Mexico's Program for Science and Technology, 1978 to 1982

Edmundo Flores

Summary. In response to a request by President José López Portillo, the National Council of Science and Technology (CONACYT) worked out a program of scientific research and development in Mexico in keeping with the economic and social priorities of his administration—food production, energy, public health, and employment. Representatives from public, private, and academic sectors participated in preparing an inventory of needs for the development of human, economic, and physical resources. The program includes 2,489 projects in basic and applied sciences at a cost of $260 million to 1982 and 17,000 scholarships at a cost of $130 million.

In June 1977, the President of Mexico, José López Portillo, called a cabinet-level meeting at the National Palace during which the members of the scientific community and officials of the National Council for Science and Technology (Consejo Nacional de Ciencia y Tecnología—CONACYT) outlined the problems facing research and development in Mexico and requested greater financial support. The President responded by stressing the need to reconcile the freedom of scientific inquiry with the country's social needs. He asked CONACYT to coordinate the preparation of a National Program for Science and Technology designed to achieve specific growth targets for the next 4 years as well as independent decision-making abilities in scientific matters in the long run.

In the course of the meeting, President López Portillo asked: What are the overall objectives for scientific research in Mexico today? What kind of research should we do using our own resources to solve our own problems? What research techniques should we import and in what areas? What knowledge should we acquire through our students abroad? What research done abroad can we replace domestically? What kind of research are we going to assign the highest priority?

Finally, the President asked CONACYT to give tentative answers to these questions and to set research priorities and specific goals, when possible, to be attained over the next 4 years of his presidency. In the following sections of this article I will briefly describe CONACYT and outline the program prepared in response to the President's mandate.

The author is Director General of the Consejo Nacional de Ciencia y Tecnología, Mexico 20, D.F.

What Is CONACYT?

The National Council for Science and Technology (CONACYT) was founded in 1970 and began its operations early in 1971. CONACYT is an autonomous government agency; its general director is also the President's science adviser and reports directly to the President. The Council is governed by a board of directors of 11 permanent and 4 temporary members. The permanent members are eight cabinet members, the rector of the National Autonomous University of Mexico (UNAM), the director of the National Polytechnic Institute (IPN), and the general director of CONACYT; the temporary members are two presidents or directors of universities or academic institutions from outside Mexico City, the head of one state-owned firm, and a representative of the private sector.

CONACYT researches the technology requirements of the public and private sectors and of higher education and consults with the scientific, technological, and university communities, in order to plan for and support their needs and to fulfill their growth targets. It also acts as a consultant for the government on complex problems related to science and technology.

Since its founding, CONACYT has received all the federal financial support it has needed. Its budget has grown at a rate of approximately 54 percent per annum and has increased from $3.4 million in 1971 to $47.6 million in 1979. The creation of CONACYT has noticeably increased funding for research. In 1970, expenditure in research and experimental development was about 0.1 percent of the gross national product. Since then it has risen to 0.6 percent.

CONACYT has established relationships with the scientific community through the operation of research programs under the direction of distinguished scientists and government officials. It has also become the agency that carries out all bilateral and multilateral scientific programs established between Mexico and other countries through their national institutions for the promotion of science and technology—for example, the National Science Foundation in the United States, the Centre National de la Recherche Scientifique in France, and such international bodies as the United Nations Food and Agriculture Organization (FAO), Unesco, and the Economic Commission for Latin America (ECLA). These programs vary from the exchange of scientists in specific areas to joint research projects in fields such as seismology, oceanography, pollution, and remote sensing.

CONACYT is also responsible for training technicians and scientists, primarily but not exclusively at the postgraduate level. More than 11,000 scholarships have been granted to Mexico's better graduates for the study of basic and applied sciences in Mexico and abroad. CONACYT also promotes the exchange of young technicians; every year, for example, 100 Japanese students come to Mexico and a like number of Mexicans travel to Japan.

Objectives of the National Program for Science and Technology

Keeping in mind this administration's economic and social priorities, its growth targets for the rest of this 6-year presidential term, and the goal of self-determination—that is, the ability to make independent decisions in research and development—CONACYT undertook the preparation of the *National Program for Science and Technology, 1978 to 1982* (*1*).

