Science and technology for development:

planning in the STPI countries
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Science and Technology for Development: Planning in the STPI Countries

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5. Evolution of Science and Technology Planning in Colombia

Fernando Chaparro

Changing Views on the Nature and Role of S&T Development

A series of studies undertaken in the 1950s demonstrated the limitations of the traditional production factors (capital and labour) in explaining economic growth. As a result, the following years witnessed a growing interest in S&T as one of the main additional factors that could be used to explain and promote economic development. This interest accounts for the efforts initiated in various countries to promote national S&T activities and to adapt them to local economic and social needs. Thus a new dimension was introduced in national development policy.

In recent years this process of promoting, planning, and coordinating S&T development has been characterized by three specific approaches: scientific, economic, and integrated. Each approach corresponds to a different view of the nature and role of S&T development.

The Scientific Approach

This approach emphasizes the development of a scientific infrastructure and national competence in the field of S&T. It assumes that the strengthening of the scientific capacity and of the research facilities in a country will somehow generate new knowledge and technology relevant to the development needs of the country. Furthermore, it assumes that this knowledge or information will somehow be incorporated into the production sector, thus improving or developing the country’s industrial capacity.

According to this point of view the basic problem is the development of a national S&T capability by strengthening the infrastructure related to these activities through such means as the training of personnel, the creation or strengthening of research centres and postgraduate programs, increasing the financial resources allocated to these activities, etc.

As part of this effort, S&T councils or similar bodies were established in many countries, and these institutions have made important contributions in the areas of research promotion and personnel training.

However, the limitations of this approach became increasingly evident when the simple strengthening of the national S&T capability did not necessarily bring about technological innovations or a greater rate of economic development. The limited capacity of the production sector to absorb and use the new technological knowledge and information, as well
as to identify its technological needs, was increasingly recognized as a serious obstacle. Thus, the problems related to the aspects of demand for S&T knowledge and activities became as important as the problems of their supply.

The Economic Approach

This approach emphasizes the fact that developing countries import most of the technology they use, at great cost, and frequently in a disadvantageous manner owing to market characteristics. Concern about this has generated a series of national and regional studies to determine the following: the characteristics of the transfer of technology; the conditions under which such transfer takes place; the forms of transfer; the obstacles to transfer, such as lack of information and a weak bargaining position; the relation between imported technology (especially when it is inadequate or inappropriate) and the needs and characteristics of the country; and financial and technological dependence. These studies have made significant contributions toward our understanding of the basic problems related to technological development.

One of these contributions has been the creation of special bodies (particularly the royalty committees) and programs to control the importation of technology or to correct its deficiencies and distortions. Nevertheless, this approach considers only a few of the many factors to be analyzed in relation to S&T development.

The analyses of the transfer of technology have generated two important trends. First, various countries have established important measures to regulate the importation of technology, especially in relation to royalty payments. This perspective is very limited, for it takes into consideration only one aspect of the problem (balance of payments). Originally its emphasis was even more restricted. Recently the functions of the royalty committees and registries of licensing agreements have been redefined in an attempt to overcome these limitations. Second, recent studies on the “commercialization of technology” have attempted to integrate the different aspects of the transfer of technology within a much wider context, to include market characteristics and the role of multinational companies. The studies undertaken by the regional program for S&T development of the Organization of American States and by the Andean Pact made important contributions toward a better understanding of this process and the factors affecting it in Latin America.

This approach is also limited in its treatment of the problem. Even though the commercialization of technology is vitally important, it is only one aspect of S&T development and should not be divorced from the strengthening of the infrastructure and national competence in this field. Likewise, the strengthening of the infrastructure should not become totally subservient to the problems related to the transfer of technology.

The combined effect of the simplistic scope of the first approach (limited to a strengthening of the research and scientific infrastructure) and the restrictive nature of the second (commercialization of technology) has introduced an erroneous and artificial distinction between scientific policy and technological policy. The former is restricted to general activities, such as the training of the necessary personnel, that strengthen and develop the research and scientific infrastructure. The latter, on the other hand, centres
its attention on the activities and regulations dealing with the selection, commercialization, adaptation, integration, and use of technology. Thus, the artificial distinction is a result of the separate actions to strengthen the national S&T infrastructure and to regulate the transfer of technology.

