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Evaluative Study of the Scientists and Engineers in Economic Development Program

SURVEY REPORT

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INSTITUTE FOR SURVEY RESEARCH
-Of The Commonwealth System Of Higher Education-
TEMPLE UNIVERSITY
1601 NORTH BROAD STREET
PHILADELPHIA, PENNSYLVANIA 19122

EVALUATIVE STUDY OF THE

SCIENTISTS AND ENGINEERS IN ECONOMIC DEVELOPMENT (SEED) PROGRAM

Final Report: Participant Survey

Prepared by: Koray Tanfer
Lee Robeson

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Any opinions, findings and conclusions or recommendations are those of the authors, as are, needless to say, omissions and errors.

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1. SUMMARY AND CONCLUSIONS

The National Science Foundation (NSF) is a principal federal government agency responsible for advancing and promoting scientific progress in the United States. Because science is a worldwide enterprise whose vigor can only be maintained through an international linkage of scientists, NSF is also authorized to engage in international cooperative scientific activities.

More than two decades ago, a separate organizational unit for international programs was established within the NSF. The present Division of International Programs (INT) annually supports the US contribution of approximately 300 cooperative scientific projects in more than 40 foreign countries, in order to help meet the need of the scientists and scientific institutions in the United States for interchange with their foreign counterparts and to assist in the development and implementation of scientific activities and programs that support US foreign policy objectives.

The SEED program (Scientists and Engineers in Economic Development) was established in 1971 by NSF, as a two-year experimental project, funded by the Agency for International Development (AID). It was designed to test the effectiveness of individual US university scientists and engineers working with foreign counterparts in developing countries on projects that contributed to economic development. The SEED program sought to stimulate more effective coupling of research and education with development priorities in less developed countries.

In 1980, a systematic evaluation was initiated of the programs of international cooperation in science administered by INT. The evaluation focuses on the scientific benefits realized from these programs, including such aspects as the value of international collaboration to individual scientists, scientific publications produced, and the establishment and

maintenance of professional contacts. As part of the evaluation, a survey was conducted to gather information from scientists supported by INT, as well as from members of a control group consisting of US scientists drawn from other NSF programs.

This report presents the results of the survey of SEED participants and of scientists funded by NSF disciplinary programs for international work in developing countries. The latter is referred to as the "COMPARISON" group, throughout this report. The survey was conducted via self-administered questionnaires. From the list of scientists provided by NSF, 99 percent were located and slightly more than 84 percent of those contacted returned their questionnaires. Given the standards and expectations in mail surveys, both the location rate and the response rate were exceptionally high.

The results show that both groups are predominantly comprised of males (93%) with doctorate degrees (98%) in academic positions. One-third of the scientists in each group specialized in life sciences; among the remaining two-thirds, SEED scientists were concentrated in fields of engineering, while COMPARISON scientists tended to specialize in earth sciences. Chronologic age at the inception of the activity and the number of years since the highest academic degree was awarded were two criteria used to approximate professional experience. SEED participants were relatively older (by an average of five years) than COMPARISON scientists and also appeared to have obtained their degrees earlier in their careers (by an average of one year). Moreover, SEED scientists, in general, held more senior positions than did COMPARISON members both at the time the award was made and also at the time of the survey. For instance, currently 75 percent of SEED, but only 60 percent of COMPARISON, scientists are full professors; at the time of the award, six in ten SEED and four in ten COMPARISON grantees held this position. This might indicate that having attained a higher rank (professorship and tenure), SEED scientists may

have been and currently are less "publish-or-perish" competitive. SEED scientists also tend more toward teaching and administration, while COMPARISON scientists spent the bulk of their time in research activities. Finally, the COMPARISON group tended to be more involved in international scientific activities as they related to their own research, while SEED scientists were more frequently involved in teaching or lecturing in the foreign science community.

Results indicated that, despite certain similarities in the composition of the two groups, there were marked differences in background items such as age, rank, field of specialization, and utilization of work time. These differences, however, were not significant enough to account wholly for the variation found in effectiveness or productivity of the two groups of scientists; nevertheless, their contribution cannot be entirely discounted.

The two study groups, SEED and COMPARISON, were considerably far apart with respect to their objectives and the nature of their scientific activity. In fact, the results indicated a clear polarization in this respect. The goals of the SEED group were primarily assisting the foreign counterparts of their activity through dissemination of knowledge, improving the relevance of scientific research to economic development, or improving the curriculum or courses offered by scientific institutions. In contrast, the COMPARISON scientists were overwhelmingly interested in collecting data and specimens for their own research or stimulating their own research through the foreign contact. The SEED scientists were more heavily involved in collaborative research activities both to improve foreign capabilities, and also to link the improvements in research capabilities to social and economic goals. The data indicate that the activities of the non-SEED scientists were more likely to be continuations of research started back in the US, and only one in ten

COMPARISON, as compared to one in two SEED, scientists taught a course while abroad. On the average, more than 50 percent of the non-SEED scientists' time abroad was spent in "fieldwork" gathering data or specimens, while only approximately ten percent of their time was spent teaching, lecturing, or discussing research. The SEED scientists, on the other hand, spent most of their time teaching or lecturing and providing assistance to the foreign institutions. Our findings point to real differences between the two groups with respect to their objectives and, consequently, their activities. Therefore, it is expected that the respective outcomes also would differ widely.

Development of measurements for performance was a fundamental focus of the study. We started with the assumption that program performance was a multidimensional concept; hence, different and independent aspects of a program had to be considered. This led us to conclude that different types of measures could be constructed to evaluate various aspects of performance based upon different sources of information and various types of outcome. With this in mind, we examined a variety of indicators, both "subjective-qualitative" and "objective-quantitative."

Using subjective measures, data indicate, for instance, that improvement of foreign research capability was one of the most important positive outcomes of SEED activities. In contrast, COMPARISON scientists singled out results closely related to the advancement of their own research as the most important outcomes of the scientific activity. The quantitatively higher publication rate of the COMPARISON group also reflects this outcome. Both groups, however, assigned a high rating to the overall productivity of the international scientific activity in which they were engaged.

One of the major goals of international scientific activity is to promote and maintain scientist-to-scientist linkage around the world, so that, through

information exchange and collaborative work, researchers can stimulate and support each other and share sometimes scarce resources. Establishment of new, and maintenance of old, professional contacts are important outcomes that lend themselves to objective quantification; in this respect, the members of both groups were very successful and contributed significantly to the realization of this objective.

Finally, we combined the two types of indicators to obtain a composite measure of performance, in other words, overall productivity. In doing so, a primary consideration was not to lose perspective of program goals. Productivity must be linked to the objectives of the activity undertaken by the members of the study groups.

The findings from our analysis of the survey data led to the conclusion that when program goals were taken into consideration, both groups were equally effective in terms of their performance. The activities of the SEED members yielded more positive results for the foreign counterparts of their projects, as intended, while the COMPARISON scientists were more prolific producers in terms of written work. SEED participants were engaged in assisting foreign institutions and strengthening relationships, and they tended to have achieved their objectives. Similarly, the COMPARISON group was primarily interested in advancing their own scientific work, and the higher level of written output was evidence of their effective performance and productivity.

If we assign equal weight to each of the performance indicators used to obtain a composite measure, the differential scores on the individual measures counterbalance each other, so that both groups were effective in achieving their objectives and fulfilling program goals. The differences between the two groups did not result from differences in qualifications or competence but rather from differences in the objectives and the activities undertaken. When

controls were imposed upon these factors, it was evident that both groups performed well and achieved their respective goals.

Scientists in both SEED and COMPARISON groups were asked to comment on various aspects of the activity and/or program. A major theme that emerged from collation of these suggestions, recommendations, and critical observations was that international scientific activities supported by NSF were useful and successful; moreover, the conclusion was that such activities should not only be continued, but expanded, if possible.

Sample surveys yield a plethora of primary data. More often than not these data are used for further analysis and reanalysis. This survey is no exception. Researchers, policy-makers, and program evaluators are encouraged to take a more in-depth look at the data.

2. BACKGROUND

The National Science Foundation (NSF) is a principal agency of the Federal Government responsible for promoting scientific advancement in the United States. This responsibility is fulfilled by awarding grants to researchers, providing research resources and equipment, and fostering education and training programs.

Science is a worldwide enterprise, and its vigor can only be maintained through an international link of scientists. By means of collaborative projects and the exchange of scientific information, researchers stimulate and support each other, and share costs, resources, and facilities.

As long as they are consistent with the foreign policy objectives of the United States, the NSF is authorized to engage in international cooperative scientific activities. This statutory authority is quite broad. International Programs was established as a separate organizational entity in NSF more than two decades ago (1958). The present Division of International Programs (INT) supports the US contributions of about 300 cooperative science projects annually, in more than 40 countries.

The two major goals of INT are (1) to help meet the need of the scientists and scientific organizations in the United States for interchange with their counterparts in foreign countries; and (2) to assist in the development and implementation of scientific activities and programs that support the foreign policy objectives of the US. Major activities of INT, in this regard, are the promotion and support of international scientific activities through bilateral cooperation under formal agreements with a number of countries. As of October of 1981, INT had active programs in 27 countries. The Division also supports cooperation in international science and technology which is not the subject of formal agreements. The scope of activities

supported under both formal and informal arrangements can be divided into three broad groups:

- Cooperative research -- includes projects designed jointly and conducted collaboratively by principal investigators from the US and the cooperating foreign country
- Research-oriented seminars and workshops -- includes jointly organized meetings, either in the US or abroad, of small groups of scientists from the US and the foreign country.
- Scientific visits -- includes visits by US scientists to participating countries or by foreign scientists to the US. These may vary in terms of duration and purpose, such as short-term visits for purposes of planning joint projects or exchanging information and longer-term visits to conduct research at an institution in the cooperating country.

Objectives and Purpose

The broad objective of the overall project was to conduct a systematic evaluation of INT programs of international cooperation in science and technology. More specifically, the evaluation focused on the scientific benefits realized from these programs, including, but not limited to, factors such as the value of international scientific collaboration to individual scientists, scientific publications produced, and development and maintenance of scientific contacts. Moreover, the evaluation sought to delineate strengths and weaknesses in individual programs. The results of the evaluation were expected to be used in making decisions relative to the scope and direction of current and future international programs administered by INT.

As part of the evaluation, a survey was conducted of US scientists supported by INT programs; of US hosts to foreign participants; and of US

scientists engaged in international activities, supported by other (non-INT) NSF programs.

This report presents the results of the survey of participants in the INT/SEED program and of a comparison group consisting of US scientists engaging in international work in developing countries through other programs sponsored by NSF.

SEED Program (Scientists and Engineers in Economic Development)

The SEED program was initiated in 1971 as a two-year experimental project designed to test the effectiveness of individual US university scientists and engineers cooperating with foreign counterparts in developing countries on research and education projects. An additional objective was to stimulate more effective coupling of less-developed-country (LDC) research and educational institutions with development priorities. A third objective was to establish long-term collaborative relationships between US and foreign scientific institutions. The United States Agency for International Development (USAID) provided the funds through which NSF-INT carried out this program.

The following guidelines for the program were established jointly between NSF and AID:

- The US grantee develops and submits his/her own proposal (under NSF guidelines).
- The proposal must include evidence that the host institution favors the project and is prepared to collaborate on it.
- The US grantee travels and works as a private citizen, without "official" US Government status or logistic support.
- The grantee's salary and expenses are shared by his/her home institution, the host institution, the grantor (AID/NSF), and the grantee.

The general goal of the program was restated at the initiation of a second phase (1975) to read as follows: "The goal of the SEED program is to enhance the capability of LDC university science and engineering programs to contribute to the solution of development problems."[1]

Between 1972 and 1979, 191 grants were awarded, totaling approximately $1.7 million, for work in more than 50 countries around the world.

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[1] PROP-Scientists and Engineers in Economic Development (SEED), Revision of March 13, 1975 (NSF); SEED Program Evaluation Plan, (NSF Document, December 17, 1976)

3. APPROACH

Survey Design

The SEED survey was conducted via self-administered questionnaires mailed to US scientists funded under the SEED program, and to grantees from other programs funded by NSF (COMPARISON group) through disciplinary research programs for work in the same countries included in SEED. Since mail surveys traditionally yield low response rates, survey procedures were intensified to encourage a higher response rate. First, an introductory packet containing a cover letter, an NSF brochure, an address correction/confirmation card, and a postage-paid return envelope was sent to all potential respondents in the sample. Two weeks after the introductory packet was forwarded, the questionnaire and a cover letter were mailed. The questionnaire was then followed by a reminder postcard one week later. If no response was received two weeks after the mailing of the postcards, a second questionnaire was sent with another cover letter. A few days after the mailing of the second questionnaire, reminder telephone calls were made to all nonrespondents. If the questionnaire was still not returned two weeks after the mailing of the second questionnaire, a third and final questionnaire was mailed. Concurrently, telephone calls were made to all those for whom we had not yet received a completed questionnaire.

Premailing Activities

Prior to mailing, two major tasks were completed -- address file construction and materials preparation. The construction of the address file involved updating and computerizing two lists of award recipients supplied by INT. The addresses on the first list (primary group respondents, SEED) were dated by year of award from 1972 through 1978 and therefore and contained

addresses from two to nine years old. The second list (COMPARISON group respondents) ranged from awards made in 1975 through 1977. Both lists had a number of information gaps, including awards whose purposes were not specified and incomplete addresses. Furthermore, several of the scientists were listed more than once, either on one or both lists. Therefore, a considerable amount of effort was spent both in obtaining usable addresses, and also in removing all but one award for each scientist. The initial lists of 221 SEED group respondents and 639 COMPARISON group respondents supplied by NSF were thus reduced to 194 and 441 names, respectively.

The survey materials used included ISR in-house record-keeping forms and files, and the letters, envelopes, and questionnaires comprising the survey package. A questionnaire prepared by NSF was reformatted at ISR and printed after revisions both at NSF and ISR. Introductory letters, cover letters, and postcards were prepared at ISR and submitted to NSF for approval and printing.

Activities During Mailing

Locating Respondents: Although addresses were supplied by NSF, a major task was to locate respondents. The addresses supplied were often out of date or, in many cases, key elements of the correct address were missing. Several steps were taken: First, all correspondence to respondents was sent in "Address Correction Requested" envelopes to encourage the US Postal Service to apply a forwarding address. Second, the envelope containing the introductory letter also included an address correction/verification postcard and a postage-paid return envelope which the respondent was requested to fill out and return to ISR.

Other steps to locate respondents were taken if ISR was notified that no forwarding address was available, or if, during the first reminder telephone call (described later in this section), the interviewer was informed that the respondent was no longer at that address. Respondents could often be located

through a forwarding address on the respondent's university personnel file. Alumni offices were also sources of forwarding addresses. Published professional organization membership lists, as well as "Who's Who" type compendiums, were also searched. In some cases, the name of the respondent was turned over to the NSF for a search of NSF records. Only five of the 635 scientists (in both groups) were never located. Table 3.1 presents the method of address confirmation for the sample.

. Mailing Procedures: The first mailing was a packet containing an introductory letter, a booklet describing INT, an address correction/confirmation postcard, and a postage-paid return envelope. The letter described the sponsor and purpose of the study and informed the respondent that a questionnaire would arrive in the mail in approximately two weeks. The letter also requested that the respondent verify the address on the address correction/confirmation card and return it to ISR.

Two weeks after the introductory packet, a questionnaire was mailed to each respondent. It contained a cover letter, a questionnaire, and a postage-paid return envelope. Meanwhile, address changes from the first mailing were received. Telephone calls were placed to confirm these addresses. Once confirmed, a survey packet combining the introductory material and the questionnaire was sent. Similar combination packets were also mailed to respondents whose addresses had been located through the tracing efforts described earlier.

One week after the mailing of the questionnaire, a reminder postcard was sent, followed two weeks later by a second questionnaire. This packet was identical to the first, except that a different version of the cover letter was included.

TABLE 3.1. METHOD OF ADDRESS CONFIRMATION FOR THE SAMPLE

	Number	Percent
Address correction/confirmation postcard returned by respondent	329	51.8
Address confirmed over the phone (during reminder phone calls)	90	14.2
Address confirmation or change from the returned questionnaire (cover page)	90	14.2
Address changed due to tracing efforts	77	12.1
Respondent contacted ISR to refuse or indicate ineligibility (address confirmation implied)	33	5.2
Address changed by Post Office or last place of work (to other domestic address)	5	0.8
Address changed by Post Office or last place of work (to foreign address)	6	0.9
Respondent never located	5	0.8
TOTAL	635	100.0

Following both the second and in some cases a third mailing, and timed to correspond with the arrival of each packet, a reminder phone call was placed to all nonrespondents. These calls resulted in discovery of addresses for scientists who had, up to that point, neither confirmed nor changed their addresses.

Problems Encountered: A few unanticipated problems developed during the survey, the most important of which was "ineligibility" by some scientists contacted. For example, some awards in the COMPARISON sample were for logistics support and not for research. In other cases, the country indicated was not the site of the research conducted. A series of rules defining eligibility became necessary. In consultation with the NSF, a set of guidelines was constructed so that individuals could be classified as

ineligible. An insert was included with the third mailing of the questionnaire. This insert explained the circumstances under which a respondent would be considered ineligible; moreover, it indicated that we wanted to know the exact circumstances of this ineligibility.

Record Keeping: When address changes or confirmations were received, the date of receipt and the information obtained were entered onto a computerized check-in file. Information indicating that a respondent could not be reached at the address on file was in addition forwarded to tracing for a more intensive search. When returned from tracing, the new address was entered on the file, and an individual mailing packet was sent to the respondent's new address.

The mailing dates of questionnaire packets and letters to each respondent were also recorded on the file along with the dates and final dispositions of the questionnaires returned. As each questionnaire was checked in, the cover sheet, containing the name and address of the respondent, was removed and the questionnaire underwent preliminary editing. If no problems were detected, the questionnaire was assigned a pack number and filed for coding. (Coding was done by packs of five questionnaires at a time.) The questionnaire cover pages for respondents who indicated that they wished to receive a copy of the final results of the study were kept separately.

Activities Following the Mailing

Concurrent with the survey activities, editors and coders were trained and a Coding Manual was prepared. The initial coding and keypunching of the questionnaires began shortly after the second questionnaire was mailed. At the outset, a number of open-ended questions were identified as requiring input from the NSF for coding and/or final summarization. Sample responses to these items, from the first 75 questionnaires returned, were sent to the NSF for recommendations. These items were identified in the Manual as items to be

coded during a second round of coding. The remaining open-ended items, including the "Other, Specify" items, underwent code construction shortly after data reduction began. As new codes were constructed, the record for each affected case was updated. A large number of open-ended items required special attention.

Twenty percent of the questionnaires coded by each coder were check-coded before they were keypunched. Coders who displayed difficulties as a result of this check were retrained. All of the questionnaires coded prior to this retraining were checked for errors and recoded when necessary. Following check coding, each pack of questionnaires was sent to keypunching for data entry. ISR uses a batch system of data entry. Each batch of data (50 to 100 questionnaires) was entered onto a data file and cleaned. Checks were made continuously for errors in logic and invalid codes. After the corrections were made, each item was studied as it appeared in tabular format. Errors detected at this point resulted in further corrections. Following each set of corrections, a new check was performed to ensure that no new errors had been introduced as a result of the cleaning procedures. Once the data were clean, they were merged onto the master data file to be used for data analyses.

Survey Results

By any definition the SEED survey was a success, particularly in view of the problems inherent in mail surveys. Only five of the 635 scientists (less than 1%) in the sample were not located, and only 18 (less than 3%) refused to participate in the survey. In addition, 60 respondents never returned their questionnaire, 68 were not eligible for the study, and 14 were unavailable for the survey because they were deceased, infirm, disabled or out of the country.

By the fourth week after the mailing of the first questionnaire, 40 percent of the respondents had returned their responses; by the sixth, the return rate increased to 65 percent; and, by the end of the ninth week, 85

percent. An examination of return dates indicate that the second and third questionnaire mailings each increased the return rate by 25 percentage points from 40 to 65 and, ultimately, to 90 percent by the end of the study. Table 3.2 shows the detailed final disposition of the SEED sample.

Finally, using various denominators, we look at the response rates for the entire sample, as well as those for the SEED and the COMPARISON groups, separately. Of the 630 scientists in the final sample, 68 were ineligible for the survey and 453 returned a completed questionnaire. Therefore, the most conservative estimate of the overall response rate is

$$\frac{\text{Completed Questionnaires}}{\text{Sample N minus Ineligibles}} = \frac{453}{630-68} = .806$$

An additional fourteen respondents were unavailable to the survey for reasons such as death (eight), disability (one), or absence from the country (five). This adjustment increases the response rate slightly

$$\frac{453}{630-68-14} = \frac{453}{548} = .827$$

Furthermore, for 17 respondents who returned their questionnaires, the information was not usable, for reasons such as answering the questions for the wrong country, or containing information already covered by another questionnaire. With this final adjustment, the response rate was:

$$\frac{453}{630-68-14-17} = \frac{453}{531} = .853$$

Regardless of which method of computation is used, both the respondent location rate (99%) and the response rate for the survey are exceptionally high, given the standards and expectations in mail surveys, which could produce response rates as low as 15 to 20 percent.

TABLE 3.2. FINAL DISPOSITION OF THE SAMPLE

Code	Definition	Number	Percent
	Address Found, No Questionnaire Returned	(60)	(9.4)
1	-Address confirmed by postcard	3	0.5
14	-Address confirmed by reminder phone call	4	0.6
16	-Reminder telephone call placed	6	0.9
17	-Second reminder telephone call placed	30	4.7
2	-Address changed by Respondent	1	0.2
12	-Address changed from tracing	1	0.2
15	-Address changed from telephone reminder call	12	2.0
34	-Address changed to foreign address from institution	2	0.3
42	-Address changed to foreign address from tracing	1	0.2
	Unable to Locate	(5)	(0.8)
13	-Unable to locate	5	0.8
	Questionnaire Completed	(453)	(71.3)
21	-Questionnaire completed by Respondent; no change in address	399	62.8
31	-Questionnaire completed by Respondent; address changed	48	7.6
41	-Questionnaire completed by Respondent's Co-Principal Investigator	6	0.9
	Refusal	(18)	(2.8)
77	-Refusal	18	2.8
	Unavailable for the Survey	(14)	(2.2)
87	-Infirm, disabled, too ill to complete questionnaire	1	0.2
97	-Unavailable for the duration of the study	5	0.8
99	-Deceased	8	1.3
	Ineligible	(68)	(10.7)
89	-Never participated; Co-Principal Investigator contacted	2	0.2
90	-Never participated; no other person available	6	0.9
92	-In transit; no foreign contact	13	2.0
93	-Research conducted in the US	5	0.8
94	-Funds converted to other uses	8	1.3
95	-Award was never used	13	2.0
98	-Respondent never received award that NSF reported	21	3.3

TABLE 3.2. (Continued)

Code	Definition	Number	Percent
	Response For Wrong Country or Other	(17)	(2.7)
88	-Project covered by other Principal Investigator's questionnaire	1	0.2
91	-Respondent responded for another country included in a later INT study	4	0.6
96	-Respondent responded for another country not included in a later INT study	12	1.9

SEED response was higher than COMPARISON response, the former being 89.2 percent (157 of the 176 eligibles responding), and the latter, 83.4 percent (296 of 355 eligibles responding). The ineligibility rate was also somewhat higher for the COMPARISON group. Detailed tables showing the known characteristics of the nonrespondents in the SEED and COMPARISON samples are presented in Appendix A. These indicate no systematic bias caused by nonrespondents.

