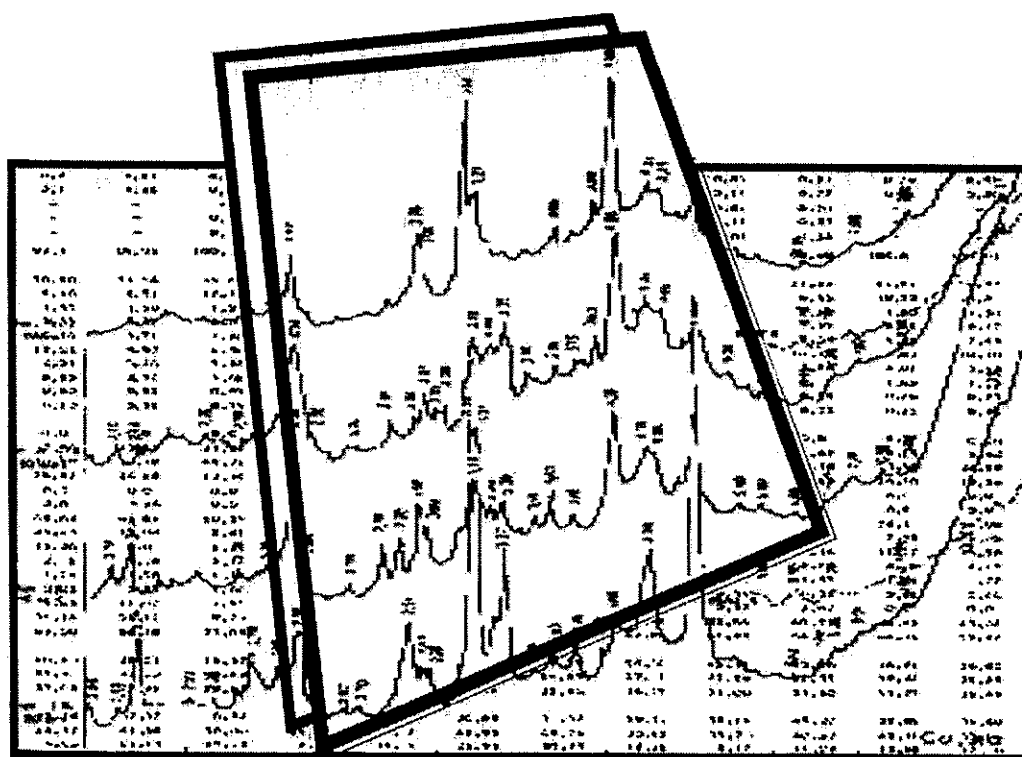


colloques
et
séminaires

LES INDICATEURS DE SCIENCE POUR LES PAYS EN DÉVELOPPEMENT

SCIENCE INDICATORS FOR DEVELOPING COUNTRIES

Textes réunis, édités et présentés par
RIGAS ARVANITIS et JACQUES GAILLARD



Actes de la Conférence Internationale sur les Indicateurs de Science
dans les Pays en Développement. ORSTOM / CNRS
Paris, Unesco, du 15 au 19 octobre 1990

ORSTOM
Editions

**ACTES DE LA CONFÉRENCE INTERNATIONALE
SUR LES INDICATEURS DE SCIENCE
DANS LES PAYS EN DÉVELOPPEMENT
ORSTOM / CNRS**

Paris, Unesco, du 15 au 19 octobre 1990

**LES INDICATEURS DE SCIENCE
POUR LES PAYS
EN DÉVELOPPEMENT**

***SCIENCE INDICATORS
FOR DEVELOPING COUNTRIES***

Textes réunis, édités et présentés par
RIGAS ARVANITIS et Jacques GALLARD

Actes publiés avec le soutien du MRT

Editions de l'ORSTOM

INSTITUT FRANÇAIS DE RECHERCHE SCIENTIFIQUE POUR LE DÉVELOPPEMENT EN COOPÉRATION

Collection **COLLOQUES et SÉMINAIRES**

PARIS 1992

La loi du 11 mars 1957 n'autorisant, aux termes des alinéas 2 et 3 de l'article 41, d'une part, que les «copies ou reproductions strictement réservées à l'usage privé du copiste et non destinées à une utilisation collective» et, d'autre part, que les analyses et les courtes citations dans un but d'exemple et d'illustration, «toute représentation ou reproduction intégrale, ou partielle, faite sans le consentement de l'auteur ou de ses ayants droit ayants cause, est illicite» (alinéa 1er de l'article 40).

