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REPORT OF THE
WORKSHOP ON RECOMMENDED IHP STRATEGIES
FOR TECHNOLOGY TRANSFER

(Submitted by the Secretariat of Unesco)

Synopsis

The Workshop on Recommended Strategies for the Acquisition of Knowledge and Technology by Developing Countries in the Field of Hydrology and Water Resources was held at Unesco Headquarters in Paris on 24-25 June 1986. It represented the implementation of IHP-III Project 18.1. A review of the effectiveness of past efforts by the IHP was made, and a number of recommendations for future strategies suggested. Included in those proposed strategies are: (1) strengthening of IHP National Committees and Unesco Regional Offices for Science and Technology, (2) the importance of education and training activities in the transfer of knowledge and technology, (3) the importance of human resources in the process, (4) the need to consider the "appropriateness" of the knowledge and technology to be transferred, (5) the need to more widely distribute IHP publications, (6) the importance of "pilot projects", (7) the importance of also diffusing locally developed technology, and (8) the need to prepare a manual to guide activities of IHP National Committees.

INTRODUCTORY NOTE OF THE WORKSHOP

The Workshop on Recommended Strategies for the Acquisition of Knowledge and Technology by developing countries in the field of hydrology and water resources was held at Unesco headquarters in Paris, on 24-25 June 1986. The workshop represents the implementation of Project 18.1(b) of IHP-III whose theme concerns the development of methods for the effective transfer of knowledge and technology in water resources and for the evaluation of their impacts in developing countries.

The workshop was attended by fifteen scientists from as many different countries, five Regional Hydrologists from Unesco's Regional Offices for Science and Technology, and two representatives of international and regional organizations as indicated in the list of participants. Mr. J.S. Gladwell participated in the meeting as project officer and served as secretary, Annex A is the List of Participants.

The meeting was opened by Mr. S. Dumitrescu, Deputy Assistant Director-General, Director of the Water Sciences Division. He welcomed the participants in the workshop and underlined the importance of the project for the IHP. He then introduced Mr. Qais Nuri Fattah (Iraq), Chairman of the Working Group for Project 18.1(a), and with the agreement of the workshop participants, invited him to chair the workshop.

The workshop then proceeded to consider as its basic document the report on "Recommended strategies for the acquisition of knowledge and technology in developing countries in the field of hydrology and water resources" which had been prepared by the Working Group of Project 18.1(a) of IHP-III. The report was presented to the participants and the basic elements of the report were underscored. A general discussion of the report and other ideas and concepts followed.

The workshop then made a number of general recommendations :

1. With modifications, the workshop endorses the report of the Working Group of Project 18.1(a). Annex B represents the accepted modified report.
2. The workshop places emphasis on the following strategies for transfer of knowledge and technology :

2.1 Strengthening of IHP National Committees and Regional Offices for Science and Technology is of paramount importance. The coordination and promotion of activities at the regional and national levels requires awareness of need and willingness to co-operate on the part of the hydrologists in each country.

Such a frame of mind needs to be nurtured, and - if not existent-generated. In order to achieve this, it is necessary to establish and/or strengthen networks enhancing the relationships between IHP National Committees, and between individual hydrologists. Exchange of information concerning activities relating to hydrology and water resources needs to be promoted and accelerated.

2.2 Education and training are very effective mechanisms of transfer of knowledge and technology. Such activities need to be carefully planned and continuously evaluated to provide feedback information necessary for maintaining relevancy of such programmes. No effort should be spared at all levels in order to encourage and facilitate the nomination and participation of suitable candidates from developing countries in these activities.

2.3 Transfer of knowledge and technology is considered to be essentially a process of development of human resources and indigenous technical capabilities. Without this, the developing countries will remain dependent on developed countries for continuous flow of technology. Developing countries need to incorporate this element in the water resources technology transfer plan indicated in the attached report of Annex B. The plan should be directed toward the specific needs of the region or country and have strategic dimensions of relevance to these needs and to the objectives of social and economic development.

2.4 The acquisition of knowledge and technology normally begins with a process of consideration of appropriate knowledge and technology specific to the country or region. The "appropriateness" should be viewed in terms of technical, human, economic, environmental, and social feasibility. In this respect, it should be mentioned that rather low-cost technologies may in certain situations prove to be more feasible and lasting than more costly or sophisticated types.

2.5 In the area of scientific and technical knowledge transfer, it is extremely important that the publications of IHP be made more widely available in developing countries. The IHP should thus consider the improvement of the present method of distribution of its publications. The publication of widely distributed newsletters at regional and national levels needs to be undertaken.

2.6 Pilot projects, either within or outside the framework of major regional projects can constitute an extremely effective mechanism for technological transfer. Introduction and development of such projects in various regions form an important part of the "hardware" component of technology transfer described in Annex B.

2.7 Efforts must be increased at the national level to improve the diffusion process of locally developed technology. In some cases, technologies produced or developed in a developing country may be more appropriate in another developing country than rather advanced technology acquired from a developed country. Coordination on a regional level and on an intra-regional level plays an important role in this process.

2.8 To assist the National Committees for the IHP it would be most useful if a manual were to be prepared. Such a manual would include organizational, and other information for the operation of an official NC/IHP -- including information on the operation of a national and regional technology transfer programme.

As noted before, a report was originally prepared by the Working Group of IHP-III Project 18.1(a). The following members participated in the formal preparation :

Dr. Qais N. Fattah (Iraq), Chairman
Dr. Jim Stewart (USA)
Mr. N.B. Ayibotele (Representative of IAHS)
Dr. S. Bruk (Yugoslavia)
Mr. J.A.H. Brown (Australia)

Contributions to the report were also received from Dr. I.A. Shiklomanov (USSR) and Dr. M. Abu-Zeid (Egypt), members of the Working Group.

Using the original 18.1(a) document as the primary discussion paper for the workshop, slight modifications to that report were prepared. The modified version is presented in Annex B to this Introductory Note of the Workshop. It represents the consensus findings of the workshop participants.

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WORKSHOP ON RECOMMENDED STRATEGIES
FOR IHP TECHNOLOGY TRANSFER

(Unesco Headquarters, Paris, 24-25 June 1986)

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REPORT OF THE WORKSHOP
IHP-III PROJECT 18.1(b)

WORKSHOP ON RECOMMENDED IHP STRATEGIES
FOR TECHNOLOGY TRANSFER

This report represents a slightly
modified version of the basic document prepared
by the Working Group of IHP-III Project 18.1(a).
The original report was prepared by :

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FOREWORD

The International Hydrological Programme (IHP) forms an integral part of the efforts made by the United Nations system as a whole to promote a rational policy for the development and management of water resources* around the world. At the United Nations Water Conference, held in March 1977, IHP was recognized as one of the principal agents through which these aims could be achieved.

The main purpose established for the IHP (which is the major component of Unesco's water resources programme) was to develop a scientific and technological basis for the rational management of water resources, as regards both quantity and quality.

The specific objectives were : 1) to improve the assessment of water resources, 2) to improve water resources management and planning, 3) to improve the evaluation of the influence of human activities on the water cycle, 4) to promote education and training in the field of water sciences, and 5) to increase the capacity of Member States to develop and manage their water resources.

IHP has gone through two phases and is now in its third phase. In August 1981, the "International Conference on Hydrology and the Scientific Bases for the Rational Management of Water Resources" was held in Paris -- convened and organized jointly by Unesco and WMO, each of which presented detailed reviews of its current activities. Numerous other international governmental and non-governmental organizations with water programmes also presented reports. With this as background information, the representatives of the Member States of Unesco developed and approved an outline plan for the third phase of IHP-III. The detailed plan was approved in March 1984 by the Intergovernmental Council of IHP.

The programme of IHP-III represents a significant departure from the earlier IHD/IHP efforts. Although the programme has a strong emphasis on the traditional hydrologic sciences, the increasing importance of rational water management has required that a much broader view of the programme be taken. This concept of IHP-III, then, has led to a much greater emphasis on application of results. It has also required that the scope of the programme include greater effort to reach areas and audiences which, up to this time, would not normally have been thought of as part of a programme on hydrology.

Current IHP programmes give increased emphasis to the application of technology to the solution of crucial hydrologic, water management and water-related problems. More attention is directed toward expanding the knowledge base in water resources and encouraging educational programmes to transfer that knowledge.

Activities relating to the transfer of technology are included in all projects of IHP-III, but a need for increased attention to strategies to increase the effectiveness of these activities has become evident. Theme 18 of the IHP-III is directed specifically to this issue. Emphasis

* In this report wherever the terms water resources and hydrology are used separately both are inferred to be in keeping with the proposed objective of IHP-IV.

there is on the use of improved methods for the effective transfer of knowledge and technology related to water resources and on the evaluation of their impacts, primarily in developing countries.

Transferring water resources technology, it should be noted, is the purposive process of moving knowledge to users and encouraging its adoption or use through a variety of approaches. While it is important to use appropriate information as rapidly as possible, different types of technology may take different pathways to reach those who can use it. The identification, creation and management of delivery systems to transfer knowledge to those needing it is a complex and difficult task. The Working Group for Theme 18 gave special attention to issues relating to technology transfer, including its effectiveness, and strategies for improving the process.

Key participants in the IHP Programme are the National Committees and Focal Points now established in 138 countries. Individuals in these units, while not the only source of water information, do have an important role in linking Unesco water programmes with leaders and scientists in their own countries. This two-way communication role between Unesco and potential users is important in transferring water resources technology to participating countries. Improvement in these technology transfer efforts can result in benefits to all participating countries.

The use of the term "technology transfer" in water resources is understood to include both diffusion and absorption of technologies and information transfer. Technology transfer is the sum of these activities leading to the adaptation, adoption, or demonstration of new technology where the audio, visual and written media provide a partial vehicle for accomplishing the transfer.

In its broadest sense, technology transfer is a process which encompasses the collection, documentation and dissemination of scientific and technical information. The process includes the use of communication and affects three groups of people : those who originate or have the information, those who transfer or extend the information, and the users. The three groups could include the following :

1. The producers and developers of water resources technology :
 - a. Universities
 - b. Government agencies
 - c. International and national organizations and associations
 - d. Non-profit research firms
 - e. Consulting firms
 - f. Research centers.

2. The transferers of technology :
 - a. Universities
 - b. Teaching firms
 - c. Libraries
 - d. Professional associations
 - e. Publishers
 - f. Journal publishers
 - g. International organizations such as IHP
 - f. Research centers.

3. The users of water resources technology :
 - a. Government agencies at national and local levels
 - b. Consulting firms
 - c. Students
 - d. Interest groups
 - e. Farmers
 - f. Industrial firms
 - g. Elected officials
 - h. Utilities
 - i. Citizen groups
 - j. Planners
 - k. Teachers

It is suggested here that the IHP participants, at all levels, need to better understand the technology transfer process and appreciate the importance of and opportunities for linking sources, transferers and users of water resources knowledge.

