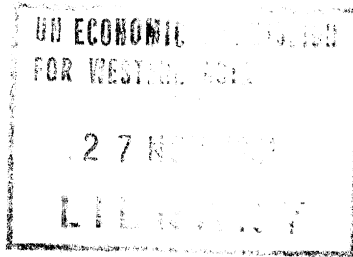




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CO-OPERATIVE PROGRAMMES IN SCIENCE
AND TECHNOLOGY IN ARAB COUNTRIES

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* The opinions expressed in this document are those of the author and do not necessarily reflect the views of the United Nations Economic Commission for Western Asia.

COOPERATIVE PROGRAMS IN SCIENCE AND TECHNOLOGY IN ARAB COUNTRIES

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Paper presented at the United Nations Economic Commission for Western Asia Seminar on Technology Policies in the Arab States, 24-29 May 1981, Beirut.

This paper examines the experience of the United States National Science Foundation (NSF) with scientific cooperation in the Arab World. It discusses the position and status of NSF within the U.S. Federal Government, explains the NSF approach to international cooperation in science and technology, describes the NSF experience in working with several Arab states, and concludes by considering possible future directions for NSF-Arab relations.

The Nature of NSF

NSF was established by an Act of Congress in 1950, one of the first such science agencies anywhere in the world. It is the principal agency of the Federal Government responsible for promoting and advancing scientific progress in the United States. NSF fulfills this responsibility by making grants to U.S. researchers in fields with significant potential for in-

creasing scientific understanding, by providing research resources and equipment needed in the conduct of science, and by fostering education and training programs to maintain U.S. scientific leadership in future generations.

The NSF budget has steadily grown and is projected at slightly over \$1.1 billion in 1982. NSF funds about 20 per cent of all federal support for basic research, as well as significant sums for applied science and science education. Unlike the other federal research funding agencies such as the Department of Energy, the National Institutes of Health, the National Aeronautics and Space Administration, and the Department of Agriculture, NSF does not have a "mission" by law to support research in a specific field such as agriculture or space. NSF supports basic research in all the physical, biological and social sciences with the exception of agriculture, medicine, and veterinary science which are funded by mission agencies. The NSF staff has remained steady for several years at approximately 1200 persons, almost all of whom are based in Washington. About one-third of the staff consist of professionals with advanced scientific training.

The NSF modes of operation differ considerably from some of its counterparts in other countries such as the French National Scientific Research

Council (CNRS). NSF funds research through awarding grants for unsolicited proposals, funding about 18,000 individual proposals a year. NSF does not conduct research itself, maintains no in-house research facilities, and operates only a few research centers in astronomy and other fields and these through sub-contracts. NSF entertains unsolicited proposals from throughout the U.S. scientific community, including for profit enterprises but more than 80 per cent of its awards go to university researchers. Thus NSF is the principal source of support for basic research at American universities in most fields except agriculture, medicine, and veterinary science.

Unsolicited proposals submitted to NSF are subject to a vigorous peer review, usually by several outside expert reviewers, mainly but not exclusively drawn from academic ranks. Reviewers receive no payment and provide one of the most important voluntary links to the U.S. scientific community. Final funding decisions on awards are made by NSF on the basis of peer reviews and other considerations. The peer review system remains the most effective means of ensuring fair and meritorious treatment of the thousands of proposals submitted.

NSF and International Cooperation

The NSF Act provides for a broad statutory authority to undertake international science and technology activities consistent with the foreign policy objectives of the United States and U.S. national interests and security. The presidentially nominated 24 member National Science Board has repeatedly confirmed this international commitment and NSF Directors have personally participated in international activities such as ministerial meetings, UN Conferences and the like. The first international program established as a separate organizational entity in NSF was its involvement in the International Geophysical Year in 1958. The first government to government bilateral agreement involving NSF was concluded with Japan in 1961.

NSF international activities currently occur in several ways.

Approximately 17 per cent of all NSF research awards have international implications, whether for research or travel outside the U.S., sharing of information with foreign scientists, or other purposes. Awards made in disciplinary fields such as physics or sociology usually do not stipulate foreign collaboration but informally there is often involvement of host country scientists and occasionally host country governments. There is

scarcely a field or sub-field in NSF, which is internally organized along disciplinary lines, where every year one or more awards with international implications are not made, especially in oceanography, climatology, earth sciences, and geology.