The Integrated Approach

Recently a third approach, based on a more comprehensive view of S&T development, has been designed. This approach is not limited to the indiscriminate strengthening of national research and scientific capacity, or to problems related to the commercialization and adaptation of foreign technology. Adopting an overall view, this new perspective considers science and technology inseparable and emphasizes the need for not only local production of S&T know-how, but also an analysis of the appropriate importation, adaptation, and assimilation of foreign technology.

This approach presents S&T development problems in the following terms: First, an analysis must be made of the economic and sociopolitical context in which the transfer of technology and the strengthening of the internal S&T system is to take place. One of the principal goals in strengthening the national infrastructure is to increase the decision-making capacity regarding the creation and adaptation of the S&T needed for national development. The analysis must take into consideration the constraints that regulate and limit this capacity (characteristics and nature of the technological market, S&T dependence, effects of these constraints on bargaining power, and factors that restrain the development of a demand for local S&T activities). Second, the efforts undertaken to develop local S&T capacity must be designed according to national needs, on the basis of an identification of specific national high-priority problems or well defined development goals. In other words, rather than limiting the activities to mere promotion of the indiscriminate growth of supply of the internal S&T infrastructure, this approach propounds the necessity for guiding S&T development according to critical national needs.

The principal tool for implementing this approach is the establishment of integrated S&T development projects in priority areas of national interest. Once national development goals and problems have been identified, the different contributions of science and technology toward their fulfillment or solution must be considered. This implies the consideration of a wide range of elements, from local research to the importation of foreign technology. Consequently, at the individual project level a variety of interrelated components must be analyzed, such as:

- Establishment of technological requirements and necessary information input.
- Nationally existing S&T know-how applicable to the solution of the identified problems.
- Strengthening of the national S&T infrastructure so as to analyze and propose solutions to these problems, including the identification of priority areas for research.
- Identification of technology importation requirements in terms of technological needs that cannot be satisfied locally, including the search for information and the identification of available technologies in the world market.
• Evaluation and selection of technology on the basis of national requirements, conditions, and characteristics.
• Creation of a demand for S&T activities and promotion of adaptive research, which contribute to the strengthening of the national S&T infrastructure and foster the local capacity for assimilating, modifying, and improving imported technology in order to reduce foreign dependence.

Thus, the comprehensive view of S&T development proposed in the third approach considers as complementary the problems of transfer of technology and the strengthening of the internal S&T system.

S&T Planning in Colombia

Colombia has not formally established an S&T policy, nor is this area explicitly treated within the national development plan. However, the national government has recognized in general terms the importance of S&T in the socioeconomic development of the country. Certain government organizations have been established to deal with problems related to S&T development, and official documents prepared by other central planning institutions have included S&T in their analysis of national problems. Nevertheless, a comprehensive system of S&T planning has not been developed to date.

Government efforts in the field of S&T have developed at both the national and the sectorial levels.

At the national level, several organizations have been established during recent years whose activities are directly related to S&T policy or to certain specific aspects of technological development in Colombia. These organizations can be grouped in two broad categories: institutions oriented to the overall design of a national S&T policy, and institutions having direct influence on specific aspects of technological development, especially in relation to the transfer of technology. Most of the latter were established to regulate foreign investment or financial transactions in foreign currency, but they have gradually included technological aspects as one of their prime concerns, owing to the importance of these aspects in the transactions they were regulating; hence, these institutions must be considered as belonging to the institutional network being created in the field of technological development.

At the sectorial level a series of government research centres have been established that function either as departments of the national ministries or as decentralized institutes (e.g. the Technological Research Institute and the Colombian Agricultural Institute). Funds are allocated directly through the budget of the respective ministry. Consequently, these research centres establish the research policy to be followed by the government in their respective sectors through the use of available financial resources in their research projects and activities.

