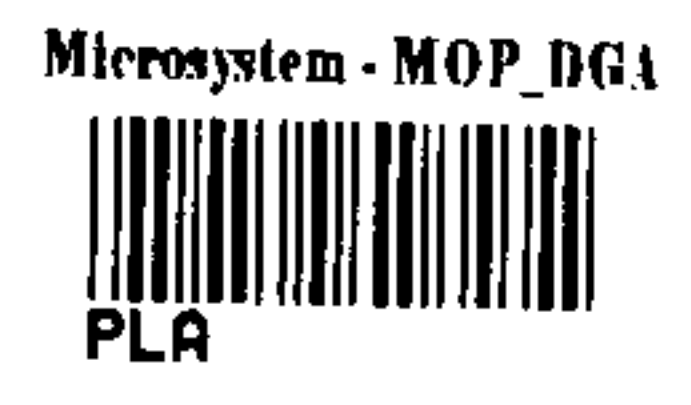


Scientific and technical water-related
documentary information in the
UNESCO
International Hydrological Programme

(UNESCO-IHP Phase III, Project 17.1)



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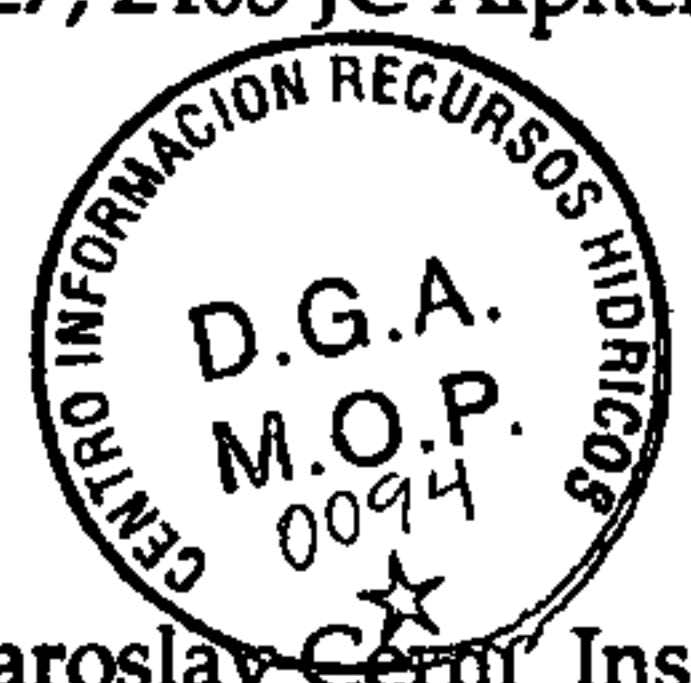
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Why should you read this?

Looking at the title of this booklet, you might ask yourself: *"Why should I read this? Is it worth spending my time?"* We would like to answer shortly: *"Yes, please make this effort. It may help you understand better your information needs and get an idea how to satisfy them best."*

In a world which changes rapidly, in which resources are becoming strained to limits, in which continents and countries are increasingly interdependent, in which individual lives are influenced and even endangered by what happens on the other side of the globe, in such a world the access to information is one of the main conditions of survival. This general statement is even more true for the water-related activities, water being one of the most valuable resources of mankind.

By its very nature, water is an omnipresent substance on Earth, a condition of human existence, and so are the activities related to water, from basic sciences to engineering applications. No simple solutions can be found to most water-related problems, due to the complexity of interactions between the many components of water systems, both natural and artificial. Basic sciences, engineering technologies, environmental aspects and human valuations are interwoven in the complex web of water systems, which, in addition, are never stationary, but rapidly changing in time, in all their main components.

The approach to water-related problems is thus multi-disciplinary, and requires the cooperation of professionals of many specialties. They cannot communicate between themselves if not informed about the abilities, capabilities and working languages of the others; and no education can provide for all that is needed in real life situations. The gap cannot be overcome but only by fast, easy and cost-effective access to information which should be as complete as possible.