NSF supports travel by American scientists to international meetings and translations into English of scientific work in several languages. NSF also supports US participation in a number of multilateral scientific efforts such as the International Geophysical Year, the North Atlantic Treaty Organization summer institutes for scientists, and the Institute for Applied Systems Analysis in Vienna. Through the U.S. National Academy of Sciences, a distinguished private organization of outstanding scientists, NSF provides funding for US participation in the International Council of Scientific Unions (ICSU), and other bodies.

The principal channel for NSF international cooperation is its Division of International Programs (INT). INT manages 24 formal bilateral agreements for scientific cooperation extant in 1981, administers the international travel, scientific translation, Science in Developing Countries, and other programs, and awards about 300 cooperative research awards a year for US participation in unsolicited bilateral and multilateral research projects, as well as 700 grants for travel, study and lectures. The INT

budget for 1980 was \$20 million of which \$12 million came from NSF funds and the rest from transfers from other US government agencies and Special Foreign Currency (local, non-convertible) currencies credited to the US government for purchases of goods and services in Egypt, India, Pakistan, Burma, and Guinea (Conakry). Between its formal and informal contacts and programs INT maintains cordial scientific and technological relations with 40 or more countries.

NSF applies a number of general criteria in the funding of its international activities. The first is, that the science involved should be of a high and meritorious quality. Secondly, the science should be of mutual interest to both participating scientific communities and freely accessible to US and foreign scientists. Thirdly, the international activity must be mutually beneficial through peer cooperation wherever possible. NSF is not a technical aid or assistance agency, lacking both the administrative structure and the means to carry out such tasks. Its strong preference is for US and foreign scientists to work together cooperatively on a peer basis on research of clear mutual interest, whether in basic or applied science. The fourth principle is derived from the third and places emphasis on the sharing of human resources rather than expensive equipment expenditures. Although willing to fund necessary research expenditures, NSF generally avoids becoming involved in major

international projects which involve expensive and hard to maintain equipment. The exception has been some of the Polar and other multi-lateral programs where facilities and equipment are a prerequisite. We are convinced that a variety of global problems can benefit from multilateral research efforts.

NSF prefers in its bilateral programs to retain as much flexibility as possible in order to better match US and foreign interests, and to reduce delays and costs. Its goals are to help meet the needs of US scientists and scientific organizations for interchange with foreign scientists and foreign scientific organizations; and to assist in the development and implementation of science activities and programs that support foreign policy objectives of the United States. Thus it acts as the lead US agency when designated as such in the implementation of formal scientific and technological agreements between the US and other countries, eg. Japan, Italy. It also acts through joint bilateral commissions which have been established to implement agreements, eg., Saudi Arabia, Jordan, Tunisia, and through less formal government to government memoranda of understanding which normally cover the bases for cooperation, eg., Greece, Pakistan, Switzerland. Memoranda of understanding or other diplomatic notes may be exchanged through respective foreign

ministries and the US Department of State and/or directly between NSF and its foreign counterpart agencies.

A world of more than 150 independent nation-states with enormous disparities in scientific and technological interests and capabilities requires several modes of cooperation subject to periodic adjustment. NSF recently established, for instance, a Science for Developing Countries program which funds unsolicited cooperative research proposals between the US and one or more of over 100 developing countries. Foreign counterpart participation on a peer basis and some foreign support is required for this program but there is no requisite for government to government or science agency to science agency formal contact. The program supports research which is basic or applied and in all those fields where NSF is active. Similarly NSF disciplinary awards, participation in multilateral research, and the International Council of Scientific Unions involves the Foundation around the world, primarily on an informal basis. Therefore, it is understandable that NSF experience with Arab states reveals a variety of modes and approaches.

INT PROGRAM REVIEW ISSUE - BACKGROUND

I. International Science Activities Under Resource Constraints

Decision Rules and Resulting Budget Allocations

The March, 1981 INT budget figures show a reduction of \$4.0 million in FY 1981 and a reduction of \$6.0 million in FY 1982 compared with those approved by NSF/NSB at the end of last year and reflected in the January, 1981 budget (Figure 1,2).

To absorb the cuts for FY 1981, international cooperative science programs were reduced by \$2.8 million, eliminating the planned expansion of cooperation with industrial countries and reducing the activities with developing countries and socialist countries, especially the U.S.S.R. Planned support for the program element International Scientific Organizations, which includes support for the International Institute for Applied Systems Analysis (IIASA) and the International Council of Scientific Unions (ICSU), was reduced \$1.2 million, necessitating support for ICSU by the research divisions. Allocation of the cuts for 1981 was complicated by their timing, halfway into the fiscal year at a point when actual spending patterns among the different program elements were uneven.