4. PROFILE OF PARTICIPANTS

In this section we review selected background characteristics of both the SEED and the COMPARISON groups. Both are predominantly comprised of males in academic positions, with doctoral degrees (Table 4.1). In terms of their areas of specialization, slightly over one-third of those in both groups are involved in life sciences; however, one-fourth of the SEED group are in fields of engineering, while one-fourth of the COMPARISON group specialized in earth sciences.

There are several ways of approximating professional experience. Chronologic age is one approximation of experience; it has been found to be related to publication productivity, which is one of the measures of output in this study.[1] Although age and professional experience are highly correlated, the use of chronologic age alone may result in differential disadvantages for scientists who, for one reason or another, were not continuously involved in scientific work or who started their careers at a somewhat older age. Hence, we use both the chronologic age at the inception of the research activity and the number of years since the highest academic degree was awarded (professional age) as proxies for experience.

SEED participants appear to be relatively older than are the scientists in the COMPARISON group; on the average, the difference is approximately five years. About one-half of the SEED members are over 45 years of age, while only one-third of the COMPARISON group are 45 years of age or older, and

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[1] Some studies show a continuous decline in publication productivity after achievement peaks around the late 30s. Others report the peak at a later age, in the 40s, followed by a 10 to 15 year sag with a comeback in the 50's. For a review of these relationships, see Scientific Productivity, Frank M. Andrews (editor)Cambridge University Press, New York, 1979.

nearly one-fourth are under 35 years of age. However, differences in the mean and median professional age of the two groups are minimal (approximately one year) (Figure 4.1).

Another indicator that approximates professional experience and competence is the rank or the title of the scientists. In the survey, the respondents were asked both their current rank/title and their rank/title at the inception of the scientific activity. It is apparent that at both times the SEED scientists, in general, held higher ranks than did the COMPARISON scientists, although the gap narrowed somewhat by the time of the survey (Figure 4.2). For instance, six of ten SEED scientists were already full professors at the time of the award, as compared to four of ten COMPARISON group members. At the time of the survey 75 percent of SEED and 60 percent of COMPARISON group scientists were full professors.

Declines in the proportions of assistant or associate professors demonstrate an upward mobility in terms of professional status for both groups in the interim period. However, SEED scientists may have been (and possibly still are) less "publish-or-perish" competitive since a larger proportion of SEED, as opposed to COMPARISON, scientists were already at the highest rung of the academic ladder at the time of the activity. This observation is corroborated by the fact that SEED scientists tend more toward teaching and administration at home institutions than do COMPARISON scientists; moreover, they spend a larger proportion of their time in these, rather than research, activities (Table 4.1.). In fact, 54 percent of SEED, as compared to only 30 percent of COMPARISON scientists, devote 50 percent or more of their time to teaching and administration; conversely, 50 percent of COMPARISON, as compared to only 31 percent of SEED scientists, spend 50 percent or more of their time in research activities (data not shown).

TABLE 4.1. BACKGROUND CHARACTERISTICS OF RESPONDENTS IN THE SEED AND COMPARISON GROUPS

CHARACTERISTIC	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
Total	100.0	100.0	157	293
Male	98.1	90.8	154	266
Female	1.9	8.2	3	24
Unknown	0.0	1.0	0	3
Age at Inception of Activity (Q. 66)	100.0	100.0	157	293
Under 35	7.6	24.6	12	72
35-39	22.9	24.6	36	72
40-44	20.4	17.1	32	50
45-49	18.5	11.3	29	33
50-54	10.8	8.9	17	26
55-59	12.7	5.1	20	15
60 and over	7.0	5.5	11	16
Unknown	0.0	3.1	0	9
Time Since Highest Degree Awarded (Q. 57) (Professional Age)	100.0	100.0	157	293
Less than 10 years	10.2	17.1	16	50
10-14 years	22.3	26.6	35	78
15-19 years	28.7	22.5	45	66
20-29 years	28.7	22.2	45	65
30 or more years	10.2	10.2	16	30
Unknown	0.0	1.4	0	4
Highest Degree Awarded (Q. 55)	100.0	100.0	157	293
Doctorate degree[a]	96.8	98.3	152	288
Master's degree	3.2	0.7	5	2
Bachelor's degree	0.0	0.7	0	2
Unknown	0.0	0.3	0	1
Field of Specialization (Q. 52)	100.0	100.0	157	293
Life Sciences	35.0	35.8	55	105
Social Sciences	15.3	19.1	24	56
Engineering	28.0	2.7	44	8
Earth Sciences	7.0	25.6	11	75
Chemistry & Physics	8.9	10.6	14	31
Math-Computer Science, Other	5.1	5.8	8	17
Unknown	0.6	0.3	1	1

[a]Includes two M.D.'s, one Ed.D., eleven Dr. Sci., and five other doctorates in addition to 421 Ph.D.'s

TABLE 4.1 (Continued)

CHARACTERISTIC	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
Rank/Title at the Inception of Activity (Q. 68)	100.0	100.0	157	293
Professor	59.9	42.3	94	124
Associate Professor	25.5	20.8	40	61
Assistant Professor	9.6	15.7	15	46
Research Associate	0.6	6.8	1	20
Graduate Student	0.0	4.4	0	13
Other	4.5	8.5	7	25
Unknown	0.0	1.4	0	4
Current Rank/Title (Q. 53)	100.0	100.0	157	293
Professor (including emeritus)	75.2	60.1	118	176
Associate Professor	15.3	19.5	24	57
Assistant Professor	3.2	2.7	5	8
Other	6.4	15.7	10	46
Unknown	0.0	2.0	0	6
Previous International Experience Within the Five Years Prior to Activity (Q. 70)				
Trips to scientific meetings abroad	77.0	76.7	114	221
Post-doctoral research abroad	24.0	38.6	30	96
Collaborative research abroad	54.7	56.4	76	149
Teaching-lecturing abroad	64.6	55.5	95	147
Visits to foreign institutions	73.0	73.9	108	201
Trips abroad to gather data/specimens	49.6	79.5	62	210
Host to foreign scientists	78.7	74.8	111	196
Other	14.9	9.0	22	26
No visit abroad	8.4	2.4	13	7
Average Percent of Time Spent Currently on Activities (Q. 54)	100.0	100.0	157	286
Research Management	9.1	11.1	n.a.	n.a.
Research	33.7	44.4	n.a.	n.a.
Teaching	38.2	29.0	n.a.	n.a.
Administration	17.1	13.6	n.a.	n.a.
Other	1.9	2.1	n.a.	n.a.

TABLE 4.1 (Continued)

CHARACTERISTIC	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
Quality of the Institutional Affiliation at Time of Award (Q. 67)[b]	100.0	100.0	157	293
Leading Institution	12.1	31.7	19	93
Research Instituion	17.2	17.1	27	50
Other	70.7	51.2	111	150

[b]See Appendix A, Table 5 for a definition of categories.

Another indicator considered was the quality of the scientist's institutional affiliation at the time of the award. Institutions were rated according to the Roose-Anderson rating and the Carnegie classification. A "leading institution" is defined as an institution frequently rated high in science and engineering by the Roose-Anderson rating. A "research institution" is defined as one of 50 leading universities (in terms of federal financial support of science as provided by the Carnegie classification) not already listed as a "leading institution." The "all others" group consists of those universities not included in the two aforementioned categories, as well as all nonuniversity facilities. Based upon this scheme of classification, a substantially larger proportion of COMPARISON, as compared to SEED, scientists were affiliated with "leading institutions" at the inception of the activity. The proportions of those affiliated with "research institutions" are similar for both groups. However, proportionately more SEED scientists were affiliated with neither of the two categories of institutions (Table 4.1).

The previous international activities of the scientists were also considered. Slightly over eight percent of the SEED, and 2.4 percent of the

FIGURE 4.1

PROFESSIONAL AND CHRONOLOGICAL AGE
AS MEASURES OF PROFESSIONAL EXPERIENCE BY GROUP

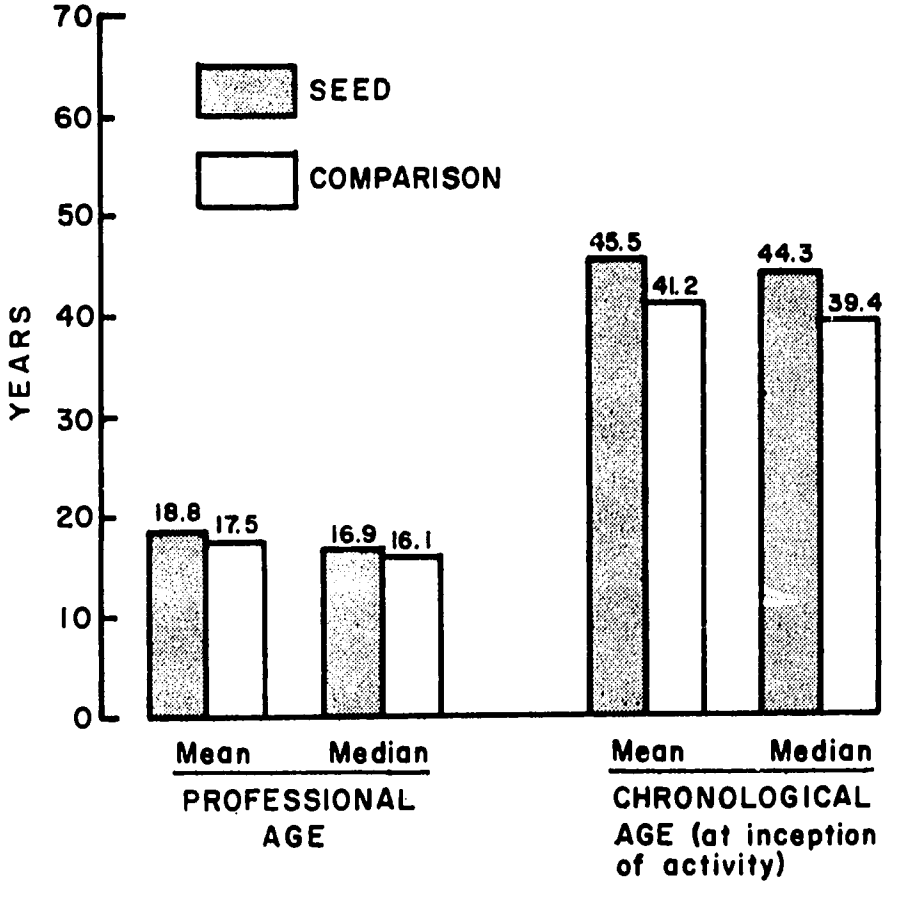
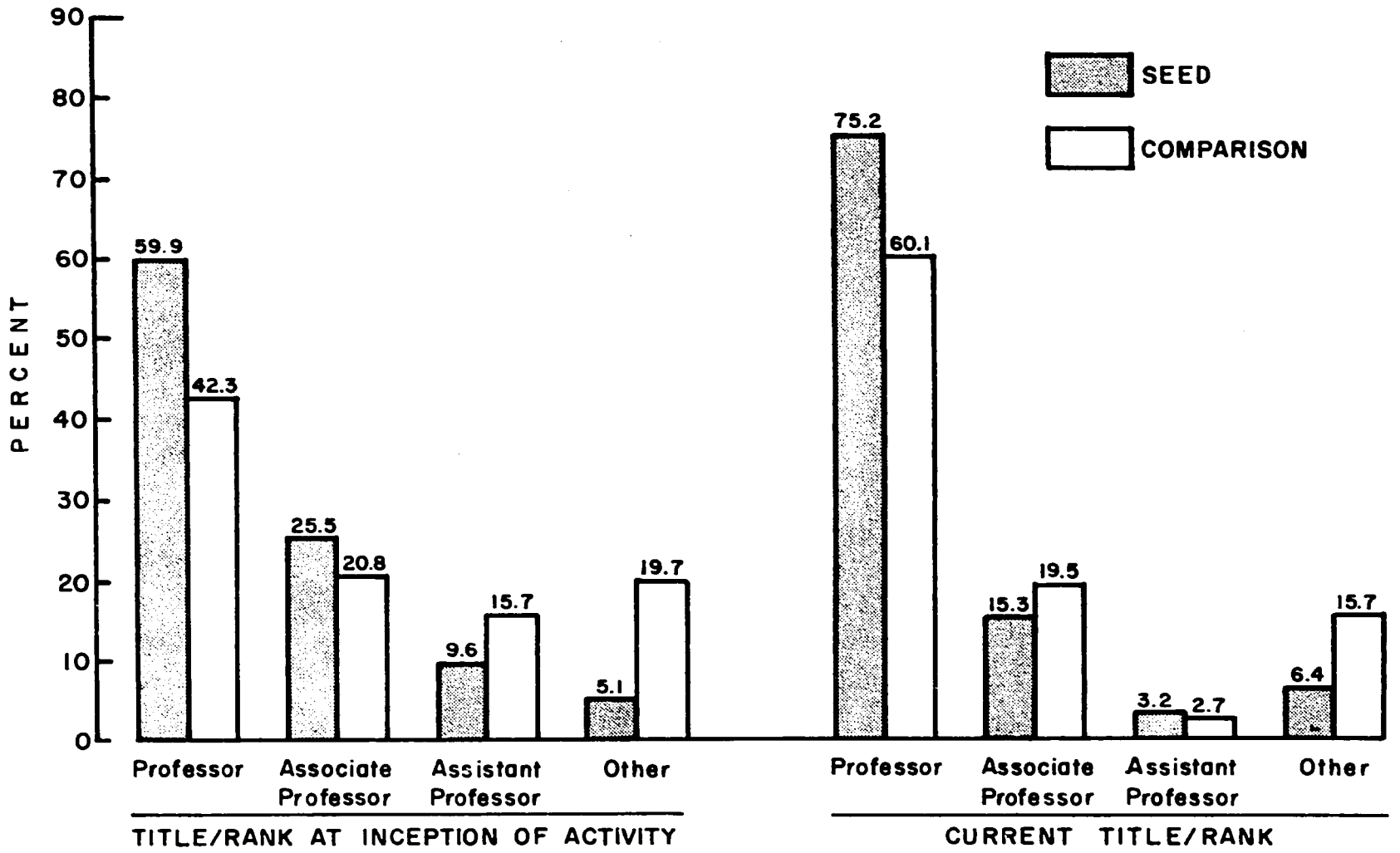


FIGURE 4.2

TITLE OR RANK AT THE INCEPTION OF THE ACTIVITY AND CURRENTLY BY GROUP



COMPARISON, group had not participated in any international scientific activity abroad during the five years prior to the activity. With respect to those who had participated, the COMPARISON group tended to have had more international experience related to their own research than did the SEED group. The latter's experience included more frequent involvement in teaching or lecturing abroad. For example, 80 percent of the COMPARISON group had made trips abroad to gather data or specimens, and 39 percent participated in postdoctoral research abroad; the corresponding figures for SEED scientists are 50 percent and 24 percent, respectively. There is a significant difference in the proportions of scientists from the two groups who have traveled abroad for data- or specimen-collection purposes. Although not statistically significant, the differential experience of the scientists in the two groups, with respect to postdoctoral research abroad, is also indicative of the general differences in the previous international experience of the SEED and COMPARISON scientists. Once again, a larger proportion of SEED members seem to have had experience in teaching or lecturing abroad.

The background characteristics reviewed here indicate that there are some marked differences in background items such as age, rank, field of specialization, and use of work time at home institutions. While these differences may not wholly account for the variations in the productivity of the two groups of scientists, their contribution should not be entirely discounted.

5. OBJECTIVES AND NATURE OF ACTIVITY

Objectives

In evaluating the effectiveness of a program, the objectives for participating must be taken into consideration. Respondents in the study were asked to select the objectives that they considered to be important in undertaking the activity. The questionnaire listed twelve frequently mentioned objectives for international activities, and asked respondents to check the items that they considered to be significant. Roughly one-half of the items listed almost exclusively referred to professional objectives related to the US scientist. The remaining items were more germane to the interests of the foreign institution and participants in the international activity. Respondents were also given the opportunity to "write in" other objectives.

The proportions of respondents who checked a given objective are shown in Table 5.1. The most frequently mentioned objective among the SEED members was "to disseminate knowledge to a foreign science community through teaching or lecturing" (cited by nearly 75%); in contrast, only one-third of the COMPARISON group members mentioned this objective. The most frequently mentioned objective by COMPARISON scientists was "to collect data/specimens essential to my own research" (83%).

These results indicate a clear polarization of objectives. SEED members more frequently cited objectives related to the interests of the foreign component of the activity, while the COMPARISON group felt that their own research objectives were more important. For instance, 60 percent of the SEED scientists cited "improving the relevance of the scientific research in a foreign country to its economic or social goals" as one of their objectives,

TABLE 5.1. OBJECTIVES FOR PARTICIPATING IN ACTIVITY: NUMBER-AND PERCENTAGE-CHECKING EACH OBJECTIVE BY GROUP

ITEM NO. (Q. 1)	OBJECTIVES	PERCENT		NUMBER	
		SEED	COMPARISON	SEED	COMPARISON
1.	To stimulate my research in new or different directions	56.7	68.6	89	201
2.	To acquire information from foreign scientists on current research	33.8	41.3	53	121
3.	To advance my research through collaboration or close cooperation with a foreign research team	43.9	42.7	69	125
4.	To advance my research through access and use of foreign research facilities	22.3	40.6	35	119
5.	To collect data/specimens essential to my research	36.3	82.9	57	243
6.	To improve my institution's contacts with foreign students and faculty and/or improve my institution's programs that involve foreign nationals	61.1	24.6	96	72
7.	To disseminate knowledge to a foreign science community through teaching or lecturing	74.5	34.8	117	102
8.	To improve the curriculum or courses offered by a foreign science institution	57.3	6.1	90	18
9.	To plan, establish or strengthen relationships between U.S. and foreign scientific institutions	72.6	45.7	114	134
10.	To improve the relevance of the scientific research in a foreign country to its economic or social goals	61.1	21.2	96	62
11.	To plan future collaborative research with foreign scientists	56.7	46.8	89	137
12.	To improve the research capabilities of a foreign science institution	61.1	25.6	96	75
13.	Other objective	3.2	2.4	5	7

as compared to 21 percent of the COMPARISON group. Similarly, 57 percent of the SEED, but only six percent of the COMPARISON, group cited "improving the curriculum or courses offered by a foreign science institution" as one of their objectives. On the other hand, more than two-thirds of the COMPARISON, as opposed to one-half of the SEED, participants cited "to stimulate my own research in new directions," and twice as many COMPARISON as SEED scientists wanted to "advance own research through access and use of foreign research facilities." Moreover, 61 percent of SEED participants chose "to improve the research capabilities of a foreign science institution," in contrast to only 26 percent of the COMPARISON group participants.

Finally, SEED grantees reported a larger number of objectives than did COMPARISON scientists; the mean number of objectives is 6.3 and 4.7 for SEED and COMPARISON groups, respectively.

In a follow-up question, the respondents were asked to select the three objectives that they considered to be their three most important objectives. Items 7, 9, and 12 (see Table 5.1) were rated as the most, second most, and third most important objectives, respectively, by the SEED members. The most important objective chosen by the COMPARISON group was item 5. Objective 1 was chosen as both the second and third most important objectives. Table 5.2 shows the item numbers of the objectives that received the highest, second highest, and third highest scores as the most, second most, and third most important objectives, by each group.

As can be seen, the SEED group consistently rated objectives related to the foreign component of the scientific activity as most important to them; the highest score was given to "disseminating knowledge to a foreign science community through teaching or lecturing" as the most important objective of the SEED scientists. The objectives of "planning, establishing or strengthening relationships between US and foreign scientific institutions"

and "improving the relevance of the scientific research in a foreign country to its economic or social goals" were also very frequently cited as most important goals by SEED scientists.

TABLE 5.2. DISTRIBUTION OF OBJECTIVES (ITEM NUMBERS SHOWN) BY SCORE AND IMPORTANCE-RATING ACCORDING TO PARTICIPANT GROUP

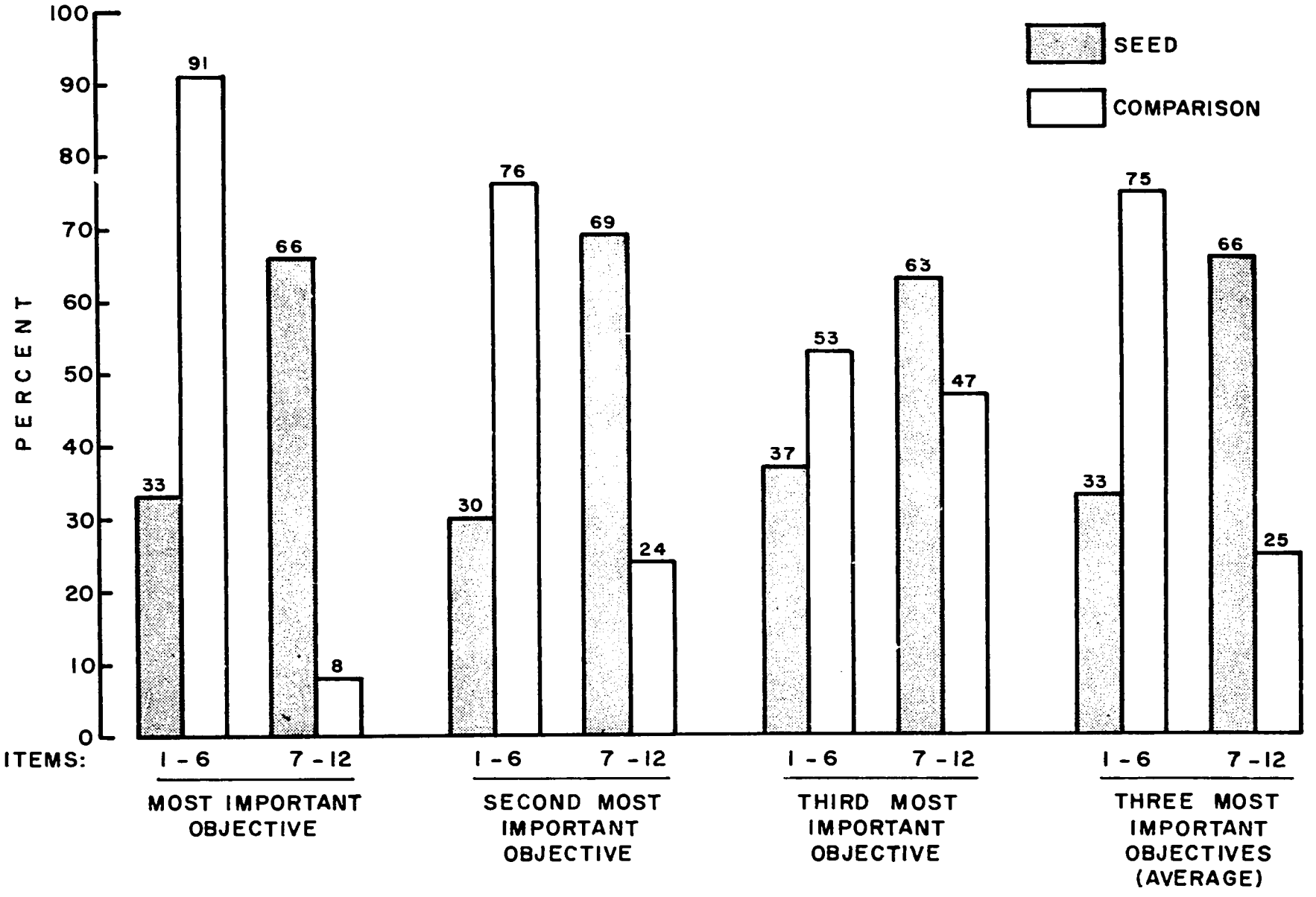
Rating	Score					
	Highest		Second Highest		Third Highest	
	S	C	S	C	S	C
Most Important	7	5	10	1	9	2
Second Most Important	9	1	7	4	8	3
Third Most Important	12	1	9	9	10	3/11

The selections (most important objectives) of the COMPARISON group are dominated by "own-interest" items. The objective most frequently cited (highest score) as the most important by COMPARISON group scientists was "collection of data and/or specimens essential to own research." Item 1, "To stimulate own research in new or different directions," was also frequently mentioned and received the second highest score as the "most important" objective, as well as the highest scores as second and third most important objectives, of the COMPARISON scientists.

