INFORMATION EXCHANGE AND INTERNATIONAL CHANGE:

THE CASE OF INFOTERRA*

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THE supply of information is increasing at an extraordinary rate, internationally no less than domestically. Of some 190 United Nations information systems now in existence, over half have been established since 1970, most of these since 1975. Moreover, the increase is especially pronounced in facilities that process and manipulate information rather than merely storing it, and which have an active outreach component rather than simply waiting to be used. The rate of growth in information systems catering to the particular needs of developing countries has been even more impressive; they now comprise over one-third of all facilities, up from less than one-tenth only a decade ago.[1]

The intended objective of any intergovernmental information system is to upgrade the quality or sophistication of decision making and policy by providing greater uniformity of access to specialized information that some and perhaps many decision-makers previously lacked. Such systems can be particularly useful in an issue-area like the human environment—in which problems are relatively novel, highly complex, and often transnational in scope, and in which information is relatively scarce, highly inter-disciplinary and often costly to produce. Here, such systems can contribute to policy change through the substantive activity of facilitating the dissemination of information, as well as through the catalytic activity of generating an awareness among policy-makers of the need to produce and utilize information where this awareness does not already exist. There is no presumption that

[1] Inter-Organization Board for Information Systems, *Directory of United Nations Information Systems* (Geneva: United Nations, 1980), 2 Volumes. The *Directory* lists 335 systems. Thirty-two of these are either (a) not operational, (b) mere public relations centers for the media, thus not informational as we use the term here, or (c) restricted in use to its own officials, thus not international as we conceive of the term for present purposes. Moreover, 111 others are simply components of larger systems. Through eliminating the first set and merging the second, we arrive at our own count of 192 systems.

international harmony will follow. Access to information can as readily sharpen conflicts of interest as attenuate them, but at the least it makes more transparent factors and forces that otherwise might have remained masked or beyond consideration altogether.

Most United Nations information systems have a second-order objective as well. On the premise that knowledge is power, the redistribution of access to knowledge is seen as a potential means to compensate for the lack of material bases of power in developing countries—as a means to substitute "brains" for "muscle," in short, and thereby to enhance the capacity of poorer countries to act beyond the limitations imposed by the world distribution of material resources.

In this article, we examine these issues in the context of the most inclusive intergovernmental system for the exchange of environmental information: INFOTERRA, a component part of the UN Environment Programme. We proceed as follows. Section I contains a brief description of the system. In Section II, we construct an activity profile of it, showing what use is made of it and by whom. In Section III, we address the more elusive issue of its catalytic role in generating interest in and awareness of the human environment and of the use of environmental information in policy-making. Section IV contains a discussion of problems and constraints which INFOTERRA has encountered. In Section V we conclude with some summary remarks about the lessons of INFOTERRA for the broader question of the role of information exchange in international change.

I. *The System*

Numerous references to the need to exchange environmental information on a systematic basis were made at the Stockholm Conference (UN Conference on the Human Environment, June 1972).[2] Of the various means imaginable for the construction of a system of information exchange, the most demanding is to create an international data bank which collects, stores and delivers information on its own; the least demanding is to refer users to sources. The Stockholm Conference adopted the concept of a referral service.[3] Its mandate called for it to react to specific requests for information and to draw upon existing sources of information, with the new international environmental organiza-

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[2] United Nations, *Report of the United Nations Conference on the Human Environment held at Stockholm*, 5-16 June 1972, A/CONF.48/14.

[3] Recommendation #101 of the "Action Plan" in *ibid*. The evolving INFOTERRA mandate as per UNEP Governing Council decisions is contained in UNEP Document INFOTERRA-2/3.

tion, UNEP, coordinating the linkage between users and sources. The referral service came to be known as INFOTERRA.

There was widespread agreement among governments that nothing more ambitious and costly than a referral service should be attempted, at least in the short run. However, there was a good deal of disagreement concerning its specific design features. Differences of view stemmed from the fact that information does not exist in a socio-economic vacuum. Information and information technology are goods which are owned or controlled by concrete private and public actors, and to some extent they reflect the needs and interests of the setting in which they originate. Therefore, the characteristics of the technology to be used and the range of subject coverage to be included in an information system can have important economic, social and political implications. In the struggle over the design of INFOTERRA, the basic cleavage divided the technologically advanced countries and the developing nations. Some of the early initiators of INFOTERRA from the technologically advanced countries, of Western Europe in particular, saw it potentially as an on-line, satellite-based, computerized system, concerned largely with physical parameters and problems, especially pollution. Others, including the United States, were satisfied with more modest means that would enable existing information and experience to flow from the industrialized North to the developing countries. Most developing countries rejected both the high-technology design and the concept of a simple transfer of the environmental lessons of the North to the South, on the grounds that this would lock them into existing patterns of technological and informational dependence, while the system itself paid relatively little attention to the particular environmental problems of most serious concern to them, such as soil erosion, human settlements and natural resource depletion. UNEP attempted to resolve these differences by opting for the gradual build-up of a system in which there would be no technological constraints on participation, designing its routines in such a fashion that manual operations would suffice, and by broadening the range of subject coverage to be included. In the process, however, some of the enthusiasm for INFOTERRA of early supporters in the advanced industrial countries waned. Today, scanning for sources is computerized in some 20 countries though no on-line search capability exists, and is performed manually in the rest. The system comprises 26 broad subject areas for which sources of information can be supplied, and nearly 1,000 cross-referenced "attributes" (key words) denoting more specific areas