The strategy for allocation of INT's funds for FY 1982 was guided by two principles:

- (1) To maintain as vital and effective international program as possible, and
- (2) to meet as many of NSF's major commitments in the U.S. and abroad as possible.

Accordingly (Figure 3,4), International Cooperative Science is reduced by \$1.5 million in FY 1982 to a revised total of \$9.8 million. US/USSR Cooperative

Research programs will be reduced by \$600,000 to a level of \$400,000. Planned increases for cooperative science programs with West Europe and developing countries will be scaled back by \$400,000 and exchanges with East European countries, particularly the USSR, will be reduced by \$500,000. Given the reduced overall budget, international programs which provide relatively greater benefits to the U.S. scientific community at equal cost were given higher priority.

At the current budget level, the budget for International Scientific Organizations and Resources has been zeroed out in FY 1982. In addition to transferring responsibility for support of U.S. participation in the International Council of Scientific Unions to other parts of NSF, support of IIASA is scheduled to be eliminated with some question of how soon.

An amount of \$800,000 is allocated for the International Travel Program. This will permit NSF to continue representation of the U.S. scientific community at international meetings at adequate levels in the face of sharply rising transportation costs.

Since US participation in international scientific organizations derives from prior US commitments, it will be necessary to renegotiate certain financial obligations. This could require residual funding during FY 1982. In that event, funds for International Cooperative Science would have to be further reduced to cover such costs.

Summary Implications for INT Programs

Budget-cuts for FY 1981 and FY 1982 will severely affect the work of the INT and the role of NSF in international science activities. The international

NSF and the Arab States

Although NSF experiences vary considerably from country to country, several common themes run throughout. These include 1) the need to identify fields of mutual interest and matching capabilities, 2) the need for NSF to find counterpart agencies which, like NSF, have access to academic and non-academic scientists, 3) the understandable preference of many governments for short-term applied research as opposed to the long-term basic research inclination of NSF, 4) the problems of funding and cost sharing, and 5) the need to establish extensive scientist to scientist contacts if the unsolicited cooperative research method is to work. None of these themes are unique to the Arab states and most have been encountered in NSF relations with other developing countries. Several approaches have been attempted and a considerable body of empirical experience has been accumulated. There are several lessons to be learned from the experience to date which will be reviewed country by country.

NSF has primarily relied on three approaches in its dealings with Arab states. The first consists of government to government or agency to agency agreement on a funding formula for jointly supported coopera-

tive research based on unsolicited research proposals. This approach usually involves one or more peer reviews, the ability of US and Arab scientists to identify mutual interests and to draft a research proposal, and at least informal agreement on the subject most suitable for cooperative research, often geology and geophysics. NSF has used this approach with Morocco and Tunisia resulting in excellent research and publications.

A second approach has been for NSF and its counterpart agency to agree on a research topic of mutual interest and to jointly support international meetings and workshops directed at developing an international research agenda. NSF and the Kuwait Institute for Scientific Research (KISR) have used this approach to generate scientific interest, publications, and a research agenda for the problem of biosalinity.

A third approach, used by NSF and Saudi Arabia, consists of NSF collaboration, funded by Saudi Arabia, in the development of a national science and technology policy and infrastructure support system including an information and documentation system, and a program of applied research awards. This approach depends on continuing and close cooperation between NSF and its counterpart agency and is specifically policy-oriented.

In addition, to these arrangements NSF has also had more informal relations with Algeria, Jordan, and Lebanon.

The U.S. government is now carefully examining all of its program costs. At least for the near future, financial support of new cooperative programs by NSF is unlikely.

Algeria

NSF and the Algerian National Organization for Scientific Research (ONRS), which is part of the Ministry of Higher Education and Science, have exchanged several visits beginning in 1979. Arid lands research has been identified as a strong candidate for a field of mutual interest, and Algerian officials have visited US university research centers in the Southwest active in this field. The question of funding remains to be resolved, possibly based on some form of shared funding. Further staff and scientific visits are expected during 1981 with the intention to more closely examine Algerian and US capabilities in certain fields. NSF teams have informally surveyed Algerian science and technology capabilities, especially with respect to arid lands. Further visits are intended to identify possible cooperative research subjects and to match Algerian and US institutions active in arid lands work.