It is evident, therefore, that each group of scientists commenced its activities with entirely different goals and priorities in mind.

The polarization of respondents with respect to the main objective for taking part in the activity can also be observed in Figure 5.1, in which the

FIGURE 5.1
MOST IMPORTANT OBJECTIVES OF THE AWARD BY GROUP



objectives have been grouped according to whether they relate to own research goals (items 1-6), or to the scientific interests of the foreign component (items 7-12). It is difficult to totally split the list of objectives into two nonoverlapping groups, since a few items could relate to both. In general, however, this split again illustrates the priorities of the two groups of scientists. While the SEED scientists overwhelmingly cited objectives related to the foreign component, the COMPARISON group's main interests were in their own research.

Scope of Activity

If the objectives for participating in these scientific activities are so widely different, we would expect the nature and scope of the activity to be different as well. Selected descriptive indicators of the nature and scope of the activity demonstrated by SEED and COMPARISON group respondents are shown in Table 5.3. As anticipated, the nature of the activity and the allocation of time to specific tasks vary widely between the two groups. For instance, nearly one-half (45%) of the SEED members were involved in teaching one or more courses, as compared to only ten percent of COMPARISON members. Similarly, almost nine in ten SEED, but four in ten COMPARISON, members were engaged in activities geared to improving the research and/or teaching capabilities of a foreign science institution. Both SEED (69%) and COMPARISON (51%) groups were involved in collaborative research; however, 82 percent of the COMPARISON, as opposed to 59 percent of the SEED, group members said that the research activity was a continuation of research conducted at home (in the US).

It appears that similar proportions in both groups participated in a formal scientific meeting or symposium. However, this was largely unanticipated by SEED members (56%), while it was the primary reason for their visit abroad for 50 percent of the COMPARISON members who attended a meeting

TABLE 5.3. DESCRIPTIVE INDICATORS OF THE NATURE AND SCOPE OF THE INTERNATIONAL SCIENTIFIC ACTIVITY ENGAGED IN BY SEED AND COMPARISON GROUP MEMBERS

		PERCENT		NUMBER	
		SEED	COMPARISON	SEED	COMPARISON
Collaborative or cooperative research (Q.21):					
	Yes	68.8	51.0	108	148
	No	31.2	49.0	49	142
Research a continuation of work conducted in US (Q. 28):					
	Yes	58.9	82.2	63	120
	No	41.1	17.8	44	26
Participate in formal, scientific meeting or symposium during activity (Q. 33):					
	Yes	39.4	42.8	61	125
	No	60.6	57.2	94	167
The role meeting played in visit (Q. 36):					
	Primary reason	8.5	49.6	5	60
	One of several planned activities	28.8	26.4	17	32
	Unanticipated	55.9	11.6	33	14
	Other	6.8	12.4	4	15
Teach a course during activity (Q. 40):					
	Yes	45.2	9.9	70	28
	No	54.8	90.1	85	255
Engage in activities to improve research or teaching capabilities of foreign institution (Q. 44):					
	Yes	88.8	39.9	135	103
	No	11.2	60.1	17	155
Steps to link research/teaching capability improvements to social-economic goals of the (foreign) country (Q. 47):					
	Yes	84.0	45.7	110	42
	No	16.0	54.3	21	50

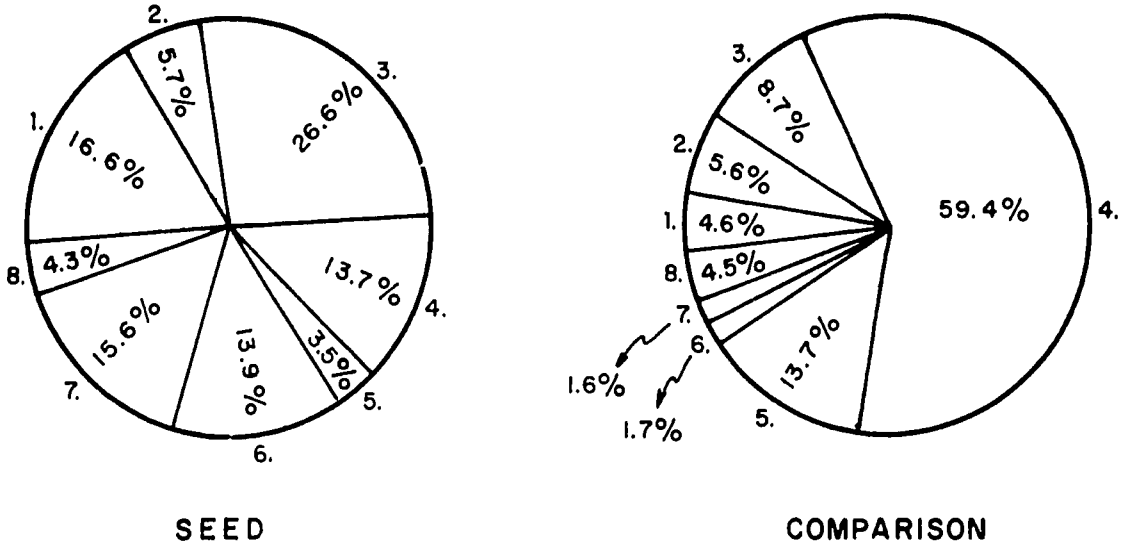
TABLE 5.3. (Continued)

	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
Average proportion of time allocated to	100.0	100.0		
- Collaborative or cooperative research on a new project	16.6	4.6	n.a.	n.a.
- Continuation of work on longer term collaborative or cooperative research	5.7	5.6	n.a.	n.a.
- Lecturing-discussing research	26.6	8.7	n.a.	n.a.
- Field work; gathering data/specimens	13.7	59.4	n.a.	n.a.
- Participation in scientific meeting/symposium	3.5	13.7	n.a.	n.a.
- Teaching courses	13.9	1.7	n.a.	n.a.
- Assisting foreign institution in research or curriculum development	15.6	1.6	n.a.	n.a.
- Other activities	4.3	4.5	n.a.	n.a.

or symposium. Eighty-four percent of the SEED group was involved in efforts to link host scientific capabilities to the socioeconomic goals of the country, while only 46 percent of the COMPARISON group was involved in such an effort. It is not surprising, therefore, that the COMPARISON group spent 59 percent of its time in field work, gathering data or specimens. The SEED group, on the other hand, spent 25 percent and 14 percent of its time, on the average, lecturing and discussing research, and teaching courses, respectively (Figure 5.2.); in contrast, the COMPARISON group spent nine percent and two percent in lecturing/discussing research and teaching, respectively. In other words, while more than one-third of the time SEED scientists spent abroad was devoted to teaching and lecturing, COMPARISON scientists spent only one-tenth

FIGURE 5.2

PROPORTION OF TIME ALLOCATED TO SPECIFIC ACTIVITIES BY GROUP



1. Collaborative or cooperative research on a new project

2. Continuation of work on longer term collaborative or cooperative research

3. Lecturing, discussing research

4. Fieldwork, gathering data, specimens

5. Participation in scientific meeting, symposium

6. Teaching courses

7. Assisting foreign institution in research or curriculum development

8. Other activities

of the time in the same activities. Moreover, the average amount of time spent teaching a course was nearly twice as long for the SEED group (15 weeks) as for the COMPARISON group (nine weeks).[1]

The output of a program cannot be assessed independently of its duration. Overall, the international scientific activity in which the COMPARISON group members participated lasted longer than that in which the SEED scientists were involved. More specifically, although a smaller group of SEED members' activities were of less than one-month's duration, the difference in the mean number of days is rather small (18 and 15 days for SEED and COMPARISON, respectively). On the other hand, COMPARISON group scientists engaged twice as frequently in activities of longer than one-year's duration (Table 5.4). The median lengths of activity for projects that lasted one or more months were 9.9 months and 23.1 months,[2] respectively, for SEED and COMPARISON groups. Nearly 25 percent of COMPARISON, as compared to 3.5 percent of SEED, scientists were involved in activities that lasted three years or longer.

Hence, it appears that COMPARISON scientists were engaged in longer term projects. There may be several explanations for the duration of the activity, on the average, appearing shorter for SEED scientists. For instance, under the SEED program, the entire activity was undertaken abroad continuously; the grant covered solely international activities. On the other hand, the awards received by the COMPARISON scientists covered international segments of larger

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[1]These durations are based upon the lengths of the first two courses mentioned. Only seven respondents in the two groups indicated teaching more than two courses (data not shown).

[2]In a highly skewed distribution, in which a few cases with extremely low or high values can distort the mean, the median is usually a more stable measure.

TABLE 5.4. DURATION OF THE ACTIVITY ENGAGED IN BY SEED AND COMPARISON GROUP MEMBERS

	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
Duration of Activity:				
Less than one month	29.6	38.6	42	96
One month or more	70.4	61.4	100	153
Less than 12 months	50.7	22.9	72	57
12 to 35 months	16.2	16.1	23	40
36 months or more	3.5	22.5	5	56

projects. Since the survey questionnaire made reference to the "entire activity up to and including" the current award, it is likely that the COMPARISON scientists reported discontinuous international visits as part of one activity. Although the time spent abroad by the two groups might be comparable, the duration of the activities could be rather dissimilar.

The most significant differences between the two groups lies in the activities undertaken, and the stated objectives. SEED activity is primarily geared to collaborative work, with a view to increasing the capabilities of scientific and technical institutions in developing countries. The COMPARISON group seems to be more intent upon pursuing their own research interests, and the activities undertaken center around this main goal. Hence, despite the fact that both groups are composed of scientists with approximately similar backgrounds, there are distinct differences in their purposes and consequently in the scope of their activities.

The effectiveness of our activity can also be a function of its environment, that is, in this case, the dependency of the participants upon the resources of the foreign institutions, and the adequacy of these

resources. The scientists surveyed were asked a series of questions regarding the utilization of such resources and their adequacy. In addition, they were asked to indicate problems that were encountered.

Overall, it appears that the SEED group was more dependent upon, and made more use of, the resources of the (host) foreign institution than was the COMPARISON group (Table 5.5). Both groups rated the adequacy of the resources rather similarly, the mean scores being clustered around the midpoint of the scale. One noticeable finding, however, was the uniqueness[3] of the equipment or the laboratory facilities used at the foreign institution during the visit by the COMPARISON group scientists. Although a slightly larger proportion of the SEED members utilized laboratory facilities and equipment, COMPARISON group scientists not only rated the adequacy of these resources as above average (3.40 vs 2.96), but also a substantially larger proportion (47.5%) indicated that these resources were unique.

This could possibly be due to the fact that a larger proportion of the scientists in the COMPARISON group were engaged in projects related to earth sciences (e.g., astronomy, geology, etc.), mostly in Latin America, and were possibly utilizing US funded research centers or US equipment shared by the foreign institutions. Typical examples of this kind of activity (more prevalent among the COMPARISON group members) would be astronomical research utilizing special equipment (telescopes) in one of the observatories that the US maintains in Latin America, or geographical research, including oceanography and seismology at US funded installations. See Appendix D for the institutions visited by SEED and COMPARISON group scientists.

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[3]By "unique" was meant that a similar resource was not available in the US. This definition was included in the text of the questionnaire.

TABLE 5.5. UTILIZATION OF RESOURCES AT HOST INSTITUTION AND THE ADEQUACY OF THESE RESOURCES

	Laboratory Facilities and Equipment	Computer	Library	Office and Conference Space	Clerical and Technical Services
Proportion who used during visit:					
SEED	70.0	22.5	83.2	94.1	87.0
COMPARISON	61.6	23.2	56.4	62.9	57.9
Mean adequacy rating on a five-point scale:					
SEED	2.96	3.00	2.62	3.37	3.05
COMPARISON	3.40	2.96	2.89	3.24	3.13
Proportion who indicated the resources were unique[a]:					
SEED	13.8	0.0	23.8	5.9	6.3
COMPARISON	47.5	0.0	26.0	1.8	6.0

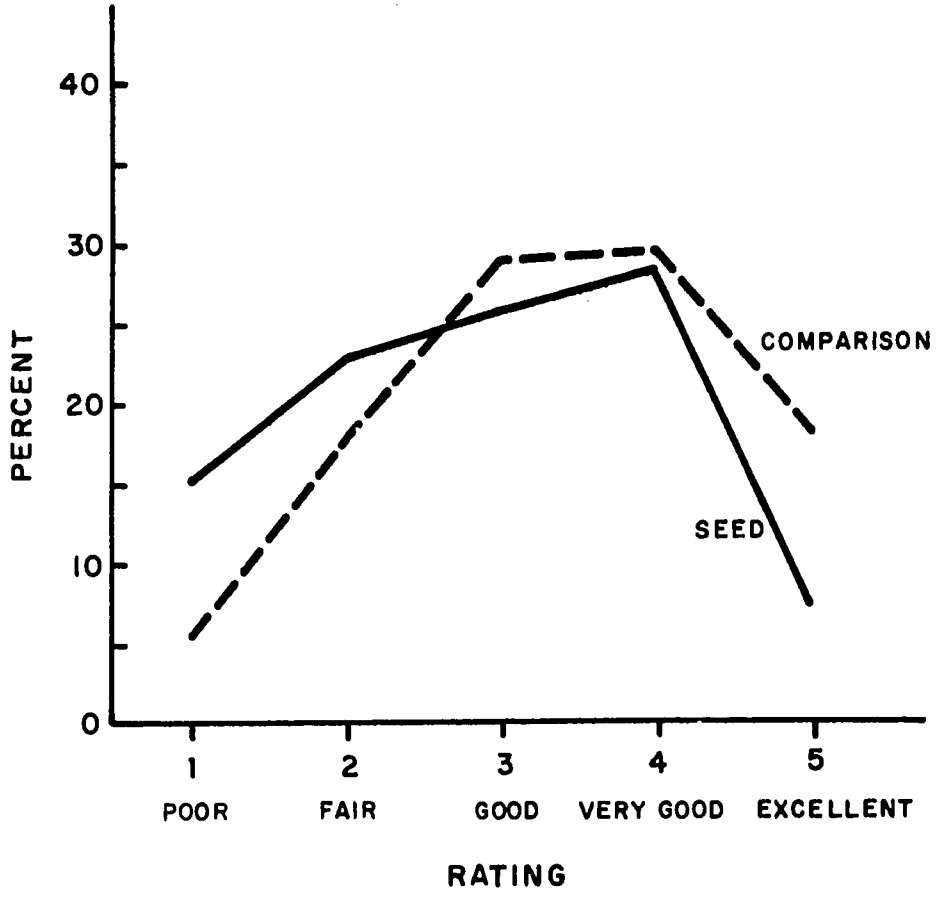
[a]By unique is meant that a similar resource was not easily accessible to the scientist in the US.

When the respondents were asked to rate the scientific quality of the work done in the group with which they interacted as compared to US research in the same area, the COMPARISON group assigned a mean rating above average (3.39) on a scale of one to five (poor to excellent), whereas the SEED scientists assigned a below average rating (2.91). The ratings of both groups are shown in Figure 5.3.

With respect to the quality of scientific work done by the foreign group, one of the factors that should be considered when comparing the two groups, is the location of the foreign component and the level of economic development

FIGURE 5.3

SCIENTIFIC QUALITY OF WORK DONE IN THE PROGRAM OR GROUP AS COMPARED WITH U.S. RESEARCH IN AREA



attained. In general, it can be expected that the higher the level of economic development, the higher the quality of the scientific work; therefore, the program would be influenced by the location at which it was implemented. Table 5.6 shows the regional distribution of SEED and COMPARISON scientist activity.

TABLE 5.6. REGIONAL DISTRIBUTION OF SEED AND COMPARISON SCIENTISTS

LOCATION OF ACTIVITY	SEED	COMPARISON
Africa	17.2	8.5
Asia	40.1	15.0
Latin America	42.7	76.5
TOTAL	100.0	100.0

More than three-fourths of the scientists in the COMPARISON group carried out their projects in Latin American countries, while more than one-half of the SEED group were engaged in activities in Asian or African countries. This result is meant only to be suggestive, to be checked by further analysis of region versus quality of lost scientific work.

Finally, the problems encountered by the US scientists were examined. The respondents were asked to check, from a list of common problems, those which they had encountered. They could also specify problems not included on the list. The list of problems and the percentages indicating each are shown in Table 5.7.

About one-third of the COMPARISON group (32.3%), twice the proportion of the SEED group (15.9%), indicated that they encountered no problems. The most

frequently mentioned problem by both groups was the relatively lower quality of the scientific resources in the host institution, as compared to those in the US. This was a far more common problem for the SEED group (50.3%) than for the COMPARISON group (27.1%). Furthermore, 41 percent of the SEED, but only 21 percent of the COMPARISON, scientists indicated that the lower quality of scientific work in the program or group in which they interacted was a problem.

Although the mean number of problems encountered by the two groups was not drastically different (SEED, 2.76; COMPARISON 1.87), Table 5.7 indicates that SEED scientists, in general, encountered more diverse problems during the activity than did the COMPARISON scientists.

The three most important problems, ranked as such by the respondents, perhaps indicative of the activities in which the groups engaged. The low quality of both scientific work and resources was mentioned by both groups. SEED members, however, also indicated the inadequate cooperation and assistance of the foreign government agency to be an important problem. Scientists in the COMPARISON group mentioned the difficulties in obtaining licenses or approval of specimens and equipment.

TABLE 5.7. PROBLEMS ENCOUNTERED IN PARTICIPATING IN INTERNATIONAL SCIENTIFIC ACTIVITY: NUMBER-AND PERCENTAGE-CHECKING EACH PROBLEM BY GROUP

PROBLEMS ENCOUNTERED DURING ACTIVITY	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
Inadequate living arrangements for a longer term stay abroad	20.4	10.4	32	30
Inefficient travel and hotel arrangements for trips	13.4	12.2	21	35
Quality of scientific work lower than in the US	40.8	20.8	64	60
Inadequate access to foreign colleagues for exchange of information/ideas	14.4	10.4	22	30
Incompatibilities between my research interests and those of foreign colleagues	8.3	10.4	13	30
Quality of scientific resources, such as materials, computers, instruments, or other research facilities, lower than in the US	50.3	27.1	79	78
Inadequate access to research facilities	15.9	5.9	25	17
Inadequate cooperation/equipment/funds for my collaborators/hosts from the responsible foreign government agency	29.3	14.2	46	41
Inadequate access to field sites	13.4	11.8	21	34
Difficulties in obtaining import/export licenses or customs approval for specimens, equipment, etc.	23.6	21.5	37	62
Inadequate time to accomplish objectives	28.7	17.7	45	51
Poor planning: too much travel to allow for adequate information exchange	2.5	2.8	4	8
Burdensome administrative requirements placed on the project by the responsible foreign government agency	14.0	17.0	22	49
No problems	15.9	32.3	25	93

6. OUTCOMES

Evaluation of performance, that is, measuring and accounting for the effectiveness and the productivity of international scientific work, is the raison d'etre for this study. Different types of measures can be constructed based upon different sources of information and various aspects of performance. The construction of a performance measure in this study proceeds from the assumption that performance is a multidimensional concept.

Furthermore, it is important to include both quantitative information about performance, such as counts of various types of outputs, and also more qualitative information, such as ratings of various results by the individuals in the program. The two types of assessments provide different information about performance. For instance, some participants in the program may be productive with respect to accomplishing the goals of the program but may not be prolific producers of journal articles, for example, a standard measure of scientific performance. Conversely, written products may be copious, but the goals of the program may not be met.

With these considerations in mind, we first look at two types of outcome indicators: subjective/qualitative information and quantitative/objective measures. Later, the two types of assessments are combined to yield a composite measure of productivity. The subjective measurements consisted of three items: important positive results of the activity, important negative results of the activity, and a rating of overall productivity. The quantitative measurements were taken on three kinds of outputs: the number of written products, the number of prototypes or other products, and the number of professional contacts established or maintained as a result of the program activity.

Subjective Measures of Outcome

The respondents in the survey who indicated that the scientific activity in which they participated had any positive and/or negative results were given a list of twelve positive and nine negative results from which to choose. They were also given the opportunity to specify results not included in the lists and asked to rate the three most important positive and negative results. The positive results consisted of six results exclusively related to the individual's own, or their institution's, interests (items 1-6), five items related exclusively to the interests of the foreign component of the activity (items 7-10 and 12), and one item (item 11) related to both domestic and foreign interests. Hereafter, these are referred to as US results and foreign results.

Positive Results

Almost all the scientists in both groups - 97.5 percent of those in SEED and 99.3 percent of those in COMPARISON - indicated that the scientific activity in which they had participated had a positive outcome. Percentages indicating each of the outcomes on the list as an important positive result of their activity are shown in Table 6.1. An overwhelming majority (87.4%) of the COMPARISON members, nearly twice the SEED number (47.1%), indicated that advancement of their (own) research, resulting in publications, papers, presentations at meetings, and so forth, was an important positive outcome of their activity. One of the primary objectives of COMPARISON scientists was to advance their own research; this result indicates their success to a large extent. In addition, slightly over one-half of the scientists in both groups considered their professional advancement and the number of contacts with foreign scientists important outcomes of their international activity.

TABLE 6.1. POSITIVE RESULTS OF SCIENTIFIC ACTIVITY: NUMBER-AND PERCENTAGE-CHECKING EACH RESULT BY GROUP

POSITIVE RESULTS	PERCENT[a]		NUMBER[a]	
	SEED	COMPARISON	SEED	COMPARISON
1. Shifted my research emphasis to more productive research problems and/or to a more fruitful research area	20.4	26.3	32	77
2. Advanced my research, resulting in publications, presentations at meetings, etc.	47.1	87.4	74	256
3. Increased the volume and output of work in which I collaborated with foreign researchers	31.8	25.6	50	75
4. Contributed to my professional advancement in that it enriched my teaching and/or increased the extent to which I am sought out by colleagues	54.1	52.2	85	153
5. Improved my institution's capability to attract and educate foreign students as well as more general capability improvements	42.0	17.7	66	52
6. Increased the number of foreign scientists with whom I exchange information thus increasing the range of research about which I am knowledgeable	55.4	55.6	87	163
7. Improved the research capability of a foreign science institution, as well as more general capability improvements	51.6	30.0	81	88
8. Improved the curriculum/courses of a foreign science institution	54.1	7.8	85	23
9. Successful completion, by science students at a foreign institution, of one or several of my courses	28.0	7.8	44	23

TABLE 6.1. (Continued)

POSITIVE RESULTS	PERCENT[a]		NUMBER[a]	
	SEED	COMPARISON	SEED	COMPARISON
10. Contributed to the professional advancement of one or several foreign researchers	49.7	28.0	78	82
11. Established or advanced an institutional relationship between a US and foreign science institution	49.0	31.7	77	93
12. Increased the relevance of the scientific research in a foreign country to the country's social or economic goals	47.8	18.4	75	54
13. Other positive result	2.5	7.5	4	22

[a]N = 157 for SEED; N = 293 for COMPARISON

What is more noticeable and interesting, however, is the bipolar distribution of the positive results cited. While SEED scientists considered foreign results as important outcomes of their activity, COMPARISON members were more concerned with US results exclusively related to their own research, professional advancement, or improvements in their institution's capability. For instance, nearly twice as many SEED (51.6%) as COMPARISON scientists (30.0%) mentioned the improvement of the research capability of a foreign science institution. Similarly, 54 percent of SEED, but only eight percent of COMPARISON, scientists considered improvement of the curriculum of a foreign science institution as an important positive result. Almost three times as many SEED as COMPARISON scientists (47.8% vs 18.4%, respectively) mentioned as an important positive outcome an increase in the relevance of the scientific research in the foreign country to the country's social or economic goals.