Although the principles are the same in all fields of information production and use, each specific field needs elaboration on its own, and an expert build-up, at both sides of the process: in defining the information needs and in providing the necessary techniques of information storage and retrieval.

One of the objectives of this report is to invite the information user community in water-related fields to appreciate information as an inexhaustible resource of knowledge and as a starting point of any activity pertaining to research, planning, design, management, or education. This fact has been recognized long ago; back in 1775, Samuel Johnson remarked:

"Knowledge is of two kinds: we know a subject ourselves or we know where we can find information on it."

Since that time, diversification of human knowledge has been immense, so that nowadays the latter kind of knowledge has become a necessity. This document treats the problem of how to master information, with the least efforts and best effects, in the specific field of water-related activities.

A positive attitude of the information user community is needed, since the users and the suppliers of information are the very same people. In consequence, the prospective user of water-related information should also agree to be the supplier of

information to others, or more generally, to contribute to the information resources of the world. Those two activities are interlinked: only those who know how to use information, can supply information properly, and vice versa.

This report will reach its aim only if it succeeds in attracting the interest and active participation of the reader, the user and creator of water-related information.

In the first place, this report will regard the problem from the end-users' point of view. Above all, they (hydrologists, engineers, policy makers,...) are our goal to reach. Therefore, as you will read in the next chapter, we schematize the present real situation concerning water-related information; we present an overview of the existing situation, in a scheme and flow chart which is applicable to most scientific and technical domains. We will see that the present information system is far from ideal, so that we also make some suggestions to improve it. These suggestions are rather general and vague; however, a complete chapter towards the end of this document is devoted to more concrete recommendations. We hope that this contribution will be useful and lead to further work in the framework of the UNESCO-IHP.

The water-related information system and suggestions for improvement

Introduction

In contrast to many outlines of documentary information systems, we start from the user who needs information, and not from the information products. This chapter is accompanied by a scheme (in the form of a flow chart) of a search for information by an end-user who is confronted with the existing (water-related) information system. The following serves as an introduction to the more concrete recommendations to UNESCO-IHP in the final chapter. Let us imagine a hydrologist or, more generally, an end-user of (water-related) documentary information; she/he requires for instance information concerning a hydrologic problem in her/his region.

The level of the end-user (1)

The production of information is characterized by a steady increase, also in the field of water-related science and technology. Every potential end-user should be information-minded. This means that she/he is aware of

- the importance of already existing information, and of
- the available methods to make a search for information successful.

Therefore, all potential users of information should be trained in order that their information-awareness be either born or developed.