Egypt

NSF initiated its activities in Egypt informally in 1972, prior to the reestablishment of US-Egyptian diplomatic relations. A bilateral science agreement was signed in 1974 and remains in force. Since 1972 Egyptian and US scientists with NSF support have engaged in 121 cooperative research projects, primarily applied research in fields such as geology, geophysics, and remote sensing. US participants have been mostly academic researchers while their Egyptian counterparts have been drawn from government research institutes and universities. There has been little or no participation by researchers from para-governmental enterprises or the private sector.

NSF expenditures in Egypt between 1972 and 1980 amounted to \$11 million of which 90 per cent came from Special Foreign Currencies. It is expected that 1981 will be the last year for such support because of a depletion of funds. Egyptian support has come through the Egyptian Academy of Scientific Research and Technology which is being reformed to serve as the prime instrument of national science and technology policies.

During January 1981 a US-Egyptian government to government agreement was reached on future scientific and technological cooperation. It

establishes a Joint Board composed of nationals from each country to provide coordination, oversight, and determine research priorities. Future funding is anticipated to come from the US Agency for International Development.

In spite of Egypt's internal problems of management, funding, equipment, manpower and lack of linkages between university and other researchers, NSF has been able to support quality cooperative research, published in international journals, and useful to Egypt and the U.S. Scientifically outstanding work has been done in geology and geophysics through close and continued cooperation between U.S. and Egyptian researchers. The most impressive example of technology transfer has been the introduction by NSF of ultrasound diagnostic techniques which have been widely disseminated and applied in Egypt. A Technology Transfer Focus Center was established in Cairo with NSF collaboration to introduce these techniques.

NSF-Egyptian cooperation has played an important part in the introduction and diffusion of remote sensing technology in Egypt through a Cairo remote sensing center. This technology has proved useful in Suez Canal tunneling operations and in geological research. Other published NSF-Egypt cooperative studies include "Evolution and Disruption of a Major Craton",

"Investigation of Methods of Determining the Porosity of Solids", "Energy Conservation in the Textile Industry", and "Corrosion and Corrosion Cracking of Materials Used in the Petroleum and Chemical Industries."

Jordan

NSF has enjoyed informal relations with Jordanian science authorities for many years. Exchange visits have occurred and discussions have been held concerning possible future understandings. Meanwhile NSF continues to make individual awards to US grantees which involve work in Jordan and the Jordanian authorities continue to facilitate access for US researchers. Jordan has shown interest in the international biosaline research effort. NSF and the Royal Science Society of Jordan have maintained close informal contact for several years including visits, seminars, discussions of science and technology planning, and exchanges of publications.

Kuwait

Although its population and territory are small Kuwait is rapidly developing a science and technology capability, principally through KISR. As its infrastructure improves Kuwait is expected to play a

leading science and technology role in the Persian Gulf.

NSF has for several years worked closely with KISR and the Kuwait government. These contacts led to the identification of biosaline research as a vital basic and applied research topic. KISR and NSF jointly sponsored an international seminar in South Carolina in 1979 to highlight the need for biosaline research and to establish an initial research agenda. Scientists from 14 countries attended, and several publications resulted including an International Directory of Biosaline Research. Scientists participating in the seminar identified promising subjects for joint research and planned for information exchanges and the development of collaborative activities. The 2nd, International Workshop on Biosaline Research was held in Mexico in November 1980, with even wider international participation, and the joint sponsorship of NSF and CONACYT, the Mexican National Science and Technology Council.

NSF and KISR have established a formal agency agreement as a basis for future activities. Another jointly sponsored international seminar on the topic of energy conservation in the petroleum industry has just taken place. Other topics are under consideration for future seminars.

Morocco

NSF involvement in Morocco occurred during the period 1972-1974 as a cooperative research project on basement geology in the Atlas Mountains. The researchers came from the University of South Carolina and the Moroccan Geological Survey. The research was funded with Special Foreign Currency which was then available in Morocco. The researchers developed outstanding rapport which has continued over time and the quality of the fieldwork was regarded as excellent. The project generated several publications including a comprehensive study of Triassic Sediments and Basin Structure of the Kerrouchen Basin in Central Morocco. This project was one of several supported by NSF on the tectonic plate system of North Africa. Its results tended to support the continental drift hypothesis with Africa and South America at one time constituting a single entity, the Gondwana land theory.