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I. EXTENT OF PARTICIPATION OF DEVELOPING COUNTRIES
IN THE IHP ACTIVITIES AND ROLE OF REGIONAL AND
INTERNATIONAL ORGANIZATIONS

1.1 NATIONAL COMMITTEES FOR THE IHP AND NATIONAL FOCAL POINTS

1.1.1 Participation in formulating various phases of the IHP

The preparation of the second and third phases of IHP started with consultants' reports scoping them. The National Committees for the IHP reacted to the proposals and indicated which projects they would like to see carried out under the different components of the programme during each phase.

For the preparation of IHP-II and IHP-III, most of the countries that responded with proposals for projects were developed countries. In addition to those projects, the distribution of working groups and rapporteurs between developed and developing countries indicate also a distinct difference. The details are as follows :

	IHP-II			IHP-III		
	Total	Developed	Developing	Total	Developed	Developing
Membership in Working Groups, and Rapporteurs	94	67	27	159	111	48
(%)	(100)	(71)	(29)	(100)	(70)	(30)

The evidence shows that the developing countries have not participated as actively as the developed countries in the planning of the last two phases of the IHP and that they have not been well represented in the implementation of projects.

These findings on the composition of groups and rapporteurs are very significant because it is believed that one cannot be committed to a programme in which one is not involved actively in implementing. The main explanation of this situation is felt to be, of course, that the developing countries do not have sufficient manpower and institutional infrastructure to attend and take part in the IHP activities. The developed countries because of their manpower sufficiency, institutional strength, and their leading positions in science and technology are able to take greater advantage of the programme.

It is emphasized that a strategy must be formulated to encourage developing countries to become involved in the Programme at a level commensurate with their level of development, resources and needs. The proposals in IHP-IV to emphasize the role of the NC/IHP's as the foundation of the Programme and establish regional co-ordinating councils for IHP to deal with common regional problems, are proposals in the right direction and should be supported.

The purchase of IHP publications has been used as one indication of the impact of IHP. As such, the participation of various regions in taking advantage of publications of the IHP is analyzed below for a sample of publications.

Analysis of the sale of selected publications* (Studies and Reports in Hydrology)

IHP PUBLICATIONS	Date of publication	Number of copies sold in :									
		Europe	North America	LAC	Arab States	Africa	Asia	Australia & Oceania	Unesco	Unesco Bookshop	Total
Groundwater Models, Vol.1	1982	184	307	6	5	5	77	21	3	28	636
Aquifer Contamination and Protection	1980	241	192	7	12	11	51	11	4	27	556
Surface Water and Groundwater Interactions	1980	214	194	7	12	10	63	14	7	43	564
Sedimentation Problems in River Basins	1982	201	262	11	15	5	70	17	8	27	616
Groundwater in Hard Rocks	1984	207	227	4	12	42	66	10	9	13	590
Methods of Computation of Low Stream Flow	1982	133	199	10	7	3	53	11	4	26	446
Methods of Hydrological Computation for Water Projects	1982	135	210	13	7	3	106	21	6	39	540
TOTAL		1 315	1 591	58	70	79	486	105	41	203	3 948

* It should be also noted that approximately 900 copies are also distributed to IHP/NC's, central libraries, etc., around the world, at no charge (see para 2.11).

From the above it can be concluded that, apart from the sales at Unesco and Unesco Bookshop, the developed countries (Europe, North America, Australia and Oceania) purchased over 81% of the 7 publications. This shows quite clearly that the developing countries are either not aware of the existence of these books or cannot afford them (or both), and so are not getting important benefits of the Programme from these publications.

1.1.2 Survey of the National Committees and Focal Points of the IHP

In the winter of 1985-86, a mail survey of the NC/IHP's and Focal Points was conducted to determine the extent and nature of their technology transfer programmes. The survey was undertaken as part of a large effort of Project 18.1(a) to assess methods used for the transfer of water resources knowledge and to determine some of the problems confronting the NC/IHP's and Focal Points. The survey was designed to obtain sufficient background on which to base a recommended programme. It also explored their knowledge and use of methods for technology transfer, preferred educational approaches, views of strengthening future programmes, and possible hindrances to future programmes.

Information gathered in the survey was designed to determine the use of approaches which presently emphasize exchange of information through publications and use of training courses, workshops and seminars. The survey also provided feedback on their needs for water resources information and their preferred methods for transferring technology. Sixty-seven (of the 138 contacted) responded to the survey. The response received was lowest from Asian countries from which only six replies were received. Following are questions that were asked and a summary of responses.

1. *"Rate the following information methods for transferring hydrology and water resources^{1/} technology to water resources scientists in your country."*

The methods suggested included newsletters, pamphlets and brochures, reports and manuals, pictures and slides, and exhibits and posters. A large majority (80%) of all the respondents to the survey rated reports and manuals very high to high as means of transferring information in their country. Pamphlets and brochures, and newsletters, were methods rated as moderate for technology transfer. National Committee members were inclined to rate pictures, slides, exhibits, and posters as moderate to low information methods.

2. *"Evaluate the impact of the following IHP mechanisms in terms of their usefulness for technology transfer in your country."*

A variety of mechanisms were listed including education and training, participation in working groups and rapporteurs, publications, workshops/seminars, symposia, conferences, major regional projects and pilot projects. Most of those surveyed indicated they felt that the approaches being used were very effective. Regardless of the region, publications (70%) and education and training (60%) received very high to high ratings and were perceived as the means having the greatest impact. Workshops and seminars,

^{1/} For questions 1 through 6 (and also 10), the respondents could circle among the following : Very High (VH), High (H), Moderate (M), Low (L), Very Low (VL), and None (N).

symposia/conferences, and participation in workshops were perceived as effective methods for technology transfer, while pilot projects, regional projects, participation in working groups, and as rapporteurs were rated somewhat lower in impact. In general, the majority of respondents saw the IHP methods as important means of technology transfer.

3. *"What kind of IHP publications would be most helpful for technology transfer in your country?"*

Traditionally, various publications are relied upon for transferring water resources information. The usefulness of some of these is frequently debated. Three-fourths of the respondents considered manuals, guides, basic science documents, and scientific reports as the most helpful for technology transfer in their country. These were followed by conference proceedings and popularized publications in their helpfulness. Popularized publications tended to vary somewhat in the degree to which they were favored by those surveyed. They were perceived as being more helpful by the African and Latin American and the Caribbean regions and less helpful by the European and North American regions.

4. *"Rate the following educational methods for transferring hydrology and water resources technology to water resources engineers and scientists in your country."*

Methods included seminars/conferences, workshops, short-term training courses, and roving courses and seminars. Training courses (75%), workshops (75%), and seminars/conferences (65%) received very high to high ratings in most regions. The roving courses and seminars tended to rank lower, especially in Europe and North America.

5. *"How would you rate the relevancy of IHP publications in meeting the needs of water resources scientists and engineers in your country?"*

IHP publications were rated very high to high by about 60% of the respondents in terms of relevancy in meeting the needs of water resources scientists and engineers. The ratings were lower in Latin America and Africa. Many of the replies received from countries in these regions commented upon the lack of translations into Spanish and French.

6. *"How would you rate the current level of knowledge of IHP by the water resources engineers and scientists in your country?"*

When asked to rate the knowledge of IHP by the water scientists, the majority (60%) of respondents gave a moderate to low rating. The knowledge of IHP was greatest in the Latin American and Caribbean and Asian regions, where about half of those who replied gave a high rating for knowledge of IHP by water resources engineers and scientists.

7. "Do you routinely send copies of IHP publications to water-related offices in your country?"

Among the respondents, 60% indicated that they did routinely send copies of IHP publications to water-related offices in their country. Below are their answers by region :

	LAC	Africa	Europe & North America	Asia & Pacific	Arab States	Total
Yes	12	8	15	2	4	41
No	4	6	8	4	4	26

8. "Do you currently use a newsletter/journal to distribute information about IHP to water-related offices in your country?"

About 70% of the respondents to the survey indicated that they did not use a newsletter/journal to distribute information about IHP. Only two respondents each among the Latin American and the Caribbean and the African countries indicated that they used a newsletter or journal. Responses, by region, are listed below :

	LAC	Africa	Europe & North America	Asia & Pacific	Arab States	Total
Yes	2	2	11	3	3	21
No	14	12	12	3	5	46

If respondents did use a newsletter/journal, they were asked to give the approximate number of people on their mailing list. As previously indicated, very little use is made of newsletters/journals in the Latin American and the Caribbean or the African countries. The greatest use of this means of communication was in the European and North American region where from 25 to 1200 persons were included on mailing lists. One respondent in Asia indicated they had more than 1000 persons on their mailing list.

9. "Has your country hosted or co-sponsored any of the following IHP-related activities in the past five years?"

The European and North American region led in the hosting of IHP-related activities such as seminars/conferences and short courses. The regions indicating the least participation in these activities were Africa and Latin America and the Caribbean. About 50% of all countries had hosted or cosponsored seminars or conferences. Approximately two-thirds of the respondents indicated that they had

not hosted or co-sponsored IHP short courses or pilot projects. Answers, by region, are shown below :

Activity	Response	LAC	Africa	Europe & North America	Asia & Pacific	Arab States	Total Responses
Seminars & Conferences	Yes	3	4	21	5	2	35
	No	10	10	1	1	6	28
Short Courses	Yes	2	1	13	3	2	21
	No	11	11	7	1	6	36
Pilot Projects	Yes	3	3	7	1	2	16
	No	10	9	12	3	6	40

10. "What level of responsibility do you believe the National Committees should have in water resources technology transfer?"

There is almost total agreement among respondents that National Committees should have major responsibility in technology transfer. None of the respondents gave this question a low or very low rating. The strongest support for this position came from the Arab, Latin America and the Caribbean, and African regions.

11. "What suggestions do you have for strengthening the transfer of water resources technology to water scientists and engineers in your country?"

Responses to this question are grouped into the categories of publications, organizations, training, data and information systems, and support.

Publications

- . The provision of copies of scientific reports and specialized papers to familiarize local professionals with recent developments in the field of water resources.
- . The publication of newsletters/journals for wider circulation.
- . The provision of more copies of IHP publications.
- . The preparation of short summaries of Unesco publications for distribution to interested organizations.
- . More publications summarizing the results of research papers.
- . The preparation of manuals for water resources engineers.
- . The improvement of the quality of printed materials to attract readers.
- . The preparation of documentary material to highlight the need for National Committees on Hydrology.

- . The preparation of a document for establishment of Hydrological Services similar to Meteorological Services.
- . The publication of the hydrological records of specific countries.
- . The preparation of publications that would be more effective for countries with little current technology.
- . The translation of more IHP publications into Spanish and French.

Organizations

- . The formation of national associations of water scientists and engineers.
- . The creation of National Committees.
- . The strengthening of water organizations with appropriate staff and financial support to create a better archive of water publications and data.
- . The increased use of local experts in working groups and as rapporteurs.
- . The development of more effective communication among agencies concerned with water resources, with support from a designated national authority as well as international links and cooperation.
- . The composition of active national bodies to follow up IHP initiatives.
- . The involvement of higher-education organizations in hydrologic research.
- . The establishment of hydrological and hydrogeological research units in universities with emphasis on practical applications.