Cette représentation ou reproduction, par quelque procédé que ce soit, constituerait donc une contrefaçon sanctionnée par les articles 425 et suivants du Code pénal.

ISSN : 0767-2896
ISBN : 2-7099-1082-9

© ORSTOM 1992

TABLE DES MATIERES

INTRODUCTION

Vers un renouveau des Indicateurs de Science pour les Pays en Développement (R. ARVANITIS, J.GAILLARD)	9
---	---

ALLOCUTIONS D'OUVERTURE

M. Marc CHAPDELAINÉ, Unesco	37
M. Jacques GAILLARD, Président du Comité d'Organisation	41

CONFERENCE INAUGURALE A LA MEMOIRE DU PROFESSEUR M. MORAVCSIK

Three scientometric etudes on developing countries as a tribute to Michael MORAVCSIK (A. SCHUBERT, T. BRAUN)	49
---	----

I - DE LA CONSTRUCTION DES INDICATEURS DE SCIENCE

1 - Peripherality in science : What should be done to help peripheral science get assimilated into mainstream science (S.ARUNACHALAM) ..	67
2.- Le "granum salis" de réalisme des indicateurs de science : le rôle du contexte historique (J.J. SALDAÑA)	77
3 - Access and retrieval of information as coordinates of scientific development in Nigeria (I. ADAMSON)	83
4 - Collective indicators as alternatives for science and technology measurement in developing countries (B.VISWANATHAN)	93
5 - Nouveaux indicateurs en science et technologie : quelques réflexions à partir de l'étude d'un petit pays (G. ARGENTI)	101
6.-Ambiguities and discrepancies in the criteria for evaluating technological research in Mexico (L. LOMNITZ, S. GARCIA SALORD)	115
7 - Information management for research monitoring (Michel J. MENOÛ)	125

II - STRUCTURATION DES CHAMPS SCIENTIFIQUES, EVALUATION ET CONDITIONS DU DEVELOPPEMENT SCIENTIFIQUE

1 - Des axes de recherche pour un programme infométrique de veille scientifique et technique (W.A.TURNER)	139
2 - The evaluation of plant biomass research: a case study of the problems inherent in bibliometric indicators (S.M. THOMAS)	149
3. Evaluation d'un fonds de financement de la recherche: stratégies scientifiques et processus productifs dans les communautés scientifiques de la périphérie (R. WAAST, J. GAILLARD)	165
4- Impact of studies published in the international literature by scientists at the National University of Mexico (H. DELGADO, J.M. RUSSEL) ...	191
5 - Scientometric indicators as a means to assess the performance of state supported universities in developing countries: the Chilean case (M. KRAUSKOPF)	209
6 - Evaluation of recent scientific research output by bibliometric method (B.K. SEN)	225
7 - Indices de structuration de l'activité scientifique: exemple de cinq domaines avant 1968 en Côte d'Ivoire (Y. CHATELIN, R. ARVANITIS)	239
8 - Analyse d'un programme pluridisciplinaire par deux méthodes d'analyse de réseaux: le cas du groupe de recherche sur Canavalia (R. ARVANITIS, T. BARDINI)	253
9 - Patterns of scientific communication among latin american journals in the field of medical education (C.A. MACIAS-CHAPULA)	271
10 - The conditions of scientific research in chemistry: a view from the Brazilian community (M.A.H. CAGNIN)	281
11 - The missing link in the infrastructure of science: agricultural research in Malaysia (S. ABDULLAH)	301

III - COLLABORATIONS SCIENTIFIQUES ET GEOSTRATEGIES

1 - Science and politics: some bibliometrics analysis (F.W. LANCASTER, S. ABDULLAH)	319
---	-----

2 - International scientific collaboration in Latin America (N. NARVAEZ-BERTHELEMOT, L.P. FRIGOLETTO, J.F. MIQUEL)	333
3 - International scientific collaboration in arab countries (J. EL ALAMI, J.C. DORE, J.F. MIQUEL)	357
4 - Cooperative research between the Spanish National Research Council and Latin American Institutions (M.T. FERNANDEZ, A. AGIS, A. MARTIN, A. CABRERO, I. GOMES)	373
6 - The Inter-Agency Development Information System (J. FURBERG) ..	385

