use of new means to supply protein — for example, sugared products, starch, and sugared fruit juices.
- Use of new or unconventional sources of protein.

In general there is a low level of industrialization of food production in Colombia, and the application of the second and third options requires the existence of at least a first stage of industrialization, to make possible the implementation of a policy of protein enrichment. Of the available sources of protein and food energy in the country, 55% are animal, and the high cost of animal protein limits the possibility of its consumption. One could try to reduce this cost through the application of technology and use vegetable and cereal protein (cereals are, on average, 32% protein).

Whatever the option chosen, it is necessary for technology to be capable of transforming a substance that is merely nutritious into the superior one of an acceptable food product whose costs and means of distribution permit it to reach the groups of the population most lacking in nutrition.

Problems related to application of the means

To identify these problems a format was used in which the problems that limit or affect the availability of a given source of protein were pointed out. Each type of problem in agriculture, economics, food technology, etc. was then classified and accorded first, second, or third priority. The priorities were initially set according to criteria established from studies carried out in the country or abroad that have since been revised, and in some cases modified. Two criteria were taken into account: the size of the effort necessary, and its order in the sequence of problems that must be resolved.

Research required

A study of the problems pointed out permitted the identification of

research projects that required organizing and promoting to reach the program's objective. The research in nutrition would support and direct research into food technology. The agricultural, economic, and educational problems were remitted to the pertinent bodies or institutions for management.

Establishment of priorities

One of the methods for the study of strategies of research, classification, and assignation of priorities to projects consists of evaluating the relative impact that different programs can have on the most pressing needs of society. This method also requires the establishment of criteria. Moreover, guidelines must be selected for measuring the impact that the application of the project may have on the objective implied by each criterion — in other words, for grading the criteria.

The technical advisory committee selected the criteria and weighted them according to relative social, economic, and operative importance, taking into account the most outstanding causes of malnutrition identified up to then, such as the low income of the population and the lack of availability of foods in relation to minimum requirements. Also taken into account were the facts that certain factors have influenced the experience of other countries, that the introduction of enriched products could have very little success, that the product must be compatible with the national eating habits, and that the necessary natural resources must be obtainable locally.

If one considers that 40% of the urban families in Colombia do not have a sufficient total income to acquire a minimum-cost diet, the production of inexpensive but highly nutritious products takes on great importance. If one also takes into account the magnitude and intensity of the problem of malnutrition in the country, the possibility of short-term benefit to the population also takes on great importance. The criteria of foreign currency and investment are also important, given the limited economic resources in the country.

In the course of grading the projects according to these criteria, no exact figures were available to permit assessment of the impact a given project might have on the achievement of an objective, but approximations were made on the basis of the information available to the working group. The multidisciplinary, multi-institutional committee tried to make this information as correct as possible for the social and economic categories. The criteria were graded on a scale of 1 to 5. Inapplicable criteria were not graded. For each project an overall grade was calculated by adding up the grades of each criterion.

The projects were graded by the committee as a whole because it was necessary that the evaluation be done simultaneously by a multidisciplinary group that would reach agreement on the grading through discussion.

Once the grades were obtained, the projects were classified into four groups according to priority. The projects with the highest grades were considered more likely to be successful in reaching their objectives. However, the grading was a relative, not a specific indicator. Thus, the project with the highest grading was not necessarily better than the second or third project of the first priority, but was probably much better than those of third or fourth priority.