The increase in petroleum output and the growth set in motion in industries with backward and forward links to the petroleum industry was the key for the

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drafting of the whole program. At presently planned rates of investment in plants and equipment, by the end of 1979 PEMEX (Petróleos Mexicanos, the government petroleum agency) will produce 2.2 million barrels a day of crude and its derivatives and will export more than 1 million barrels a day. In return for these massive exports, Mexico will receive a flood of foreign exchange (marks, yen, pesetas, and dollars), thus creating a huge surplus in our balance of payments. This means that whether we like it or not, we will have to industrialize at accelerated rates in order to diminish unemployment, to further diversify our economy, and to decrease our dependence on foreign markets for food, raw materials, and finished products.

Thus, unless Mexico takes immediate and far-reaching measures to broaden its infrastructure and productive capacity, to improve the training of its labor force and increase its numbers—from biologists, mathematicians, and engineers to blacksmiths, welders, mechanics, and farmers—the country will find itself in the classic position of a rich, underdeveloped oil-producing country, the victim of conspicuous consumption by the minority and of massive imports, which will neither release the nation from technological dependence nor spare the poor from unemployment and misery.

Fortunately, Mexico has a larger, more mature, and more diversified infrastructure than any Third World oil-producing country. It already has good universities, research centers, and a growing, skilled labor force. Thus, it will not be necessary to send massive numbers of students abroad, nor will we have to import armies of skilled workers or be forced to speculate in foreign real estate markets because of the lack of investment alternatives.

The program addresses the issue of conventional and nonconventional energy production, the urgency of improving public health facilities, the struggle against unemployment, and the task of independently choosing the science and technology most efficient and productive for Mexico's needs.

Table 1. Government demand for research in science and technology and for training of human resources including projects presented as of 30 September 1978. The second column gives the number of project proposals submitted by the government agency listed in column 1; the third column refers to proposals submitted by scientists and selected or approved by the government agencies as shown.

Government agency	Projects presented by		Total
	Public sector	Science sector	
Ministry of Programming and Budget		107	107
Ministry of Finance	103		103
Ministry of Agriculture and Hydraulic Resources	699	57	756
Fisheries Department	49		49
Ministry of National Property and Industrial Promotion	33	42	75
Ministry of Commerce	10	5	15
Ministry of Tourism	24		24
Ministry of Communications and Transportation	74	29	103
Ministry of Human Settlements and Public Works	46	19	65
Ministry of Public Education	451		451
Ministry of Labor and Social Welfare	95		95
Ministry of Health and Welfare	87	50	137
Ministry of the Interior	69		69
Attorney General of the Mexican Republic	57		57
Attorney General of the Federal District	26		26
Ministry of Foreign Affairs	4		4
Ministry of National Defense	15		15
Ministry of the Navy	10		10
Federal District Government	19		19
Mexican Institute for Social Security	125		125
Institute for Social Security Services for State Employees	2		2
Institute for Funding Housing for Employees	18		18
National System for Integrated Family Development	90		90
National Fund for Social Activities	65	9	74
Total	2171	318	2489

Table 2. Summary of programs and projects by priorities. The figures presented refer to proposals received as of 30 September 1978.

Priority area	Number of programs	Number of projects	Cost* (million pesos)	Cost (million dollars)
Basic research	28	231	159.6	7.0
Agriculture, animal husbandry and forestry	21	693	1511.3	65.7
Fishing	8	75	172.8	7.5
Nutrition and health	18	387	734.5	31.9
Energy sources	26	60	445.5	19.4
Industry	10	193	2060.4	89.6
Construction, transportation, and communications	9	100	534.6	23.2
Social development	12	530	409.6	17.8
Public administration	10	196	212.9	9.3
Total	142	2465	6241.2	271.4

*These figures do not include the cost of training human resources, which appears in Table 3.

Preparation of the Program

CONACYT called in scientific representatives from the public, private, and academic sectors. These were grouped by field and asked to present projects, estimate their cost, structure the program, and set dates and deadlines for training technical and scientific personnel to meet the targets. The following three areas and 39 fields were identified.