Training

- . The greater participation of hydrologists in workshops and short courses.
- . The organization of regular seminars/workshops/symposia.
- . The promotion of local and international seminars and workshops to expose scientists and engineers to water resources management theory and techniques.
- . The development of a variety of short training courses and workshops devoted to specific applications.
- . The granting of fellowships/sponsorships for long-term training and attendance at conferences.
- . The provision of financial support for scientists to participate in training courses and pilot or demonstration projects.
- . The organization of Unesco-sponsored courses which have the participation of professors and experts from developed countries to present new technologies in the field of water resources.

Data and information systems

- . The establishment of computer data bases with lists of the names of individual hydrologists and water experts.
- . The establishment of specialized information networks.
- . The conversion to more automatic procedures, such as remote sensing and computerized methods, for the processing, storage and analysis of hydrologic data.

Support

- . The provision of increased funds to cover printing and distribution costs, seminars, workshops, and student and institutional support.
- . The provision of funds for support of libraries.

Other

- . The encouragement of changes in government policy that would foster technology transfer efforts.
- . The production in different countries of films on water-related problems and their corresponding solutions.

12. *"Please list the titles of five IHP publications in water resources which have been most useful to assist you in addressing water problems in your country."*

This question was used to assess the familiarity of the respondents to IHP publications. Approximately half of all the respondents were able to list five IHP publications. The titles of the publications varied considerably, as might be anticipated.

13. *"What factors provide the greatest hindrance in conducting technology transfer activities in your country?"*

Respondents listed many problems that constrain the implementation of technology transfer programmes in water resources. The most outstanding were : (1) limitations in funding and resources, especially deficiencies in staff and budgets for IHP activities; (2) lack of trained personnel and experience; (3) organizational issues; and (4) lack of knowledge and interest in technology transfer. The following is a summary of the responses :

Funding and resources limitations

- . The deficiency in budgets for staff, equipment, and facilities for IHP activities. (This statement was indicated by 25 respondents).
- . The need for a full-time secretariat for the local IHP Committees.
- . The lack of time to devote to technology transfer.
- . The prohibitive cost of translation of scientific and engineering journals.

Lack of trained personnel and experience

- . Lack of experience in organizational activities.
- . Lack of trained personnel.
- . Poor experience in good quality editing and distribution of materials.
- . Deficiency in foreign language knowledge, particularly English.
- . Translation problems with articles written in the original language.
- . An inadequate number of qualified hydrologists and hydrogeologists.

Organizational issues

- . Deficiencies and weaknesses in the organizational structure of some of the services that have the responsibility for water resources; these create difficulties in the rational transfer of new technology.
- . The multitude of departments -- technical divisions, etc. -- involved in hydrology and water resources.
- . The under-development of water resources planning; one of the greatest hindrances to technology transfer is therefore the lack of awareness of the needs for proper planning, and research into, and monitoring of water resources.
- . The lack of co-ordinating centres for technical information.
- . The failure to establish National Committees for the IHP.

Knowledge and interest in technology transfer

- . The lack of sufficient perception of what technology transfer involves in its entirety.
- . The lack of recognition of technology transfer as a profession.
- . The difficulties incurred by a small country with small institutions in giving adequate priority to educational activities.
- . Communication problems due to the lack of reliable facilities.
- . The need for improvements in internal dissemination of information.
- . The lack of enthusiasm by local nationals to devote spare time to such activities.
- . The lack of interest in research - this may be due to lack of facilities.

14. *"Please give your job or position title."*

There were a large number of job titles, indicating the variety in make-up of the National Committees and Focal Points. A sample of the titles included : hydrologist, director of water resources research institute, chief hydrologist, head of water resources inventory board, secretary of the IHP, executive secretary of IHP, senior hydrologist, principal technical officer-hydrology, senior engineer, and director of division of soil and water conservation.

Not only was there a diversity of job titles, but there was also a wide range of organizations in which the IHP National Committees were affiliated.

The International Hydrological Programme (IHP), the major component of Unesco's water resources programme, has in recent years given greater consideration to technology transfer, with an emphasis on application of results to solve crucial hydrologic, water management and water-related problems. More attention is given to expanding the knowledge base in water resources and encouraging educational programmes to transfer that knowledge.

The 1985-86 mail survey was made to obtain information from IHP National Committees of their perception of the need for certain aspects of technology transfer. Sixty-seven responses to the questionnaire were received (of the 138 mailed). The respondents represented a wide range of scientific interests and were located in a diversity of organizations.

In summary, those responding to the survey showed a preference for reports, manuals, guides, and basic science documents as publications for technology transfer. They favored the use of publications and education and training as mechanisms for technology transfer. These approaches were followed closely by the use of workshops, seminars, symposia and conferences.

The relevancy of IHP publications for water engineers and scientists was given a very high rating. On the other hand, the current level of knowledge of IHP by engineers and scientists was rated as moderate to low.

The level of technology transfer activity by the National Committees varied considerably. Over half of the Committees indicated that they distributed IHP publications. However, only about a fourth of the Committees used a newsletter/journal to inform others of IHP information. This mechanism was seldom used in the Latin American and the Caribbean and the African regions. Approximately half of the countries have hosted or co-sponsored IHP seminars, conferences, and short courses.

The respondents perceived that they should have a major responsibility for technology transfer, and they made numerous suggestions for strengthening the programmes. The major improvements suggested included the need for increased numbers and variety of IHP and other publications. Respondents saw a need for strengthening the organization of their National Committee and increasing communication with water scientists and educational organizations. They perceived a need to expand participation in workshops and short courses and a need for fellowships and other means of support to encourage participation. Establishment and improvement in data and information networks was considered important.

National Committees see constraints on their ability to implement technology transfer programmes. These constraints include limitations in funding and resources for staff, publications, and trained personnel. Some respondents indicated a lack of knowledge and interest in technology transfer.

1.1.3 Effectiveness of IHP National Committees

Since no action can be expressed at the national level without a National Committee or Focal point, an analysis was made of the number of countries which have these institutions. The result (as of 15 March 1986) is tabulated as follows :

Number of Unesco Member States with:	Total	Europe & North America	Africa	Asia & Pacific	Arab States	Latin America & Cari- bbean
No Focal Points or National Committees	20	2	5	9	3	1
Focal Points	40	3	11	2	7	17
National Committees	98	30	27	17	9	15
Total (responding to questionnaire)	158 (67)	35 (23)	43 (14)	28 (6)	19 (8)	33 (16)

A second measure of effectiveness of the National Committees is the number of seminars, short courses, and pilot projects which have been held in their countries as demonstrated from the survey results shown below :

Activity	Response	LAC	Africa	Europe & North America	Asia & Pacific	Arab States	Total
Seminars & Conferences	Yes	3	4	21	5	2	35
	No	10	10	1	1	6	28
Short Courses	Yes	2	1	13	3	2	21
	No	11	11	7	1	6	36
Pilot Projects	Yes	3	3	7	1	2	16
	No	10	9	12	3	6	40

It is evident from the above that the developed countries have made more use of seminars/conferences and short courses as means of technology transfer.

Another measure of effectiveness of National Committees is their role in ensuring that information about the IHP is routinely sent to water-related offices in their countries. Below is the result of the analysis of the response to a question on this matter that was put to the National Committees and Focal Points :

	LAC	Africa	Europe & North America	Asia & Pacific	Arab States	Total
Yes	12	8	15	2	4	41
No	4	6	8	4	4	26

It has also been noted that overall only 31% of the National Committees use newsletters/journals to distribute information. The situation is much worse in Latin America and Africa, where only 13 and 16%, respectively, use this medium.

1.2 THE ROLE OF REGIONAL HYDROLOGISTS IN TECHNOLOGY TRANSFER

Located in each of the five Regional Offices for Science and Technology, the Regional Hydrologists are key figures in the development and implementation of the IHP. They play a strategic role in linking National Committees with a variety of organizations, specialists and other information sources. Regional Hydrologists can be especially important in ensuring that the most suitable technology is transferred, made available, and used appropriately.

Specific duties of the Regional Hydrologist include, but are not limited to, the following : (a) promoting regional co-operation in hydrology and water resources; (b) co-operating with national institutions and with members of National Committees for the IHP in the advancement of scientific hydrology and in its application to problems of assessment, rational use, management, and development of water resources; (c) assisting in the development of national and regional hydrologic networks and directories of institutions and specialists in various fields of water resources; (d) assisting in the planning and execution of national and regional research studies and projects on selected problems; and (e) co-operating in the preparation of technical assistance proposals at the request of Member States.

Many of these duties are directly or indirectly related to technology transfer. The Regional Hydrologists communicate with many groups, act as catalysts to stimulate action, assist in linking information and knowledge sources with those who need them, and facilitate the transfer of technology through a variety of channels.

In November 1985 a survey was made by the Secretariat of the IHP to obtain from the Regional Hydrologists ideas regarding technology transfer; three basic questions were asked :

1. What is the role of the Regional Hydrologists in water resources technology transfer ?
2. What are the major constraints faced by Regional Hydrologists in conducting water resources technology transfer at the regional level ?
3. What are the main recommendations for improving the role of Regional Hydrologists in water resources technology transfer ?

The following is a summary of the Regional Hydrologists' responses.

(a) The role of the Regional Hydrologist in water resources technology transfer

- (i) Review available information on water resources technology transfer which seems relevant to the region.
- (ii) Find adequate means for this information to be communicated to the specialists of the region. This could be achieved through strengthening co-operation with the regional organizations and specific national institutions.
- (iii) Coordinate activities and exchange information among specialists of the region through conferences, seminars, and other events in the region. He should be able to advise or assist in providing the necessary information, literature, fellowships, and study and travel grants.
- (iv) Encourage the specialists in the region to participate in conferences, seminars and courses, and also make available to them the outcome and proceedings of important meetings.
- (v) Ensure liaison and close links between the IHP and the National Committees and individual water scientists.
- (vi) Encourage activities at the regional level as a mean for closer contacts between the scientists of the various countries in the region.
- (vii) Make use of Unesco newsletter, ROST's bulletin, and other publications to announce conferences, seminars, meetings, training courses, etc., at both the international and regional levels.
- (viii) Make available the IHP material currently published by Unesco, as well as relevant material produced by other international organizations.
- (ix) Endeavour to arrange for translations of important material into the regions' languages. This can be achieved by seeking support and contribution from the regional and national organizations.

(b) Major constraints facing Regional Hydrologists in conducting water resources technology transfer at the regional level

- (i) Insufficient facilities for assisting personnel.
- (ii) Insufficient funds to initiate regional activities.
- (iii) Insufficient participation of national specialists in international and regional meetings and conferences due to normal budgetary constraints.
- (iv) Insufficient free publications available for wide distribution.
- (v) Major differences in the actual activities of the National Committees within the region.