of expertise of listed sources.[4] INFOTERRA is aimed mainly at the needs of decision-makers, not those of scientific specialists.

INFOTERRA is a decentralized system, based upon and operating through so-called focal points. Each participating country is required to designate a national focal point (NFP), an office in an appropriate ministry that will serve as the link with INFOTERRA. NFPs are to identify local sources of environmental information which are "willing and able" to provide it to would-be users. Such sources are registered with the INFOTERRA Programme Activity Centre (PAC) in Nairobi which includes them in its Directory of Sources in standardized and coded form, indicating their areas of expertise as well as the conditions under which they are willing to part with information. A source can be an agency of government, a research organization or university, a commercial establishment, or even an individual. NFPs must revalidate each of their sources every two years to avoid having them dropped from the Directory. Updated supplements of the Directory are published at six-month intervals. UNEP is also encouraging the inclusion in INFOTERRA of Sectoral Focal Points, established by international organizations active in environmentally-related fields, and of Regional Focal Points established by bodies like the EEC and CMEA. This decentralized structure was thought to be not only the least costly means of facilitating information exchange, but also the design most likely to catalyze governments and international organizations to upgrade existing information systems or to create them where none existed.

The referral procedure is activated when a potential user of information requests its NFP to provide it with a list of appropriate sources. Ideally, the following sequence of transactions is to ensue. The NFP codes the query and scans the subject index for the right combination of attributes. It then sends the would-be user an annotated list of sources. The would-be user in turn analyzes the list and forwards requests for information directly to selected sources. The sources so addressed close the loop by supplying the information that was requested. The only funding

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[4] See UNEP-INFOTERRA, *IRS Operating Manual* (Nairobi: UNEP, May 1977). The twenty-six subject areas are these: atmosphere and climate; oceans, seas and estuaries; fresh water; energy: resources, supply and use; non-renewable resources; chemical and biological agents and processes; physical energy phenomena; disasters; renewable resources; land use and misuse; food and agriculture; wildlife—animal and plant; recreation; population; human settlements and habitats; human health and well-being; transportation; technology and industry; monitoring and assessment; management and planning; socio-economic aspects; education, training and information; subject disciplines; geographic references; pollution; wastes.

that UNEP is mandated to provide is for the infrastructure of coordination, including the Directory of Sources and related publications, as well as a variety of training exercises in the use of the system.

In sum, by virtue of its design, the success of INFOTERRA depends almost entirely on the efforts of partner countries. For its part, UNEP has attempted to build up a system in which a large number of diverse countries might have an interest in participating, and to reduce technological and organizational obstacles that might stand in the way of their participating. The central organization of INFOTERRA consists of the Programme Activity Centre in Nairobi and a Computer Unit in Geneva, with a combined professional staff complement of ten, and a total budget of less than $1 million per annum.

II. *Activity Profile*

INFOTERRA began to function in 1976, and became fully operational in January 1977 with the participation of a dozen countries, most of them developed. By January 1981, 112 National Focal Points had been designated, over 8,000 current sources were listed in its Directory, and a cumulative total of approximately 7,000 referrals had been processed. The monthly referral rate had levelled off at about 150 in 1978, but it had since more than doubled. Thus, INFOTERRA is a recent and still evolving system, so that a static snapshot of it at this point in time may not do it full justice. The following figures should be interpreted in this light.