1) *Basic research*: physics, chemistry, mathematics, and biology.

2) *Applied research*: food production, agriculture, animal science, forestry, health, marine science and limnology, ecology, earth sciences, meteorology, information sciences, space sciences, and social sciences.

3) *Development of technology*: food technology, energy, agriculture, animal sciences, forestry, agricultural engineering, mining, chemical industry, telecommunications, transportation, textiles, ferrous and nonferrous metallurgy, hydrology, electronics, metal mechanics, automotive industry, pharmaceutical chemistry, leather tanning and shoe industries, lumber and paper industries, construction, instrumentation standardization, technological innovation in library science, and engineering and consulting services.

Representatives from the federal government and private enterprise were consulted to determine their needs for scientific and technological research and development for their projected long-term expansion, and how these compared with the projects and proposals

presented by the research team in that field (see Table 1). A computerized data bank is being built to record the details of each research project and facilitate communications among those interested in specific areas. Information can be kept up to date and new projects can be implemented by making the data bank available. Communications have been clearly established between the sectors and are coordinated on a permanent basis.

Today's Program for Science and Technology is based on a careful inventory of the needs presented by various institutions and specialized groups and the supply of human, economic, and physical resources. The number of projects will vary according to the needs presented.

Each scientific field is considered separately and administered independently in order to follow the projects or include new ideas. The programs have been grouped into nine priority areas according to today's development policy: basic science; agriculture, animal science, and forestry; fisheries; nutrition and health; energy; industry; construction, transportation, and communications; social development; and public administration. The approximate cost of the projects submitted to date is more than $260 million (see Table 2).

Human Resource Training

The Human Resource Training Program will grant 17,000 scholarships in accordance with the specific goals set by academic institutions, private enterprise, and the government. The cost of this program will be approximately $130 million. Around 40 percent will be granted through existing agreements with academic institutions and government agencies. The scholarship funds will be distributed according to priorities and projected expansion, as shown in Table 3 and Fig. 1.

Preference has been given to master's degree work in Mexican institutions; postgraduate specialization work at the doctoral and postdoctoral level will mainly be done abroad. One of the important goals is to strengthen local graduate programs and reduce the number of students going abroad. Another goal is to decentralize the academic work from Mexico City and support state universities throughout the country.

The preliminary estimate of specialized personnel was based on the demand for teachers to meet the projected increase in enrollment and the projected growth of research. The result is that more than 85,000 scientists and high-level technicians will be needed in the next 4 years. The human resource program will supply about 21 percent of that figure and cost approximately $19 million in 1978.

The projects, which will include international participation or cooperation, are expected to increase to 4335 by 1982 (see

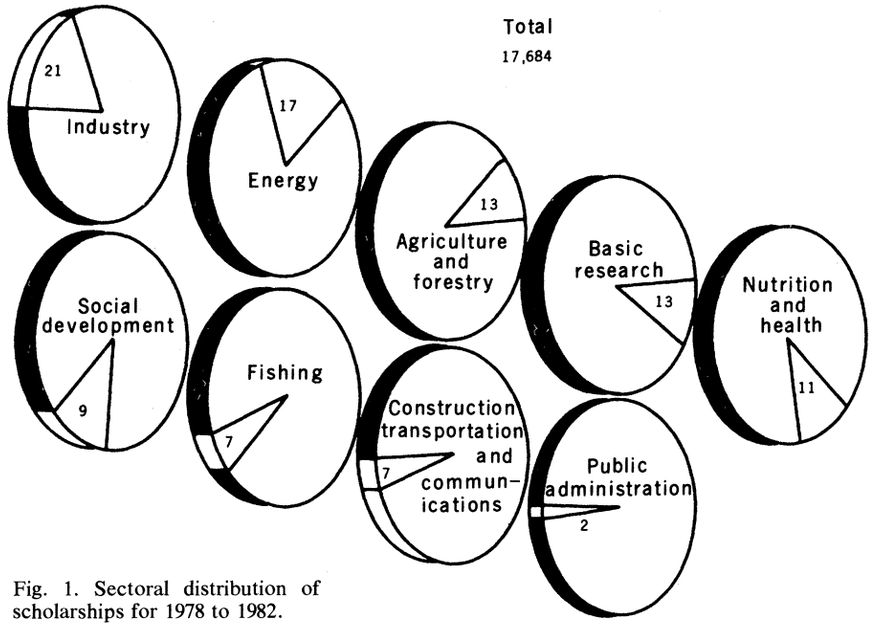

Fig. 1. Sectoral distribution of scholarships for 1978 to 1982.