(c) Recommendations for improving the role of the Regional Hydrologists in water resources technology transfer

- (i) Increase distribution of objective and concise information in newsletters, pamphlets, and brochures free of charge.
- (ii) Produce all IHP studies and reports in hydrology in an inexpensive form of publication and distribute them free of charge so that they can reach a comparatively greater number of specialists.
- (iii) Invite more specialists from the various countries of the region to contribute to the IHP projects by providing the relevant working groups with material and scientific articles which could be evaluated, abstracted, and eventually used as input to IHP publications. This will automatically involve greater numbers of specialists and create additional interest in the IHP activities.
- (iv) Produce, in an inexpensive form, and distribute widely copies of all lectures delivered in Unesco co-sponsored courses.
- (v) Organize short-term roving courses and training workshops to be addressed to specialists at sub-regional level. Field trips and other means of gaining further details on specific technologies should be incorporated in these sessions.
- (vi) Assist regional hydrologists in initiating regional activities through co-ordination with other international and regional organizations. This will require assistance from headquarters.
- (vii) Encourage more frequent visits and contacts between headquarters specialists and the regions to advise and provide knowledge of international activities and resources for technology transfer.
- (viii) Organize more scientific meetings (conferences, seminars, workshops,..) in the regions, with the participation of specialists from the developed countries.
- (ix) Exchange visits between the regional hydrologists and specialists in the region.
- (x) Provide funds for initiating pilot projects in the regions.
- (xi) Explore opportunities for interregional exchanges of scientists. All regions and nations have knowledge and technology of potential value to others.
- (xii) Based on the needs of the region, include in the regular programme research studies, pilot projects on selected problems and other activities which could facilitate transfer of technology.
- (xii) Explore and encourage the provision of funds to be used in expanding technology transfer for specific subject areas through the submission of proposals to organizations.

1.3 ACTIVITIES OF OTHER INTERNATIONAL ORGANIZATIONS AND PROGRAMMES

In order to assess the results achieved within the IHP in terms of transfer of knowledge and technology, it is helpful to consider other international organizations and programmes involved in transfer of knowledge and technology in hydrology and water resources. In order to carry out this study, written material was requested and examined. Moreover, the Chairman of the Working Group made visits to the headquarters of three international organizations (FAO, WHO and WMO). The main findings of this study are presented in the following sections.

1.3.1 Food and agriculture organization (FAO)

The following mechanisms have been adopted for technology transfer in FAO :

- a. Workshops
- b. Training courses of 2-3 weeks' duration on specific subjects encompassing all levels going to the farmer level.
- c. In-service training (on-the-job) where experts and training staff work with the farmers. This is felt to be a very effective method.
- d. Practical publications in three languages with some in Arabic and Chinese.
- e. Field projects aimed primarily at helping national agencies to adapt technology.
- f. Fellowships abroad.

FAO has traditionally emphasized work at the field where the problems are. It is now moving into institution development.

1.3.2 World Health Organization (WHO)

The following mechanisms have been adopted by WHO :

- a. Regional Offices with strong authority to identify problems and programmes.
- b. Seminars, workshops, symposia.
- c. Fellowships : these need to be integrated within an institutional development framework.
- d. Field projects.
- e. Publications.
- f. Collaborating centres at the national level financially supported by countries with partial support from WHO.
- g. Pilot projects at the regional level to serve the needs of the area. This is felt to be a very effective mechanism.

1.3.3 World Meteorological Organization (WMO)

The following mechanisms have been adopted by WMO in their Operational Hydrology Programme (OHP) :

- a. Publications of a practical nature to provide guidance on methodologies.
- b. Training courses to explain the use of various technical methodologies for university graduates and for technicians.
- c. Field projects supported by funds from UNDP or through technical bilateral co-operation. This is felt to be an effective method. There is a technical assistance department within WMO concerned with this work.
- d. Exchange of technology in operational hydrology through HOMS, with nearly 90 participating countries, involving mainly :
 - instrument description
 - manuals
 - computer software.
- e. Technical meetings aimed at application of methodologies.

1.3.4 Man and the Biosphere (MAB), Unesco

MAB has adopted a system of pilot projects for research and demonstration for development to serve the following goals :

- a. developing methodological bases for problem research.
- b. providing bases for integrated use of natural resources.
- c. demonstration of results.
- d. development of local capabilities for research and management.

Activities involve :

- a. training through fellowships, seminars and training courses.
- b. demonstration in project area.
- c. planners seminars.

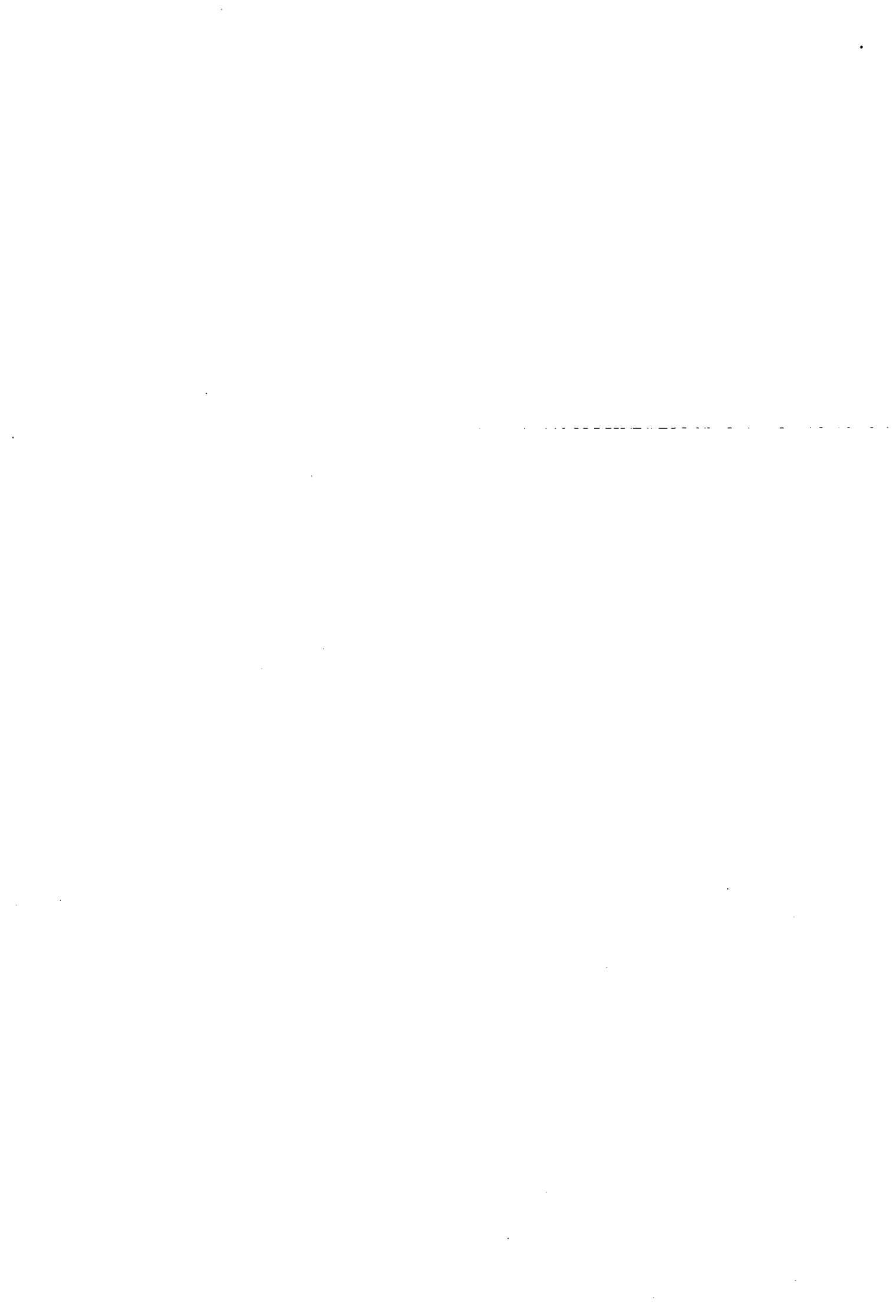
1.3.5 Comparison with IHP

The International Hydrological Programme (IHP) uses the following mechanisms in the execution of its projects :

- a. Education and training through Unesco-sponsored courses.
- b. Working groups and rapporteurs.
- c. Publications.

- d. Workshops and seminars
- e. Symposia and conferences
- f. Major Regional Projects
- g. Pilot projects.

If the above list is compared with the corresponding lists of mechanisms adopted by other international organizations and programmes, it may be seen that the types of activities covered by the IHP are in general similar to those of other international programmes. The difference - not to be taken lightly - lies mainly in the level of emphasis or priority assigned to each type of activity by the various organizations.



II. RECOMMENDATIONS CONCERNING TECHNOLOGY TRANSFER

2.1 INTRODUCTION

The projects of IHP have been traditionally divided into scientific and educational categories. The educational projects essentially develop methodologies such as curricula, in order to improve the quality of education in hydrology and water resources in general, and in the IHP-sponsored courses in particular. From the point of view of transfer of knowledge and technology, IHP has contributed significantly in education in the field of hydrology and water resources.

The scientific projects of IHP have dealt with important problems, issues, and methods of vital interest to the various regions of the world. The products of these projects have usually taken the form of publications, seminars, workshops, symposia or conferences. For the developed countries, these products are sufficient since various systems are available in these countries to absorb quickly and comprehensively the products of such projects. Hence, these countries have not had the need to request IHP to carry out traditional activities in order to facilitate application of the results of its scientific projects.

In the developing countries, however, the situation is different. The necessary systems required to absorb and apply the products of the scientific projects are not completely developed, but rather are in various stages of development. Hence, the extent of the benefits derived from IHP scientific projects in the developing countries is relatively small. This fact has led several developing countries to express concern about the impact of IHP projects in their countries and to suggest that IHP should carry out further activities in order to improve this impact.

As indicated above, the products of the scientific projects of IHP are usually in the form of publications, symposia, etc. In the transfer of technology jargon, such methodologies are referred to as "software". The "hardware" methods include pilot projects, field projects, or representative basins in which the "software" acquires its physical interpretation. It is strongly recommended that the scientific project activities of IHP acquire "hardware" components in developing countries. Of course, this need not be done for every project in every developing country. In fact, not all the scientific projects are translatable into "hardware" components. It would be extremely advantageous, nevertheless, to identify a significant number of appropriate scientific projects of IHP and develop methodologies to present their results in the form of hardware components in pilot or field projects on a regional or sub-regional basis. This direction is very much in line with the guidelines formulated in the Preliminary Report on the Planning of IHP-IV (IHP/IC/VII/10) of 15 April 1986. Moreover, in the process of selecting regional projects and proposing global ones, this "hardware" component should be seriously considered and included as part of these projects. This relatively new dimension can only be considered beneficial and complementary to the scientific component of IHP. Nevertheless, it is absolutely necessary, for the continuation of transfer

of knowledge and technology in IHP, to continue and expand the scientific projects which are regularly needed to provide the "software" for the process of a well-balanced system of development.