Table 1 contains overall activity profiles of INFOTERRA, comprising cumulative statistics on access to the system, sources registered and referrals processed. (Right-hand triangles are percentaged down, left-hand triangles are percentaged across.) Access depends initially on the designation of a National Focal Point. As indicated in Table 1-A, not all countries have as yet done so, though those which have represent some 98% of the world's population.[5] However, only about one half of all NFPs can be described as being active. With respect first to the registration of sources, Table 1-A shows that the largest single group of NFPs falls into the "negligible sources" category with developing countries making up a disproportionate share. Nonetheless, ten developing countries have registered more than 50 sources, with another

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[5] For example, the five Western industrialized countries with no NFPs are Iceland, Lichtenstein, Luxembourg, Monaco and San Marino. The developing countries without NFPs by and large are either strife-torn (e.g. Afghanistan, Iran) or very small (e.g. Bahamas, Comoros).

ten between 25 and 50.[6] The majority of the Western Industrial members have registered more than 50 sources, though four of them also fall into the "negligible" category.[7] The CMEA countries cluster in the intermediate range; it is their policy and their wish for INFOTERRA as a whole not to include individuals as sources.[8]

Table 1-B includes only those countries which have designated NFPs, and indicates their level of activity in terms of the number of requests for sources of information that they have processed over the course of the entire life-span of INFOTERRA.[9] Again, the single largest group, indeed, fully one-half of all cases, falls into the "negligible" category. But here the Western Indus-

TABLE 1: INFOTERRA ACTIVITY PROFILE
(cumulative totals, January 1976 — January 1981)

A: SOURCE REGISTRATION

LEVEL OF ACTIVITY	TYPE OF COUNTRY			
	LDC	CMEA	WESTERN INDUSTRIAL	
	percentaged down			
NO NATIONAL FOCAL POINT YET DESIGNATED	32.2% / 86.4%	11.1% / 2.3%	17.7% / 11.4%	n=44
NUMBER OF SOURCES REGISTERED BY NFP:				
NEGLIGIBLE (0-5)	31.4% / 78.7%	22.2% / 4.3%	14.3% / 8.5%	n=47
LOW (6-25)	19.5% / 92.0%	22.2% / 8.0%	---	n=25
MEDIUM (26-50)	8.5% / 55.5%	33.3% / 16.7%	27.8% / 27.8%	n=18
HIGH (more than 50)	8.5% / 40.0%	11.1% / 4.0%	50% / 56.0%	n=25
	n=118	n=9	n=28	

trial countries are divided almost evenly between "negligible" and "high activity," and almost as many developing countries fall into the "high" range. Table 1-C separates out those instances of
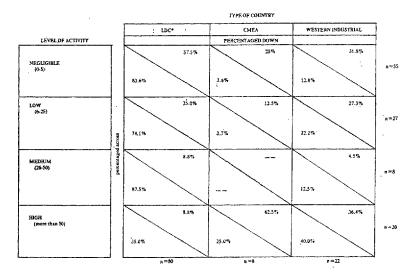
[6] The ten LDCs with more than 50 registered sources are Bangladesh, Brazil, Chile, China, Colombia, India, Kenya, Mexico, Philippines, and Thailand.

[7] The four are Austria, Belgium, New Zealand and Switzerland.

[8] The position of the CMEA countries is to consider as sources only "units which are not smaller than independent laboratories and departments in research institutions or schools of higher educational establishments." *Report of INFOTERRA* 2, UNEP Document INFOTERRA-2/16, p.27. Such differences in the specification of sources makes a strict comparison on this basis among countries somewhat problematical.

[9] These are instances of *reported* referrals, and therefore are subject to differences in national reporting practices.

referrals in which the NFP forwards a request for sources to the INFOTERRA Programme Activity Centre for it to process. The number is substantial: nearly one-third of LDC referrals fall into this category, as do just under 30% of CMEA referrals.

B. REFERRALS TO SOURCES

TYPE OF COUNTRY

LEVEL OF ACTIVITY	LDC*	CMEA	WESTERN INDUSTRIAL	
	PERCENTAGED DOWN			
NEGLIGIBLE (0-5)	57.5% / 83.6%	25% / 3.6%	31.8% / 12.8%	n=55
LOW (6-25)	25.0% / 74.1%	12.5% / 3.7%	27.3% / 22.2%	n=27
MEDIUM (26-50)	8.8% / 87.5%	— / — —	4.5% / 12.5%	n=8
HIGH (more than 50)	8.8% / 35.0%	62.5% / 25.0%	36.4% / 40.0%	n=20
	n=80	n=8	n=22	

(percentaged across)

C. REFERRALS PROCESSED BY UNEP-PAC*

TYPE OF COUNTRY	% OF TOTAL
LDC	32.1%
CMEA	28.3%
WESTERN INDUSTRIAL	13.9%

*Cumulative totals as of January 1980

Sources: A and B calculated from UNEP/GC.9/5; C calculated from UNEP Document INFOTERRA EM-1/6-C.