In addition to the bipolarization of the positive results, it is interesting to note that, in general, SEED grantees seem to have had a more diverse range of results. That is, more results were cited for a larger proportion of the SEED grantees than were for the COMPARISON scientists. For instance, nine results were indicated by more than 40 percent of the SEED sample, in contrast to three results by the COMPARISON group.

On the other hand there are some similarities between the two groups in terms of the positive results of the activity. About one-half of the respondents in each group indicated that the activity had contributed to their professional advancement and had increased the number of foreign scientists with whom they exchanged information.

The bipolarization of the outcomes, as measured by the positive results mentioned, becomes more apparent when we look at the importance attached to the results. Respondents were asked to indicate the three most important results. Improvement of foreign research capability was the most frequently mentioned outcome among the top three cited by SEED scientists. In contrast, this outcome was not among the three most important cited by the COMPARISON group; instead, the most frequently mentioned outcome among the top three was advancement of their own research, resulting in publications or other written products. US and foreign results were separated, and the percentages of each group considering them as important outcomes are listed in Table 6.2.

Hence, it is clear that COMPARISON scientists were much more concerned with US results than were SEED members. This, however, is not surprising, since the programs have different objectives. Such results illustrate that both groups were working and getting results along the guidelines provided by program objectives.

TABLE 6.2. IMPORTANT OUTCOMES, SEPARATED INTO US AND FOREIGN RESULTS, CITED BY SEED AND COMPARISON GROUPS

POSITIVE RESULTS	SEED	COMPARISON
US (Items 1-6, 11)	45.9%[a]	75.7%
Foreign (Items 7-12)	51.4%	20.3%

[a]The totals may not equal 100.0 because the "other results" category is not included.

Finally, some comparisons can be made between stated objectives and reported results in order to ascertain to what extent "important objectives" for each of the two groups were met. Keeping in mind that there is no simple one-to-one correspondence between the lists of objectives and results, this relationship can be examined in two ways. First, a comparison can be made between the proportions of scientists who cited certain objectives and corresponding results (i.e., comparing the figures in Table 5.1 with those in Table 6.1). The second method is a refined version of the first. We determined for those who indicated a particular objective how many scientists also stated a corresponding positive result. These proportions are shown in Table 6.3 and are listed separately for SEED and COMPARISON scientists.

More than one-half of the SEED scientists indicated that "to improve the curriculum of courses offered by a foreign science institution" was an important objective; of these scientists, approximately 86 percent indicated that this was a positive result of their activity. Similarly, approximately six of ten SEED scientists cited "improving the relevance of the scientific research in a foreign country to its economic or social goals" and "improving the research capabilities of a foreign science institution" among their most important objectives. It appears that about 60 percent of these scientists realized their expectations.

TABLE 6.3. PERCENT OF SCIENTISTS WHO REPORTED A RESULT CORRESPONDING TO A STATED OBJECTIVE[a]

SEED			
Objectives (Q.1)	Percent Indicating Objective in Col. 1	Results (Q.4)	Percent Indicating Result of Those Who Indicated Objective
(1)	(2)	(3)	(4)
# 7. To disseminate knowledge to a foreign science community through teaching or lecturing	73.2	# 9. Successful completion by science students at a foreign institution, of one or several of my courses	35.7
		#10. Contributed to the professional advancement of one or several foreign researchers	53.0
		# 9. and #10. (Combined)	67.9
# 8. To improve the curriculum or courses offered by a foreign science institution	57.3	# 8. Improved the curriculum or courses of a foreign science institution	85.6
# 9. To plan, establish, or strengthen relationships between US and foreign scientific institutions	72.6	#11. Established or advanced an institutional relationship between a US and foreign science institution	54.4
#10. To improve the relevance of the scientific research in a foreign country to its economic or social goals	61.1	#12. Increased the relevance of the scientific research in a foreign country to the country's social or economic goals	62.5
#12. To improve the research capabilities of a foreign science institution	61.1	# 7. Improved the research capability of a foreign science institution, as well as more general capability improvements	60.4

TABLE 6.3. (continued)

COMPARISON			
(1)	(2)	(3)	(4)
# 1. To stimulate my research in new or different directions	63.3	# 1. Shifted my research emphasis to more productive research problems and/or to a more fruitful research area	36.5
		# 2. Advanced my research resulting in publications, presentations at meetings, etc.	90.5
		# 1. and # 2. (Combined)	92.0
# 2. To acquire information from foreign scientists on current research	41.3	# 6. Increased the number of foreign scientists with whom I exchange information, thus increasing the range of research about which I am knowledgeable	71.1
		# 3. Increased the volume and output of work in which I collaborated with foreign researchers	29.8
		# 6. and # 3. (Combined)	74.4
# 3. To advance my research through collaboration or close cooperation with a foreign research team	42.7	# 2. (See above)	84.0
# 4. To advance my research through access and use of foreign research facilities	40.3	# 2. (See above)	93.2
		# 3. (See above)	28.8
		# 2. and # 3. (Combined)	95.8
# 5. To collect data/specimens essential to my research	80.9	# 2. (See above)	94.9
		# 3. (See above)	23.2
		# 2. and # 3. (Combined)	95.8

[a]The percent figures in column 2 show the percent of scientists who indicated the specific objective stated in column 1. The percent figures in column 4 show the percent of the scientists among those in column 2 who also indicated the result in column 3. Therefore: N = universe = 157 for SEED, and 293 for COMPARISON; column 2 = (n in column 2) / N; and column 4 = (n in column 4) / (n in column 2).

Similarly, 63 percent of the COMPARISON scientists aimed to stimulate their research, and it seems that a great majority of them met their expectations. For the COMPARISON group, the one-to-one correspondence of objectives and results is not as obvious as in the case of SEED scientists; however, their expectations about data and specimen collection, information acquisition, and advancement of own research seem to have been met.

In fact, despite the lack of strict correspondence between the objectives and positive results as they were listed in the questionnaire, data indicate that, not unexpectedly, the results are along the lines of stated objectives for taking part in the activity. A large proportion in each group seem to have realized their expectations.

Negative Results

Relatively smaller proportions of the scientists, namely 38.5 percent of the SEED and 16.4 percent of the COMPARISON group, indicated that the scientific activity had important negative results. The fact that twice as large a percentage of SEED, in contrast to COMPARISON, scientists indicated negative results may be due to the fact that the activities of SEED scientists depend more upon the performance and resources of the foreign component (see pp. 38-40). Moreover, since SEED program objectives were directed toward the improvement of foreign science resources, it is more likely that there might be some negative effects on the more "standard" interests of US scientists (i.e., research, publication, promotion). The distribution of negative results, presented in Table 6.4, strongly implies that most negative outcomes were related to the domestic professional interests of the US scientists (items 1-6) as opposed to the foreign component of the activity. In addition, SEED scientists seem to have been affected more than COMPARISON scientists. Nearly one-half of SEED scientists who mentioned any negative result indicated

TABLE 6.4. NEGATIVE RESULTS OF SCIENTIFIC ACTIVITY: NUMBER-AND PERCENTAGE-CHECKING EACH RESULT BY GROUP

NEGATIVE RESULTS	PERCENT[a]		NUMBER[a]	
	SEED	COMPARISON	SEED	COMPARISON
1. Loss of time at home set me back in my research	45.0	23.4	27	11
2. My publication rate was diminished	23.3	14.9	14	7
3. Activity abroad did not contribute to possibility of promotion at home	31.7	14.9	19	7
4. Activity abroad contributed to loss of contacts with American colleagues	21.7	8.5	13	4
5. My absence was disruptive to my department and institution	20.0	25.5	12	12
6. My absence was disruptive to the training of my graduate students	31.7	34.0	19	16
7. My requirements for resources and/or staff complicated the research projects of my foreign colleagues and led to their diminished productivity	6.7	12.8	4	6
8. The relevance of the research in a foreign country to its economic or social goals was diminished	0.0	2.1	0	1
9. The scientific resources of a foreign country decreased because one or several scientists migrated to US	3.3	2.1	2	1
10. Other negative result[b]	35.0	38.3	21	18

[a]N = 60 for SEED; N = 47 for COMPARISON

[b]"Other negative result" is comprised of the following:
"Led to aggravated personal and family problems"; SEED = 0, COMPARISON = 7
"Problems were caused by politics of the host country"; SEED = 5, COMPARISON = 3
"Objective of the visit was not achieved"; SEED = 2, COMPARISON = 1
"Noncodeable other"; SEED = 14, COMPARISON = 7
(Although 35.0% and 38.3% may seem high, it should be remembered that they represent only 13.4% and 6.1% of the two groups overall, respectively.)

that the time spent abroad set them back in their own research, as compared to approximately one-fourth of non-SEED scientists. Conversely, disruption to the home institution was more frequent for scientists in the COMPARISON group. SEED scientists were more likely to be negatively affected on an individual basis. More SEED than COMPARISON scientists said that their publication rate was diminished, that the activity did not contribute to the possibility of promotion, and that they lost some contacts with US colleagues. In both groups, negative outcomes affecting the foreign institution were sparse. The percent in each group indicating personal, domestic institutional, or foreign negative results is shown in Figure 6.1.

Finally, the following were the three most important negative results for SEED scientists:

- Loss of time at home, which set the scientist back in his/her research
- Absence disruptive to training of graduate students
- Activity abroad did not contribute to the possibility of promotion at home

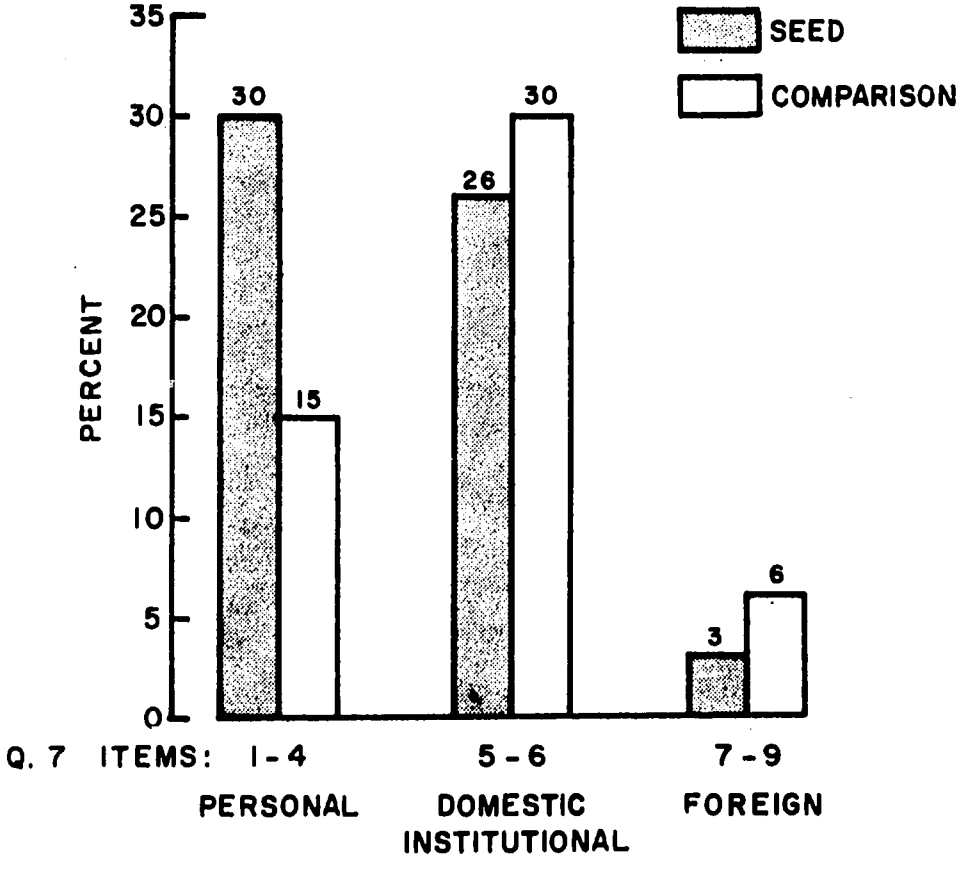
The COMPARISON scientists also indicated that "disruptiveness to training graduate students" and "loss of time in research at home" were important negative results. In addition, for proportionately more COMPARISON than SEED, scientists their "absence was disruptive to the department and institution."

Overall Rating

The last subjective measure of performance is an overall rating of the productivity of the activity. Slightly over 25 percent of SEED and slightly more than 40 percent of the COMPARISON scientists rated the overall productivity of the activity as excellent. In fact, the mean rating for both

FIGURE 6.1

NEGATIVE RESULTS: PERCENT INDICATING EACH GROUP



groups was approximately "very good," 3.9 by SEED and 4.2 by COMPARISON members (Table 6.5 and Figure 6.2). It should be kept in mind, however, that a definition of overall productivity was not provided to respondents, and therefore we cannot say what factors were used to make this assessment.

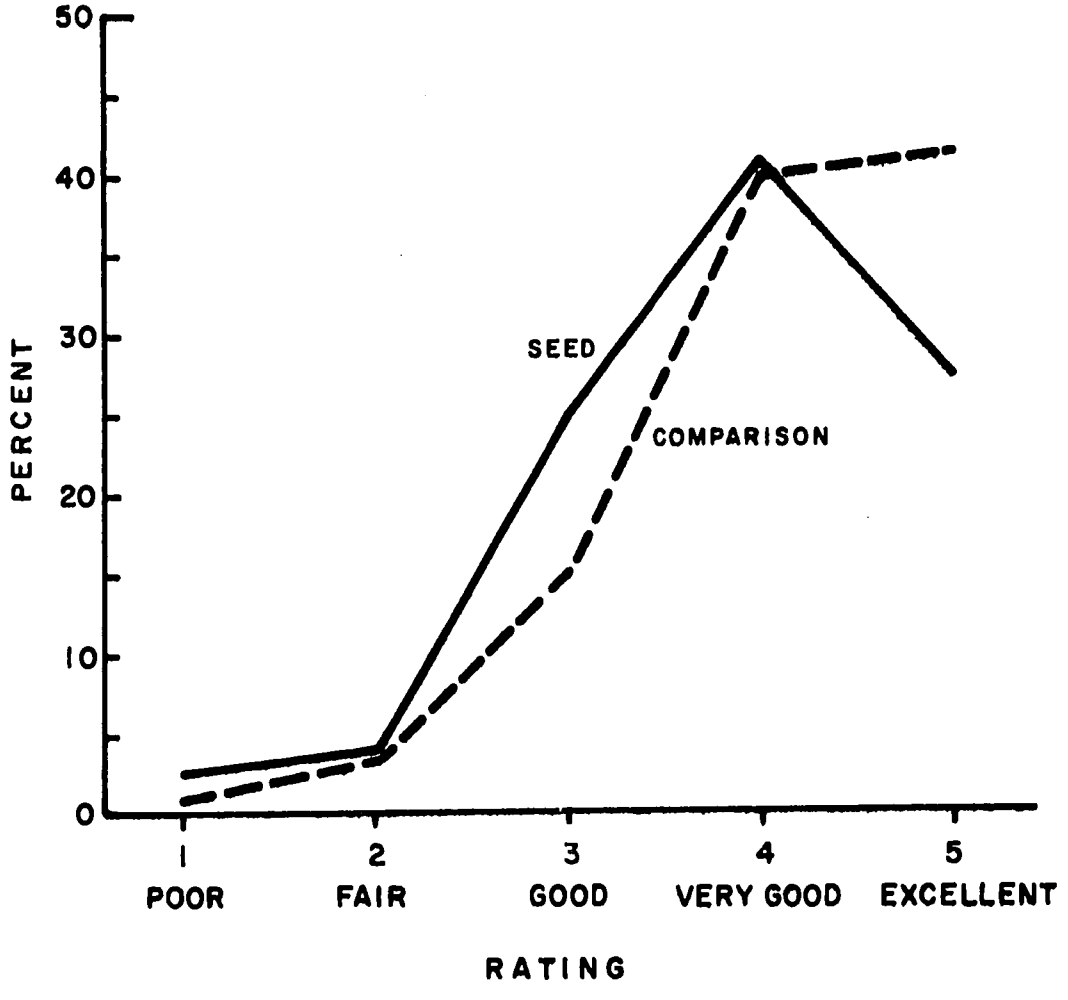
TABLE 6.5. OPINION OF THE PARTICIPANTS ON THE OVERALL PRODUCTIVITY OF THE SCIENTIFIC ACTIVITY

	PERCENT		NUMBER	
SCALE	SEED	COMPARISON	SEED	COMPARISON
1. Poor	2.6	0.7	4	2
2. Fair	3.9	3.5	6	10
3. Good	24.8	15.1	38	43
4. Very Good	41.2	39.3	63	112
5. Excellent	27.5	41.4	42	118
Total	100.0	100.0	153	285

Objective Measures of Outcome

We now turn to quantitative assessment. One of the major goals of international programs is to promote and maintain scientist-to-scientist links around the world. Through scientific information exchange and collaborative projects, researchers can stimulate and support each other and share resources, facilities, and costs. Therefore, the establishment of professional contacts is an important outcome of any international scientific activity.

FIGURE 6.2
OPINION OF OVERALL PRODUCTIVITY



Contacts

An overwhelming majority of the scientists - 92.4 percent of the SEED and 81.2 percent of the COMPARISON group - established contact with new colleagues during their activity, and nearly nine in ten scientists in both groups continued their professional contact with these new colleagues (Table 6.6). In addition, 88 percent of SEED and 73 percent of COMPARISON scientists continued their contact with their principal host or collaborator in the activity. The results indicate that both SEED and COMPARISON scientists heavily rely on correspondence to maintain their contact with both old and new colleagues. While COMPARISON scientists seem to visit more often (or get visited by) their colleagues in this activity, SEED scientists rely more upon institutional relationships to maintain contact with both the new colleagues and the principal host or collaborator in the activity.

Hence, it appears that SEED scientists are somewhat more successful in establishing new links and in maintaining these contacts. One of the major goals of the SEED program is establishing and strengthening relationships between foreign and US institutions; these results indicate that this program objective is being met in many cases.

Written Products and Prototypes

The other quantitative output measures we have used for assessing performance are (1) the number of written products represented by published journal articles, books, and/or chapters in books, dissertations or theses, reports, and papers presented at scientific meetings, and (2) the number of prototypes and other products such as instruments, apparatus, experimental materials (fibers, glass, plants, alloys), computer programs, and audiovisual materials. The number and percentage of SEED and COMPARISON scientists,

TABLE 6.6 INDICATORS OF INTERNATIONAL RELATIONSHIP BUILDING BY SCIENTISTS IN SEED AND COMPARISON GROUPS

INDICATORS	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
Establish contact with new colleagues?				
Yes	92.4	81.2	145	238
No	7.6	18.8	12	55
Maintained professional contact with new colleagues?				
Yes	86.9	87.0	126	207
No	13.1	13.0	19	31
Means of maintaining contact with new colleagues:				
Professional correspondence	93.7	92.7	118	191
Visits	29.4	34.5	37	71
Cooperative or collaborative research	29.4	28.6	37	59
Institutional relationship	27.8	15.0	35	31
Student exchange	3.2	1.5	4	3
Professional meetings	3.2	8.3	4	17
Other means	6.3	2.9	8	6
Maintained contact with principal host or collaborator?				
Yes	87.8	72.8	137	201
No	12.2	27.2	19	75
Means of maintaining contact with principal host or collaborator:				
Professional correspondence	95.6	89.1	131	179
Visits	35.0	49.3	48	99
Cooperative or collaborative research	30.7	35.8	42	72
Institutional relationship	27.7	19.9	38	40
Student exchange	5.1	2.5	7	5
Professional meetings	5.8	2.5	8	5
Other means	5.1	4.0	7	4

whether they have produced any given type of product, and if so, the number of such products, are shown in Table 6.7.

Scientists in the COMPARISON group were more productive in terms of written output (Table 6.7, uppermost panel); in fact, with the exception of reports, a higher percentage of COMPARISON scientists are found in every category of written products. Overall, 71 percent of SEED and 88 percent of COMPARISON respondents indicated that their activity had resulted in one or more written products. Moreover, among those who estimated the volume of their written output, COMPARISON scientists seemed more prolific than those in the SEED program. In other words, not only a larger proportion of non-SEED scientists reported written products as a result of their activity, but also the mean (and median) number of such products was higher for the COMPARISON scientists. A higher percentage of COMPARISON scientists seems to have produced more journal articles, books and/or book chapters, and papers than did SEED participants.

On the other hand, almost twice as large a percentage of the SEED group indicated output other than written products (Table 6.7, last panel).

When considering these numbers, it is important to keep in mind that SEED participants were primarily in the "business" of assisting foreign institutions and strengthening relationships between foreign and US institutions, as reflected by objectives of the respondents; a very small proportion aimed to advance their own research. These differences in objectives and activities alone could account for the differences in the publication rate.

Equally important to keep in mind is that in this study the products were not reviewed for their scientific quality. It is not unreasonable to assume

TABLE 6.7. PRODUCTS RESULTING FROM ACTIVITY: NUMBER AND PERCENTAGE OF SCIENTISTS BY GROUP AND TYPE OF PRODUCT

PRODUCTS	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
			n=154[a]	n=288[b]
All Written Products (one or more of the following)	70.8	88.2	109	254
Journal articles	37.7	68.8	58	198
Books and/or book chapters	20.8	41.3	32	119
Dissertation/theses	16.2	20.8	25	60
Paper presented	33.1	44.8	51	129
Reports	20.1	17.8	31	50
Journal Articles	100.0	100.0		
None	62.3	31.3	96	90
In preparation	0.6	0.7	1	2
One or two	15.6	26.4	24	76
Three or four	7.1	9.4	11	27
Five or more	4.5	15.3	7	44
Number not ascertained[c]	9.7	17.0	15	49
Books and/or book chapters	100.0	100.0		
None	79.2	58.7	122	169
In preparation	0.0	1.0	0	3
One or two	9.7	18.8	15	54
Three or more	1.9	5.6	3	16
Number not ascertained	9.1	16.0	14	46
Dissertation/theses	100.0	100.0		
None	83.8	79.2	129	228
One or more	16.2	4.9	25	14
Number not ascertained	0.0	16.0	0	46
Papers presented	100.0	100.0		
None	66.9	55.2	103	159
One or two	16.9	16.0	26	46
Three or more	6.5	11.8	10	34
Number not ascertained	9.7	17.0	15	49

[a]Three SEED respondents did not answer this question.
[b]Five COMPARISON group respondents did not answer this question.
[c]Includes vague answers with respect to the number (many, several, etc.)

TABLE 6.7. (Continued)

PRODUCTS	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
Reports	100.0	100.0		
None	79.9	82.6	123	238
One or two	14.3	4.9	22	14
Three or more	1.3	3.5	2	10
Number not ascertained	4.5	9.0	7	26
All written products	100.0	100.0		
None	29.2	11.8	45	34
In preparation	1.9	2.8	3	8
One or two	30.5	27.1	47	78
Three or four	16.9	13.5	26	39
Five or more	10.4	27.4	16	79
Number not ascertained	11.0	17.4	17	50
Prototypes	100.0	100.0	157	293
None	73.9	84.6	116	248
One or two	24.2	12.6	38	37
Three or more	1.9	2.6	3	8

that some are of unequal scientific importance. Assigning "quality" credits to various kinds of output might yield different results.