IV - VISIBILITE ET STRATEGIES DE PUBLICATION

1 - Access to Third World science in international scientific and technical bibliographic databases (G. WHITNEY)	391
2 - Misjudgements and shortcomings in the measurements of scientific activities in Less Developed Counties (R. SANCHO)	411
3 - Communications patterns in agricultural research in Cameroon (P. THORPE)	425
4 - Use of publication lists to study scientific production and strategies of scientists in developing countries (J. GAILLARD)	439
5 - Brazilian production in biochemistry: international versus domestic publication (R. MENEGHINI)	457
6 - Publications of scientists in developing countries: national and international production of Argentinian ecologists (J.E. RABINOVITCH)	467
7 - Partial assesment of Mexican health sciences research 1982-1986 (J. LICEA de ARENAS)	479
8 - Access to national and international scientific information as revealed by scientific activities in three peripheral countries (M.W. LUBOWA)	487
9 - Measurement of the scientific production in Brazil: the case of economics (D.B. de MIRANDA PUERARI, M. de NAZARE FREITAS PEREIRA)	497

V - LE ROLE DES REVUES SCIENTIFIQUES

- 1 - Bibliometric control and international visibility of Latin American periodical publications (V. CANO) 511
- 2 - Evaluation of the sectorial program of publications in science and technology FINEP/SCT/Brazil (P. MORICONI VALERIO) 527
- 3 - Breaking the information barrier: a computerized research journal produced by and for developing countries (T.R. PRESTON, A.W. SPEEDY) 539
- 4 - The role of scientific journals in developing countries: the case of physics in Latin America (C.D. GALLES) 547
- 5 - Citation behavior of Philippine biological scientists (J.L. MACLEAN, M.J.M. VEGA) 557

VI - LES SYSTEMES NATIONAUX DE RECHERCHE

- 1 - Measuring the development of national agricultural research systems (J. ROSEBOOM, P.G. PARDEY) 571
- 2 - Regional databases and S&T development indicators: problems, achievements and utilization of GRADE's Latin American database (P. Mc L. de ARREGUI) 593
- 3 - A profile of scientific research in health in Venezuela (J.D. POLANCO, L. YERO) 603
- 4 - The measurement of national scientific and technological potential for policy making purposes (Y. de HEMPTINNE, J. MBA-NZE) 619
- 5 - Les enjeux en matière d'information scientifique et technique dans un pays en développement: le cas de Madagascar (J. RATSIMANDRAVA) ... 631
- 6 - Bibliometric analysis applied to a science policy database (M. F. RAMOS) 637
- 7 - Research on China's science and technology indicators (DU X, FEI S., GAN X., SUN D., WANG. H.) 645

ANNEXES

1.- Liste des membres du comité scientifique	649
2.- Liste des membres du comité d'organisation	650
3 - Listes des auteurs et participants à la Conférence	651
4 - Fiches signalétiques des travaux empiriques présentés à la Conférence.	653

REGIONAL DATABASES AND S&T DEVELOPMENT INDICATORS: PROBLEMS, ACHIEVEMENTS AND UTILIZATION OF GRADE's LATIN AMERICAN DATABASE

Patricia McLauchlan de ARREGUI
Group of Analysis for Development (GRADE)
Apartado 18-0572, Lima 18, Peru

ABSTRACT

GRADE (Group of Analysis for Development) has from 1970 onwards accumulated a large volume of S&T and socio-economic indicators gathered in a database. The purpose of this database is to maintain updated statistical data which can be used to monitor the evolution of scientific production in the region, as well as to assess its contribution to social and economic development. After two years of project implementation this article is discussing the achievements and the reasons for its relative underutilization.

RESUME

GRADE (Groupe d'Analyse pour le Développement) a accumulé depuis 1970 une quantité importante d'informations S&T et socio-économiques qu'il a rassemblé dans une base de données. L'objectif de cette base est de tenir à jour les données statistiques nécessaires à l'observation de l'évolution de la production scientifique dans la région, ainsi qu'à l'évaluation de sa contribution au développement économique et social. A près deux années de fonctionnement cet article discute les résultats obtenus et les raisons de sa relative sous-utilisation.

INTRODUCTION

For several years since its creation in 1980, researchers at GRADE have been conducting theoretical and empirical studies on Science and Technology (S&T) policy. They have at the same time been monitoring the evolution of policies applied in Latin America and in the Caribbean countries, as well as their differential results. While several books and many scholarly and policy papers in

those two fields of work have been published¹, particularly by Francisco Sagasti, two review reports on the situation of S&T in these regions, published as working papers in 1983 and 1985², have been most frequently quoted as valuable sources of information³.