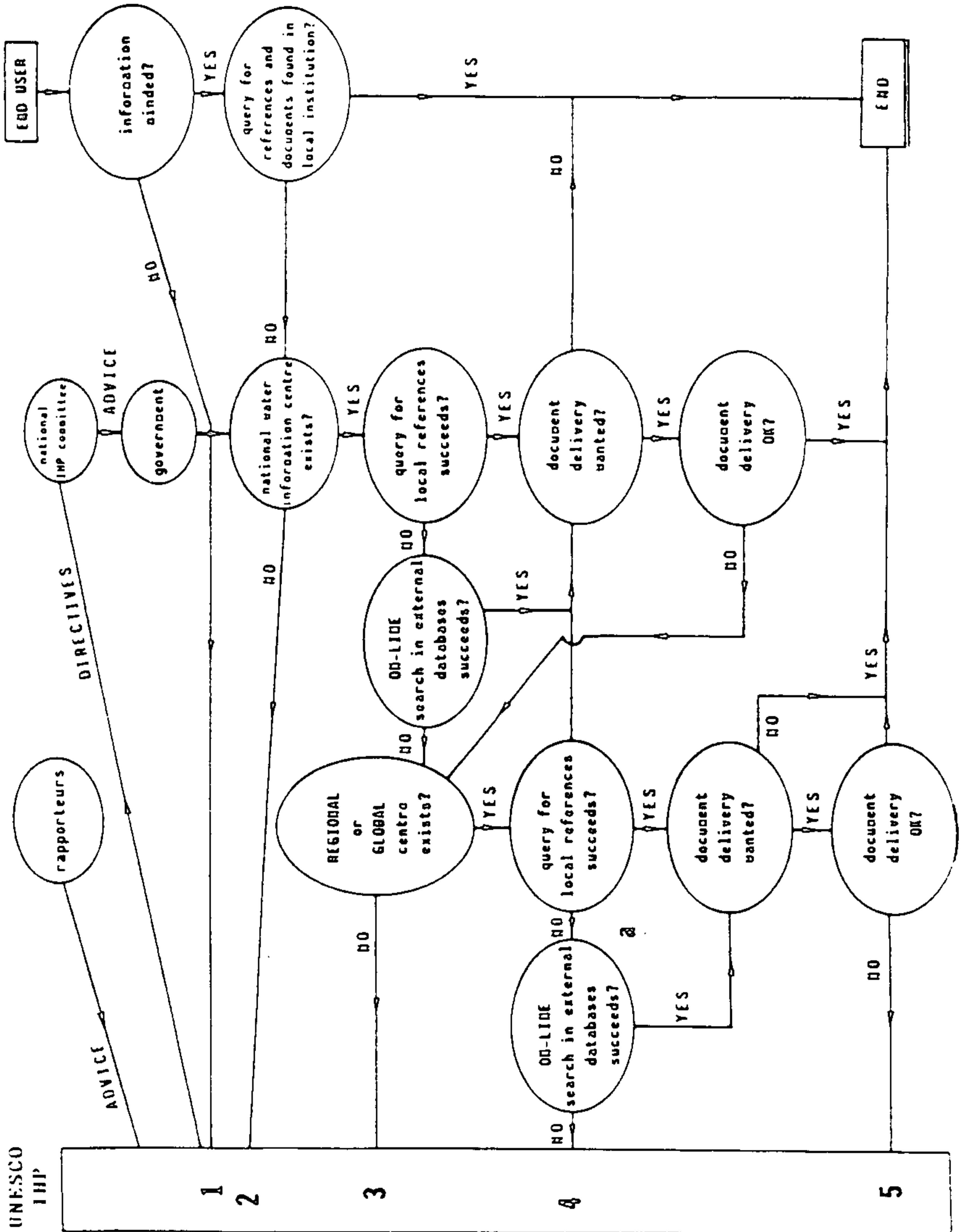
In particular, we recommend the training of end-users in the framework of UNESCO-supported courses, seminars, conferences and programs (for instance, the Inter-university Postgraduate Programme in Hydrology, IUPHY, at the Free University of Brussels in Belgium, and the summer schools at the 'Jaroslav Cerni' Institute for the Development of Water Resources, in Belgrado, Yugoslavia).

The end-user should be offered the information which is available concerning the working of UNESCO and other organizations in the field of water-related information. The end-user should know the general organizational structure of the water-related information system. This should include national water-related information intermediaries and regional centres. Information about this system can take the form of leaflets, folders, reports, training and education programs. An effective publicity and education program which develops continuously can achieve these goals.

END USER

NATIONAL

INTERNATIONAL



The national level (2)

Supporting the existing national water-related information centres

Let us first suppose that the end-user is aware of an existing local or national water-related information intermediary institute, for instance a library. This organisation should ideally be advised and supported through UNESCO-IHP by a training and education program. Leaflets or brochures explaining the complexity of the organization should be available. Librarians and information specialists should be available to assure that the end-user receive the maximum benefit from the library resources. They should also provide information through searches using internal, local databases or national and international remote databases; the apparatus required includes a terminal or preferably, a (micro)computer located in the information centre.

The end-user should have access to an outline of the available information resources and of the experience of the available information intermediaries (= persons assisting the end-user at the information intermediary institute).

The information intermediary/centre should publish catalogues or descriptive lists (for instance annually) of newly published or acquired books, reports and maps.

Contributors to local and national databases would require training.