One last measure we examined involved the extent of the teaching activities in which the scientists participated. Proportionately more SEED scientists (45%) were involved in teaching than were COMPARISON scientists (10%). Among those who indicated teaching, one-half of each group reported teaching only one course (Table 6.8). The average number of courses taught are virtually the same for both groups (SEED=1.6; COMPARISON=1.7). The enrollment figures, however, show a more distinct disparity. Over 50 percent of SEED scientists had a total of more than 30 students in their classes; the corresponding figure for COMPARISON scientists is only 36 percent. The mean number of students taught by the SEED and COMPARISON scientists was 36.4 and 28.1, respectively. The length of time spent teaching was also longer for

SEED; 60 percent of these scientists and 50 percent of the COMPARISON group spent more than eight weeks teaching a course. The mean duration was 23.0 SEED and 12.7 (COMPARISON) weeks for the two groups.

TABLE 6.8 TEACHING ACTIVITIES BY SCIENTISTS IN EACH GROUP

ACTIVITIES	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
Scientists who taught a course	45.2	9.9	70	28
Number of courses taught				
One	47.1	50.0	33	14
Two	47.1	39.3	33	11
Three or four	5.7	10.7	4	3
Number of students taught (total)[b]				
1-10	7.4	7.1	5	2
11-20	19.1	46.4	13	13
21-30	22.1	10.7	3	3
31-40	16.2	17.9	11	5
41-50	14.7	3.6	10	1
Over 50	20.6	14.3	14	4
Total number of weeks teaching[b]				
1- 8	39.4	48.1	26	13
9-16	13.6	25.9	9	7
17-24	7.6	11.1	5	3
15-32	18.2	11.1	12	3
Over 32	21.2	3.7	14	1

[a]The base excludes those who did not answer the question.
[b]Data available only for the first two courses mentioned.

Finally, because the objectives of the two groups vary, the individual measures of performance may not be indicative of "success". Hence, a composite measure incorporating and comparing both the subjective (qualitative) and the objective (quantitative) measurements may produce a different picture. In the next section we discuss the results using a

composite measure and explore individual and groups of factors related to these results.

Composite Measures of Outcome

In the previous sections we examined various outcome measures and concluded that, given the wide variety of purposes and activities involved, a single indicator would not be a good measure of relative productivity. Moreover, the concept of "productivity means publications" was not felt to be entirely justifiable in view of the broad dissimilarity of goals. Therefore, five indicators that measured a variety of aspects of productivity were chosen in order to construct a composite measure of outcome, one of which was the number of publications. These five were then standardized, averaged, and normalized to obtain a single scale of overall productivity.[1] The five indicators are as follows:

1. "Results for US" - This measure was constructed using selected sub-items of question 4 of the questionnaire. The question asked for the most important positive results generated by the activity. The options offered could be reasonably broken into positive results for US scientists and institutions and positive results for the foreign scientists and institutions. (This latter portion was used to form the second of the five indicators.) The sub-items of question 4 used on this measure were numbers 1, 2, 3, 4, 5, 6, and 11. A respondent's score is the sum of the total number of sub-items chosen (e.g., if only items 3 and 4 were checked, the respondent received a score of 2).

2. "Results for Foreign" - This measure, similar in purpose to the preceding one was obtained using sub-items 7, 8, 9, 10, 11, and 12 of

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[1]Grants to attend symposia were excluded from the respondent pool, since they were found only in the COMPARISON group, and it was necessary to make the two study groups comparable in terms of award purpose.

question 4. It provides an understanding of the positive results that were accrued by the foreign scientists or institutions from a particular award.

3. "Written Products" - This is the total number of written products by the respondent as a result of the activity. It includes publications as well as reports, dissertations, and papers presented in professional meetings. To reiterate, the measure makes no attempt at specifying the quality of the written product, only the quantity. The count was taken from question 9.

4. "Contact Maintained" - One of the purposes of the SEED awards was to establish and/or strengthen lines of communication between scientists. A measure of outcome which was felt to address this purpose was whether the scientist established and/or maintained contact with the host (principle collaborator) and/or with new scientists met during the activity. Questions 15 and 17 obtained this information. The measure is dichotomous and scored as 0 or 1. A "0" indicates that no contact was maintained; a "1" indicates that some contact was maintained.

5. "Self-Evaluated Productivity" - Question 11 asked the respondents to evaluate "the overall productivity of this international scientific activity." A five-point scale ranging from Poor (one) to Excellent (five) was used.

"Overall Productivity" - This measure is a composite of the preceding five indicators. First, the five measures of each respondent were standardized.[2] For each respondent, these five standard scores were then summed and divided by five, to obtain an average score. Respondents who did not respond to one or more of the five items were excluded from the composite score. Using the mean plus or minus (±) four standard deviation units as the

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[2]The standard or Z score for each case represents the deviation from the mean of that group in terms of standard deviation units. (See Runyan, R. P. & Haber, A. Fundamentals of Behavioral Statistics, 3rd edition. Reading, MA, Addison-Wesley Publishing Company, 1977, or any basic statistics book for a more thorough discussion of standard scores.)

extremes of the composite scale, the score for each respondent was transformed into a scale ranging from 0 to 100, with an expected population mean value of 50. At that time, (±) four standard deviation units were deemed to be adequate to contain all but the most extreme cases. In fact, as it turned out, no score on this scale was below 25 or above 75. It should be emphasized that while this overall measure is an attempt to summarize a variety of productivity indicators, it is by no means exhaustive, and it may not be accepted by all readers as representative. The population mean of Overall Productivity is 50.027 (S.D. = 7.028), with a median score of 50.116.

It was expected that the five indicators would tend to be correlated with one another. It was hoped that these correlations would not be very high, however. If the correlations were high, it would indicate that the measures involved were redundant, that is, the measures would represent the same dimensions of the overall productivity measure. It is preferable that the five measures be independent or not highly correlated, each measure thus indicating a different aspect of the overall productivity measure. In a similar vein, one would expect high correlations between the five measures and overall productivity, since overall productivity is composed of these measures. Table 6.9 shows that although all the correlations between the five measures are positive, with one exception, none is particularly high. The one exception is the correlation between "Results for US" and "Results for Foreign" in the COMPARISON group data (r=.46). Although this indicates some overlap in terms of the construction of the overall productivity measure it is not, in and of itself, enough to hamper the analysis seriously.

The correlations between the five measures and overall productivity are almost all relatively high and indicate the relative effect of each measure on the overall productivity measure. For both groups, the "Results for US" tend

TABLE 6.9. COEFFICIENTS OF CORRELATION (r) FOR THE INDIVIDUAL PRODUCTIVITY MEASURES AND OVERALL PRODUCTIVITY[a]

	Overall Productivity	Results for US	Results for Foreign	Written Products	Self-Evaluated Productivity	Contacts Maintained
Overall Productivity		0.74	0.67	0.51	0.73	0.42
Results for US	0.67		0.24[b]	0.31	0.32	0.18
Results for Foreign	0.59	0.46[b]		0.25	0.32	0.03
Written Products	0.59	0.18	0.13		0.26	0.12
Self-Evaluated Productivity	0.49	0.11	0.06	0.23		0.21
Contacts Maintained	0.59	0.33	0.21	0.02	0.12	

[a]The upper triangular matrix represents correlations based upon SEED data, while the lower is based upon COMPARISON data.
[b]Correlations of "Results for US" with "Results for Foreign " are calculated after removing item 11 of question 4, which is common to both measures and whose inclusion would produce higher, but spurious, correlations. The correlation coefficients including this item are r=0.35 (SEED) and r=0.60 (COMPARISON).

to show higher correlation with the overall measure, thus indicating that the value of the overall measure for each case is affected to a greater extent by this submeasure. The overall productivity for the SEED group is also affected by the "Self-Evaluated Productivity" measure.

The mean values (and standard deviations) of the individual productivity measures, as well as the mean "overall productivity" scores for SEED and COMPARISON scientists, are shown in Table 6.10. As the reader will note, the overall productivity scores of the two groups are very similar and near the expected mean, despite considerable differences in two of the five individual measures. While the SEED members score higher on "Results for Foreign," COMPARISON scientists have more than twice as many written products that resulted from the scientific activity funded by NSF. Although less significant in terms of the difference, COMPARISON group's "self-evaluated productivity" score is higher than that for the SEED, probably due to personal research benefits obtained. Nevertheless, the differential scores on the individual measures seem to cancel each other, yielding comparable "overall productivity" scores of 50.7 and 49.6 for SEED and COMPARISON samples, respectively. Once again, let us caution that the composite measure assumes that the indicators comprising the overall productivity score are of equal importance. If this assumption is not acceptable, it will be necessary to determine a set of weights to use in the combination process. There are various possible methods for determining appropriate weights that would be feasible, and theoretically reasonable. For instance, a simple ordinal scheme, based upon the judgments of an independent panel of experts of the relative importance of the measures making up the composite score, could be used to examine the differential productivity of the two groups.

TABLE 6.10. INDIVIDUAL AND COMPOSITE PRODUCTIVITY MEASURES BY GROUP

MEASURE	STUDY GROUP	
	SEED	COMPARISON
Overall Productivity[a]		
Mean	50.7	49.6
Standard Deviation	6.52	7.35
N	130	181
Results for US[b]		
Mean	2.9	3.0
Standard Deviation	1.71	1.56
N	157	253
Results for Foreign[c]		
Mean	2.8	1.3
Standard Deviation	1.46	1.46
N	157	253
Written Products[d]		
Mean	2.3	5.9
Standard Deviation	3.40	8.88
N	134	193
Contact Maintained[e]		
Mean	0.9	0.8
Standard Deviation	0.26	0.37
N	157	244
Self-Evaluated Productivity[f]		
Mean	3.9	4.2
Standard Deviation	0.96	0.85
N	153	245

NOTES:
[a]Possible range: 0-100
[b]Possible range: 0-7
[c]Possible range: 0-6
[d]Possible range: 0-∞ ; maximum observed value, 19 for SEED and 72 for COMPARISON
[e]Possible range: 0-1
[f]Possible range: 1-5

As was discussed previously, award characteristics and/or characteristics of grantees may be responsible for variations in the outcomes of scientific activity. Key award/grantee characteristics have been cross-tabulated by the five individual indicators and the "overall productivity" measure (Table 6.11.). In the following sections, we first examine the award characteristics of the SEED and COMPARISON members vis-a-vis the productivity measures, and then compare the two groups on the same characteristics with respect to their productivity. Finally, we present the results of a multivariate analysis performed in an attempt to explain the variation in the measure of overall productivity.

Award Characteristics -- SEED Group. Examination of Table 6.11 indicates that SEED members who received travel awards, as opposed to research/teaching awards, were slightly less productive overall and particularly less productive both in terms of positive results for foreign institutions and scientists, and also with respect to the number of written products. That SEED travel awards are usually of much shorter duration than research/teaching awards should be taken into consideration. The breakdown by predominant type of activity abroad shows that, scientists who conducted research abroad tended to benefit foreign scientists and institutions relatively less than did those who taught abroad. Conversely, the benefits for US scientists and institutions were less for teaching activities than for research activities abroad. Also, fewer written products result from teaching activities. Similar results are shown in the table under the heading of "Dominant Activity in U.S." Benefits for foreign institutions were higher for those scientists whose US work is predominatly teaching rather than research.

Age at inception of the funded activity was expected to influence productivity. The overall productivity measure shows a decline in ages 50 to

TABLE 6.11. MEAN VALUE OF PRODUCTIVITY MEASURES FOR DIFFERENT AWARD CHARACTERISTICS BY GROUP

AWARD CHARACTERISTICS	OVERALL PRODUCTIVITY		RESULTS FOR U.S.		RESULTS FOR FOREIGN		WRITTEN PRODUCTS		CONTACT MAINTAINED		SELF-EVALUATED PRODUCTIVITY	
	SEED	COMP.	SEED	COMP.	SEED	COMP.	SEED	COMP.	SEED	COMP.	SEED	COMP.
TYPE OF AWARD												
Research-Teaching Award	51.6	50.5	2.9	3.2	3.2	1.4	2.9	6.8	0.9	0.9	3.9	4.2
Travel Award	49.7	47.1	3.0	2.6	2.3	0.9	1.6	3.7	0.9	0.8	3.9	4.3
REGION OF COUNTRY INVOLVED												
Latin America	51.4	49.7	3.3	3.0	2.8	1.4	2.1	5.9	0.9	0.8	3.8	4.3
East Asia	51.2	49.3[a]	3.0	3.0	2.8	1.3	2.5	4.4	1.0	0.8	3.9	4.1
Africa	48.8	49.1	3.1	3.1	2.5	1.0	1.3	6.2	0.9	0.8	3.5	4.3
DOMINANT ACTIVITY ABROAD												
Research	50.7	49.6	3.1	3.0	2.4	1.2	2.5	6.0	0.9	0.8	3.9	4.2
Teaching[a]	49.0	49.4	2.0	2.0	3.2	3.0	1.9	0.0	0.9	1.0	3.7	4.0
Mixed (Research and Teaching)[a]	52.3	43.3	3.1	2.0	3.5	1.0	2.2	2.0	1.0	0.5	3.8	4.0
TYPE OF FOREIGN INSTITUTION INVOLVED												
Government Agency	52.5	51.9	3.1	3.6	2.7	1.8	4.3	7.1	1.0	0.9	4.0	4.2
University	51.8	51.1	3.2	3.5	3.2	2.0	2.4	6.6	0.9	0.9	3.9	4.2
Other[b]	52.1	49.4	3.2	3.1	2.5	1.3	2.7	7.1	1.0	0.9	4.2	4.4
FIELD OF SCIENCE												
Life Sciences	52.7	50.9	3.6	3.1	2.9	1.4	2.9	7.6	0.9	0.9	4.2	4.3
Social Sciences	51.2	51.4	3.4	3.5	2.4	1.5	2.4	6.0	1.0	0.8	3.9	4.4
Engineering[a]	48.1	39.5	2.1	4.0	2.6	3.5	1.3	5.5	0.9	0.5	3.7	4.0
Mathematics and Computer Sciences[a,b]	52.1	48.7	2.6	4.0	3.9	1.0	1.3	2.0	1.0	1.0	3.9	3.5
Chemistry and Physics[b]	48.2	47.3	2.5	3.0	2.9	1.3	0.9	3.3	0.8	0.8	3.1	4.2
Earth Sciences[b]	49.2	48.5	2.8	2.7	2.6	1.0	2.3	5.0	0.8	0.8	3.6	4.2

[a]Less than 15 cases in COMPARISON
[b]Less than 15 cases in SEED

TABLE 6.11. (Continued)

AWARD CHARACTERISTICS	OVERALL PRODUCTIVITY		RESULTS FOR U.S.		RESULTS FOR FOREIGN		WRITTEN PRODUCTS		CONTACT MAINTAINED		SELF-EVALUATED PRODUCTIVITY	
	SEED	COMP.	SEED	COMP.	SEED	COMP.	SEED	COMP.	SEED	COMP.	SEED	COMP.
TITLE AT INCEPTION OF ACTIVITY												
Professor	51.3	49.8	3.1	3.0	2.8	1.4	2.5	5.2	0.9	0.9	3.9	4.3
Associate Professor	49.1	49.7	2.9	3.2	2.8	1.3	1.8	5.9	0.9	0.8	3.6	4.3
Assistant Professor	49.0[b]	49.0	2.2	3.1	2.7	1.0	2.1[b]	5.9	0.9	0.8	3.9[b]	4.3
Graduate Student	--	52.2[a]	--	3.1	--	1.5	--	12.9	--	0.8	--	4.4[a]
Research Associate[b]	52.5	48.9[a]	2.0	2.3	3.0	0.7	1.0	6.1	1.0	0.7	5.0	4.2
Project Director or Administrator[a,b]	60.9	48.7	4.0	3.2	3.0	2.0	3.0	6.2	1.0	0.8	5.0	3.9
Other[a]	--	53.6	--	4.5	--	3.5	--	6.0	--	0.5	--	3.5
AGE AT INCEPTION OF ACTIVITY												
Less than 40	49.2	49.5	2.9	3.1	2.6	1.2	2.2	6.5	0.8	0.8	3.7	4.2
40-49 years	51.7	48.6	3.1	2.8	2.9	1.3	2.5	6.5	0.9	0.8	3.9	4.1
50-59 years	49.0	51.6	2.5	3.5	2.6	1.6	1.6	4.2	0.9	0.9	3.7	4.4
60 years or older[b]	57.4	49.1	3.8	2.3	3.6	0.9	3.7	2.5	1.0	1.0	4.8	4.5
DOMINANT ACTIVITY IN (in US)												
Research	50.5	49.2	3.1	2.7	2.5	1.3	2.5	5.7	1.0	0.8	3.9	4.2
Teaching	49.6	48.7	2.5	3.3	2.8	1.2	1.9	6.1	0.9	0.8	3.9	4.0
Mixed	51.8	50.1	3.3	3.2	2.9	1.3	2.6	6.2	0.9	0.9	3.8	4.3

[a]Less than 15 cases in COMPARISON

[b]Less than 15 cases in SEED

(NOTE: See note for Table 6.9 for the possible ranges of values for each measure. The standard deviations and N-sizes are shown in Appendix Table B.)

59, following an increase in the younger age groups. There is, however, a recovery from this relative "slump" at ages 60 and over.

Award Characteristics - COMPARISON Group. Similar to SEED, travel award recipients in the COMPARISON group seem to be less productive on all measures, with the exception of self-evaluated productivity than research/teaching award recipients. The field of science classification indicates a tendency for respondents in "softer" sciences (e.g., Social Sciences) to be more productive in terms of overall productivity, as well as with respect to written products and self-evaluated productivity. The US and foreign benefits, on the other hand, are higher in engineering and similar "hard" science fields. The age of the respondent appears to have had some effect on productivity, but not consistently. Unlike SEED, COMPARISON respondents who were 60 years old or older at the time of the activity showed the second lowest overall productivity, yielded the fewest positive results for US or foreign participants, and had the smallest number of written products. Their scores on contacts maintained with colleagues and on self-evaluated productivity were, however, somewhat higher than those of the other age groups. The table shows 50- to 59-year-olds to be the most productive in terms of all indicators, except written products, in which younger scientists seem to do better.

Comparative Comments

Type of Award--While generally travel award recipients in both groups relatively less productive than the research/teaching award recipients, this was most pronounced with respect to foreign results and number of written products. These two measures also showed the clearest differences between the two groups. The SEED group, tended to generate a higher level of results for foreign scientists and institutions than did the COMPARISON group. On the

other hand, the COMPARISON group was at least twice as prolific in terms of written products. For other measures, differences were less pronunced.

Region--No one region showed consistently higher scores for all indicators, although overall productivity was slightly higher for both groups in Latin America. Trends reported above dominated regional differences. That is, the COMPARISON group tended to have more written products than did the SEED group, and its self-evaluated level of productivity was higher, regardless of the region. By comparison, the SEED group maintained a higher level of communication with foreign colleagues and attained more positive results for foreign colleagues, independent of the region involved.

Dominant Activity Abroad--It is difficult to make comparisons on the basis of this variable, since the sample size for the "Teaching" and "Mixed" activity groups of the COMPARISON scientists is very small for meaningful analysis. For those involved in research only, the observed patterns were similar to those shown above.

Type of Institution--The patterns of productivity indicators were again similar to those observed above. However, it is interesting to note that many more written products were produced by SEED scientists in government institutions than in other types. This becomes particularly important because a most notable difference between the two groups is the proportion of respondents visiting each type of institution. Results show the SEED group tended to work mostly in universities (65%), almost to the exclusion of government agencies or other types of facilities. The COMPARISON group varied more (universities - 38%, government installations - 40%, other - 22%) in type of institution.

Field of Science--It is difficult to make comparisons on the basis of this variable, since the sample size of all but the "Life Sciences" and "Social Sciences" fields was very small in one or both groups. For those

involved in these two fields, however, the observed patterns were similar to those shown above.

Title at Inception of Activity--Evaluation of the impact of this characteristic was hampered by the large proportion of professional titles among the SEED respondents. Distribution of titles indicates that the COMPARISON group comes from a more varied job background. The high SEED group scores on foreign results and contact maintained were again present, as well as the higher number of written products and higher self-evaluated productivity by the COMPARISON group members. In the SEED group, the associate and assistant professors had lower scores than did full professors in terms of results for US scientists and written products. This tendency was not observed in the COMPARISON group.

Age at Inception of Activity--While the overall productivity measure in the COMPARISON group was 48.6 and 51.6 for those 40 to 49 and 50 to 59 years of age, respectively, in the SEED group, the scores were higher for those scientists 40 to 49 years of age than for those 50 to 59 years of age, and surged from 49.0 for the latter group to 57.4 among those 60 years of age or older. Not only was the range greater, but the lowest scoring age group among the SEED members was the highest scoring group in the COMPARISON. The 60-years-of-age and older SEED respondents had unexpectedly higher scores on every measure than did the same age group of COMPARISON respondents. Moreover, in the oldest group, contrary to the other results, SEED scientists had more written output than did COMPARISON scientists, as well as a higher level of self-evaluated effectiveness.

Dominant Activity in US--The SEED group includes proportionately more "teachers" than does the COMPARISON group. However, the overall productivity scores were not remarkably different for each dominant activity in the US. The relationship of each of the three activities in both groups to overall

productivity was also similar; "teachers" were the least productive, and those who mixed teaching and research were the most productive members in each group.

Multivariate Analysis

In an attempt to discover those factors most useful in explaining the variation between individuals in the overall productivity measure, several different sets of variables were examined and subsequently entered into multiple regression equations. These can be classified into one of the following groups: (1) investigator qualifications, (2) host country contributions, (3) problems encountered, and (4) the predominant activity during the award. The variables used are listed below:

Investigator Qualifications

1. Title or rank at the inception of the activity (Q. 68).
2. The amount of previous international participation (Q. 70) (this variable, initially coded as 1, 2, or 3 representing "none," 1-5 trips, or 6+ trips, respectively, was recoded as 1, 3, or 7 for the purposes of this analysis).
3. The quality of the institution from which the investigator received his/her degree
4. The quality of the institution at which the investigator was employed at the time of the grant award for this activity.
5. Age at the inception of the activity (Q. 66)
6. The percentage of time currently spent performing research functions at the home institution based upon the sum of sub-items A and B of Q. 54.

Host Country Contribution

1. The sum of respondent ratings of the scientific quality of the work done (Q. 25), the skills of the foreign scientists (Q. 26), and the

extent to which collaboration was an important factor in accomplishing the research objectives (Q. 27).

2. The adequacy of the facilities used at the foreign institution (These ratings were obtained from each item of Q. 24 and entered into the equation individually rather than "en masse," due to the variation in the number of respondents answering each sub-item. The sub-item concerning computer adequacy was dropped because of the very small number of responses.)

Problems Encountered

1. The number of problems mentioned, as reported in Q. 48. (The number of problems ranged from 0 to 15.)

Major Activity During the Award

1. The number used was based upon the total percentage of time reported at teaching or assisting foreign institutions in curriculum improvement (The sum of sub-items F and G of Q. 20 yields this measure.)

A stepwise regression procedure was used in this portion of the analyses. The method was to obtain one of the best combinations of independent variables by adding one variable at a time to the equation on the basis of the highest partial correlation with the dependent variable. As each variable was entered, the partial correlations of the remaining variables (not in the equation) were recalculated, taking into account the variation already explained by the variable(s) in the equation. The regression analysis was somewhat hampered by the small number of cases responding to some of the questionnaire items. A listwise rather than pairwise deletion of cases was used because of the instability problems inherent in the latter technique. The cost of this, however, was the variation in sample size across measures.