An activity profile of INFOTERRA based on the mere fact of membership alone to some extent is an artifical construction, since simply belonging to UNEP or even designating a National Focal Point for INFOTERRA can and oftentimes does represent a purely formal commitment on the part of governments. We therefore supplement this aggregate profile with a look at the system's most active members. They are listed in Table 2. There is a striking difference between levels of activity as measured by sources registered and referrals processed. With respect to sources, the top five countries, all Western, account for well over half of

the total. Referral activity is distributed far more evenly among the various groups, with LDCs constituting five of the ten most active members.[10] Two conclusions are suggested by this pattern. First, developing countries are far more active in the system than the aggregate figures based on membership alone would indicate. Second, the original model of North-South information transfer, which the LDCs rejected at the time of Stockholm and for a period thereafter, appears now to characterize the structure of information flow in INFOTERRA. This conclusion is reinforced when we note that the main areas of inquiry within INFO-TERRA have been pollution, chemical and biological agents, technology and industry, management and planning, atmosphere and climate, and monitoring and assessment[11]—and not those areas for which the LDCs agitated at an earlier time. The most

TABLE 2: INFOTERRA'S MOST ACTIVE MEMBERS

(cumulative totals as of January 1981)

Sources Registered		*Referrals Processed**	
USA	1495	USA	1625
United Kingdom	1045	Morocco	476
Federal Republic of		India	458
Germany	910	China	344
Canada	663	United Kingdom	265
Australia	514	German Democratic	
India	501	Republic	260
Netherlands	389	Australia	217
France	225	Colombia	213
Thailand	168	Kenya	193
Bangladesh	163	Poland	155
Total for all member countries	8213	Total for all member countries	5741

* Preliminary figures; total is expected to be approximately 7000.

Source: UNEP/GC.9/5

[10] The figures for the United States and for Morocco require special mention. The extremely high number of referrals reported by the US does not reflect domestic queries only, but also includes international queries sent to the US Environmental Protection Agency—which in many cases is better known abroad than the fact that a NFP may exist in the country in which the query originated. When such queries find their way to the US INFOTERRA Focal Point, which is housed in EPA, they are reported as INFOTERRA queries. In the case of Morocco, any query which is responded to using the tools of INFOTERRA (its Directory and search procedures) is reported as an INFOTERRA query.

[11] UNEP Document INFOTERRA-2/4, p.10.

plausible explanation for this change is that the earlier posture of the developing countries by and large was articulated by representatives of foreign offices, whereas INFOTERRA's present clientele consists of officials representing environmental agencies and concerns.

Lastly, we place the levels of activity within INFOTERRA into a broader comparative perspective, so that we can get a clearer sense of what they signify. We are interested in particular in how the distribution of information via INFOTERRA compares with that of other UN information systems, and with national attributes that have some bearing on environmental problems and policy. There is not a great deal of comparative data available, but Table 3 is suggestive in several respects.

The distribution of National Focal Points for UN information systems may be taken as a measure of the distribution of access to the information that these systems provide. Table 3 suggests that NFP distribution (column 5) favours the "rich" and "very rich," while disadvantaging the "poor" and "very poor" when compared to the proportion of countries (column 1) or of world population (column 2) falling into the various income groups. But what is striking is how little the poorer groups are disadvantaged and the richer favoured when compared to general measures of national industrial capacity (column 3) or more specific measures of national scientific capability (column 4). The major difference between NFP distribution in the universe of UN information systems as a whole (column 5) and that in INFO-TERRA (column 6) is that INFOTERRA NFPs are distributed more evenly among income groups. Measured in this fashion, INFOTERRA is particularly strongly represented in the intermediate ranges of income groups.

Turning to the distribution of sources in INFOTERRA (column 7), we of course see their heavy concentration in the "very rich" category. Perhaps less obvious but no less interesting is the fact that for each of the "very poor," "poor" and "medium" income groups, the proportion of INFOTERRA sources is nearly twice their proportion of world scientific and technological personnel (column 4). Looked at from this vantage point, the poorer groups actually contribute more than their share of sources and the richer less than theirs. The same pattern holds for the distribution of INFOTERRA referrals (column 8), except that the relative participation of the "very poor" and "poor" is more striking still.