The staff should be able to select incoming information which is best suited to the purpose of the end-user, (e.g. documents dealing with specific subfields of water resources management). Again the education and training program is essential.

We recommend the support of a publicity and education program at the national level aimed at library and information science and at end-user education. Perhaps such an activity can be related to the national information intermediary.

To avoid that a potential end-user would not be able to locate the existing local or national information intermediary, all potential end-users should receive a list of intermediaries in a region or country, in the field of water-related information

In conclusion, if a water-related information intermediary already exists, it should be supported.

Creation of new national water-related information centres

When a co-ordinating, specialised water-related information intermediary/centre/-unit does not exist yet, UNESCO-IHP should stimulate its creation. The members of such a national unit should ideally consist of one or more professionals skilled in information science and of hydrologists. Any international water-related information system could efficiently fulfil its functions in any given country only if that country has or would develop simultaneously a national water intermediary. By working through the UNESCO-IHP National Committees, the ministerial and departmental involvement and commitment to the establishment of a water-related

information intermediary should grow. Recommendations should therefore be given to the governments of the countries involved. A possible scenario is outlined in the following. Initially, each national committee organizes and subsidizes a sensitizing meeting to be held for policy makers, information specialists, members of national water-related bodies and agencies, and members of the water industry of that country. These people may become aware of the objectives of a water-related information system, and of its vital importance to their country and/or company. This meeting can be followed by an online information retrieval session, in which available water-related databases are searched (for instance, a local database, as well as an international one). The water-related community should become aware in this way of the whole range of facilities and services of a good water-related information system. The national committees should help raising the money required for the personnel and the infrastructure of national water-related information centres in the various countries. The national committees should help choosing which intermediary to support primarily, after a study of the existing candidate institutions related to water information; this should keep the costs relatively low, in comparison with the creation of completely new information centres 'ab initio', which seems not efficient and simply too expensive. The national intermediary may be a university department, or a department of the national library (if this exists in the particular country). Many contacts have to be established among

- the National Committees for IHP,
- the National Committees for UNISIST and the General Information Programme of UNESCO (PGI), and
- the contributors to this project.

The National Committees for the IHP of the countries which are interested in the water-related information system make their choice known to a co-ordinating unit, established by UNESCO-IHP in Paris.

Tasks of the national water-related information centres

In reality, most cases will be situated between the two extremes outlined above (finding immediately the needed information or not being information minded). In general however, the national centres should at least try to accomplish the following tasks:

- To collect copies of water-related documents, with an emphasis on those documents which were created in the country.
- To take part in the creation of a computerized water-related bibliographic database of references to their own national documents and other data collections; to make this database internationally available.
- To search online computerized databases for end-users, which requires online information retrieval equipment and skilled personnel.
- To maintain or establish a telecommunication system between various water-related institutions.

An expert intermediary on supra-national scale and/or a consultant with an advisory group chosen by UNESCO should advise the national water-related intermediaries and guide them, e.g. in their efforts to establish their own national water-related files/database.

The international level: a network of water-related information centres (3)

Even in the case that a suitable national centre functions, problems will arise. For example, the end-user cannot find a suited reference in the national water information system, or when the query should succeed, the document (if needed) is not available or not existing in the local library files. Therefore, the implementation of at least one globally oriented or a few regionally oriented water-related information centres will offer advantages. The staff there should also provide information through database searches (online); telephone reference should also be available. These regional centres should function in the same way as the national centres, but in a complementary way. They can also advise on activities of national centres.

UNESCO-IHP can stimulate the establishment of an expert water-related information centre, or of a few regional centres related to hydrology information, i.e. on a supra-national scale, within the broader framework of other water information services. This information intermediary should clearly supplement, rather than replace, the other existing services. The co-ordinating unit within UNESCO-IHP should draw up a list of candidate institutes for this role; all the national water-related information centres are obvious candidates. Of course, the co-ordinating unit should outline criteria which have to be fulfilled by an institute in order to serve as an expert supra-national water-related information intermediary. The national committees and the co-ordinating unit should invite candidates, evaluate the proposals, and make up a choice which should lead to the provision of support and assistance (in part financial) of the selected water-related intermediaries.