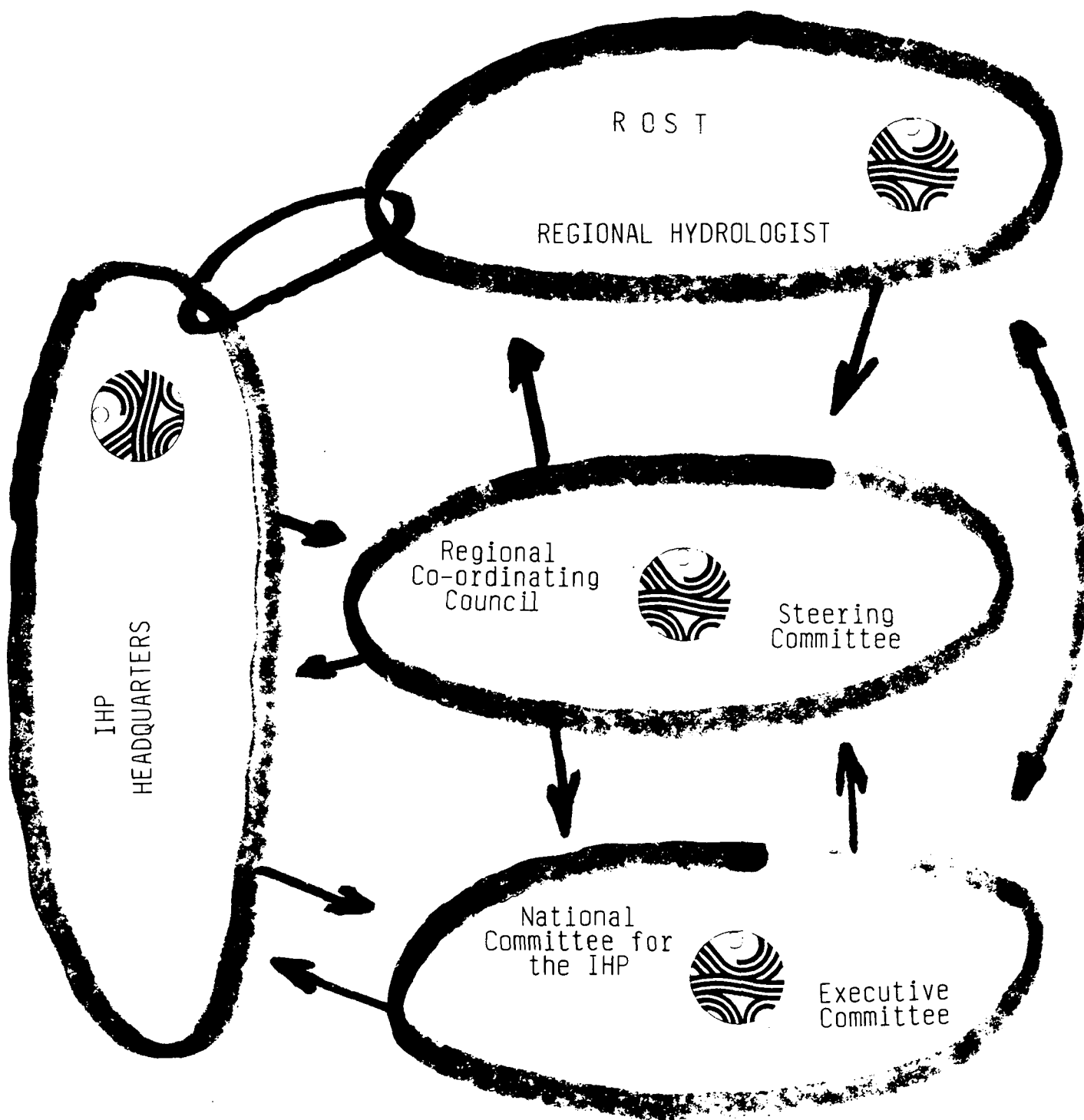
The specific recommendations for transfer of knowledge and technology follow.

2.2 STRUCTURING OF IHP AT REGIONAL AND NATIONAL LEVELS

In order to facilitate the transfer of knowledge and technology, the relationship between the Unesco Regional Offices for Science and Technology and the IHP National Committees and Focal Points requires clarification and strengthening. Moreover, at the national level the existence of National Committees for the IHP is critical, and to be effective the National Committees need to have the necessary organizational structure. Suggested structural relationships have been purposely avoided in this report; nevertheless, efficient channels for conveyance of knowledge and technology are required. The elements of such a structure would include the following :

1. Establishment and/or strengthening of regional (or perhaps even sub-regional) coordinating councils with representation by IHP National Committees (NC/IHP) of countries in the region -- as decided by the countries of the region. It is to be stressed that it is the function that is important here, and not the precise administrative organization. The Regional Office for Science and Technology (ROST), through the Regional Hydrologist, could provide the secretariat for the council.
2. The probable establishment of a steering committee of the council. The meetings of the steering committee would be more frequent than those of the council. It should operate in full coordination with the ROST, which normally would be expected to provide it with the necessary secretariat.
3. Establishment by each NC/IHP of an executive committee in order to carry out the decisions by the IHP National Committee as well as to implement the national programme and to take the necessary measures related to the regional and international IHP programmes. If at all possible it would be provided with a permanent secretariat by the national host agency. The executive committee would communicate with the water-related agencies in the country, the universities, water research centres, and operational hydrology centres. It would maintain close liaison with the ROST.

In general it is believed that the identification of strong common "problems" in need of joint or coordinated approaches will do as much as anything for identifying the need for good administrative structures.



The three principal elements for structuring the IHP at the regional and national levels are the ROST's, regional co-ordinating councils and the NC/IHP's. The key to success is the NC/IHP. Flexible relationships between the elements must be determined regionally and locally. Their interactions with IHP HQ is crucial, yet not exclusive.

2.3 THE ROLE OF IHP HEADQUARTERS IN TRANSFER OF KNOWLEDGE AND TECHNOLOGY

The role of IHP Headquarters in the transfer of knowledge and technology on a global scale is crucial, but it also affects greatly the efficiency of this activity on the regional and national levels. Its role as a clearing house for relevant information is indispensable. Experience has shown that the work of the regional hydrologists, national committees, professional and scientific associations become more effective if close contacts with IHP Headquarters are maintained.

Several international, regional and national agencies are involved in the transfer of knowledge and technology in water resources management. Only the IHP Headquarters can take care of collecting information on these activities and passing it on to other regional and national bodies as well as to the various IHP working groups and committees. IHP Headquarters should have major responsibility for co-ordinating the IHP activities with the efforts in technology transfer of co-operating groups, increasing thus the efficiency of both the IHP and the other undertakings. In particular, the IHP Headquarters should maintain a two-way track with the participating NGO's (such as IAHS, IAH, IAHR, IWRA, etc.), both inducing them to take part in technology transfer and receiving from them suggestions on the main professional and scientific issues in the field of hydrology and water resources management.

The role of Headquarters is indispensable in co-ordinating IHP activities with other Unesco programmes and other UN agencies. And, of course, the major responsibility of making the IHP activities better known internationally rests with the IHP Headquarters.

IHP Headquarters must also continue to interact as much as possible with the regional and national levels of IHP activity. Missions of highly qualified and well informed IHP personnel to the regions are an invaluable tool for enhancing efficiency.

Finally, it is imperative that IHP Headquarters encourage those countries which have not established National Committees for the IHP to do so; and suggest that these new Committees as well as the existing ones, be constituted in such a way that, through them, it would be possible to co-ordinate hydrological activities on a national level, related to different international hydrology programmes. To this end, it would be of great value if a manual for IHP/NC activities were developed.

2.4 THE ROLE OF THE REGIONAL HYDROLOGIST

Much of the work of the Regional Hydrologist, with some change in emphasis or focus, can already be directly related to knowledge and technology transfer. However, a conscious effort needs to be undertaken if more water technology and scientific knowledge are to be made available and used in the regions. The Regional Hydrologist is clearly in a position to facilitate and encourage increased transfer of technology. It is important that the Regional Hydrologists bring the passive NC/IHP's into the mainstream of IHP activities.

For technology transfer to receive appropriate emphasis it should be incorporated as part of a regional programme plan. Such a plan, developed in close co-operation with National Committees, should: (1) identify priority

water problems where better hydrologic expertise and/or technology are needed for the solution of those problems, (2) identify specific categories of water scientists, agency persons and others to be reached with the technology, (3) determine the approaches and resources to be used, (4) specify who in the ROST, National Committees or among other resource persons will undertake the work, and (5) develop means of measuring or evaluating the results. To help carry out these functions it is recommended that Regional Hydrologists have a staff person the majority of whose time is devoted to technology transfer.

Because of the very high work load imposed upon the Regional Hydrologists, developed countries should be encouraged to sponsor associate experts or full professionals who would work under them, assisting in all phases of their duties. It is envisaged that they would be made available on a secondment basis with their salaries and related costs being met by their own countries. Other expenses, such as intra-regional travel costs, should be met from the IHP budget. These experts should be appointed for a minimum term of one year but ideally for at least three years.

Several efforts of broad regional significance can be identified as being of importance to the Regional Hydrologists' activities. These include :

1. Development of several important information bases and assistance in evaluating other information bases for their relevancy, quality, availability and cost for use in the region.
2. Reviewing publications and journals for information appropriate to problems and issues in the region. Where possible he could reproduce abstracts or summaries for specific National Committees. This and other information could be included in a regional newsletter.
3. Encouragement and support for regional and national scientific meetings (conferences, seminars and workshops). Regional specialists could assist in organizing and suggesting names of technical persons who can be programme participants or instructors.
4. Assistance to NC/IHP's in the development of computerized lists of staff of universities, consulting firms, water specialists, showing their interest, expertise and experience. This could be used to help respond to inquiries from a variety of organizations.

2.5 THE ROLE OF NATIONAL COMMITTEES

The IHP National Committees play a key role in a successful programme for the transfer of knowledge and technology. Their organization will not necessarily be uniform, but their critical role within the IHP cannot be overstated. This role should encompass at least the following activities :

1. Co-ordination of technology transfer activities at the national level, including organizations and individuals.
2. Identification and encouragement of technology transfer oriented projects.
3. Evaluation of national activities in view of their contribution to technology transfer.

4. Provision of guidelines related to the preparation of national technology transfer projects.
5. Identification of national agencies for execution of technology transfer projects and activities.
6. Execution of some of the technology transfer activities and projects in co-operation with national agencies.
7. Co-ordination of national activities with regional activities in co-operation with the ROST.
8. Preparation of proposals for projects at the regional and international levels.
9. Provision of information linkages between the national level and the regional and international levels.

These national activities would be best carried out in full co-ordination with the Regional Hydrologist; however, it is not the intention that the ROST take over the responsibilities of the NC/IHP in this area. Success depends upon the NC/IHP's willingness to work and co-operate regionally. As noted in paragraph 2.3, it would be of great value to the NC/IHP's if an activity and organizational manual were developed.

2.6 WORKING GROUPS AND RAPORTEURS

The Intergovernmental Council of IHP at its third session in 1979 adopted a resolution encouraging an increase in the appointment of scientists from developing countries as working group members and rapporteurs on IHP projects. Since then, a significant increase of such appointments was realized in IHP-II and then in IHP-III. In percentage terms, however, the ratio has remained relatively stable. It is strongly recommended that increased involvement be effected.

The ROST's, in co-operation with the regional co-ordinating council and the National Committees, should play a much more active role in identifying potential nominees from developing countries for working groups and rapporteurs, as well as encouraging and following up on these nominations.