I - ORIGINS, PURPOSES, OUTCOMES AND PROSPECTS OF GRADES' S&T DATABASE

In the course of those activities, the institution had by 1987 accumulated a large volume of statistical information. Therefore, it was decided, with support from the Organization of American States and of Canada's International Development Research Centre, that the best way to put it to advantageous use was to create a computerized database, containing statistical series dating from 1970 onwards on the most commonly used indicators of S&T development.

The data which were originally incorporated include annual standard input and output measures for each of 33 Latin American and Caribbean countries, as well as general social and economic development indicators which are useful to assess the relative standing of each of the region's countries. These statistical series are as complete as allowed by the periodicity with which relevant primary information is collected in each country.

Examples of those indicators are the following: number of Research and Development (R&D) units and projects; scientists, engineers and technicians in R&D; enrollment and staff in different levels of higher education; university degrees; R&D expenditures; export and import composition; direct foreign investment; foreign royalty payments.

Other data refer to production and productivity indicators such as patents, mainstream S&T journal publications, citations and authors, domestic S&T publications and international prizes obtained by local scientific researchers or innovators. Also included are general socioeconomic indicators such as population, birth and mortality rates, life expectancy at birth, population per physician and hospital bed, daily per capita calory supply, gross domestic product, per capita energy consumption, value added in manufacture, exchange and inflation rates and foreign debt.

¹ A representative set of such papers can be found in Sagasti et al. (1988). Other more recent publications include Cueto (1989), Garland (1988 and 1989), Garrido Lecca (1985), Sagasti and Garland (1985).

² Sagasti et al.(1983); Sagasti and Cook (1985).

³ A representative set of such papers can be found in Sagasti et al. (1988). Other more recent publications include Cueto (1989), Garland (1988 and 1989), Garrido Lecca (1985), Sagasti and Garland (1985).

Many of the input variables are in turn disaggregated according to the different criteria proposed by UNESCO: type of research (basic, applied, experimental development), scientific field (exact and natural, agricultural sciences, engineering and technology, health, social, others), sector of performance (public and private; productive, higher education, general services), economic sector, etc.. Another important classification criterion is main economic aim (evaluation and exploration of the earth, sea, and atmosphere; civil space; agricultural, forestal, and silvicultural development; industrial development; production, conservation and distribution of energy; development of transport and communications; development of educational services; development of health services; social development and socioeconomic services; environmental protection; advancement of knowledge; defence; other aims).

The purpose of this project has been to assemble and maintain updated statistical data which can be used to monitor the evolution of scientific production in the region, as well as to assess the efficacy and efficiency of its contribution to social and economic development. The S&T DB is intended to provide this information in a timely, homogeneous and comparable manner to a variety of users, including academics, planners, politicians and public officials working in this area.

At first glance it may seem strange that this task be assumed by a private research center. One would believe that its "natural" location would be a national S&T promotion or regulatory agency or a regional development agency interested in these issues. However, the instability of policies and politicians in Latin America, as well as of their administrative styles, and the precarious financial and institutional conditions in which they must operate, including high rotation rates of technical personnel, in addition to GRADE's own initiative, determined that this institution would carry out the project in its first phase.

The initial --and continuing-- processes of identifying sources of primary and secondary information, of obtaining their collaboration, of reviewing and contrasting data obtained from different sources, of assessing the methodologies applied for collecting and processing data in each country, and of evaluating the completeness of the obtained information were rather difficult. While the volume of information quickly became substantial, notorious gaps were left open. It was not possible to determine whether those gaps could be attributed to a real lack of primary data sources or rather to the simple fact that communication efforts had been insufficient or less productive than desired. Establishing contact with information providers was rather more difficult than anticipated, even in spite of the good offices of the agencies who had previously promoted and financed national surveys on S&T capacity in this region and who were supporting the current effort.

A simple optimistic explanation might have been that the existence of the database remained yet largely unknown, and that well planned dissemination efforts would take care of the problem in the near future. However, serious consideration had to be given to the possibility that the general thrust of the

project, or the way in which it was being carried out (that is, incorporating at first the conventional S&T input and output indicators), did not respond to the real needs of planners and decision makers.