Planning at the National Level

The effort to plan S&T development at the national level began formally in 1968. Before then, the efforts of the public sector in promoting
the development of scientific activities had been limited basically to the creation of centres of research in different economic sectors (such as the Colombian Agricultural Institute, which was created in 1962). These institutions establish their own explicit or implicit research policies.

In February 1968, at the First Seminar on Science and Technology for Development it was recommended that administrative structures be created to design and put into practice a policy that would vigorously stimulate S&T activities in Colombia according to the needs of the country and with the aims and objectives of the development plans. Welcoming this recommendation, the national government created the National Council for Science and Technology (CONCYT) as a consulting body responsible for advising about everything related to the policy of S&T development. At the same time it created the Francisco José de Caldas Colombia Fund for Scientific Research and Special Projects — (COLCIENCIAS) — as a decentralized institute dependent on the Ministry of Education and responsible for the stimulation, coordination, and financing of S&T development.

CONCYT is one of the four national councils at the level of the presidency of the republic (the other three being Economic and Social Policy, Security, and Population and Environment). It is made up of the following 18 members: the president of the republic, who presides over it; the ministers of education, agriculture, health, and development; seven representatives of the scientific community (rectors of universities, and directors of research institutes and of professional scientific associations); two representatives of industry; and four presidential advisers on S&T. The functions assigned to CONCYT by law are to:

- Advise the national government on the design and execution of the S&T policy.
- Give opinions on the plans and projects submitted for its consideration by the national government.
- Advise the government on its relations with international organizations and other countries.
- Suggest the measures necessary to ensure that the utmost use is made of the experts in Colombia and to promote the return home of Colombian scientists and technicians.
- Study the policy of Latin American integration in the field of S&T and present the pertinent recommendations to the government.

COLCIENCIAS is headed by a board of directors of seven members that is presided over by the minister of education and a manager. Although it functions as the executive secretariat of CONCYT and thus for the policies, plans, and programs of the government in S&T development, it does not do so for the S&T activities themselves, such as research. Its functions are to stimulate, coordinate, and finance such activities, not to put them into practice.

Among the various activities of COLCIENCIAS, two are of special importance: the financing of research projects, with the aim of stimulating such activities in Colombia; and the forming of a national S&T policy.

The work of COLCIENCIAS in the field of S&T planning has been
carried out at two levels. At an overall level an effort has been made to identify areas of high priority for the country with respect to research. The priorities and objectives outlined by the government in its policies and plans for socioeconomic development were taken into consideration as a starting point and have determined the areas of research considered important for the country in view of the government's development objectives.

There are two principal methods for the establishment of priorities in the field of research: the deductive method and the method of successive approximations. In the past COLCIENCIAS placed greater emphasis on the first method, but it has gradually ventured into the second. Given the existence in Colombia of important centres of research at a sectorial level, each determining its own research policy with a certain autonomy, a national planning strategy must be based on or take into consideration the method of successive approximations.

Similar planning efforts have been made at the sectorial level with “special projects.” These programs have been structured around some problem or area of research considered to be of national importance, with the development priorities of the country taken into consideration.

The task of determining research priorities for the special projects has been carried out by technical advisory committees, in which representatives of the scientific community, other government institutions, and the production sector participate. Greater emphasis has recently been placed on the participation of the last group. The “indicative plans of research” formed at the sectorial level have proved much more influential than the general outlines of overall research priorities. This may be due to the nature of these programs, their greater stability and the greater participation of the various sectors in the technical advisory committees.

During its 6 years of existence, COLCIENCIAS has financed 350 S&T research projects with an approximate value of $50 million (almost U.S. $2 million).

This financial mechanism has, until now, been the main direct instrument COLCIENCIAS has had to implement and to which the research policies it has established could be applied. Because of its characteristics as a fund, COLCIENCIAS has been able to use the financial resources at its disposal in a strategic way to complement the funds of the different organizations carrying out research. Without such financial leverage, the power of a policymaking institution to influence such activities in the country would be minimal. Therefore, financing and the designing of national policy in this field are complementary and should be carried out in an integrated manner.