TABLE 3: ACTIVITY PROFILES & OTHER ENVIRONMENTAL INDICATORS, BY INCOME GROUPS

(circa 1979)

Income Group a	(1) % of Countries	(2) % of World Pop. b	(3) Mean Per Cap. Energy Cons. c	(4) % of World S/T Personnel d	(5) % of all UN NFPs e	(6) % of INFOT NFPs f	(7) % of INFOT Sources g	(8) % of INFO Referrals
very poor	27.3	30.5	79	6.2	21.5	19.4	11.5	18.6
poor	19.9	30.1	469	2.9	15.6	17.1	5.0	9.7
medium	14.3	6.7	837	2.0	14.4	16.3	5.8	3.9
rich	16.8	8.0	2.260	14.3	18.6	20.4	8.1	7.0
very rich	17.8	24.3	5.628	74.3	27.0	22.4	69.6	60.4
OPEC very rich	4.3	.4	3.322	.2	2.9	4.1	0.04	0.4

Notes and Sources:

a

Income group attributions as follows:

Very Poor: GNP per capita of $300 or less in 1977
Poor: 301 to 700
Medium: 701 to 1,200
Rich: 1,201 to 3,000
Very Rich: 3,001 and over
OPEC Very Rich: OPEC member countries with per capita GNP of over $3,000

Calculated from IBRD, World Development Report, 1979, pp. 126-27, 176.

b
IBRD, World Development Report, 1980, pp 110-11. Figures are for 1978.

c
Measured in kg of coal equivalent. 1978 world mean = 2,099 kg. IBRD, World Development Report, 1980, pp. 122-23.

d
World total = 66.7 million, based on various years reported during the 1970s. Unesco, Statistical Yearbook, 1980, pp. 755-58. (Category of "poor" excludes China; category of "medium" excludes Algeria, Mexico, and Turkey.)

e
Total number of NFPs = 1039. Computed from United Nations, Inter-Organization Board for Information Systems, Directory of United Nations Information Systems (Geneva: United Nations, 1980), Vol. 2.

f
As of mid 1979, so as to be comparable to preceding. Computed from UNEP Document INFOTERRA-2/4, prepared for Second Infoterra Network Management Meeting, Moscow, 1-6 October 1979, Table IV.

g
As of January 1980. Calculated from UNEP Document INFOTERRA EM-1/6-C.

We now summarize the general pattern of access, source registration and use within INFOTERRA, drawing on our own findings as well as on the results of a recent questionnaire survey of National Focal Points, users and sources, which was conducted by an independent evaluation team with the assistance of UNESCO.[12] At present, it is clear that the system is not being overburdened by use. The cases in which no NFP has yet been established, or in which the sources registered and/or referrals

[12] The questionnaire surveys were part of a broader evaluation of INFO-TERRA, the results of which are published in UNISIST, *Report on the Evaluation of INFOTERRA for the United Nations Environment Programme* (Paris: UNESCO, 1981). Questionnaires were sent to all NFPs; 61 were returned in time to be included in the analysis. Questionnaires were also sent to a random sample of 200 users, with a return rate of 38%, and to a selected sample of sources (unspecified in number), of which 156 responded. All the results of these surveys referred to here are from this source.

processed are "negligible" in number comprise the largest clusters of countries. In the survey of sources, only 25 of 156 reported that they had ever been queried. And the NFPs responding estimated that if INFOTERRA capabilities were to be fully developed within their countries, they would expect inquiries to number anywhere from three times their present level to six times and beyond, depending upon region.[13]

As best as we can tell, the structure of information flow follows a North-to-South transfer pattern. This is so not only because developing countries are far more active as consumers of the system than they are as producers, but also because the industrialized countries, especially the West Europeans, exhibit only moderate interest in being consumers themselves.[14] Although the developing countries at one point had rejected this pattern as perpetuating their dependency, the survey of users reports high levels of satisfaction at present.[15]

Lastly, the distribution of access to INFOTERRA is skewed somewhat less among income groups than is the comparable distribution in all UN information systems—and far less than the international distribution of comparable measures of national capacity. Moreover, compared to indicators of national capacity, the poorer countries actually "over-participate" in the system, both as sources of information and as originators of queries. To this extent, then, the exchange of information via INFOTERRA partially compensates for the extant allocation of resources in the world that bear on environmental problems and policy.

III.   *The Catalytic Role*

Levels and patterns of activity within the INFOTERRA network tell but one part of its story. Another part concerns the catalytic task that it was assigned by Stockholm: to generate within the policy-making community, particularly among development planners, an interest in and awareness of the human environment and of the role of environmental information in the decision-making process. This is an elusive goal, difficult to

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[13] Using this indicator, Eastern Europe is closest to operating at capacity level ("only" a three-fold increase), and South America has the longest way to go.

[14] Most of the available evidence suggests that the level of commitment to an active involvement in INFOTERRA is lowest among the West European nations. They of course have their own information systems, and they tend to view INFOTERRA as being too unsophisticated for their own needs and capacities.