Moreover, uncertainties about the quality of the available information (which database managers are constantly trying to assess, requesting generating agencies' cooperation) and about the appropriateness of some of the standard development indicators were not assuaged throughout that first stage of the project. Repeated requests for comments, suggestions and criticisms submitted to potential policy-making users remained largely unmet.

It became evident to database managers that, in order to promote cooperation with and utilization of the system, they would have to be the first users of their own services. Thus, two simple studies on scientific production and productivity were carried out in 1988 and 1989. It was expected that their publication would show the type of use that could be given to the available data. It would generate more interest in the information source and would stimulate demand for its services, assessments of data validity and reliability and discussion of necessary additions or changes in the database.

The better known of those papers⁴, which was published as part of the International Development Bank's 1988 annual development report and later on as a GRADE working paper, reviewed available statistics on papers authored by Latin American and Caribbean researchers in mainstream scientific journals, citations of those publications, patents requested and awarded in this region of the world and international prizes granted to Latin American scientists. In this same line of work, an essay was written⁵ which compares research productivity - measured in terms of the relationship between the number of registered mainstream publications and citations, the number of scientists and engineers involved in research and development, and the volume of R&D expenditures-- as well as its thematic distribution among the largest countries of the region.

Thereafter, information obtained from the papers themselves, and through direct requests to GRADE, has been used quite frequently by researchers both within the region and elsewhere. The papers have been extensively cited and have allowed the incorporation of their authors into international academic networks. They have also elicited varied and contradictory reactions regarding both their practical utility and their academic soundness, on grounds of many of the issues which are being considered in the various sessions of this meeting.

However, the project's objectives were mainly and explicitly aimed at satisfying information needs of those involved in the design, application and/or evaluation of S&T development policies for individual countries or for the region as a whole, who could use the S&TDB indicators to compare their domestic situation with that of other Latin American countries in terms of the sufficiency,

⁴ Arregui (1988).

⁵ Torero and Arregui (1989).

efficacy and efficiency of resource allocation. By comparing the results obtained in other places with different policies, they could, for example, explore the convenience of introducing changes in the strategies pursued in their own countries. In that process, it was expected that they would alert database managers on data errors and limitations, articulating demands for additional and different variables to be included in it and promoting that responsible agencies in each country would devise means for assembling new necessary statistics. The final outcome of this continuous process would be the availability of a sound information system for decision making in this important development field.

Among those who were initially identified by database managers as those "involved in the design, application and/or evaluation of S&T development policies" and who were therefore targeted as primary potential users, can be found a wide range of social institutions and actors. While there was a definite implicit interest in satisfying information needs of scientists, professional organizations and trades unions, scientific associations, universities and other educational institutions, international technical cooperation agencies and academics (particularly those studying science itself), prime intended subjects whose information needs were to be met --and prompted-- were politicians, congress members, productive sector representatives, national S&T promotion and regulation agencies, national or regional planning bodies and governmental executive offices.

After two years of project implementation, it must be admitted that those planners and policy makers, however, are not yet among those utilizing the information provided by the S&T DB. For some reason, the "numbers" are not being "sold".

Thus, there is now a need to evaluate the present usefulness of the database and to plan its future evolution. Furthermore, it is necessary to evaluate the adequacy of the conventional indicators it contains, particularly in terms of their relevance for planners active in the field of S&T policy. Therefore, the project's current objective is to assess these issues and to propose and promote the adoption of additional and/or alternative indicators, as well as to improve those currently available.

A series of activities are being carried out this year, which will certainly benefit from the discussions being held during this international meeting. Those activities include the updating and verification of available data, the preparation of users' guides, the provision of information to interested parties, the application of a user survey and the design and publication of a statistical handbook based on the information in the database.

Furthermore, a Latin American seminar has been scheduled for the end of November, during which participants will review "state of the art" issues related to the design, collection and utilization of S&T indicators, will analyze theoretical, methodological and technical aspects of those issues and will jointly evaluate user reaction to the database. Efficient means of data collection and processing, as well as the appropriate balance between national and regional

information systems will also be given consideration. By the end of the year, decisions about the continuity of the project, about the data it should contain and about the most convenient institutional framework for its future development will be taken.