In determining what effects the financing of research projects has on the economic and social development of the country, two aspects must be distinguished. First, the financing of projects has certainly contributed to the strengthening of the research infrastructure and of the national S&T capacity simply by supporting research in the universities and other centres, contributing to the training of researchers, and increasing the facilities and resources for research in Colombia. But of what real use have the results of this research been, and what effective contribution has the research made to the development of the country?

Earlier in this chapter, I discussed the need for an integrated view of S&T development, beyond the mere strengthening of the national capacity
in this field or the increasing of the supply of this type of services and activities in Colombia. This implies, among other things, that the functions of COLCIENCIAS should not be limited to the financing of research projects but should also include the use of the results of these projects in the production sector, which would necessitate following up the results of each project. Despite the fact that most of the projects financed by COLCIENCIAS have been in the field of applied research, it is difficult to determine or even to estimate what proportion of them have been transformed into concrete technological innovations in the production sector and, therefore, into contributions to the development of the country.

Related to this issue is an important bottleneck in the financing of S&T activities in Colombia. The funds of COLCIENCIAS are generally used to finance basic and applied research as well as technological development efforts that suggest or describe a new technological process or a specific technological innovation. The financing activity of this institution is much more limited in the phase that immediately follows — that is, the transition between the obtaining of results and their effective use in the production sector; transition activities include, for example, basic and detailed engineering, and the building of prototypes and pilot plants.

The lack of a financial mechanism specifically oriented to the transition phase is a serious limitation to the transformation of the national research efforts into technological innovations that can contribute to the development of the country. COLCIENCIAS has been examining, in conjunction with the National Fund for Development Projects, the possibility of creating a fund specifically for financing activities of technological development that could ensure or facilitate the connection between basic and applied research and the effective use of the results of this research in the production sector. Given the nature of these activities the fund would have to consider the relatively high risks in the type of projects it would be financing.

Planning at the Sectorial Level

Important governmental research centres exist at the sectorial level that concentrate most of the research activities carried out in their respective areas.

Colombia has no mechanism to coordinate government funds that are allocated to research or to S&T activities in general; the assignment of financial resources to these institutions is done directly through the budget of the respective sector or ministry. As a consequence of this, the research centres determine the government's research policy in each of these sectors on the basis of how they allocate funds among the research projects they are carrying out. This does not mean that these research institutes have an explicit, clearly defined research policy. In fact, in most cases they do not.

The institutional relationship between the establishment of research priorities at a sectorial level and the analogous process that COLCIENCIAS puts into effect at a national level has been very limited and sporadic. This is one of the important gaps in S&T development planning in Colombia. If no specific link is established between the two levels the policy in this field made at the national level will be condemned to be of no real significance.
In certain areas a link between the two levels has been partly achieved through the special projects. This link has been sought through the direct participation of research centres in the establishment of research priorities at a national level in specific fields. This mechanism of "participatory planning" may turn out to be much more efficient in linking these levels than the establishment of an institutional or formal relationship between them, especially in a fairly decentralized sociopolitical system such as there is in Colombia.

Conclusions

The efforts of the Colombian government with regard to overall S&T development have basically been limited to the creation of institutions concerned with the planning of S&T development or some specific aspect of it. However, these efforts have not been translated into an explicit national policy or national development plan for this field. Moreover, despite the institutional framework that has been created, no operational mechanism through which such a policy or plan could be established or implemented has been clearly defined.

At the sectorial level important government research centres exist to which funds are allocated directly through the ministries. The fact that these institutes invest considerable amounts of money in research in their respective fields implies that they are making and implementing a research "policy" in each sector. The level at which the designing and formalizing of such policies takes place varies from sector to sector; however, the policies are usually not explicit. It would be interesting to analyze the levels of formalization of the sectorial policies and the procedures used in policymaking. COLCIENCIAS and the Colombian Agricultural Institute are currently designing a joint project to analyze these matters in relation to agricultural research.