[15] The responses indicated that most users thought the information received to be either "extremely useful" (28%) or "useful" (41%). The other ratings were "of slight use" (11%) and "of no use" (20%).

measure, and it can easily become a refuge for rationalizing failure on .other fronts. Nevertheless, it is a major objective of UNEP as a whole and INFOTERRA in particular. And just as UNEP as a whole can claim some credit for the creation of national environmental agencies where none existed or were even contemplated, so too can INFOTERRA claim some credit for having helped set in motion domestic activities in the field of environmental information.[16]

While little is known systematically about the success of INFOTERRA's catalytic mission, the survey of INFOTERRA referred to above does shed some light on it. Of the National Focal Points who responded to the questionnaire circulated by the evaluation team, twenty-three reported that their own establishment had also led to other institutional developments in the provision of environmental information within their respective countries; thirty reported that no such developments had taken place. Thirty-five NFPs reported an increase since their inception in the demand for environmental information within their countries; eighteen reported that no such effect had taken place. Over thirty reported improved cooperation among organizations concerned with environmental information, both within their countries and internationally; under twenty noted neither effect. These catalytic effects are most pronounced in developing countries. However, the data also showed that there seems to be more demand for information for scientific and technical purposes than for policy-making. And this tendency too is more pronounced in developing countries.

As noted, the survey of users indicated considerable satisfaction, which is important because personal contact with the system appears to be the most effective means of promoting it. However, it also suggested that because of the length of time it takes to obtain the desired end-product, users tend to rely on the referral mechanism for cases which lack great urgency or when other mechanisms have been exhausted.[17]

Lastly, the survey of sources produced the startling finding

[16] For a fuller discussion of the latent functions of international collaborative mechanisms in the context of global environmental issues, see John Gerard Ruggie, "On the Problem of 'The Global Problematique': What Roles for International Organizations?" *Alternatives,* 5 (January 1980).

[17] It takes an average of 40 days to get substantive information through the network. The major problem is the non-availability of telex—only 59% of NFPs have telex access (as few as 25% in Central and South America)—and lack of funding for telephone communication, as a result of which a great many NFPs have to rely on postal systems, which are slow and unreliable to begin with in many parts of the world and deteriorating elsewhere.

that nearly one-half of those responding were unaware of their involvement in INFOTERRA, while another third had never received a query from a user.

In sum, there are modest indications that progress has been made in catalyzing the creation of domestic activities in the field of environmental information. More national systems are coming into existence. And an international network of environmental information specialists is slowly emerging and is sustained in part by the INFOTERRA framework. The impact of these developments on the policy-making process, however, remains more problematical.

IV. *Problems and Constraints*

INFOTERRA self-consciously employs the instrument of information exchange in the attempt to produce international change. It seeks in general to upgrade the quality of national decision-making in domains having an impact on the human environment, through the dissemination of environmental information and by generating an awareness among policy-makers of the need to produce and utilize such information. And it seeks more particularly to compensate for the lack of appropriate resources in developing countries by enhancing their capacity to formulate and implement environmentally-sound development plans and policies. Because INFOTERRA is still evolving as a system, no definitive judgment is possible at this time of its long-term prospects in meeting these objectives. Nevertheless, present levels and patterns of activity within INFOTERRA do suggest that certain types of problems and constraints systematically shape its performance. We differentiate between situational and structural factors.

The most obvious situational constraints affecting INFO-TERRA are its mandate and the location of its headquarters. Governments chose to provide for a referral service, which limits how much INFOTERRA can do to facilitate the actual dissemination of information. And the annual budget of INFO-TERRA now is some 2.5% of UNEP's total, down from roughly 5% at its peak, which offers little scope even for the fuller implementation of existing services by, for example, providing greater assistance in obtaining documents from sources or paying for the translation of those that are obtained. As for its location, in Nairobi the INFOTERRA Programme Activity Centre is far removed from other UN information systems and even from its own computer unit, which by necessity is housed in Geneva, and

is not easily accessible to those of its members lacking telecommunications facilities. The most frequent suggestion made by developing country users and NFPs is for INFOTERRA to move beyond mere referral, toward the actual provision of information. While limited steps in this direction may be taken, the basic mandate of INFOTERRA is not likely to be altered fundamentally, and the problem of its geographic isolation will abate only slowly and partially as communication infrastructures are improved.

National Focal Points are subject to their own situational constraints. Only about 20 NFP offices have at least one full-time staff person engaged in INFOTERRA activities. Outside of the advanced industrial areas of the world, NFPs tend to lack adequate facilities, with the scarcity of access to telecommunications equipment being particularly pronounced. Separate budget allocations for INFOTERRA NFPs are the exception rather than the rule, so that financial commitments are not easily determined; however, the survey of INFOTERRA referred to above concluded that at the NFP level, the system operates largely on the goodwill and ingenuity of individuals juggling inadequate resources. As for quality control, relatively few NFPs have mechanisms for the routine updating of information about sources and, except for Eastern Europe, there exists no systematic mechanism to monitor the performance of sources. Here again, marginal improvements over time can be expected to take place, but there is no indication of any generalized upsurge in support for these component units of the INFOTERRA network from within their own governments.