2.7 REGIONAL CENTRES FOR TECHNOLOGY TRANSFER IN HYDROLOGY AND WATER RESOURCES

In order to increase the rate of transfer of knowledge and technology to the developing countries, co-ordination and follow-up activities must be heightened at the regional level. Part of these activities would probably be carried out by the ROST's and the regional co-ordinating council. However, in order to impart continuity and reinforcement to such activities, it is suggested that serious consideration may need to be given to the establishment of regional centres for transfer of knowledge and technology in hydrology and water resources in developing countries. Such centres need not be heavily staffed since their activities would involve effectively the following elements :

1. Assist in identification of technical needs at national and regional levels.
2. Assist in preparation of proposals for technical projects at national and regional levels.
3. Follow-up execution of projects and activities.
4. Co-ordinate technology transfer activities within the region.
5. Arrange short courses at various levels.
6. Provide positive responses to requests for technology transfer activities from developing countries.

In view of the vast geographical areas of the regions, as well as the variety of water-related scientific and technological problems, more than one regional centre might be established in some regions, for the different aspects of hydrology and water resources management.

Such centres could be attached to existing institutions in the region (e.g. hydrological or water resources services, universities, research institutions) and co-operate with the ROST's and the regional co-ordinating councils as well as between themselves.

2.8 NATIONAL RESEARCH CENTRES OR AGENCIES

It is important that national research centres or agencies (located in the national universities or otherwise) be represented on the IHP National Committees. This is because they are important agents for generating knowledge and technology about local hydrology and water resources, and as such basic agents for their transfer. In the developing countries they are normally mission-oriented, in the sense that they are funded to work on programmes meant to generate information for immediate application in water management projects in various sectors of the economy. Their findings should be available to professionals of national operating hydrological agencies, consulting engineers, planners, decision-makers, politicians and the lay public. They also have a role in transferring new knowledge and techniques to students at the undergraduate and post-graduate levels through teaching, using the most appropriate transfer mechanisms (workshops/seminars, short courses, guides, popular publications, brochures, the press, etc.) to reach their various target groups.

Since it is anticipated that at the regional level countries will come together to work on common hydrological and water resources problems, they must have institutions and specialists to represent them and to work on specific assignments. The research centres and agencies can play very significant roles by acting as such representatives and thus contributing to the overall solution of problems of a regional nature.

A third role which these centres can play is in the adaptation of technologies developed from outside the region to make them applicable to local conditions.

2.9 NATIONAL HYDROLOGY AGENCIES

The national hydrology agency in a country carries the prime responsibility for the collection, processing, storage and publication of the basic hydrology data of that country. In some cases the responsibility extends to analyses of these data to provide the hydrologic input for the investigation and design of water development projects. In some countries the responsibility for this work is distributed among a number of agencies. Because of the importance of the basic hydrologic data in the development, investigation, management and protection of the water resources of a country, it is vital that sufficient data be collected and that they be of a high standard. While other international agencies such as the World Meteorological Organization (WMO), are active in providing guidance and assistance to the national hydrologic services of developing countries, there is also an important role to be played here by the IHP. Indeed, if it is to be effective, it must maintain close contact with the national water agencies. This can be done through the National IHP Committees and the Regional Hydrologists who, in consultations both formal and informal, with representatives of the water agencies and WMO, can :

- identify the most important hydrologic problems of the country;
- review activities of national water agencies;
- become familiar with water resources assessment programmes;
- examine staff training requirements;
- prepare submissions for training courses, workshops, purchase of equipment, etc.;
- prepare distribution lists for the dissemination of IHP news and information;
- arrange for talks presenting the work of the IHP and hydrologic topics of broad interest and relevance.

2.10 EDUCATION AND TRAINING

2.10.1 Education

One of the most important mechanisms for knowledge and technology transfer to the developing countries has been the Education and Training component of the IHD/IHP. This particular mechanism has always enjoyed support from both developed and developing countries. It has, however, been targeted primarily at water specialists and engineers at the post-graduate level and also at the training of sub-professionals-technicians. Other professionals who play significant roles in water resources management, such as economists and lawyers, have not yet benefited from the training courses. The same applies to the general public. That particular group has had its important role recognized in IHP-III, and projects have been targeted at it.

However, the Education and Training efforts of the IHP have been mainly to promote the Unesco-sponsored postgraduate courses. A preliminary evaluation of these courses carried out under IHP-III Project 13.1 shows that the courses are held mainly (56%) in Europe and the majority (65%) are offered in the English language, while 12% and 15% are in French and Spanish, respectively. The rest are in Russian and Portuguese. It is felt that the geographical and language distribution should be balanced by initiating courses in the developing countries and in other languages. This should, however, be based on an assessment of the real need for training more people. In cases where new courses in the developing countries are justified, twinning arrangements with the established courses in Europe are recommended. In any case, the Education and Training programme should be operated as a network.

The curricula and syllabi of the courses have been found to vary considerably, and it has been suggested that model curricula should be developed for the guidance of the courses and also for further courses that may be established.

It is suggested that, following the present trends in water resources education, IHP should widen the audiences by including target groups other than younger water resources specialists. It should also enlarge the coverage of relevant subjects to include the humanities in the continuing educational activities.

In addition to the longer term courses referred to above, the following approaches to the different target groups are recommended :

2.10.1.1 For water resources specialists

- Short refresher courses or seminars for imparting working knowledge on selected topics of high professional and scientific interest.
- Medium duration courses for younger specialists, with an emphasis on the systems approach to water resources management and an outline of the relevant non-technical aspects.
- Short courses or seminars for senior staff, focusing on water resources management objectives, constraints and criteria.
- Workshops and seminars on water resources decision support, addressed to water resources specialists, aimed at the improvement of their capability to influence decisions.

2.10.1.2 For non-specialists in water resources participating in water resources management

- Roving seminars moving intra-regionally and from region to region as well, aiming at the explanation of the basic principles of water management as applied to local or regional situations.

2.10.1.3 For the community at large

Public relations activities using mass media, directed jointly by water resources and mass media professionals.

IHP could initiate new educational activities and/or influence the existing courses to move along the lines described above. To achieve this, it is recommended that the IHP :

1. Adopt a clear strategy with regard to the target groups, educational approaches and methods.
2. Interact with existing and/or potential sponsors and organizers of the courses and seminars in order to get their co-operation on the adopted strategies.
3. Encourage the IHP National Committees to formulate their views on the educational needs of the countries and regions.
4. Appeal to non-governmental organizations for co-operation in defining educational goals and methods in the various aspects of water resources management.
5. Link the co-sponsoring of courses, seminars, workshops, etc., to the requirements of the educational patterns to be followed.

IHP should strive to increase the involvement and responsibility of local educational forces in the process of transfer of knowledge and technology. In this respect, the key educational institutes in the countries and regions should be identified (such as universities and colleges, governmental bodies, water development agencies, etc.). These entities should be encouraged to interact with the course organizers by expressing their views on curricula and syllabi, as well as teaching methods, recruiting the most suitable participants, contributing to the teaching staff, following up the professional performance of past participants, etc. Eventually, parts or entire courses might be transferred to local centres.

The present trends of educating water resources technicians on the local and regional levels should be maintained. Refresher courses in selected centres of excellence within the region should regularly complement the education of technicians, paralleled by in-service, on-the-job and other forms of "hands-on" training.

Finally, it is important that the need for specific education and training activities be established -- it can be a complete waste of time and effort if, in fact, it is not needed or if it is established with the wrong national agency.

2.10.2. Training

2.10.2.1 Definition

A distinction is made in this report between "training" and education. The latter is assumed to be the attendance of the individual being instructed at some formal course which is usually conducted away from his normal work place. Training is used to refer to instruction given primarily on-the-job. The two are complementary and interdependent. Training cannot take place without prior education, while education alone does not confer the ability to carry out a task. The essential ingredient is experience which is only obtained after a period of training during which the individual performs the tasks which he has been educated to do.

Training can take a number of forms. Those discussed in these notes are :

- in-service training (in own or host country)
- the counterpart system
- the use of advisers.

2.10.2.2 Prerequisites for training

For the successful transfer of knowledge a number of preconditions must be satisfied. These include :

- Language

Adequate language training must be provided in those cases where the medium of instruction is not the mother tongue of the candidate. Not only must trainees be familiar with the everyday language but they also should be conversant with the relevant technical terms. Ideally any training course should be preceded by an intensive language course for those trainees who are not already proficient. Alternatively, instructors should be able to lecture in the language of the trainees. In practice, this is often difficult to ensure, but it is often possible to arrange for the translation of lecture notes and manuals into the language of the trainees. However, much of the technical reference material is published in the more widely used international languages and fluency in at least one of these is highly desirable.

- Cultural awareness

Instructors should be familiar with the history, culture, and customs of those to whom they have to impart knowledge. Conversely, some introductory material should be given to these persons who undertake training in foreign countries, especially in those situations where the respective ways of life are strongly in contrast with each other.

- Budget

Although the availability of adequate funds is obviously a sine qua non, there is often failure to make proper provision for all costs. For example, funds for such items as clothing, the purchase of technical publications, and the maintenance of an adequate standard of living, is essential in those cases where trainees travel to foreign countries. The costs associated with the preparation of training programmes and with the supervision of in-service training are often overlooked.

- Commitment

Trainees must have a strong sense of commitment and motivation if they are to gain maximum benefit from their training. Too frequently relatively senior officers are sent to training courses as some form of reward rather than in anticipation of any useful benefits. On the other hand instructors must also be properly motivated and have the necessary skills to motivate their trainees

and hold their interest. At a higher level senior officials and governments must be prepared to support those who have undergone training and give them freedom to implement new procedures and more generally to make the most effective use of their newly acquired skills.

- Adequate educational background

For the transfer of knowledge (and technology) to be successful, the recipients must have a sound educational background. For professional staff in the field of water resources this must include adequate training in the mathematical and physical sciences and in computer programming and the use of computers. If such a background is not available it must be provided. Certain minimum standards are also required for technicians.

2.10.2.3 Philosophical questions

A number of philosophical issues present themselves to those responsible for the transfer of knowledge and technology. These are discussed below before a number of alternative training approaches are examined.

Foremost among these issues is the level at which knowledge is to be transferred. Should an attempt be made to present the most up-to-date and sophisticated procedures requiring the most advanced technology or should some intermediate level be sought and an effort made to find the most "suitable" as opposed to the "best". Although the latter approach is usually supported and given lip-service, there is often strong pressure for the former because of reasons of prestige or national pride or mistaken views on the reliability and accuracy of the alternatives.

Frequently academic training is over-emphasized at the expense of practical training whereas the two should be treated as complementary. Knowledge can only be used effectively when the individual has to apply it himself in the real world situation. Thus any academic training, attendance at short training courses, etc., should be followed up soon afterwards by a period of time during which there is opportunity to put into practice the skills that have been acquired. It is only in this manner that experience and judgement can be developed. Too often this does not occur. In-service training where the trainee effectively becomes part of the host organization is a means of overcoming this shortcoming.