As a consequence, two complementary aspects should be mentioned. First, when formulating an S&T policy at a national or overall level one must take into account the fact that most of the research activities in the public sector are carried out in sectorial research centres according to the policies established by each institution. The existence of these sectorial policies cannot be ignored, although in most cases they have not been explicitly designed but are simply "resultant" policies that have emerged from the allocation of funds to ongoing research projects. Among other things, this raises the problem of the relations and coordination between the institutions responsible for establishing a national S&T policy and the large sectorial research centres. Furthermore, this implies that research priorities defined at the national level will have to follow a gradual method of "successive approximations," through which the priorities defined by the research centres and those defined by the policymaking institutions will gradually become more consistent.

The second aspect is that the allocation of funds to the sectorial research centres is made directly through the budgets of each sector or ministry, not through any coordinating body that allocates public financial resources to technological R&D activities. This dispersion of the government's allocation of funds to research activities represents an obstacle to the establishment and implementation of a truly integrated national S&T
policy. Therefore, it is suggested that a coordinating body be created at the national level to advise the government on the allocation of these funds. With, for example, a national budget for S&T the allocations to research activities in the sectorial budgets could be clearly contemplated and analyzed. An interinstitutional body composed of various ministries, the National Planning Department, and others would probably have to be established to forge close relations with those responsible for drawing up the national budget.

The two groups of institutions reflected, in the initial phase of their activities, the different views on S&T development.

The first effort COLCIENCIAS made in relation to S&T development was oriented to strengthening the internal infrastructure of research, largely the scientific aspect. As it became conscious of the complexity of the process, COLCIENCIAS expanded its activities, becoming one of the first advocates of the integrated approach to S&T development. However, as an isolated institution, it is limited in its possible activities in this area.

On the other hand, the second group of institutions has tended to limit its activities to "economic problems" related to the commercialization of technology following the economic approach to S&T development. Many of these institutions were created basically to attempt to solve problems created by foreign commerce, foreign investment, the balance of payments, and the scarcity of foreign currency. Since their scope was limited to these purely economic matters, these institutions did not deal directly with the problem of a national S&T policy. As they have become more aware of the importance of the many aspects of technological development, the institutions have accorded these aspects more importance in their functioning.

The difference between the two groups of institutions is also reflected in their position in the government's administrative framework. Whereas COLCIENCIAS has its principal ties with CONCYT, the National Council for Science and Technology, the organizations of the second group are more directly associated with CONPES, the National Council for Economic and Social Policy, the highest planning institution in Colombia.

Since CONCYT has had only two meetings since it was created, it is difficult to judge the effectiveness of the division between the two national councils. However, the following general observations can be made: CONPES is responsible for developing general economic policy or "implicit policies," which may well be more important than the "explicit policies" in determining the S&T development of the country. Similarly, CONPES intervenes in specific decisions on important sectorial projects. It is through these projects that S&T is integrated into the economic development process and that the principal technological decisions about national S&T development are taken. If one accepts the integrated approach to S&T development, it is necessary to achieve greater interrelation between S&T planning and economic development planning. Thus, there are two alternatives: to encourage greater participation in CONCYT by the institutions of the second group and greater coordination of CONCYT with CONPES so as to integrate the two planning systems; or to reevaluate the reasons for the parallel existence of the two national councils.
The responsibility for making and implementing a national S&T policy is obviously too great for any single institution. On the contrary, one must think in terms of building and coordinating an institutional network made up by the principal organizations that take part in making the basic decisions that orient the S&T development of the country. Such a network has gradually been emerging in Colombia: several of the institutions participate in interinstitutional committees (such as the royalty committees) or are linked informally as a consequence of initiatives for interinstitutional meetings and projects that have often arisen through personal, informal contact between the people who work in the various institutions. What this informal network can do at the level of personal relations or small joint projects between institutions may be of vital importance in the progressive integration of the S&T planning system and may even be more important than the simple bureaucratic administrative definition of a planning system in this field. The main weakness of informal networks is their vulnerability to personnel turnover.