We distinguish between two types of structural factors that affect the performance of INFOTERRA: information structure, and institutional structure. In terms of the first, INFOTERRA deliberately refrains from delimiting its subject coverage. It treats information as being environmental in character if governments take it to be so. And since different governments give different priority to different subject areas, INFOTERRA simply sums up the range of governments' perceptions. This "deliberate imprecision" is justified by INFOTERRA on the grounds that it is most likely to induce would-be users, on whom the burden of defining the totality and its component parts fall, into a fuller awareness of the inter-connectedness of the human environment. But it also reflects the compromise struck as a consequence of the initial skirmish between the industrialized and developing countries over specifying priority subject areas for the system. What

is more, INFOTERRA employs a search tool that it describes as an "index list" (the twenty-six subject areas), consisting mainly of "subject attributes" (for example: fish; toxic chemicals; human health) which may and often do appear under more than one subject area. A subject attribute, in term, is characterized as an "incomplete descriptor." That is to say, whereas a true descriptor would fully define an environmental concept of the system's vocabulary, it takes two or more INFOTERRA attributes combined to construct a usable concept (for example, the human health problems/of toxic chemicals/in fish). And whereas a true descriptor would bear a code indicating the place of that concept in an overall logical structure, the codes attached to INFO-TERRA attributes are purely nominal and thus are logically meaningless. INFOTERRA's justification for not employing a more sophisticated search tool is three-fold. First, it is said that the human environment is so complex as to make the task of constructing a lasting hierarchy of concepts inherently impossible. The simple case of water is offered as an illustration of the problem. Water is a broad environmental subject area under which narrower terms are listed, such as pollution or irrigation. But it is also a narrower subject attribute of other broad environmental subject areas, such as agriculture or climate. And it has a place alongside other media in functional categories such as monitoring and assessment. In other words, water is both broader and narrower than as well as equal to other terms in a hierarchy of environmental terms. Second, it is felt that a looser arrangement in any case enhances the prospects for serendipity, because it forces both users and sources to think about the widest possible set of combinations and permutations, so that what is lost in "elegance" is compensated for by "substantive richness." Lastly, some 80% of INFOTERRA focal points employ manual search methods in coding queries and locating sources, for which a cross-listed set of nominal attributes is deemed to be the most flexible and least difficult tool to use.

However, some National Focal Points find this method of information structuring and retrieval to be either complex and cumbersome, or unsophisticated, depending upon their own national information handling capacities. In the survey of NFPs, uncertainty was expressed about the very concept of an index list

itself.[18] The listing of subject attributes under the headings of the index list was almost universally criticized; virtually all NFPs felt that attributes were insufficiently specific, and most thought that the listing required greater structure. A large number of NFPs also found it difficult to coordinate attributes so as to construct a usable concept on the basis of which to search the Directory for sources. Moreover, of the NFPs who had referred queries to Nairobi rather than processing them themselves, nearly three-fourths found the Directory search to be too complex; one half indicated that the attribute listing was inadequate to express the subject matter on which information was requested. Thus, the loose information structuring, which at least in part was inspired by the desire to make the system widely accessible to those lacking expertise in and equipment for information processing, may have resulted in a system that is too demanding of their time and manpower resources—even while it is viewed as being too amateurish by information professionals in the advanced countries.

Several measures are intended to deal with these difficulties. Some industrialized countries and India have made available their computer facilities to neighbouring developing country members for the final stage of the search procedure, scanning the Directory for sources. INFOTERRA does the same through its own computer unit as a temporary expedient, but it lacks the mandate and the resources to continue it as routine practice. INFOTERRA also engages in extensive training programmes and seminars for National Focal Points. And an effort is under way by the INFO-TERRA-PAC to provide greater structure to the terminology of the system, though the cost and the inherent difficulty of doing so mean that this too will be a slow process.[19]

Lastly, INFOTERRA' smost fundamental constraint may stem from precisely that feature which was to have been its

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[18] More than half of those responding expressed "no opinion" on whether a different indexing method should be adopted, while about a third felt that the issue was not important. The evaluation team took this to mean that the basic indexing method is considered to be satisfactory. But experience with survey responses suggests that such an extraordinarily high expression of no opinion is far more likely to mean that the question was not understood. In other words, it may well be that a substantial number of NFPs responding did not know what the present indexing method consists of, or what alternatives to it might look like. (See footnote 12 for the source of this and the following findings from the surveys.)