Results

Investigator Qualifications--Initial analysis of these variables indicated that once "previous experience in international" activities was entered into the equation, no further significant increase in explanation of the variation in overall productivity would be obtained with the introduction of other variables. This variable explained only 4.36 percent of the variance in productivity. While this was statistically significant (probability of this occurring by chance is less than .002), its usefulness was dubious, since 95.64 percent of the variance in productivity was still unexplained.

Host Contribution--The analysis was based upon only 52 cases because many scientists did not use the facilities specified. Three of the variables entered into this regression equation produced relatively sizeable but statistically insignificant R^2.[3] In combination, the adequacy rating of the office and conference space, of clerical and technical services, and the sum of scientific contributions yielded an explained variance of 9.78 percent in overall productivity. While this was larger than that obtained in the investigator qualifications analysis, the sample size was too small to claim statistical significance.

Problems Encountered--Since only one variable was used in this analysis, the simple correlation squared was the same as the R^2 found following the regression analysis. The simple correlation of the number of problems mentioned with the overall productivity measure was -.0203 (R^2 = .00041); again, an insignificant amount of the variation was explained.

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[3] R^2 is the squared correlation (r) of the independent variables entered into the equation with the dependent variable. Its value indicates the proportion of variance in the dependent variable explained by the independent variables. The independent variables in this case were the three host contributions described.

Major Activity During the Award--The result was similar to that found using the number of "Problems Encountered." The simple correlation (r) of .0816 is the equivalent of less than one percent (.67%) explained variance in the overall productivity.

Overall Regression Analysis -- The variables from each set which seemed to make an important contribution to the explained variance were then combined in a separate regression equation; this failed to increase the proportion of variance explained over that explained by the "Host Contributions". This was due in large part to a drastic reduction in the number of cases that occurred when the "Host Contributions" variables were entered into the equation.

Conclusion -- The regression analyses on the measure of "Overall Productivity" does not prove to be very helpful in explaining the total variation. The variables used, when associated either individually or jointly, do not explain very much of the variation in "Overall Productivity." Investigator qualifications as measured by "Previous Experience" explains about 4% of the variance and "Host Contributions" explains about 10%, although this latter result is qualified further by the small sample size. It should be noted that these results are in line with those of other studies, that is, productivity is determined by many factors, and one should not expect more than very modest relationships between single characteristics of research activities and productivity.

7. PARTICIPANT RECOMMENDATIONS

At several points in the questionnaire the scientists were asked to provide recommendations about various aspects of the international activity and/or program. These were basically open-ended (unstructured) questions preceded by a screener (Yes/No) question. Not all respondents made recommendations, and some suggestions were neither applicable nor appropriate. Results are summarized in this section.

When asked what changes, if any, they would recommend in order to improve the productivity of international scientific activities, 58 percent of SEED and 41 percent of COMPARISON scientists made suggestions (Table 7.1). A major focus of both groups was funding; 41 percent of SEED and 35 percent of COMPARISON scientists recommended that funding levels be increased, that more assistance be provided to foreign scientists and students in terms of funds and facilities, or that activities should be funded for longer durations. The second major suggestion, although mentioned by far fewer respondents, concerned the continuation of this or a similar activity through follow-up visits and increased interaction between US and foreign scientists and institutions. A slightly higher percentage of COMPARISON (16.0%) than SEED (14.3%) seems to favor this particular approach for improving the productivity of international scientific activities. Slightly more than one in ten scientists suggested that better planning, scheduling, and preparation of the US scientists were required. Similarly, eleven percent of SEED and eight percent of COMPARISON indicated that assistance support and cooperation from US agencies in the foreign countries might help improve the productivity of the program.

TABLE 7.1. PARTICIPANT RECOMMENDATIONS TO IMPROVE THE PRODUCTIVITY OF INTERNATIONAL SCIENTIFIC ACTIVITIES

SUMMARY ITEMS	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
All answers (Q. 12)	100.0	100.0	91	119
Increased funding, more assistance, longer duration projects	40.7	35.3	37	42
More follow-up trips, exchanges; more interaction or contact	14.3	16.0	13	19
Proposal-related suggestions: rapid response, who should be funded, etc.	7.7	14.3	7	17
Cooperation and support from US agencies in foreign countries	11.0	7.6	10	9
Better planning, scheduling; language training, and preparation of scientists as to what to expect abroad	13.2	11.8	12	14
Reduced restrictions on travel, reporting requirements; less governmental interference	2.2	5.9	2	7
Other miscellaneous recommendations	11.0	9.2	10	11

Roughly 50% of SEED and 40% of comparison scientists responded to a question regarding the features of NSF programs for the support of international scientific activities, which they felt were important to change. Once again an overwhelming majority of SEED (71.3%) and COMPARISON (65.2%) scientists responding indicated the need for increased and less restricted funding (Table 7.2). The verbatim answers below are a few samples to illustrate this emphasis:

TABLE 7.2. PARTICIPANT RECOMMENDATIONS REGARDING FEATURES OF NSF PROGRAMS FOR SUPPORT OF INTERNATIONAL SCIENCE ACTIVITIES

SUMMARY ITEMS	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
Features important to change (Q. 79)	100.0	100.0	80	92
Funding policy more realistic, with increased levels of awards, less restrictions and for longer duration	71.3	65.2	57	60
Unfair or biased procedures in proposal review; more rapid evaluation of proposals	6.3	15.2	5	14
Encourage cooperation from foreign hosts and from US agencies abroad; inform about conditions abroad	10.0	5.4	8	5
Other miscellaneous features	12.5	14.1	10	13
Features important not to change (Q. 80)	100.0	100.0	62	95
Levels and areas of funding	24.2	17.9	15	17
Program goals and objectives	30.6	29.5	19	28
Flexibility and scientific freedom	19.4	21.1	12	20
Proposal review and evaluation process	11.3	15.8	7	15
NSF policy regarding requirements and restrictions; conduct of the program; cooperation of NSF program officers	8.1	8.4	5	8
Other miscellaneous features	6.5	7.4	4	7

> "I believe that programs such as the one that I participated in are very worthwhile. The level of support should be maintained if not increased." (SEED scientist)

> "More U.S. $ to each U.S. scientist. Stop being stingy to known and established U.S. scientists. NSF needs to give more $ to International Programs." (SEED scientist)

> "Research support for my field must be increased in $ amount and length of approved projects." (COMPARISON scientist)

> "Such support programs should be expanded and continued ..." and that NSF should "Enhance level of support, increasing both number and size of awards." (other COMPARISON scientists)

Another feature that the scientists felt was important to change concerned the review of proposals. About six percent of SEED and more than twice that percentage of COMPARISON scientists suggested that NSF should guard against unfair or biased proposal review, ensure a more informed peer review, and more quickly evaluate the proposals submitted. Combined with recommendations regarding funding aspects, these two features account for about eight-tenths of the suggestions made by both SEED and COMPARISON members.

Among the other suggestions were requests that NSF encourage more cooperation from the foreign institutions, as well as more support from the US agencies based abroad.

The scientists surveyed also agreed upon several features of the international programs that they felt should <u>not</u> be changed. For instance, about one-third of both SEED and COMPARISON participants responding iterated

that the program goals and objectives were worthwhile to pursue and should not be changed (Table 7.2):

> "I think the foreign exchange program is potentially valuable ... It should be maintained."

> "It is very important for our government and NSF to facilitate international exchanges of this sort."

One in five scientists, in both groups, suggested that the flexibility in terms of allocating grant funds and the scientific freedom devoid of excessive restrictions or requirements on the part of the agency (NSF) were valuable features to maintain. Slightly over ten percent of SEED and approximately 16 percent of COMPARISON scientists also mentioned the proposal review and evaluation process as a feature that should not be altered. Relatively large groups in SEED (24.2%) and COMPARISON (17.9%) suggested that the funding mechanism remain unchanged.

Finally, at the end of the survey instrument, respondents were asked to make any other additional comments that they felt were relevant to the activity (Table 7.3). A small proportion (approximately one-third) provided additional comments, with a larger proportion of SEED than COMPARISON scientists offering remarks. Of those responding more than 40 percent of the SEED respondents noted the usefulness and the success of their projects, while only 23 percent of the COMPARISON respondents reflected on their activity. Most of these suggestions were recommendations made earlier. A few verbatim sample responses are shown below:

> "In my opinion, this is the most effective form of foreign aid." (SEED scientist)

TABLE 7.3. ADDITIONAL PARTICIPANT COMMENTS, SUGGESTIONS, RECOMMENDATIONS

SUMMARY ITEMS	PERCENT		NUMBER	
	SEED	COMPARISON	SEED	COMPARISON
All comments (Q. 81)	100.0	100.0	56	83
Program useful, successful, essential; should be continued, expanded	42.9	22.9	24	19
Suggestions for future international scientific activities with respect to funding, recipients, requirements or specific projects	25.0	14.5	14	12
Remarks regarding the specific circumstances of individual awards	8.9	21.7	5	15
Comments about the survey, the questionnaire and specific items in the instrument	8.9	26.5	5	22
Other miscellaneous comments	14.3	14.5	8	15

"An outstanding program and a significant professional experience for me ...."

There were other reflections on the same theme:

"NSF grant support is extremely valuable for persons in my field of research ...."

"It was an intellectually, personally, and professionally satisfying and fulfilling experience. Also some very good scientific work was done."

An additional 20 percent of COMPARISON, as compared to nine percent of SEED, scientists commented on the circumstances surrounding their grants. Twenty-five percent of SEED and approximately 15 percent of COMPARISON members made various suggestions regarding the future of this or a similar program. There were also suggestions to increase the budget of the Division of International Programs (" ... because of the benefits/costs of collaborative international research") and complaints about lack of funds, equipment, and cooperation. In contrast to SEED respondents, more than 25 percent of the COMPARISON scientists raised issues (e.g., utility and appropriateness of method) about the survey. Some thought it was long and tedious, while others remarked that the instrument did not suit the particular activity in which they participated. It appears, however, that this was not a major issue with SEED, since only about nine percent commented specifically on the survey.

A major theme that emerged time and again from the collation of suggestions, recommendations, and critical remarks was that international scientific activities were useful and successful and should not only be continued, but also expanded.

APPENDIX A

Nonrespondent Characteristics

TABLE A1

Type of Award by Nonrespondent Compared to Total Eligible Population
Crosstabulated by Group

	SEED Group			COMPARISON Group		
Award Purpose	Number of Nonrespondents	Total Number of Eligible*	Percentage Not Responding of Total Eligible Cases by Category	Number of Nonrespondents	Total Number of Eligible*	Percentage Not Responding of Total Eligible Cases by Category
Research	12	92	13.0	36	221	16.3
Travel	8	85	9.4	23	92	25.0
Symposia	--	--	--	5	47	10.9
TOTAL	20	177	11.3	64	360	17.8

*Includes respondents and nonrespondents.

TABLE A2

Year of Award by Nonrespondent Compared to Total Eligible Population
Crosstabulated by Group

	SEED Group			COMPARISON Group		
Year of Award	Number of Nonrespondents	Total Number of Eligible*	Percentage Not Responding of Total Eligible Cases by Category	Number of Nonrespondents	Total Number of Eligible*	Percentage Not Responding of Total Eligible Cases by Category
1972	3	17	17.6	--	--	--
1973	5	24	20.8	--	--	--
1974	2	17	11.8	9	45	20.0
1975	3	23	13.0	19	95	20.0
1976	2	25	8.0	15	99	15.2
1977	2	30	6.7	21	121	17.4
1978	3	25	12.0	--	--	--
1979	0	16	00.0	--	--	--
TOTAL	20	177	11.3	64	360	17.8

*Includes respondents and nonrespondents.

TABLE A3

Region Visited by Nonrespondent Compared to Total Eligible Population
Crosstabulated by Group

	SEED Group			COMPARISON Group		
Region	Number of Nonrespondents	Total Number of Eligible*	Percentage Not Responding of Total Eligible Cases by Category	Number of Nonrespondents	Total Number of Eligible*	Percentage Not Responding of Total Eligible Cases by Category
Latin America	8	74	10.8	43	271	15.9
East Asia	5	50	10.0	8	32	25.0
Asia and Mid-East	5	21	23.8	11	30	36.7
Africa	2	32	6.3	2	27	7.4
TOTAL	20	177	11.3	64	360	17.8

*Includes respondents and nonrespondents.

TABLE A4

Field of Science by Nonrespondent Compared to Total Eligible Population
Crosstabulated by Group

Field of Science	SEED Group			COMPARISON Group		
	Number of Nonrespondents	Total Number of Eligible*	Percentage Not Responding of Total Eligible Cases by Category	Number of Nonrespondents	Total Number of Eligible*	Percentage Not Responding of Total Eligible Cases by Category
Life Sciences	3	58	5.2	13	119	10.9
Social Sciences	3	27	11.1	12	69	17.4
Engineering	10	55	18.2	8	16	50.0
Mathematics and Computer Sciences	1	6	16.7	3	5	60.0
Chemistry and Physics	1	15	6.7	6	37	16.2
Earth Sciences	2	13	15.4	22	97	22.7
TOTAL	20	177**	11.3	64	360**	17.8

*Includes respondents and nonrespondents.

**Including cases not reporting their field of science or coded "Other."

TABLE A5

Type of University or Institution at Which Nonrespondent is Currently, Crosstabulated by Group

Type of Institution	SEED Group			COMPARISON Group		
	Number of Nonrespondents	Percentage of Nonrespondents	Percentage of Total Eligible Cases	Number of Nonrespondents	Percentage of Nonrespondents	Percentage of Total Eligible Cases
Leading Institution[a]	1	5.0	0.6	22	34.4	6.1
Research Institution[b]	4	20.0	2.3	10	15.6	2.8
All Others[c]	15	75.0	8.5	32	50.0	8.9
TOTAL N-SIZE	20	100.0	177	64	100.0	360

[a]A "Leading Institution" is defined as an institution frequently rated high in science and engineering by the Roose Andersen rating.

[b]A "Research Institution" is defined as one of 50 leading universities in terms of Federal financial support of science as provided by the Carnegie Classification, and the institution was not listed as a "Leading Institution."

[c]"All Others" includes all other universities not included above and all nonuniversity facilities.

APPENDIX B

Mean Values of Productivity Measures by Various Award Characteristics

for SEED and COMPARISON Groups

TABLE B1

MEAN VALUES OF PRODUCTIVITY MEASURES BY VARIOUS AWARD CHARACTERISTICS (SEED GROUP)

		OVERALL PRODUCTIVITY	RESULTS FOR U.S.	RESULTS FOR FOREIGN	WRITTEN PRODUCTS	CONTACT MAINTAINED	SELF-EVALUATED PRODUCTIVITY
POSSIBLE RANGE		0-100	0-7	0-6	0-∞[a]	0-1	1-5
Type of Award							
Research/Teaching	$\bar{X}$	51.6	2.9	3.2	2.9	0.9	3.9
	N	66	81	81	68	81	79
	S.D.	6.67	1.63	1.30	3.73	0.26	0.99
Travel	$\bar{X}$	49.7	3.0	2.3	1.6	0.9	3.9
	N	64	76	76	66	76	74
	S.D.	6.25	1.81	1.50	2.80	0.25	0.91
Region Involved							
Latin America	$\bar{X}$	51.4	3.3	2.8	2.1	0.9	3.8
	N	37	44	44	38	44	43
	S.D.	6.36	1.77	1.66	2.75	0.26	1.00
East Asia	$\bar{X}$	51.2	3.0	2.8	2.5	1.0	3.9
	N	38	43	43	38	43	43
	S.D.	6.58	1.57	1.43	3.45	0.15	1.01
Africa	$\bar{X}$	48.8	3.1	2.5	1.3	0.9	3.5
	N	15	18	18	15	18	18
	S.D.	6.80	1.94	1.43	2.06	0.24	1.10

[a]Highest observed value = 19

TABLE B1 (Continued)

MEAN VALUES OF PRODUCTIVITY MEASURES BY VARIOUS AWARD CHARACTERISTICS (SEED GROUP)

		OVERALL PRODUCTIVITY	RESULTS FOR U.S.	RESULTS FOR FOREIGN	WRITTEN PRODUCTS	CONTACT MAINTAINED	SELF-EVALUATED PRODUCTIVITY
POSSIBLE RANGE		**0-100**	**0-7**	**0-6**	**0-∞[a]**	**0-1**	**1-5**
Predominant Activity Involved							
Research	$\bar{X}$	50.7	3.1	2.4	2.5	0.9	3.9
	N	78	96	96	80	96	94
	S.D.	7.06	1.77	1.49	3.88	0.26	1.00
Mixed	$\bar{X}$	52.3	3.1	3.5	2.2	1.0	3.8
	N	30	33	33	30	33	33
	S.D.	5.96	1.54	1.46	2.29	0.17	0.97
Teaching	$\bar{X}$	49.0	2.0	3.2	1.9	0.9	3.7
	N	20	24	24	22	24	22
	S.D.	4.00	1.35	0.66	2.60	0.28	0.77
Type of Institution Predominantly Involved							
Government Ministry or Department	$\bar{X}$	52.5	3.1	2.7	4.3	1.0	4.0
	N	15	23	23	16	23	22
	S.D.	6.65	1.73	1.25	5.15	0.21	1.17
University	$\bar{X}$	51.8	3.2	3.2	2.4	0.9	3.9
	N	59	70	70	59	70	70
	S.D.	6.45	1.75	1.61	3.35	0.28	0.89
Other	$\bar{X}$	52.1	3.2	2.5	2.7	1.0	4.2
	N	10	11	11	10	11	11
	S.D.	7.12	1.78	1.37	2.63	0.00	0.98

[a]Highest observed value = 19

TABLE B1 (Continued)

MEAN VALUES OF PRODUCTIVITY MEASURES BY VARIOUS AWARD CHARACTERISTICS (SEED GROUP)

		OVERALL PRODUCTIVITY	RESULTS FOR U.S.	RESULTS FOR FOREIGN	WRITTEN PRODUCTS	CONTACT MAINTAINED	SELF-EVALUATED PRODUCTIVITY
POSSIBLE RANGE		0-100	0-7	0-6	0-∞[a]	0-1	1-5
Field of Science							
Life Sciences	$\bar{X}$	52.7	3.6	2.9	2.9	0.9	4.2
	N	43	51	51	44	51	50
	S.D.	6.84	1.65	1.23	3.67	0.24	0.94
Social Sciences	$\bar{X}$	51.2	3.4	2.4	2.4	1.0	3.9
	N	19	21	21	19	21	21
	S.D.	4.30	1.43	1.12	2.45	0.22	0.73
Engineering	$\bar{X}$	48.1	2.1	2.6	1.3	0.9	3.7
	N	32	39	39	33	39	38
	S.D.	6.21	1.56	1.70	2.23	0.27	0.89
Mathematics and Computer Sciences	$\bar{X}$	52.1*	2.6*	3.9*	1.3*	1.0*	3.9*
	N	7	8	8	7	8	8
	S.D.	3.79	1.60	1.36	1.60	0.00	0.35
Chemistry and Physics	$\bar{X}$	48.2*	2.5	2.9	0.9*	0.8	3.1
	N	9	11	11	9	11	11
	S.D.	6.80	1.13	1.87	1.05	0.41	1.22
Earth Sciences	$\bar{X}$	49.2**	2.8	2.6	2.3*	0.8	3.6*
	N	5	10	10	6	10	9
	S.D.	9.94	2.53	1.90	2.88	0.42	0.88

[a]Highest observed value = 19

*Instances with fewer than 10 cases should be interpreted with reservation.

**Instances with five or fewer cases are not necessarily reliable and should be viewed conservatively.

TABLE B1 (Continued)

MEAN VALUES OF PRODUCTIVITY MEASURES BY VARIOUS AWARD CHARACTERISTICS (SEED GROUP)

		OVERALL PRODUCTIVITY	RESULTS FOR U.S.	RESULTS FOR FOREIGN	WRITTEN PRODUCTS	CONTACT MAINTAINED	SELF-EVALUATED PRODUCTIVITY
POSSIBLE RANGE		0-100	0-7	0-6	0-∞[a]	0-1	1-5
Title of R at Inception of Activity							
Professor	$\bar{X}$	51.3	3.1	2.8	2.5	0.9	3.9
	N	86	96	96	88	96	94
	S.D.	6.90	1.79	1.48	3.75	0.26	0.96
Associate Professor	$\bar{X}$	49.1	2.9	2.8	1.8	0.9	3.6
	N	29	41	41	30	41	40
	S.D.	5.78	1.61	1.42	2.16	0.26	0.93
Assistant Professor	$\bar{X}$	49.0	2.2	2.7	2.1	0.9	3.9
	N	11	15	15	12	15	14
	S.D.	4.88	1.42	1.67	3.26	0.26	0.83
Graduate Student	$\bar{X}$	-	-	-	-	-	-
	N	-	-	-	-	-	-
	S.D.	-	-	-	-	-	-
Research Associate	$\bar{X}$	52.5**	2.0**	3.0**	1.0**	1.0**	5.0**
	N	1	1	1	1	1	1
	S.D.	0.00	0.00	0.00	0.00	0.00	0.00
Project Director or Administrator	$\bar{X}$	60.9**	4.0**	3.0**	3.0**	1.0**	5.0**
	N	1	2	2	1	2	2
	S.D.	0.00	2.83	1.41	0.00	0.00	0.00
Other	$\bar{X}$	-	-	-	-	-	-
	N	-	-	-	-	-	-
	S.D.	-	-	-	-	-	-

[a]Highest observed value = 19

**Instances with five or fewer cases are not necessarily reliable and should be viewed conservatively.

TABLE B1 (Continued)

MEAN VALUES OF PRODUCTIVITY MEASURES BY VARIOUS AWARD CHARACTERISTICS (SEED GROUP)

		OVERALL PRODUCTIVITY	RESULTS FOR U.S.	RESULTS FOR FOREIGN	WRITTEN PRODUCTS	CONTACT MAINTAINED	SELF-EVALUATED PRODUCTIVITY
POSSIBLE RANGE		0-100	0-7	0-6	0-∞[a]	0-1	1-5
Age at Inception of Activity							
Less than 40	$\bar{X}$	49.2	2.9	2.6	2.2	0.8	3.7
	N	38	48	48	39	48	47
	S.D.	6.87	1.83	1.56	2.42	0.28	0.94
40-49 years	$\bar{X}$	51.7	3.1	2.9	2.5	0.9	3.9
	N	48	61	61	50	61	59
	S.D.	6.01	1.60	1.41	3.94	0.28	0.98
50-59 years	$\bar{X}$	49.0	2.5	2.6	1.6	0.9	3.7
	N	34	37	37	34	37	37
	S.D.	5.68	1.69	1.21	2.41	0.23	0.90
60 years or older	$\bar{X}$	57.4	3.8	3.6	3.7	1.0	4.8
	N	10	11	11	11	11	10
	S.D.	5.50	1.54	1.80	5.27	0.00	0.42
Activity Usually Involved In (in U.S.)							
Research	$\bar{X}$	50.5	3.1	2.5	2.5	1.0	3.9
	N	25	27	27	26	27	26
	S.D.	5.98	1.52	1.34	4.16	0.00	1.02
Mixed Activities	$\bar{X}$	51.8	3.3	2.9	2.6	0.9	3.8
	N	54	68	68	54	68	68
	S.D.	7.02	1.92	1.54	3.63	0.24	1.02
Teaching	$\bar{X}$	49.6	2.5	2.8	1.9	0.9	3.9
	N	51	62	62	54	62	59
	S.D.	6.14	1.47	1.41	2.59	0.32	0.85

TABLE B2

MEAN VALUES OF PRODUCTIVITY MEASURES BY VARIOUS AWARD CHARACTERISTICS (COMPARISON GROUP)