One of the most effective means of training is by the use of the "train the trainer" concept. This is particularly suited to the training of technicians who may only possess very limited knowledge of the language of the instructor. Initially candidates are selected who have a reasonable facility in the language of instruction and potential skills as trainers. These are then given intensive training both in the technical subjects and training methods. They, in turn, conduct training courses for their compatriots in their own organizations. In the area of water resources, this is an appropriate training system for hydrometric technicians.

2.10.2.4 In-service training in host countries

As suggested earlier, in-service training (including work on pilot projects) can be an ideal means of bridging the gap between theory and practice. It requires a host organization which is willing to accept the trainee and allow him to participate fully in its work. Arrangements have to be made for the provision of an adequate living allowance/salary for the trainee. Frequently this approach is used through projects funded by international lending organizations such as the World Bank, the Asian Development Bank, the various Arab funds among others. Trainees can be placed within government or semi-government authorities, or with consulting companies although in the latter case the normal needs of their practice make it more difficult for them to provide continuous training. Difficulties may also be encountered in providing adequate funds to cover the time of supervisors.

In all in-service training programmes, attention must be paid to the following factors to ensure that the recipients receive the maximum benefit from the training :

- their full-time engagement on useful and productive tasks without any periods of idleness (a common fault is to give trainees reports to read for long periods of time).
- their integration in the organization so that they feel themselves to be members of the team.
- the need for the provision of regular guidance, supervision, and explanations.
- their social and cultural enrichment.
- the adequacy of their accommodation and transport.

The trainees themselves must also meet certain obligations, exhibit a willingness and eagerness to learn, and avail themselves fully of all the opportunities presented.

2.10.2.5 The counterpart system

In this report the "counterpart system" is defined as the allocation of a counterpart to an overseas specialist who is engaged for a period of time on a project in a less developed country than his own. Usually the counterpart will nominally be a specialist, or aspiring to be a specialist, in the same discipline.

For a number of reasons the counterpart system is often not as successful as it should be. These include :

- the language barrier.
- the pressures placed on the specialist to finish his tasks in the shortest time possible (to reduce the costs to his organization and to meet the deadlines of the client).
- the frequently large disparity between the skills and the knowledge of the two parties.

There is also a tendency for the counterpart to be allocated the more simple and repetitive type tasks. Considerable effort and goodwill is required on both sides to enable the system to meet its objectives of imparting knowledge (including experience) to the counterpart.

2.10.2.6 Advisers

Experts in hydrology are often appointed to serve as advisers in the water resources (or equivalent) departments of governments. In this position they are called upon to review national hydrologic data collection programmes, review locally executed hydrologic studies and the work of foreign consultants, provide advice on instruments and analytical techniques, etc. The Unesco Regional Hydrologists serve a somewhat similar function but with more emphasis perhaps on education and training and the organization of seminars, etc. In both these cases the success of the efforts depends upon the energy, ability, and personality of the expert together with the willingness of the authorities concerned to accept and implement the advice given.

Occasionally a whole team of overseas experts may be assigned to a national water authority or to a particular project. The main advantage of this approach is that the work is largely carried out by the personnel of the less developed country. Thus they are building up their experience but avoiding errors, and learning from the assistance given by the advisers.

2.10.2.7 Recommendations

It is strongly recommended that much greater attention be paid to the practical training of those personnel who have undertaken IHP-sponsored or other educational courses. It is essential that such persons have the opportunity to put into practice the knowledge that they have acquired during their education before they lose the incentive to do so or, in fact, the knowledge itself.

Because the role of the IHP is essentially an educative and advisory one, this will not be an easy task. It could be accomplished through the combined efforts of National Committees (if they are motivated and sympathetic) and the Regional Hydrologists. A number of forms of training have been indicated. The most appropriate one will vary according to circumstances, and in the final analysis should be determined at the local or national level.

2.11 PUBLICATIONS

2.11.1 The present position

The IHP has been very active in the transfer of knowledge and technology through the distribution of its publications. These have included the proceedings of conferences, manuals and guides, scientific reports, as well as bulletins and newsletters, and pamphlets and brochures. Lists of the publications which have been purchased are available in the Studies and Reports in Hydrology (SRH) and Technical Papers in Hydrology (TPH) series. The publications can be purchased from book distributors holding the agency for Unesco publications. Free copies of these series are also sent to :

1. All Member State delegations to Unesco (who in practice could be expected to pass them on to organizations in their countries -- 158 copies).
2. All IHP National Committees and Focal Points (138 total).
3. Depository libraries around the world (425 total).
4. Unesco National Commissions (receive offers of free copies, almost always request them -- 158 copies).
5. All members of the Unesco Executive Board (who in practice could be expected to pass them on to organizations in their countries -- 50 copies).

Thus, each issue of the two series could have in excess of 900 free copies distributed.

In addition to the SRH and TPH series, the IHP publishes a third series entitled Technical Documents in Hydrology. These are produced in limited numbers (usually 1000 copies) and are made available at no charge for single copies upon request as long as they last. Most of these documents are well underway to being out of stock.

A selected analysis of sales (see Para. 1.1.1) has shown that by far the greatest proportion of the IHP publications for sale are being purchased by countries of the Europe and North America region, with very limited sales to Africa, Asia and Latin America. This would seem to be a consequence of cost and of a limited marketing strategy. It is strongly suggested that the means for providing more free copies to developing countries be explored.

In general, the publications serve obvious purposes. The proceedings of conferences provide a record of material which may not be published elsewhere and thus constitute a valuable means for transferring knowledge. On the other hand, some of the manuals and guides produced by the IHP contain information which is sometimes available from other sources. They do, nevertheless, introduce an international flavour largely missing from those of individual commercial sources. They would be more valuable, however, if they were written in the languages of the countries for which they are intended, especially in those cases where they are directed towards the work of technicians who are less likely to possess a knowledge of the language (principally English) in which the manuals and guides are typically originally written.

IHP publications are more useful when they cover topics not adequately covered in the standard texts and reference works or when that coverage is spread among several works and has not been brought together in one volume. It would seem that manuals and guides on nearly all the important aspects of hydrology are already available -- either through other international organizations, or through the hydrologic services of member countries. In consolidating these efforts the IHP serves a very useful purpose.

2.11.2 The future

It is believed that publications will continue to constitute a most important means for the transfer of knowledge and technology. The IHP activities in this area should be continued. There is a need perhaps for a more selective approach, however, as was described above. In general,

priority should be given to publishing material that is not already available, such as :

- the proceedings of conferences
- scientific reports
- brief newsletters on IHP activities.

Continuing the basic philosophy of the IHP, manuals and guides should be published where it can be shown that the material to be included in them is not already available in existing publications. In this effort it would seem appropriate that the Regional Hydrologists could survey the requirements for publications, after which the availability of existing material should be ascertained. If convenient documents are readily available, or can be combined from more than one source, then the possibility of cheap reproduction for use in developing countries should be investigated. This may entail the release of copyright. If the material is not available, arrangements may have to be made for its compilation. Publishers of popular texts and manuals should be approached with a view to arranging for cheaper editions to be made available in some countries.

All documents produced by IHP should be published in sufficient numbers to ensure a wide distribution. Their availability should be widely advertised to ensure that those in need become aware of their existence.

New publications of IHP could be introduced through professional societies in the countries by special lectures at national conferences and symposia. In this and all national marketing strategies the NC/IHP's should assume an important role.

It would also be useful to get feed-back information from the users of the publications about the quality and usefulness of the respective publications.

It is recommended that the ROST's assist, within the means and budget available to them, in securing translations of regionally relevant documents into the languages pertinent to their specific regions.

2.12 SYMPOSIA, CONFERENCES, SEMINARS AND TRAINING WORKSHOPS

2.12.1 Symposia and Conferences

Symposia and conferences are the traditional way of exchanging scientific and professional information, and thus their importance for the transfer of knowledge and technology is assured, by definition.

However, the efficiency of these mechanisms can be greatly improved by careful planning and judicious intervention of the IHP in conjunction with regional and national bodies. The following aspects of possible IHP involvement merit consideration :

1. Selection of subjects of relevance to the transfer of knowledge and technology, in close co-operation with the NGO's and co-sponsors of the symposia.

2. Selection of suitable places for the symposia and conferences, thereby ensuring that participants from developing countries can participate in greater numbers.
3. Sponsoring the participation of scientists and professionals from developing countries, thus exposing them to direct exchange of ideas with their colleagues from other parts of the world.
4. Linking widely attended symposia and conferences with seminars, workshops and other tutorial activities for the benefit of acquiring knowledge by participants from developing countries.
5. Combining the symposia and conferences with educational activities, such as IHP-sponsored post-graduate and other courses, which would make possible a wide participation of young professionals in these conferences without too much additional expense.
6. Ensuring that the conference proceedings reach the professionals in the developing countries.
7. Giving preference to the inclusion of state-of-the-art reports in the conference agenda, so as to provide the professionals in developing countries with up-to-date information on various scientific, technical and technological developments.

Good co-ordination with NGO's seems to be the most efficient way to achieve these and similar goals.

2.12.2 Distinction between symposia, seminars and training workshops

Symposia (and conferences), seminars and training workshops provide a graduated approach in the transfer of knowledge. In symposia and conferences the audience is largely passive, with the speaker providing all the input. The listener can make an effort to assimilate the content of the talk or he can "switch off". They are of more benefit when they are held in the country to which knowledge is to be transferred as this allows much greater attendance of engineers and scientists from that country. One of the most important advantages, perhaps, of symposia is that they facilitate personal contact between specialists. This personal contact and discussion of mutual problems is undoubtedly extremely beneficial. Symposia are also a useful vehicle for the dissemination of new techniques and the results of the application of proven procedures. A busy person may not be able to find the time to read through the proceedings of a conference but, if attending one, he is able to give it his full attention. However, because of their short duration, the lack of opportunity for problem solving, and occasionally because of language difficulties, except as noted above they are not regarded as a major means for the transfer of knowledge.

Seminars usually concentrate more on a particular subject and are more informal in character than symposia, with greater involvement of the audience and greater exchange of ideas.

Training workshops are designed to give the participants actual experience in problem-solving. They thus require active full-time involvement from all the participants, not only the workshop leader.

They are particularly useful in giving training in numerical techniques, especially those utilizing computer-modelling. For example, the object of a workshop may be the introduction of a particular rainfall-runoff model. In this instance computer terminals, or micro-computers, test data, and users' manuals would be provided for the participants who would thus gain "hands-on" experience (plus a copy of the computer programme and manual).

2.12.3 Recommendations

While each of the three means of transfer of knowledge just discussed has its own purpose and, if properly conducted, will achieve these objectives, it is believed that training workshops are potentially the most effective of them for the transfer of knowledge and technology. Experience has shown that attendance at a training course or conference is by itself not sufficient to complete the knowledge transfer process. It is essential for the person being trained to be given the opportunity (or rather "forced to") to apply the procedure or knowledge which is being transferred.

It is strongly recommended, therefore, that emphasis be placed upon training workshops dealing with selected topics. Suitable topics could be identified by the Regional Hydrologists and the Regional Co-ordinating Councils.