II - POTENTIAL NEEDS AND RELATIVE UNDERUTILIZATION OF GRADE'S DATABASE

Having briefly described the origins, purposes and current outcomes and prospects of this project, in what is left of this presentation, I would like explore some of the reasons why demand for the data base's services has not been forthcoming from its targeted audience. Obviously, there is a whole set of issues dealing with theoretical, conceptual and methodological aspects and limitations of conventional indicators which may have made it difficult for local officials to utilize them as planning instruments. Many of the presentations in this meeting have dealt with those issues, however, and I will therefore concentrate on a somewhat different matter: institutional aspects of the project's development which may better explain its relative underutilization by those parties whose needs it most particularly sought to satisfy.

In the first place, it is convenient to recall what it is that S&T indicators seek to measure and with what aims. Their objective is to evaluate the situation, the pace of progress being attained and the impact of S&T activities, as well as to foresee their likely contribution to social and economic development. They can be used to make decision makers aware of the interrelationships among the many variables which intervene in a scientific system's efforts and help them to establish priorities for the allocation of scarce resources to various disciplines and institutions. They can also be used to improve research institutions' management of their programs, given that they allow detecting implicit changes in the objectives of scientific efforts, and to evaluate their linkages to other social activities.

Supposedly, a country's S&T regulatory and promotion agencies would require information in order to facilitate decision making and day-to-day management, as well as to design and propose mid- and long term policies in this field. In practice, however, this may be far away from the real interests of these organizations, which can easily become so bureaucratized that their sole concern is their own survival, or which can be used by their leaders as a power base for the recruitment of future political support. Where this is true, it is clear that policies effectively applied will not easily be congruent with the "planning" focus of efforts such as the previously described database.

With respect to other potential users of the database, that is, academics, politicians, providers of S&T services, entrepreneurs, etc., almost as little is known about their perceived needs, except that when they are in urgent need to

make some public declaration or to present some diagnostic statement or proposal, they request particular bits of information.

It is difficult to believe there are no real needs, for which reason it will be momentarily assumed that the problem lies in a lack of channels through which demands can be formulated. When thinking about how S&T indicators are used elsewhere, the first image which comes up is that of scientific establishments as lobbies or particular interest groups and their negotiations with governments in order to obtain a larger piece of the pie in public resource allocation. Data provided by the National Science Foundation are waved by the educational system to demand more resources with arguments such as "The Japanese are taking up all openings in science graduate programs in the U.S.. Meanwhile, less and less resources are being allocated to basic research. It is essential to increase the quantity and quality of those programs if we are not out to destroy our industrial competitiveness and to relinquish our position in international trade". Another typical use of indicators occurs when mainstream publication and citation counts of a university's faculty are compared to average output or to other institutions in order to argue in favor of continued financial support from the federal government or of increased contributions from alumnae to institutional investment funds. Why is it that this does not occur in our countries?

A tentative response is that, very much like our industry, science has developed under the --not very-- protective mantle of the State. One could argue over the effectiveness of that protection, over its consistency through time or over its coherence with other public policies in the State's spheres of social and economic intervention. However, few practitioners of S&T activities would advocate that the obtention and distribution of resources for science should be determined solely by the free play of market forces.

However, once interest groups are successful in establishing public agencies responsible for the promotion or regulation of S&T activity, they back up and cease to provide them with information and other inputs --including the pressure of their demands for processed information-- which those agencies would require in order to fulfill their role. The typical document containing S&T plans which --with luck-- these agencies may regularly produce remains largely unread.

Other problems which occur in Perú may be also true of many of our countries. The general public does not perceive any tangible benefits arising from science or technological innovation which might make it worthwhile for them to become more interested in their development⁶. The productive system

⁶ Arregui and Acosta (1988), in a study of desirable scenarios for the future of Perú, found that S&T factors have no space in young Peruvian leaders' expectations for "a better future". With the almost single exception of references to the positive impact of the introduction of computers into many spheres of social and personal life, the few other spontaneous references to S&T incorporated into their descriptions of their dreams and expectations were remarks on the need to control them so that "progress" would not increase unemployment.

nourishes its weak growth with imported technologies and does not demand much from the local S&T system. Scientists do not organize themselves as pressure groups (except the few which teach in universities) in order to demand support. Therefore, none of these potential sources of demand for information to support policy proposals becomes effective.

Another reason which might explain why there has not been more interaction between information supply (i.e., the database) and potential demand is the difficulties which assail dialogue between research institutions and public sector agencies. Researchers and bureaucrats have different cultures, logics, discourses and languages, which make two-way exchanges rather difficult. It would be necessary that *active* scientists become more involved in public planning work, even at the price of their already fragmented time availability⁷. They should participate not only as technical advisors in their fields of specialization, but in all phases of what should be a constant process of identifying consensual mid and long term objectives, fixing targets, formulating strategies and evaluating results. Planners, in turn, need to invest time in convincing scientists that resources are really scarce, that priorities therefore need to be established and that they need to use available funding effectively and efficiently.