		OVERALL PRODUCTIVITY	RESULTS FOR U.S.	RESULTS FOR FOREIGN	WRITTEN PRODUCTS	CONTACT MAINTAINED	SELF-EVALUATED PRODUCTIVITY
POSSIBLE RANGE		0-100	0-7	0-6	0-∞[a]	0-1	1-5
Type of Award							
Research/Teaching	$\bar{X}$	50.5	3.2	1.4	6.8	0.9	4.2
	N	132	182	182	136	178	177
	S.D.	7.21	1.48	1.52	10.05	0.34	0.85
Travel	$\bar{X}$	47.1	2.6	0.9	3.7	0.8	4.3
	N	49	71	71	57	66	68
	S.D.	7.23	1.69	1.25	4.48	0.43	0.86
Region Involved							
Latin America	$\bar{X}$	49.7	3.0	1.4	5.9	0.8	4.3
	N	98	142	142	102	136	139
	S.D.	7.61	1.60	1.52	9.47	0.37	0.85
East Asia	$\bar{X}$	49.3	3.0	1.3	4.4	0.8	4.1
	N	12	20	20	15	20	19
	S.D.	7.91	1.81	1.33	3.94	0.41	1.03
Africa	$\bar{X}$	49.1	3.1	1.0	6.2	0.8	4.3
	N	16	22	22	18	20	20
	S.D.	6.03	1.42	1.17	4.98	0.41	0.79

[a]Highest observed value = 72

TABLE B2 (Continued)

MEAN VALUES OF PRODUCTIVITY MEASURES BY VARIOUS AWARD CHARACTERISTICS (COMPARISON GROUP)

		OVERALL PRODUCTIVITY	RESULTS FOR U.S.	RESULTS FOR FOREIGN	WRITTEN PRODUCTS	CONTACT MAINTAINED	SELF-EVALUATED PRODUCTIVITY
POSSIBLE RANGE		0-100	0-7	0-6	0-∞[a]	0-1	1-5
Predominant Activity Involved							
Research	$\bar{X}$	49.6	3.0	1.2	6.0	0.8	4.2
	N	176	246	246	187	237	239
	S.D.	7.41	1.56	1.44	8.99	0.37	0.86
Mixed	$\bar{X}$	43.3**	2.0**	1.0**	2.0**	0.5**	4.0**
	N	2	2	2	2	2	2
	S.D.	5.31	1.41	1.41	0.00	0.71	0.00
Teaching	$\bar{X}$	49.4**	2.0**	3.0**	0.0**	1.0**	4.0**
	N	1	1	1	1	1	1
	S.D.	0.00	0.00	0.00	0.00	0.00	0.00
Type of Institution Predominantly Involved							
Government Ministry or Department	$\bar{X}$	51.9	3.6	1.8	7.1	0.9	4.2
	N	43	56	56	43	56	56
	S.D.	6.97	1.68	1.45	8.76	0.26	0.86
University	$\bar{X}$	51.1	3.5	2.0	6.6	0.9	4.2
	N	33	50	50	34	50	49
	S.D.	7.85	1.46	1.64	7.19	0.30	0.85
Other	$\bar{X}$	49.4	3.1	1.3	7.1	0.9	4.4
	N	19	27	27	20	27	26
	S.D.	8.74	1.73	1.64	15.57	0.27	0.81

[a]Highest observed value = 72

**Instances with five or fewer cases are not necessarily reliable and should be viewed conservatively.

TABLE B2 (Continued)

MEAN VALUES OF PRODUCTIVITY MEASURES BY VARIOUS AWARD CHARACTERISTICS (COMPARISON GROUP)

		OVERALL PRODUCTIVITY	RESULTS FOR U.S.	RESULTS FOR FOREIGN	WRITTEN PRODUCTS	CONTACT MAINTAINED	SELF-EVALUATED PRODUCTIVITY
POSSIBLE RANGE		0-100	0-7	0-6	0-∞[a]	0-1	1-5
Field of Science							
Life Sciences	$\bar{X}$	50.9	3.1	1.4	7.6	0.9	4.3
	N	72	99	99	74	97	99
	S.D.	6.14	1.39	1.61	10.27	0.33	0.82
Social Sciences	$\bar{X}$	51.4	3.5	1.5	6.0	0.8	4.4
	N	28	40	40	32	39	37
	S.D.	8.50	1.63	1.30	5.08	0.37	0.79
Engineering	$\bar{X}$	39.5**	4.0**	3.5**	5.5**	0.5**	4.0**
	N	1	2	2	2	2	1
	S.D.	0.00	4.24	2.12	4.95	0.71	0.00
Mathematics and Computer Sciences	$\bar{X}$	48.7**	4.0**	1.0**	2.0**	1.0**	3.5**
	N	2	2	2	2	2	2
	S.D.	1.44	1.41	1.41	2.83	0.00	0.71
Chemistry and Physics	$\bar{X}$	47.3	3.0	1.3	3.3	0.8	4.2
	N	16	22	22	16	22	22
	S.D.	8.26	1.65	1.36	2.36	0.43	1.02
Earth Sciences	$\bar{X}$	48.5	2.7	1.0	5.0	0.8	4.2
	N	43	63	63	48	57	60
	S.D.	7.54	1.60	1.30	10.92	0.38	0.86

[a]Highest observed value = 72

**Instances with five or fewer cases are not necessarily reliable and should be viewed conservatively.

TABLE B2 (Continued)

MEAN VALUES OF PRODUCTIVITY MEASURES BY VARIOUS AWARD CHARACTERISTICS (COMPARISON GROUP)

		OVERALL PRODUCTIVITY	RESULTS FOR U.S.	RESULTS FOR FOREIGN	WRITTEN PRODUCTS	CONTACT MAINTAINED	SELF-EVALUATED PRODUCTIVITY
POSSIBLE RANGE		0-100	0-7	0-6	0-∞[a]	0-1	1-5
Title of R at Inception of Activity							
Professor	$\bar{X}$	49.8	3.0	1.4	5.2	0.9	4.3
	N	72	100	100	78	98	96
	S.D.	7.52	1.65	1.59	8.93	0.32	0.86
Associate Professor	$\bar{X}$	49.7	3.2	1.3	5.9	0.8	4.3
	N	43	57	57	46	54	55
	S.D.	7.14	1.48	1.34	9.65	0.38	0.73
Assistant Professor	$\bar{X}$	49.0	3.1	1.0	5.9	0.8	4.3
	N	32	44	44	33	42	43
	S.D.	7.54	1.52	1.39	4.69	0.40	0.90
Graduate Student	$\bar{X}$	52.2*	3.1	1.5	12.9*	0.8	4.4
	N	9	15	15	9	15	14
	S.D.	3.02	1.69	1.55	14.44	0.41	0.63
Research Associate	$\bar{X}$	48.9	2.3	0.7	6.1	0.7	4.2
	N	14	22	22	16	20	22
	S.D.	8.79	1.17	1.08	10.60	0.47	0.66
Project Director or Administrator	$\bar{X}$	48.7*	3.2*	2.0*	6.2*	0.8*	3.9*
	N	6	9	9	6	9	9
	S.D.	9.60	1.56	1.41	6.24	0.44	1.27
Other	$\bar{X}$	53.6**	4.5**	3.5**	6.0**	0.5**	3.5**
	N	1	2	2	1	2	2
	S.D.	0.00	2.12	0.71	0.00	0.71	2.12

[a]Highest observed value = 72

*Instances with fewer than 10 cases should be interpreted with reservation.

**Instances with five or fewer cases are not necessarily reliable and should be viewed conservatively.

TABLE B2 (Continued)

MEAN VALUES OF PRODUCTIVITY MEASURES BY VARIOUS AWARD CHARACTERISTICS (COMPARISON GROUP)

		OVERALL PRODUCTIVITY	RESULTS FOR U.S.	RESULTS FOR FOREIGN	WRITTEN PRODUCTS	CONTACT MAINTAINED	SELF-EVALUATED PRODUCTIVITY
POSSIBLE RANGE		0-100	0-7	0-6	0-∞[a]	0-1	1-5
Age at Inception of Activity							
Less than 40	$\bar{X}$	49.5	3.1	1.2	6.5	0.8	4.2
	N	98	133	133	101	129	130
	S.D.	7.11	1.58	1.38	8.18	0.40	0.81
40-49 years	$\bar{X}$	48.6	2.8	1.3	6.5	0.8	4.1
	N	45	67	67	50	65	64
	S.D.	8.71	1.40	1.62	12.51	0.38	0.97
50-59 years	$\bar{X}$	51.6	3.5	1.6	4.2	0.9	4.4
	N	23	31	31	26	29	30
	S.D.	6.45	1.65	1.54	4.10	0.26	0.68
60 years or older	$\bar{X}$	49.0	2.3	0.9	2.5	1.0	4.5
	N	10	13	13	11	12	13
	S.D.	5.06	1.38	1.19	2.42	0.00	0.88
Activity Usually Involved In (in U.S.)							
Research	$\bar{X}$	49.2	2.7	1.3	5.7	0.8	4.2
	N	57	82	82	60	79	80
	S.D.	7.57	1.54	1.40	8.60	0.40	0.85
Mixed Activities	$\bar{X}$	50.1	3.2	1.3	6.2	0.9	4.3
	N	92	124	124	98	119	121
	S.D.	7.31	1.64	1.51	9.16	0.34	0.81
Teaching	$\bar{X}$	48.7	3.3	1.2	6.1	0.8	4.0
	N	27	40	40	29	40	38
	S.D.	7.35	1.29	1.49	9.39	0.41	0.89

[a]Highest observed value = 72

APPENDIX C

Sample Questionnaire

INSTITUTE FOR SURVEY RESEARCH
TEMPLE UNIVERSITY
-Of The Commonwealth System Of Higher Education-
1601 NORTH BROAD STREET
PHILADELPHIA, PENNSYLVANIA 19122

STUDY #518-037-01
WINTER 1980

OMB NO.: 099-S80003
EXPIRES: DECEMBER 1982

SURVEY OF NSF INTERNATIONAL SCIENTIFIC ACTIVITIES

U.S. PARTICIPANT QUESTIONNAIRE

(Please complete):

NAME : _____

INSTITUTION: _____

DEPARTMENT *(If applicable)*: _____

ADDRESS : _____

_____

TELEPHONE : ( ) _____

☐ Please check here if you would like a copy of the results of this survey.

This questionnaire is concerned with your participation in NSF-sponsored international scientific activities. The information you provide will be given maximum protection from disclosure, subject to applicable laws including the Freedom of Information Act, 5USC 552. Individuals will not be identified with their answers. This questionnaire applies to the international scientific activity supported by the award indicated below, and previous NSF awards to you for work being continued by this award. Consider the entire activity up to and including this award when formulating your responses.

LABEL HERE

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INSTRUCTIONS FOR COMPLETING THIS QUESTIONNAIRE

In answering the various questions in this questionnaire you may feel you cannot provide an exact answer or you may not remember some of the details. Please give us your best estimate, or as much detail as you can remember, in such cases, before continuing with the next question.

There are basically three type of questions: the closed-end "yes" or "no" questions; open-end questions where you are asked to fill in the information sought; and questions with rating scales. An example of each type is shown below.

1. Have you ever received support from the NSF to participate in an international scientific activity?

   1. [X] Yes — *(ANSWER Q. 2)* 2. [ ] No — *(GO TO Q. 3)*

2. When was the first such time you received NSF support?

   April (MONTH) 1975 (YEAR)

3. On a scale ranging from "not important" (1) to "very important" (5), how would you rate the role of external support in the professional development of a scientist?

NOT IMPORTANT →				VERY IMPORTANT
1	2	3	4	5
[ ]	[ ]	[ ]	[X]	[ ]

4. Some of the common problems encountered in any scientific activity are shown below. Which are important for you?

   [ ] 1. Insufficient financial resources.

   [X] 2. Lack of skilled support staff.

   [X] 3. Inadequate access to facilities.

   [ ] 4. Excessive administrative requirements.

   [X] 5. Inadequate time to accomplish objectives.

   [X] 6. Inefficient cooperation among colleagues.

5. Of the items chosen in Question 4, which <u>three</u> do you consider most important?
   (Rank by using the item numbers from Q. 4.)

MOST IMPORTANT	SECOND MOST IMPORTANT	THIRD MOST IMPORTANT
5	3	6

6. What do you think is the primary role of periodic evaluations of research programs?

   To make sure the objectives of the program are being met, and that the specific objectives are worthwhile to pursue, in terms of their contribution to the society as a whole.

Please answer all the questions that apply to you and follow the directions which may ask you to skip certain questions. In the absence of any instructions always go to the next question. Even if you feel only part of the questionnaire applies to you, or there are some questions that you cannot answer, please return the entire questionnaire in the enclosed postage-paid envelope.

We appreciate your participation and thank you for taking time to complete the questionnaire.

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SECTION I

Questions in this section are about the objectives and outcomes of the international scientific activity in which you have participated.

1. Some of the most frequently mentioned objectives for participating in international scientific activities are shown below. Which of the items do you consider to be important among your own objectives for engaging in this activity?

(Check all that apply.)

1. ☐ To stimulate my research in new or different directions.
2. ☐ To acquire information from foreign scientists on current research.
3. ☐ To advance my research through collaboration or close cooperation with a foreign research team.
4. ☐ To advance my research through access and use of foreign research facilities.
5. ☐ To collect data/specimens essential to my research.
6. ☐ To improve my institution's contacts with foreign students and faculty and/or improve my institution's programs that involve foreign nationals.
7. ☐ To disseminate knowledge to a foreign science community through teaching or lecturing.
8. ☐ To improve the curriculum or courses offered by a foreign science institution.
9. ☐ To plan, establish or strengthen relationships between U.S. and foreign scientific institutions.
10. ☐ To improve the relevance of the scientific research in a foreign country to its economic or social goals.
11. ☐ To plan future collaborative research with foreign scientists.
12. ☐ To improve the research capabilities of a foreign science institution.
13. ☐ Other objective, not listed above *(Please specify)*: _____

_____

2. Of those items selected in Question 1, which three do you consider to be your most important objectives?

(Please rank by placing the item numbers, from Q. 1, in the appropriate boxes below.)

MOST IMPORTANT	SECOND MOST IMPORTANT	THIRD MOST IMPORTANT
☐	☐	☐

3. Were there any positive outcomes of the international scientific activity in which you participated?

1. ☐ Yes *(ANSWER Q. 4)* ←

2. ☐ No *(GO TO Q. 6)* ←

(4) Which, of the following items, do you consider as the important positive results of the scientific activity?

(Check all that apply.)

1. ☐ Shifted my research emphasis to more productive research problems and/or to a more fruitful research area.

2. ☐ Advanced my research, resulting in publications, presentations at meetings, etc.

3. ☐ Increased the volume and output of work in which I collaborated with foreign researchers.

4. ☐ Contributed to my professional advancement in that it enriched my teaching and/or increased the extent to which I am sought out by colleagues.

   (If this item is checked, please complete the following:)

   Please describe how. _____

   _____

5. ☐ Improved my institution's capability to attract and educate foreign students, as well as more general capability improvements.

   (If this item is checked, please complete the following:)

   Please describe how. _____

   _____

6. ☐ Increased the number of foreign scientists with whom I exchange information thus increasing the range of research about which I am knowledgeable.

7. ☐ Improved the research capability of a foreign science institution, as well as more general capability improvements.

   (If this item is checked, please complete the following:)

   Please describe how. _____

   _____

8. ☐ Improved the curriculum/courses of a foreign science institution.

9. ☐ Successful completion, by science students at a foreign institution, of one or several of my courses.

10. ☐ Contributed to the professional advancement of one or several foreign researchers.

    (If this item is checked, please complete the following:)

    Please describe how. _____

    _____

11. ☐ Established or advanced an institutional relationship between a U.S. and foreign science institution.

12. ☐ Increased the relevance of the scientific research in a foreign country to the country's social or economic goals.

    (If this item is checked, please complete the following:)

    Please describe how. _____

    _____

13. ☐ Other positive result *(Please specify)*: _____

    _____

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5. Of those items selected in Question 4, which three do you consider to be the most important positive results?

(Please rank by placing the item numbers, from Q. 4, in the appropriate boxes below.)

MOST IMPORTANT	SECOND MOST IMPORTANT	THIRD MOST IMPORTANT
☐	☐	☐

6. Were there any negative outcomes of the international scientific activity in which you participated?

1. ☐ Yes → *(ANSWER Q. 7)*

2. ☐ No → *(GO TO Q. 9)*

7. Which of the following items do you consider as the important negative results of the scientific activity?

(Check all that apply.)

1. ☐ Loss of time at home set me back in my research.
2. ☐ My publication rate was diminished.
3. ☐ Activity abroad did not contribute to possibility of promotion at home.
4. ☐ Activity abroad contributed to loss of contacts with American colleagues.
5. ☐ My absence was disruptive to my department and institution.
6. ☐ My absence was disruptive to the training of my graduate students.
7. ☐ My requirements for resources and/or staff complicated the research projects of my foreign colleagues and led to their diminished productivity.
8. ☐ The relevance of the research in a foreign country to its economic or social goals was diminished.
9. ☐ The scientific resources of a foreign country decreased because one or several scientists migrated to U.S.
10. ☐ Other negative result *(Please specify)*: _____

_____

8. Of those items selected in Question 7, which three do you consider the most important negative results?

(Please rank by placing the item numbers, from Q. 7, in the appropriate boxes below.)

MOST IMPORTANT	SECOND MOST IMPORTANT	THIRD MOST IMPORTANT
☐	☐	☐

9. What written products, if any, resulted from this activity?

(Please give bibliographic information on: journal articles, papers presented at scientific meetings, dissertations, technical reports, manuals, books or textbooks or chapters in these, as well as those in progress, with expected dates of completion. Attach additional sheets if necessary.)

_____

_____

_____

_____

_____

_____

☐ *Check here if no documents produced.*

10. What prototypes or other products, if any, resulted directly or indirectly from this activity?

(Please list: prototypes of instruments and apparatus, experimental materials such as fibers, glass, plants, alloys, computer programs, and audio-visual materials, etc.)

_____

_____

_____

_____

_____

_____

☐ *Check here if no products produced.*

11. On a scale ranging from "Poor" (1) to "Excellent" (5), what is your opinion of the overall productivity of this international scientific activity?

(Check the box on the scale that corresponds to your opinion.)

POOR →				EXCELLENT
1	2	3	4	5
☐	☐	☐	☐	☐

12. What changes, if any, would you recommend to improve the productivity of international scientific activities?

_____

_____

_____

_____

☐ *Check here if no recommendations.*

13. Is professional contact between you and your <u>principal</u> host or collaborator in the activity still maintained?

1. ☐ Yes → *(ANSWER Q. 14)*

2. ☐ No → *(GO TO Q. 15)*

(14.) By what means have you maintained professional contact?

(Check all that apply, and GO TO Q. 16.)

1. ☐ Professional correspondence
2. ☐ About _____ visits a year
3. ☐ Cooperative or collaborative research between us
4. ☐ Relationships between our institutions
5. ☐ Other means *(Please specify)*: _____

_____

(15.) What are the reasons for not maintaining professional contact?

(Check all that apply.)

1. ☐ Our research and interests are so divergent I saw no value in further contact.
2. ☐ The scientist was not of high enough quality for me to devote more time to further contacts.
3. ☐ The ability of the scientist was adequate and we have interests in common, but I can more easily get similar information/expertise from U.S. researchers.
4. ☐ I attempted to continue contact with the scientist, but received no response.
5. ☐ The scientist expressed the view that continued contact would not be productive.
6. ☐ Other reason *(Please specify)*: _____

_____

(16.) About how many new colleagues did you establish contact with during this activity?

_____ (NUMBER) *(ANSWER Q. 17)* ← OR ☐ NONE *(GO TO Q. 19)* ←

(17.) Have you maintained professional contact with these new colleagues?

1. ☐ Yes *(ANSWER Q. 18)* ← 2. ☐ No *(GO TO Q. 19)* ←

(18.) By what means? *(Check all that apply.)*

1. ☐ Professional correspondence
2. ☐ About _____ visits a year
3. ☐ Cooperative or collaborative research between us
4. ☐ Relationship between our institutions
5. ☐ Other means *(Please specify)*: _____

_____

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(19.) What other comments would you make on the outcomes, effects or consequences of this activity?

_____

_____

_____

_____

☐ *Check here if no additional comments.*

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The questions in this section deal with how you spent your time, the resources used in this activity, their quality, and any problems you may have encountered.

(20) Approximately what percentage of your time did you allocate to each of the following during the activity?

A. _____% Collaborative or cooperative research on a new project at a single institution.

B. _____% Continuation of work on a longer-term collaborative or cooperative research project at a single institution.

C. _____% Lecturing and/or discussing research, exchanging ideas and information, at one or several institutions.

D. _____% Fieldwork such as gathering specimens or data.

E. _____% Participating in an international scientific meeting or symposium.

F. _____% Teaching courses.

G. _____% Assisting a foreign institution, in research or curriculum improvement.

H. _____% Other activity *(Please specify)*: _____

_____

I. _____% Other activity *(Please specify)*: _____

100 %

_____

(21) Was collaborative or cooperative research involved in this activity?

1. ☐ Yes *(ANSWER Q. 22)* ←

2. ☐ No *(GO TO Q. 33)* ←

(22) What was the one institute or laboratory at which you spent most of your time?

_____
(INSTITUTE OR LABORATORY)

_____
(ADVISOR OR PRINCIPAL COLLABORATOR)

_____
(ADVISOR'S OR PRINCIPAL COLLABORATOR'S POSITION)

(23) Was this institute or laboratory in: *(Check one.)*

1. ☐ a Ministry or Department of the Government,
2. ☐ a university or other institution of higher learning,
3. ☐ an industrial corporation, or
4. ☐ some other facility? *(Please specify)*: _____

_____

(24) For each of the facilities or services listed below, please

A. indicate whether or not it was used during your visit,

B. rate the adequacy of those used on the scale provided, and

C. indicate if the facilities or services used were unique.

[By unique is meant that a similar resource was not easily accessible to you in the U.S.]

	A. Not used 1	A. Used 2	B. Poor → Excellent 1	2	3	4	5	C. Unique 1	C. Not unique 2
1. Laboratory facilities and equipment	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Computer	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Library	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Office and conference space	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Clerical and technical services	☐	☐	☐	☐	☐	☐	☐	☐	☐

(25) On a scale ranging from "Poor" (1) to "Excellent" (5), how would you rate the scientific quality of the work done in the program or group with which you interacted, as compared with U.S. research in the same area?

(Check the box on the scale that corresponds with your opinion.)

POOR →				EXCELLENT
1	2	3	4	5
☐	☐	☐	☐	☐

(26) On a scale ranging from "Not Important" (1) to "Very Important" (5), how would you rate the impact of the knowledge and technical skills, contributed by the participating foreign members of the project team, on the achievement of the project objectives?

(Check the box on the scale that corresponds with your opinion.)

NOT IMPORTANT →				VERY IMPORTANT
1	2	3	4	5
☐	☐	☐	☐	☐

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27. On a scale ranging from "Not Important" (1) to "Very Important" (5), please rate the extent to which collaboration was an important factor in accomplishing the research objectives.

[By collaboration we mean close and continued interaction and extensive cooperation, including such factors as modification of your own ideas/approaches. Examples of products of collaborative research are jointly developed models or co-authored publications that represent an integration of the authors' ideas.]

(Check the box on the scale that corresponds with your opinion.)