2.13 PILOT AND REGIONAL PROJECTS

2.13.1 Major Regional Projects

Because of similarities in the geographical, climatological, hydrological, socio-economic situations and level of development within the regions, there are often common techniques which can be used to solve their water management problems. To this end, the Major Regional Projects (MRP) for stressing the application of appropriate techniques in water conservation and national water utilization and disposal have been initiated by Unesco for Latin America and the Caribbean, Africa south of the Sahel, the Arab States and Asia. The MRP's are meant primarily for rural areas and the most disadvantaged sections of urban fringe populations. The projects are intended to develop a scientific basis for the various techniques (many of which are thousands of years old) and to gather information that can make their use, transfer and adaptation in other regions more efficient. The projects are executed by means of study tours, pilot projects, workshops, seminars, etc. The IHP provides the necessary momentum for the projects -- it has also given prestige to the local technologies and pride in those who have offered them to other regions. Since the objectives of these projects are in keeping with "technology transfer", it is important that the MRP's not be overlooked as one of the important mechanisms for technology transfer at the regional level.

2.13.2 Field projects

Various techniques have been used in different countries to implement water management projects. Some have been successful; others have not. It is important that the reasons for success or failure be documented and made known, as a guide to the future acceptance of new technologies.

In addition to providing documentation, these projects could be used as case studies to demonstrate what the factors for success and failure were. They could be used to teach students, researchers, consulting engineers, etc. At the national level, these should be used as part of the mechanisms for transfer of technology. They could also be used regionally if the lessons to be learned from them are of regional interest.

2.14 INFORMATION SYSTEMS

Because the access to information is one of the most relevant aspects in the transfer of technology and knowledge, IHP must do as much as possible to bridge the information gap which is widening between the most advanced parts and the rest of the world. Perhaps jointly with the other Unesco programmes, IHP should promote the establishment of information networks in the countries.

The ways of rational access to information should be explored, including the selection of hardware and software, linkage to existing information systems, education and training in water-related documentation, and co-operation in the promotion of water-related data bases.

An important aspect of documentation and information concerns the users, who should be instructed about the existence and the contents of the data bases, on the ways of using them, on the advantages and benefits which can be obtained. The users should also provide the IHP with advice about the main difficulties they meet in the field of information (access to data bases, difficulties in obtaining documentation, etc.).

III. RECOMMENDED STRATEGIES FOR TRANSFER OF KNOWLEDGE AND TECHNOLOGY IN HYDROLOGY AND WATER RESOURCES

3.1 INTRODUCTION

IHP projects can be divided basically into scientific and educational projects. From the point of view of transfer of knowledge and technology, IHP has already contributed significantly to education in the field of hydrology and water resources. The products of the numerous scientific projects have taken the form of publications, seminars, workshops, symposia and conferences. In the developed countries, various systems are available to absorb such products. In the developing countries, the absorption systems are in various stages of development, leading to incomplete and limited impact of scientific projects. In order to improve this impact, the "software" products of the scientific projects of IHP (publications, seminars, etc.) need to be reinforced in selected areas with "hardware" components (pilot projects, institutions, field projects, etc.) in the developing countries. This relatively new dimension is in line with the spirit of the Preliminary Report on the Planning of IHP-IV, of 15 April 1986. Moreover, it will be beneficial and complementary to the scientific projects of IHP, which need to be continued and expanded to provide the new "software" necessary for balanced development.

Unesco through the International Hydrological Programme can strengthen and improve its knowledge and technology transfer efforts and significantly advance water management programmes all over the world. Water resources knowledge like other types of knowledge, can be produced, stored, transferred and used. To speed the rate and extent of the use of water resources technology, IHP should enhance the level of communications and interface with as many water groups and individuals as possible. This will not occur by chance, but major advances can be made if IHP at all levels can develop and implement a coherent technology transfer programme. The plan will have to focus on the needs of specific users in the field of water resources and determine specific technology transfer objectives, select specific mechanisms and evaluate results. In the final analysis it is the quality of the human resources that is critical. A technology transfer programme must therefore be directed at the individuals upon which success will depend. The technology transfer plan identifies :

- The target groups or users
- Technology needs of the groups and individuals
- Suitable mechanisms to reach the groups and individuals
- Resources required to reach users
- A schedule of technology transfer activities
- An estimate of costs
- Monitoring and evaluating procedures.

The plan should also provide a guide for implementing the technology transfer programmes, and serve as a management tool for monitoring purposes.

The recommended strategies for effective transfer of knowledge and technology in hydrology and water resources may be divided into two categories : institutional strategies and mechanisms.

3.2 INSTITUTIONAL STRATEGIES

3.2.1 Co-ordination of IHP at the regional level

In view of the fact that regional and national activities play a paramount role in the process of transfer of knowledge and technology, attention must be focused on the proper promotion of relationships at the regional and national levels to promote streamlined effective transfer of technology under the overall umbrella of the IHP. A suggested regional co-ordinating council function whose membership would be composed of representatives of all National Committees for the IHP in the region should participate actively in establishing plans, policies and guidelines, and should assist in executing the regional IHP programme in full co-operation with the ROST's.

It is suggested that the IHP National Committees keep under review the desirability of establishing regional co-ordinating councils (or mechanisms) to carry out decisions as well as implement a regional programme. The ROST's should be closely associated with the functioning of such a body.

3.2.2 Roles of National Committees, Regional Hydrologists and IHP Headquarters in technology transfer

The National Committees for the IHP are identified in this report as the key linkages required at the national level. Their activities should involve identification, co-ordination, encouragement and evaluation of technology transfer projects. The ROST's provide the major linkage between IHP Headquarters and the National Committees. Moreover, they should have a major responsibility for technology transfer activities at the regional level. The ROST's should work closely with regional co-ordinating councils to develop the regional programme in conformity with the priorities of the region. This co-operative effort should also be directed towards the implementation and evaluation of projects. Since technology transfer criteria and activities form the major portion of the work of the Regional Hydrologist, it is recommended that a staff person be appointed in each ROST for technology transfer activities, in addition to professional associate experts seconded by various countries.

The role of IHP Headquarters in transfer of knowledge and technology in water resources is extremely important. The headquarters provides support, encouragement and guidance for transfer of technology activities at the regional and national levels. Interaction among the three levels in both directions is most important. Planning of IHP programmes will continue to take into consideration national and regional requirements. Moreover, IHP Headquarters should co-ordinate regional efforts as well as activities with other international or non-governmental organizations with particular emphasis on technology transfer. IHP Headquarters should strive to promote co-operation between the ROST's and other regional water-related organizations. IHP Headquarters should promote, through proper funding or arrangement of funding from other agencies, the establishment and strengthening of institutions for technology transfer in water resources.

The number of appointments of members of IHP working groups and rapporteurs from developing countries should be increased in line with the present IHP policy. The ROST's and the National Committees should play active roles in identifying potential nominees and following up on these nominations.

3.2.3 National Hydrology and Water Resources Institutions

National research centres or agencies can play an important role in technology transfer. New knowledge and techniques developed in these centres or adapted from developed countries should be transmitted to the various target groups by training courses, workshops, etc.

National hydrology agencies are mostly on the receiving end of technology transfer. Their main task in this respect is the development of high absorptive capacities for technology transfer. This necessitates making full utilization of various mechanisms of technology transfer that are made available to them. Of particular importance to these agencies are training programmes on collection, processing and analysis of hydrologic data.

3.3 MECHANISMS

A variety of mechanisms or approaches are available to assist with the technology transfer process, ranging from the use of publications to person-to-person communications. The mechanisms used are heavily dependent upon the target audience to be reached and its particular need, and must be decided upon according to local requirements. Some mechanisms are designed to create an awareness of a technology while others are used to help the user implement or actually apply technology to a particular problem. A series of mechanisms are also needed to move users from a state of awareness to the point where they are able to apply technology. The mechanisms are familiar ones, but it is the way they are designed and linked together to emphasize technology transfer for specific needs that is important.

The following is a summary of suggested mechanisms and key features critical to technology transfer.

3.3.1 Education

Education should continue to be a major focus of IHP as it expands its role in technology transfer. Participants in IHP-sponsored courses are key persons to help extend technology to others. The course length, the educational approaches and methods used should be based on the needs of the target groups to be reached, i.e. water resources specialists, non-specialists and lay audiences. These courses should also give greater emphasis to knowledge created within a country. Refresher courses for previous participants should also be organized.

The present trend of educating water resources technicians on the local and regional levels should be continued. These efforts should be paralleled by in-service, on-the-job and other forms of training.

The NC/IHP's and Regional Hydrologists should play an increasing role in the IHP education and training programmes. The Regional Hydrologist should keep the NC/IHP's informed of fellowship recipients or beneficiaries of IHP post-graduate or technician training courses each year within each region so that progress of the recipients can be effectively monitored.

3.3.2 Publications

A variety of publications are used to assist with the transfer of knowledge developed through the IHP. It is recommended that a wide range of publications continue to be used by IHP including proceedings of conferences, manuals and guides, scientific reports, bulletins and newsletters, and pamphlets and brochures. Certainly more free copies should be provided the NC/IHP's.

Priority should be given to publication of materials that are not readily available from other sources including the proceedings of conferences, scientific reports, and brief newsletters on IHP activities.

Publications written in the various user languages should be produced by IHP, in sufficient numbers to ensure a wide distribution. The use of bulletins and newsletters is encouraged to help create an awareness of and information about other publications.

3.3.3 Organized group meetings

Symposia, conferences, seminars and training workshops provide a variety and a graduated approach in the transfer of knowledge. The selection of the organized group approaches for transfer of knowledge will depend upon the audience and the detail of technology to be presented. When possible the use of training workshops should be encouraged to give the participants actual experience in problem-solving. The training workshops are potentially the most effective for the transfer of knowledge and technology. These sessions require that emphasis be placed on selected topics that are closely linked to the identified needs of the target audience or user.

3.3.4 Pilot and Regional Projects

The Major Regional Projects are an important mechanism for technology transfer. Because of similarities in geography, climate, hydrology, socio-economic situations and level of development, there are common techniques which could be used to solve water management problems. It is recommended that greater use be made of the Major Regional Projects and that study tours, pilot projects, seminars and training workshops be used to enhance the transfer and application of the new technology. Field projects should also be used to demonstrate the latest technology to students, researchers, consulting engineers and others that need hands-on experience relating to adoption of new practices.

3.3.5 Water-related documentation and information systems

To help bridge the information gap IHP should work (perhaps with other Unesco programmes) to establish information networks in countries with regional and global focal points on important aspects of water resources management. IHP Headquarters and Regional Hydrologists working with National Committees should help identify priority information needs, select hardware and software, and suggest linkages to existing information systems, education and training documents and water-related data bases, with and without the use of computers.

In order to impart continuity and reinforcement to transfer of technology activities, it is recommended that consideration be given to the establishment of regional centres for transfer of knowledge and technology in water resources in developing countries. Such centres would probably be lightly staffed and attached to existing national institutions. Their main contribution would be co-ordination of regional transfer of technology activities as well as assisting in identification of needs and preparation of proposals for projects.