Informal contacts between NSF and Moroccan science authorities continue and Morocco has expressed interest in renewing cooperative research with NSF. Funding and other problems remain to my worked out. An expression of Moroccan and NSF interest was my participation in the Arab Conference on Science and Technology

(CASTARAB) held in Rabat in 1976. This participation included the demonstration of tele-video links.

Saudi Arabia

NSF involvement in Saudi Arabia was initiated in 1974 with support at the highest level from both governments. Since then it has evolved into a unique program directed at improving Saudi technology policy making capabilities. The establishment of Joint Commissions and Working Groups going back to 1974 has permitted the essential time for mutual trust to develop and for long-range planning to take place. The NSF-Saudi Arabian government agreement is one of several involving US government agencies which are managed through the U.S.-Saudi Arabia Joint Commission on Economic Cooperation.

The Saudi Arabian National Center for Science and Technology (SANCST) has been the principal collaborator with NSF. The NSF effort has been directed at strengthening the policy-making capabilities of SANCST, relying on NSF experience when appropriate. Thus NSF has worked closely with SANCST in compiling an inventory of existing science and technology resources in Saudi Arabia, the first of its kind, supporting the establishment of a SANCST office

in Washington, DC, designing a Saudi National Information and Documentation System considered to be one of the most advanced in the world, providing a series of five comprehensive state of the art research papers as background for the SANCST technology plans, and assisting in the initiation of a SANCST applied research program.

The collaboration in development of a Saudi applied research program represents an example of NSF transfer of "software." SANCST is now in the third year of an applied research grant program based on unsolicited proposals from Saudi institutions and subject to rigorous peer review. This is the first research grant program ever in Saudi Arabia.

Tunisia

NSF was active in Tunisia between 1972 and 1977. During that period several international conferences and cooperative research in geology, soil mechanics, and other fields were supported. Tunisian counterparts were drawn from the National Institute of Engineering (ENIT), the Ministry of Mines, and University of Tunisia faculty from several disciplines. The cooperation involved several US universities including Minnesota, Houston, Brigham Young, Rice, and South Carolina, and

American faculty and graduate students. Relations were particularly close with ENIT where NSF support contributed to strengthening research and teaching capabilities. Throughout this period the NSF counterpart agency was the Tunisian Ministry of Higher Education and Scientific Research. NSF participation ended in 1977 with the depletion of the SFC funding in Tunisia.

The most intensive NSF involvement was with ENIT. NSF supported American researchers took part in an extensive soil mechanics study with ENIT staff which resulted in a permanent improvement in ENIT capabilities in this field. Considerable savings resulted from improved siting of bridges and other public works. Research supported by NSF also led to the establishment of an Instrumentation and Measurement Research Lab at ENIT.

The Tunisian government has approached NSF about a renewed involvement. This could possibly be based on a memorandum of understanding and a formula for joint sharing of costs.

Conclusions

This general survey shows that the NSF has been active in a

number of Arab states and that the future offers many opportunities for more and better involvement. NSF is able to offer the Arab world its own experience as the leading supporter of basic research anywhere in the world, its multiple access to the 600,000 scientists and engineers of the US research community, and its own scientific and technological capabilities. NSF has proven itself to date in the Arab world a reliable and competent partner.

NSF is interested in the Arab states because of the strong US foreign policy and national security interest, because of the unique research opportunities that exist in the region, and most of all because of the interest of American scientists in getting to know and working with the rapidly growing number of Arab counterparts. NSF and its Arab counterparts have already demonstrated that international cooperation in science can be mutually beneficial, whether in a bilateral context or in major multilateral research efforts.

Experience has also taught that effective future NSF cooperation with counterparts in Arab States will depend on reaching mutually satisfactory agreement on difficult problems. Some means are needed to share costs, whether through joint commissions or foundations, ad hoc funding or other devices. Careful attention must be given to identifying fields

of mutual interest and an appropriate balance between applied and basic research. The United Nations Economic Commission for Western Asia may have a role to play in helping to identify national and regional research priorities and in assisting governments to inventory their existing resources. Counterpart agencies are needed which will have access to academic and non-academic scientists and with enough influence in their own governments to implement decisions. Finally and most critically Arab and American scientists and scientific administrators must have opportunities to meet and to know each other on a person to person basis. This meeting has played an important role in facilitating such contacts.

This paper represents the views of the author and not necessarily those of the National Science Foundation.