NOT IMPORTANT →				VERY IMPORTANT
1	2	3	4	5
☐	☐	☐	☐	☐

28. Was this research essentially a continuation of the line of research in which you were engaged at home (in U.S.)?

1. ☐ Yes *(ANSWER Q. 29)*

2. ☐ No *(GO TO Q. 30)*

29. Do you feel that you accomplished anything in your research abroad that you would not have accomplished at home (in U.S.)?

1. ☐ Yes

2. ☐ No *(GO TO Q. 30)*

Please specify: _____

_____

30. Was the research essentially a continuation of the line of research in which the participating foreign scientists had been previously engaged?

1. ☐ Yes *(ANSWER Q. 31)*

2. ☐ No *(GO TO Q. 32)*

31. Do you feel that they accomplished anything additional with your collaboration?

1. ☐ Yes

2. ☐ No *(GO TO Q. 32)*

Please specify: _____

_____

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(32.) How many, if any, foreign and/or U.S. graduate students participated in the project?

(Record the number of each in the appropriate box. If you can't remember the number, check the box.)

☐ Foreign ☐ U.S.

(33.) Did you participate in a formal, scientific meeting or symposium during this activity?

1. ☐ Yes → *(ANSWER Q. 34)*

2. ☐ No → *(GO TO Q. 40)*

(34.) What was the name of the scientific meeting, its principal organizer and his/her institutional affiliation?

_____
(TITLE OF MEETING)

_____
(PRINCIPAL ORGANIZER)

_____
(INSTITUTIONAL AFFILIATION)

(35.) Please provide the following information about this meeting.

Subject: _____

Duration: _____

Approximate number of participants: _____

(36.) What role did this meeting play in your visit? *(Check one.)*

1. ☐ It was the primary reason for my visit.
2. ☐ It was one of several planned activities.
3. ☐ It was unanticipated in planning the visit, but I heard about it and/or my attendance was encouraged by my foreign colleagues.
4. ☐ Other role *(Please specify)*: _____

_____

_____

37. What was your participation in this meeting? *(Check all that apply.)*

1. ☐ Organizer or arranger
2. ☐ Participant/discussant
3. ☐ Observer
4. ☐ Presented invited paper
5. ☐ Presented contributed paper
6. ☐ Other participation *(Please specify)*: _____

_____

38. What was the format of the meeting? *(Check one.)*

1. ☐ Program consisting primarily of invited papers, by well-established scientists.
2. ☐ Program consisting of invited and refereed papers.
3. ☐ Program consisting mainly of short presentations by all or most attendees and interactive discussion; few or no formal papers presented.
4. ☐ Other format *(Please specify)*: _____

_____

_____

39. On a scale ranging from "Poor" (1) to "Excellent" (5), what was your opinion on the quality of this meeting?

(For each of the items below, please check the box that corresponds to your opinion.)

	POOR → EXCELLENT 1	2	3	4	5
1. The arrangements for the meeting or symposium were:	☐	☐	☐	☐	☐
2. The context and quality of the presentations were:	☐	☐	☐	☐	☐
3. The size of the meeting in relation to what it sought to accomplish was:	☐	☐	☐	☐	☐
4. The opportunities for contact and discussions were:	☐	☐	☐	☐	☐
5. In comparison with other professional meetings, this one was:	☐	☐	☐	☐	☐

40. Did you teach a course during this activity?

1. ☐ Yes → *(ANSWER Q. 41)*

2. ☐ No → *(GO TO Q. 44)*

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(41) Please indicate the following for each course you taught during this activity. *(Attach additional sheets if necessary.)*

COURSE 1.

A. Title of course: _____

B. Subject: _____

C. Institution/Department: _____

D. Number of students: _____

E. Duration: _____

COURSE 2. ☐ *Check here if only one course taught.*

A. Title of course: _____

B. Subject: _____

C. Institution/Department: _____

D. Number of students: _____

E. Duration: _____

(42) Was there any feature of this course (content, teaching, methods, etc.) that you thought particularly effective?

1. ☐ Yes 2. ☐ No *(GO TO Q. 43)*

Please specify: _____

_____

(43) Was there any feature of this course that you thought particularly ineffective?

1. ☐ Yes 2. ☐ No *(GO TO Q. 44)*

Please specify: _____

_____

(44) Did you engage in any activities aimed at improving the research or teaching capabilities of a foreign science institution?

1. ☐ Yes 2. ☐ No *(GO TO Q. 48)*

Please specify: _____

_____

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(45.) Was there any feature of this effort that you thought particularly effective?

1. ☐ Yes 2. ☐ No
(GO TO Q. 46)

Please specify: _____

_____

(46.) Was there any feature of this effort that you thought particularly ineffective?

1. ☐ Yes 2. ☐ No
(GO TO Q. 47)

Please specify: _____

_____

(47.) Were steps taken in this effort to link these research or teaching capability improvements to the social or economic goals of the country?

1. ☐ Yes 2. ☐ No
(GO TO Q. 48)

Please specify: _____

_____

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(48.) Some of the common problems encountered in participating in international scientific activities are shown below. Which, if any, were problems for you?

(Check all that apply.)

1. ☐ Inadequate living arrangements for a longer-term stay abroad.
2. ☐ Inefficient travel and hotel arrangements for trips.
3. ☐ Quality of scientific work lower than in the U.S.
4. ☐ Inadequate access to foreign colleagues for exchange of information/ideas.
5. ☐ Incompatibilities between my research interests and those of foreign colleagues.
6. ☐ Quality of scientific resources, such as materials, computers, instruments, or other research facilities, lower than in the U.S.
7. ☐ Inadequate access to research facilities.
8. ☐ Inadequate cooperation/equipment/funds for my collaborators/hosts from the responsible foreign government agency.
9. ☐ Inadequate access to field sites.
10. ☐ Difficulties in obtaining import/export licenses or customs approval for specimens, equipment, etc.
11. ☐ Inadequate time to accomplish objectives.
12. ☐ Poor planning; too much travel to allow for adequate information exchange.
13. ☐ Burdensome administrative requirements placed on the project by the responsible foreign government agency.
14. ☐ Other problem *(Please specify)*: _____

    _____
15. ☐ Other problem *(Please specify)*: _____

    _____
16. ☐ No problems *(If this item is checked, GO TO Q. 51.)*

(49.) Of those items selected in Question 48, which <u>three</u> do you consider to be the <u>most</u> important problems?

(Please rank by placing the item numbers, from Q.48, in the appropriate boxes below.)

MOST IMPORTANT	SECOND MOST IMPORTANT	THIRD MOST IMPORTANT
☐	☐	☐

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(50.) Please discuss the problems, identified in Question 48, which delayed the activity or interfered with its accomplishments. If possible, recommend ways in which these problems can be alleviated.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(51.) Were there features of this activity that you thought particularly facilitated the accomplishment of objectives?

1. ☐ Yes

2. ☐ No

(GO TO Q.52)

Please specify: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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SECTION III

This section includes questions about your background, and how this project came about.

52. What is your field of specialization?

_____
(FIELD OF SPECIALIZATION)

53. What is your current title or rank? *(Check the appropriate box(es).)*

1. ☐ Professor
2. ☐ Associate Professor
3. ☐ Assistant Professor
4. ☐ Other title, not listed above *(Please specify)*: _____

_____

54. Roughly, what percentage of your time is devoted to the following activities?

A. _____% Research management

B. _____% Research

C. _____% Teaching

D. _____% Administration

E. _____% Other activity *(Please specify)*: _____
100 %

_____

55. What is the highest degree that you have received?

_____
(HIGHEST DEGREE)

56. In what field or discipline was this degree granted?

_____
(FIELD OR DISCIPLINE)

57. In what month and year was this degree granted?

_____ (MONTH) _____ (YEAR)

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(58) From which institution was the degree received?

_____
(INSTITUTION GRANTING DEGREE)

(59) What country is that institution in?

_____
(COUNTRY)

(60) What is your native language?

_____
(NATIVE LANGUAGE)

(61) What is your sex?

1. ☐ Male 2. ☐ Female

(62) Did your participation in the scientific activity identified on the cover sheet last less than one month?

1. ☐ Yes → *(ANSWER Q. 63)* 2. ☐ No → *(GO TO Q. 65)*

(63) Approximately how many days did you spend on the activity?

_____
(NUMBER OF DAYS)

(64) What date did you begin your participation in this activity?

(Please indicate month, day and year.)

_____ (MONTH) _____ (DAY) _____ (YEAR) → *(GO TO Q. 66)*

(65) What were the beginning and ending dates of your participation in this activity?

(Please indicate month and year.)

BEGAN: _____ (MONTH) _____ (YEAR)

ENDED: _____ (MONTH) _____ (YEAR)

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66. How old were you at the inception of this activity?

_____
(AGE)

67. At the time this activity began, what was your institutional affiliation?

_____
(INSTITUTIONAL AFFILIATION)

68. At the inception of this activity, what was your title or rank? *(Check the appropriate box(es).)*

1. ☐ Professor
2. ☐ Associate Professor
3. ☐ Assistant Professor
4. ☐ Other title, not listed above *(Please specify)*: _____

_____

69. In what field of specialization would you place your research while participating in this activity?

_____
(FIELD OF SPECIALIZATION)

70. Please indicate the number of times you have participated in each of the following activities, during the five years prior to the activity mentioned on the cover sheet.

(Check one box for each activity.)	None (0) 1	A Few (1-5) 2	Many (6+) 3
A. Trips abroad to scientific meetings.	☐	☐	☐
B. Post-doctoral research project(s) abroad.	☐	☐	☐
C. Collaborative research project(s) abroad.	☐	☐	☐
D. Teaching or lecturing abroad.	☐	☐	☐
E. Visit(s) to foreign scientific institutions to exchange information.	☐	☐	☐
F. Trip(s) abroad to gather data or specimens.	☐	☐	☐
G. Host to foreign scientist.	☐	☐	☐
H. Other activities involving foreign scientists. *(Please specify)*: _____	☐	☐	☐

_____

_____

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71. How many of your visits abroad, noted in the answer to Question 70, were to the country or region specified on the cover of this questionnaire? *(Check one.)*

1. ☐ None (0)
2. ☐ A few (1-5)
3. ☐ Many (6+)
4. ☐ No visits abroad in Q. 70.

72. This question refers to advances made in the field of the activity mentioned on the cover page. Do you try to keep up with the scientific advances made in the country or region specified on the cover of this questionnaire?

1. ☐ Yes → *(ANSWER Q. 73)*

2. ☐ No → *(GO TO Q. 75)*

73. How do you attempt to keep up on these advances? Listed below are a number of potential information sources. Please choose the most important sources for you.
(Check all that apply.)

1. ☐ Visits to the country.
2. ☐ Visits by foreign scientists to U.S.
3. ☐ Attendance at international scientific meetings.
4. ☐ Literature sources.
5. ☐ Preprints/correspondence from foreign colleagues.
6. ☐ U.S. colleagues knowledgeable about the country.
7. ☐ Other source *(Please specify)*: _____

_____

74. Of those items selected in Question 73, which <u>three</u> do you consider to be the <u>most</u> important information sources?

(Please rank by placing the item numbers, from Q. 73, in the appropriate boxes below.)

MOST IMPORTANT	SECOND MOST IMPORTANT	THIRD MOST IMPORTANT
☐	☐	☐

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(75) Which of the following statements best describes what led you to seek funding for the activity with which this questionnaire is concerned? *(Check one)*

1. ☐ Foreign colleagues suggested I seek support for this activity.

2. ☐ Professional colleagues, at my university, suggested I seek support for this activity.

3. ☐ Professional colleagues in other U.S. universities suggested I seek support for this activity.

4. ☐ The NSF suggested I seek support for this activity.

5. ☐ I heard or read there were funds available and applied.

6. ☐ I developed the project on my own initiative, and then sought funding for it.

7. ☐ Other reason *(Please specify)*: _____

_____

(76) What was the approximate total cost of your participation in this activity?

$ _____
(APPROXIMATE TOTAL COST)

(77) What percentage of the funds were provided by the following sources?

(Enter percentage of total funding by each source.)

A. _____% National Science Foundation (NSF)

B. _____% Other government agency (not NSF)

C. _____% Academic source

D. _____% Industrial source

E. _____% Personal funds

F. _____% Private Foundations

G. _____% Other source *(Please specify)*: _____

100 %

_____

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(78) If you had not received funding for the activity from the NSF Division which supported it, what would have been your next step? *(Check one.)*

1. ☐ Cancelled or postponed the activity.
2. ☐ Encouraged my institution to support it.
3. ☐ Sought funding from another NSF Division.
4. ☐ Sought funding from another U.S. Government Agency.
5. ☐ Sought funding from a foundation.
6. ☐ Sought funding from foreign sources.
7. ☐ Sought funding from an international organization.
8. ☐ Paid for it myself.
9. ☐ Asked for a budget reallocation on an existing NSF grant.
10. ☐ Other step *(Please specify)*: _____

_____

(79) In light of your participation in this activity, are there features (e.g. policies, level of support, operations, management, etc.) of NSF programs for support of international science activities which you feel are important to change?

1. ☐ Yes 2. ☐ No *(GO TO Q. 80)*

Please specify: _____

_____

_____

_____

(80) Are there features of these programs which you feel it important <u>not</u> to change?

1. ☐ Yes 2. ☐ No *(GO TO Q. 81)*

Please specify: _____

_____

_____

_____

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81. Please make any additional comments below.

_____

_____

_____

_____

_____

_____

_____

_____

_____

82. Finally, if you have a copy of your publications list that you can send us, please enclose it in the envelope with the questionnaire.

Thank you for completing this questionnaire. Please take a few minutes to make sure you have answered all the applicable items, and that your name and address appear on the cover. Use the postage-paid preaddressed envelope to return the questionnaire. If you would like to receive a copy of the survey results, check the box on the cover page.

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APPENDIX D

Institutions Visited by Country

for SEED and COMPARISON Groups

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Institution At Which Most of Time Was Spent, Presented by Country and SEED vs. Comparison Group

SEED Group		COUNTRY	Comparison Group	
Institution	Number of Times Listed		Institution	Number of Times Listed
		AFGHANISTAN		
Kabul University Cartography Facility	1			
		BOLIVIA		
Consortium for International Development - La Paz in Ministerio de Asuntos Campensinos y Agropecuarios	1			
Servicio Geologico de Bolivia	1			
		BRAZIL		
Departamento de Ciencias Socias Aplicadas	1		INPA, Instituto Nacional De Pesquisas da Amazonia	3
Federal University of Paraiba, Campina Grande, Brazil	1		RV Alpha Helix	5
ICE, da Universidade Federal de Monas Gerais			Universidade Federal de Para	1
			Universidade de Sao Paulo	4
Institute Biological Science Lab - Plant Pathology	1		University of Brasilia	1
Instituto Biologico	1		University de Campinas	2
Universidade Federale da Belria	1			
University of Sao Paulo	1			
Unspecified or illegible	1			

(3)

COUNTRY

CHILE

SEED Group Institution	Number of Times Listed
Catholic University of Valparaiso, Chile	1
Dept. of Forestry Forest Pathology Lab	1
Universidade Federal Sao Carlos, Brasil	1
University Austral de Chile	1
University of Chile	1
University of Concepcion, Chile	1
University of Santa Maria	1

Comparison Group Institution	Number of Times Listed
Cerro Tololo Interamerican Observatory	8
Departomento de Biologia	1
Departmento de Oceonografia	1
Empresa Nacional del Petroleo (de Chile) - Punta Arenas Office	1
Geological Survey of Chile	1
Instituto Antarctica Argentino	1
Instituto Hidrogratico Naval de la Armada del Chile	1
Instituto do la Patagonia	1
Las Campanas Observatory	2
Observatorio Austral El Leoncito Yale	1
Universidad Catolica de Chile	3
Universidad de Chile	1
Universidad Nac. de San Juan	1
Universidad del Valparaiso	1
Unspecified or Illegible	5

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COUNTRY

SEED Group		Comparison Group	
Institution	Number of Times Listed	Institution	Number of Times Listed
COLOMBIA			
EAFIT	1	Alpha Helix	1
Hospital Infantil de Bogota	1	Centro Internacional de Agricultura Tropical	1
Instituto de Asuntos Nucleares	1	Lomalinda Center in Colombia	1
Instituto de Pesquisas Hidraulicas, Porto Alegre, Brazil	1	My Own	1
Technical University of Bucarawonga	1		
Universidad Industrial de Santander	1		
Universidad Javeriana, Bogota Colombia S.A.	1		
Universidad de Medellin	1		
Universidad del Valle	2		
Unspecified or Illegible	1		
COSTA RICA			
CATIE of the OAS	1	Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costo Rica	1
Escuela Geol. Centro Amer., Univ. de C. Rica			
Genetic Resources Program - C.A.T.I.E. Turrialba, Costa Rica	1	Green Turtle Station, Tortuguero, Costa Rica	1
		La Selva Field Station	2

COUNTRY	SEED Group Institution	Number of Times Listed	Comparison Institution	Number of Times Listed
COSTA RICA	Inst. Geol. Min. Petrol Government Agency	1	Museo Nacional de Costa Rica	1
	University of Costa Rica	1	Smithsonian Tropical Research Institute	2
			University of Costa Rica	1
			Not Applicable	1
DOMINICAN REP.	Ministry of Agriculture	1		
	Universidad Catolica Madre y Maestra	1		
ECUADOR	Escuela Politecnica Nacional	1	Darwin Research Station	1
	INIAP	1	Museo del Banco Central in Guzyaquil	1
GHANA	Universidad of Dar es Salaam	1		
	University of Ghana	1		
	University of Science & Technology, Kumasi, Ghana	1		

COUNTRY	SEED Group: Institution	Number of Times Listed	Comparison Group: Institution	Number of Times Listed
GUATEMALA				
	ICAITI	1		
	Institute of Nutrition of Central America and Panama (INCAP)	1		
	School of Engineering Universidad Rafael Laudivar	1		
HAITI				
	Department de l'Agriculture	1		
HONDURAS				
	Dir. Gen'l. de Minae e Hidrocarberos	1		
	University of Honduras	1		
INDIA				
	Indian Institute of Technology, Kharagpur	1		
			Indian Statistical Institute	2
			International Statistical Institute	1
			Physical Research Lab	3
			RV Melville	1
			Tata Institute	1

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SEED Group		COUNTRY	Comparison Group	
Institution	Number of Times Listed		Institution	Number of Times Listed
		INDONESIA		
Andalas University, Padong, Sumatra, Indonesia	1		Geol. Research and Development Center	1
BIOTROP	1		Indonesian Inst. Sciences	1
Bogar Agricultural Univ., Faculty of Forestry (Indonesia	1		National Inst. of Mining & Geology (a sub-division)	
Gadja Madu Univ.,Yogya Karta, Java	1		Lambaga Biologi Nationale	1
National Biological Institute of Indonesia	1		Rumphius Memorial Laboratory	1
Orchid Laboratory, Kebum, Reuja, Begor	1		Wan Ecology Institute	2
Rural Development Program, Gov't. of Indonesia	1			
Satya Wacana Christian University, Salatiga, Java	1			
		JAMAICA		
			Discovery Bay Marine Laboratory	3
			University of West Indies	3
		KENYA		
Gecaga Instl. Tropical and Comparative Endocrinology, U.Nairobi, Kanya	1		Amboseli National Park	1
Kanya Rangeland Ecological Monitoring Unit	2		East African Academy	1
			Nairobi Museum (T.I.L.M.I.A.P.) Kenya	1
University of Nairobi	6		National Museum of Kenya	6
			University of Nairobi	3

COUNTRY	SEED Group: Institution	Number Times Listed	Comparison Group: Institution	Number Times Listed
KOREA	Korea Advanced Institute of Science	1	Unspecified or illegible	1
	Korea Atomic Energy Research Institute	1		
	Korea Institute of Science & Technology	4		
	Seoul National University	1		
	Sogang University	1		
	Yonsei University, Seoul, Korea	1		
MALAYSIA	Regional Education Center for Science and Mathematics	4	Department of Meteorology	1
	Southeast Asian Ministers of Education Organization	1	Forest Research Institute, Kepong, Selangor	1
			Lizard Island Research Station, Great Barrier Reef, Australia	1
			University of Malaya	1
MEXICO	Consejo de Recursos Minerales, Mexico, D.F.	1		

COUNTRY	SEED Group: Institution	SEED Group: Number of Times Listed	Comparison Group: Institution	Comparison Group: Number of Times Listed
NEPAL				
	Tribhuvan University Institute of Science	1		
NIGERIA				
	Department of Geography	1	University of Ibadan	1
	I.I.T.A.	1	Unspecified or Illegible	1
	Instituto Biologico			
	Nigerian Mining Co.	1		
	University of Ibadan	2		
	University of Lagos, Lagos Nigeria	1		
PAKISTAN				
	Pakistan Institute of Nuclear Science and Technology	1		
PANAMA				
	University of Panama	1	Coco Solo Hospital	1
			Discovery Bay Marine Laboratory	1
			Smithsonian Tropical Research Institute	5
			Unspecified or Illegible	1

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COUNTRY

SEED Group		Comparison Group	
Institution	Number Times Listed	Institution	Number of Times Listed
PAPUA NEW GUINEA			
Division of Botany, Office of Forests, Lal Papua, New Guinea	1		
PERU			
Catholic University of Peru	1	Cocha Cashie Biological Station Mann National Park	1
International Potato Center	1	Jicamarca Radio Observatory	5
University of Lima	1	Instituto Geofisico del Peru	2
		Instituto del Mar del Peru	7
		IMARDE, Institute Marine and Fisheries Research	4
		Instituto Nacional de Cultura Filial de Trujillo	1
		Instituto Oceonografico	1
		International Potato Center	1
		Universidad Catolica del Peru	1
		Univ. de Huamanga	1
		Univ. Nacional Agraria	1
		Univ. Nacional de Amazonia	1
		Univ Nacional Mayor de San Marcos	2
		Univ. Nacional del Trujillo	1
		Unspecified or illegible	4

COUNTRY	SEED Group: Institution	Number of Times Listed	Comparison Group: Institution	Number of Times Listed
PHILLIPPINES	ASEAN Postharvest Horticulture Training & Research Center	1	Institute for Philippine Culture	1
	Institute for Small Scale Industries	1	Ministry of Nieves, Manila	1
	International Rice Research Institute	2	National Museum of the Philippines	1
	Silliman University	2	Phili Bureau of Mines	1
	Southern Capital Colleges	1	Silliman University	1
	University of the Philippines	3	Unspecified or Illegible	1
SRI LANKA	Bogar Agr'l. Univ	1		
SUDAN	Department of Business Administration	1		
TANZANIA	Ardhi House	1		
THAILAND	Asian Institute of Tech.	1		
	Institute for the Promotion of Science & Technology	1		

SEED Group		COUNTRY	Comparison Group	
Institution	Number of Times Listed		Institution	Number of Times Listed
		THAILAND (cont'd)		
Kasetsart University	2			
Research Center, Ramathibodi Hospital, Bangkok	1			
		TRINIDAD		
Ministry of Agriculture	1			
		TURKEY		
Bagazici Universitasi	3			
Geological Engineering Dept.	1			
Middle East Technical University	1			
		VENEZUELA		
Instituto Venezolano de Investigaciones Cientificas	1		Fundacion Centro de Investigacion de Astronomia	1
			I.E.S.A.	1
			Instituto de Botonica, Sao Paulo, Brazil	1
			Instituto Venezolano de Investigaciones Cientificas	5
			INTEC	1
			M.I.T.	1
			Servicio de Meteorologia	1
			Universidad Central de Venezuela	1
			Univ. Nacional Agraria	1
			Univ. de Oriente	

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SEED Group		COUNTRY	Comparison Group	
Institution	Number of Times Listed		Institution	Number of Times Listed
		ZAMBIA		
Zambian Department of Fisheries			The Institute for African Studies, Lusaka Zambia	1

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