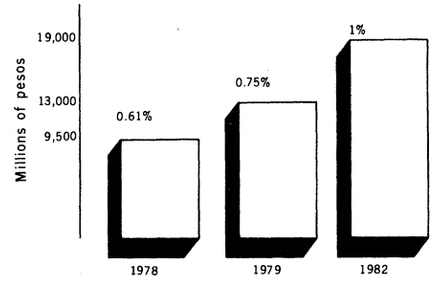

Fig. 2. Projected national expenditure on science and technology as a percentage of gross national product.

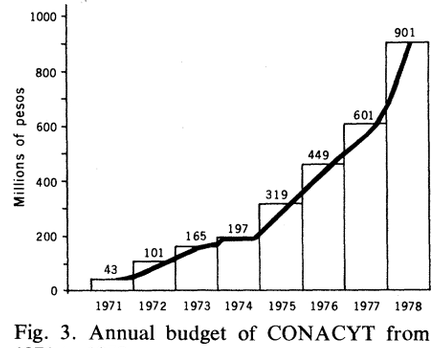

Fig. 3. Annual budget of CONACYT from 1971 to 1978.

Table 3. Program for training human resources, 1978 to 1982: number of scholarships, levels, and costs.

Priority	Total scholarships	Total cost		Doctorate	Master's degree	Academic specialization	Technical training	Thesis scholarships
		Thousand pesos	Thousand dollars					
Basic research	2,289	384,377	16,712	270	1,150	142	307	420
Agriculture, animal husbandry, and forestry	2,363	489,760	21,293	301	860	618	463	120
Fishing	1,236	201,012	8,739	126	517	117	163	313
Nutrition and health	1,924	308,379	13,407	180	619	231	536	358
Energy sources	2,924	468,382	20,364	270	708	544	1,047	355
Industry	3,740	748,370	32,537	313	1,265	751	1,317	94
Construction, transportation, and communications	1,213	112,391	4,886	32	75	151	747	208
Social development	1,549	309,217	13,444	301	927	216	55	50
Public administration	447	76,232	3,314	15	198	69	165	
Total	17,685	3,098,120	134,696	1,808	6,319	2,839	4,800	1,918

Table 4). An inventory will be made of the scientific and technical cooperation agreements and the projects under way with each country or organization. These projects will be evaluated and followed by new systems. Research centers at state universities and in the interior will be integrated further within these agreements to promote decentralization.

The program also takes stock of human resources available in Mexico and the resultant picture is encouraging.

1) There are 13,300 people working in scientific and technological research. Of these, more than 3000 hold doctoral degrees and 5500 have bachelor's degrees.

2) Between 1945 and 1975, close to 180,000 students graduated from universities: 54,000 in administration and social sciences; 47,000 in engineering and architecture; 33,000 in medicine and dentistry; 28,000 in the humanities, arts, and crafts; 16,000 in chemistry and biology, and 2000 in physics and mathematics.

3) Between 1940 and 1970, 30,000 to 40,000 Mexicans, mostly from upper middle-class families, did postgraduate work at American universities; 7000 more are estimated to have done postgraduate studies in France during the same period, not including the war years. A count has not yet been made of those who have attended universities in England, Italy, Canada, and Germany, but many have done so.

4) From its creation in 1971 to the present, CONACYT has awarded 11,500 scholarships for postgraduate work to professors, researchers, and technicians, about 50 percent for study abroad and the rest in Mexican institutions. This figure represents more than two-thirds of the total scholarships granted in the country during this period.

In accordance with national priorities seeking increased food production and energy sources, improved public health, and decreased unemployment, CONACYT is placing great emphasis on the training of technical personnel. This does not mean, however, that the training of a critical mass of specialists in basic science has been overlooked, since without these specialists Mexico could not choose vital alternatives in many areas of science.