Finally, another reason why there is no demand for information from planners is that no real planning is going on. Increasingly over the last decades, social planning, which is eminently a mid- and long term oriented function, despite being considered necessary, appears more and more distant from the main and urgent concerns of politicians and decision makers (Sagasti 1988). Moreover, even where, in spite of the awareness of its problems and limitations, people and governments accept the possibility and convenience of rational interventions to guide national development, planning agencies tend to easily become some sort of technical secretariat of the Presidency, attending short term issues and becoming involved in political controversies (Sagasti 1988) in ways which contradict its essentially "harmonizing" (*concertadora*) mission (Santa Cruz 1990).

It is crucial to redefine the role and structure of planning institutions, clearly establishing that the main responsibility of its central body, specially in this age of information overload, should be the reception, filtering, organization and distribution of information for high-level decision making.

⁷ "...a full time researcher in an American university probably spends more time really doing research than his officially equivalent Latin American colleague, who in fact spends half his time teaching and advising, another half doing research, another half doing administrative and planning activities, half time doing private consulting, half time looking for funding, half time carrying out public relations for his or her institution, saving only two of his remaining half times in order to write mass-audience articles based on his studies, take care of his personal hygiene and try to balance his checkbook (always in the red, to be sure)..." (Arregui 1990, pp.16-17).

FINAL REMARKS

Meanwhile, and while the future course of the database project is determined, I can't help but make use of this opportunity to request support from all of you, by providing new data and corrections to the samples of output which we have distributed during this meeting, by making suggestions as to the strategy which ought to be followed in order to obtain more cooperation from relevant statistical offices and, specially, by giving us your opinions about the value, real or potential, of this effort. Thank you.

REFERENCES

- ARREGUI, Patricia McLauchlan (1988). "Indicadores comparativos de los resultados de la investigación científica y tecnológica en la América Latina" en Banco Interamericano de Desarrollo. Progreso Económico y Social en América Latina 1988. Washington.
- ARREGUI, Patricia McLauchlan (1990). "Los Indicadores Convencionales de Desarrollo Científico y Tecnológico: Indicadores de Insumos y Producción". Paper presented at the Latin American Seminar on S&T Development Indicators organized by GRADE and IDRC, held in Lima in November 1990. Lima, GRADE, mimeo.
- Cueto, Marcos. Excelencia Científica en la Periferia: Actividades Científicas e Investigación Biomédica en el Perú 1890-1950. Lima, GRADE/CONCYTEC, 1989.
- GARRIDO-LECCA, Hernán (1985). WARC-ORB-85: sharing a pie in the sky? Lima, GRADE.
- GARLAND, Gonzalo (1989). "Ciencia y tecnología en el área andina: programas prospectivos hacia el año 2000". Caracas, UNESCO (mimeo), mimeo.
- GARLAND, Gonzalo (1988). "Algunas reflexiones sobre el impacto de las nuevas tecnologías en los campos de competencia de la UNESCO". Reunión de Consulta, Caracas, UNESCO, mimeo.
- SAGASTI, Francisco; CHAPPARO, Fernando; PAREDES, Carlos; JARAMILLO, H (1983). "Un Decenio de Transición: Ciencia y Tecnología en América Latina Durante el Decenio de 1980". Lima, GRADE, mimeo.
- SAGASTI, Francisco and COOK, Cecilia (1985). "Tiempos Difíciles: Ciencia y Tecnología en América Latina Durante el Decenio de 1980". Lima, GRADE, mimeo.
- SAGASTI, Francisco et al. (1988). Conocimiento y Desarrollo: ensayos sobre ciencia y tecnología. Lima, GRADE/Mosca Azul.
- SAGASTI, Francisco and GARLAND, Gonzalo (1985). Crisis, knowledge and development: A review of long-term perspectives on science and technology for development. Lima, GRADE.
- TORERO, Máximo and ARREGUI, Patricia; "Publicar y/o Morir: la Productividad e Impacto de la Investigación Científica en América Latina" in VESSURI, H. (ed.) La capacidad científica y tecnológica en América Latina. N.Y., U.N. University, (forthcoming).