[19] An alternative method of structuring the terminology would be by means of a thesaurus. The AGRIS thesaurus of the FAO is said to have cost over $1 million and several years to construct. The inherent difficulty no doubt is higher in the field of the human environment than it is in agriculture.

greatest virtue and source of strength; its decentralized institutional structure. The success of the system is utterly dependent upon the willingness and the ability of focal points to make it work. Such a design may be ideal for a small group of countries, having similar interests in and capacities for sharing information with one another. However, we know that as the size of any group increases, certain "collective action" problems may be expected to emerge, whereby the perceived necessity and therefore the *incentive* of any one member to contribute to the common enterprise in order to enjoy its benefits will decline. Should there also exist significant gaps in the *capacity* of members to contribute to such a joint effort, in the absence of some redistributive mechanism the worse-off among them are likely to be even more reluctant to allocate their scarce resources to it. And should the members of the larger group also have very different substantive concerns, their respective *interest* in the benefits of the collective activity will tend to decrease, and redistributive mechanisms will be opposed by those who would bear their costs. In circumstances such as these, "side payments" to actors are required to assure a reasonably satisfactory level of collective action.[20]

There is very little that INFOTERRA can do about these collective action problems stemming from its decentralized structure. To some extent it has succeeded in creating its own constituency of environmental information specialists, but this constituency, in turn, itself suffers from limited resources and impact, reflecting the low level of demand among policy-makers for environmental information, especially in developing countries. It may be that the promise of access to information and communication technology could serve the role of side payment to the broader community of policy-makers, triggering a greater interest in and commitment to systems such as INFOTERRA. But the opportunity for exploiting this incentive in the case of INFO-TERRA was missed some time ago. Given the initial enthusiasm of the industrialized countries for a high-technology system, it might not have proved impossible to obtain their support for the kind of technology transfer and technical assistance that made the

World Weather Watch feasible. It is true that the developing

[20] The basic reasoning behind this argument is explicated in Mancur Olson, Jr., *The Logic of Collective Action* (Cambridge, Mass.: Harvard University Press, 1965). Applications to problems in international organization may be found in Bruce M. Russett and John D. Sullivan, "Collective Goods and International Organization," *International Organization*, 25 (Autumn 1971), and John Gerard Ruggie, "Collective Goods and Future International Collaboration," *American Political Science Review*, 66 (September 1972).

countries at the time objected strongly to any technological dependence that such a system might have locked them into. But then again, they were never offered an internationally supported system that would have satisfied their demand for "additionality."[21] UNEP's own ideological affinity for "soft" technology, which might well have been appropriate in a domain characterized by a different demand pattern, reinforced the shift in attention away from the more "glamorous" designs.

V. *Conclusion*

What lessons can be drawn from the INFOTERRA experience for the broader question of the relationship between information exchange and international change? Four in particular stand out.

First, INFOTERRA confirms the impression, which we gained from a review of recent developments in all UN information systems,[22] that the supply and diversity of information available to policy-makers has increased exponentially. To some extent, this might well have taken place in the absence of UN systems, under the auspices of private firms or national governments, for example. But it is doubtful whether any other external means could duplicate the perceived legitimacy of demand-creation, especially in developing countries, that has been a major function of UN systems. And it is doubtful whether indigenous sources in developing countries would have arisen initially in the absence of at least some measure of external stimulus.

Second, we find that access to such systems, while highly skewed, is much more favourable to developing countries than the distribution of other resources in the international system. Accordingly, if dependency is seen as a condition resulting from the extant distribution of material resources, to the extent that this condition is amenable to change via information inputs, UN information systems have gone some way toward reversing dependency.

On the other hand, if we conceive of dependency as a cultural phenomenon, of being involuntarily tied to the precepts of western science and technology, as cognitive grids structuring one's world view and inspiring one's plans for the future, then the advent of UN information systems has not reduced dependency. Indeed, it

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[21] By additionality, the developing countries meant that any expenditures for environmental purposes, including by international aid agencies, should be appropriated in addition to extant commitments to development assistance, and not at their expense.

[22] See footnote 1 for source.

has probably increased it, because the flow of information continues to run from North to South, and the principles of design underlying the systems are western in nature. Here, however, the decentralized institutional structure of several of the major systems, including INFOTERRA, and their intended catalytic effects, may in the end result in a greater role for indigenous products and designs, and thus facilitate greater self-reliance.

Lastly, it is clearly easier to construct international information systems, and even to trigger the creation of domestic specialized constituencies making use of such systems, than it is to guarantee a hearing for them in policy arenas. Thus, until we know with greater certainty the conditions under which and the purposes for which information is actually used by policy-makers, our conclusions about information exchange and international change perforce must remain somewhat speculative in nature.