Table 4. International Cooperation Program, 1978 to 1982. Abbreviations: COMECON, Council for Mutual Economic Assistance; OAS, Organization of American States.

Priority area	Action		Countries and international organizations, present and potential
	Number	Percent	
Basic research	1191	27	Canada, Czechoslovakia, France, Germany, Hungary, Israel, Poland, Venezuela, COMECON, OAS, United Nations, United States, Soviet Union
Agriculture, animal husbandry, forestry	818	19	Argentina, Australia, Central America, Czechoslovakia, China, Ecuador, Egypt, France, Germany, Great Britain, Holland, India, Israel, Italy, Japan, Panama, Peru, Sweden, Tanzania, Venezuela, Yugoslavia, COMECON, OAS, United Nations, United States, Soviet Union
Fishing	100	2	Great Britain, Brazil, China, Cuba, France, Israel, Japan, Norway, Peru, Venezuela, COMECON, OAS, United Nations, United States, Soviet Union
Nutrition and health	718	17	Argentina, Austria, Brazil, Canada, Colombia, Cuba, Czechoslovakia, France, Great Britain, Honduras, Hungary, Israel, Italy, Jamaica, Japan, Norway, Rumania, El Salvador, Caribbean Community, Venezuela, Yugoslavia, COMECON, OAS, United Nations, United States
Energy sources	360	8	Canada, China, Cuba, Czechoslovakia, France, Iran, Israel, Italy, COMECON, OAS, United Nations, United States
Industry	859	20	Argentina, Canada, Colombia, Costa Rica, Cuba, Czechoslovakia, China, France, Germany, Great Britain, Holland, India, Israel, Italy, Japan, Rumania, Sweden, Tanzania, Caribbean Community, COMECON, OAS, United Nations, United States, Soviet Union
Construction, transportation, communications	185	4	Argentina, Brazil, Canada, Central America, Cuba, Czechoslovakia, Israel, Italy, Japan, Nicaragua, Venezuela, OAS, United States
Social development	69	2	Canada, Cuba, Czechoslovakia, France, Israel, Italy, Japan, Trinidad and Tobago, Venezuela, Yugoslavia, Soviet Union
Public administration	35	1	Argentina, Brazil, Canada, China, Cuba, Spain, France, Great Britain, Israel, Italy, Japan, Yugoslavia, OAS, Soviet Union
Total	4335	100	

Of the 17,000 scholarships for postgraduate training to be awarded to Mexican graduates over the next 4 years, half will be for training abroad, especially in the United States, England, France, Canada, Japan, Germany, Israel, and the Soviet Union. In addition, it will be necessary to hire many foreign technicians —preferably, because of cultural affinities, Latin Americans who have been forced to emigrate because of political instability in their countries.

Conclusion

The National Program for Science and Technology is made up of 2465 specific research projects at a cost of more than $260 million, and we expect a substantial increase in research projects as more funds become available. The program recommends increasing expenditures for research and development, which today amount to 0.6 percent of the gross domestic product, to 1.0 percent by 1982 (Fig. 2). For this, federal expenditure must grow at the rate of about 22 percent a year. At current prices, this means a budget increase from $356 million in 1978 to $826 million in 1981.

The program was presented to the community, the media, and the general public on 19 October 1978. At the closing of the meeting the President said: "Development requires the availability of financial resources to apply science and technology to the nation's progress. . . . Sound management of our petroleum reserves should allow us to parallel our financial self-determination with self-determination in science and technology. . . . This program now has to be converted into a budget, a financing system, and an effective system of cooperation between the productive and educational sectors. Only thus we will have the necessary feedback to begin our self-determination in research and face our future problems without jeopardizing political harmony."

The annual budget of CONACYT from 1971 to 1978 is shown in Fig. 3. CONACYT and other agencies of the government are already working on an expanded budget and a financing system for research and development as suggested by the President. There is little doubt, then, that the coming 4 years will witness a spectacular transformation in the active role of science and technology in Mexico.

References

1. *The National Program for Science and Technology, 1978-1982* (CONACYT, Mexico D.F., 1978).