Co-ordination between several regional intermediaries (or between an expert water-related intermediary and all national intermediaries related with water information) is essential to avoid overlap of activities and duplication of effort. This co-ordination will also ensure a balanced coverage of material from all relevant disciplines, subject fields, and document types (e.g., conference papers and dissertations).

The expert water-related intermediary or a regional intermediary should draw up (and afterwards update) a list of intermediaries related to water information and of all their activities for all users. However, the first version of such a directory can also be created by a consultant in the framework of UNESCO-IHP, because this seems an important project, while the selection of one or a few UNESCO-IHP supported centres may perhaps take a long time.

Water-related bibliographic databases (4)

National water-related databases

One of the aims of an information system is the cataloguing of all documents related to water information in a bibliography. The co-ordinating unit of UNESCO-IHP should advise the National Committees to establish a depot where all authors related with water information send one copy, so that references and documents become better available.

The establishment or, and even better, the support and enlargement of an existing specialized database is recommended; such a database can contain then at least a reference to the documents, including grey literature (unpublished documents). Of course a computerized database is preferable.

Internationally accessible water-related database

Most of the water-related documents which have been included in a national database, as discussed above, should also be recorded in one or more databases which can be accessed internationally by the public. Therefore, the cooperation with one or more of such existing computerized water-related databases is desirable. A host computer should load the common computerized water-related database to make the data available through the world-wide data-communications network. UNESCO-IHP should support those efforts.

The importance of computerized water-related documentary information is steadily growing. Therefore, we devote the next chapter completely to the present situation in this area.

Universal availability of publications in the area of water-related information (5)

Interlibrary loan

The universal availability of publications is one of the ideals we should bear in mind; the well recognized importance of this ideal has even lead to the well-known acronym 'U.A.P.'

A better cooperation between water-related intermediaries should improve the exchange of catalogues (in hard copy as well as computerized) and the related inter-library loan arrangements. This should result in the faster delivery of any document.

National water-related information centres

The national centres should collect water-related documents and make these available. Of course the national production will be emphasized.

International water-related information centres

These centres should collect water-related documents of regional or global interest and make these available to all interested users. This function should be complementary to the role of other international institutes concerned with document delivery, which are less specialized in water-related information.

Computerized water-related documentary information

General trends

In spite of many, mainly technical, developments, the situation in the field of water-related online (bibliographic) information has not been improved much in recent years. Most changes are invoked by technical developments, like the lower price and extended possibilities of computer storage, the use of microcomputers, and optical storage media; however, all have only influence, for the time being, on the form in which existing information is available or distributed.

There are much less changes or improvements when it comes to the contents of existing information services.

A related problem is that only 4% of all computers are located in the Third World; also, the use of them is often far below their capacity. This leads to the dilemma either to keep up with 'Western' technology and invest in computers and networks and stay completely dependent on 'Western' suppliers or try to develop own systems (EADI Conference, Amsterdam, September 1987).

Computer and data communication networks are steadily growing in size and intensity, but still mainly in the 'developed' world, where one is already working on the next generation networks, like the ISDN (Integrated Services Digital Network). In general, telecommunications in the developing countries are at a very low level (Hudson, 1987); for instance in a town like Tokyo, there are more telephones than in the whole of Africa.

The developments on making available 'grey literature' are slow and still limited to the 'developed' countries, like the SIGLE project for Europe or GLIN in the Netherlands. A recent article describes the problems of acquiring documents in Africa in quite another field, demography, but can serve as an example of the problems in this area; researchers from Ghana, for instance, prefer to send their reports to documentation centres in the USA and UK, to receive international recognition; copies of these papers are only available abroad, which means that other researchers have to make expensive trips to Europe or the USA to consult information about their own countries (Kwafo-Akoto, 1988).

The most important hosts for scientific and technical information are still there, like Dialog in the USA and ESA/IRS (European Space Agency/Information Retrieval Service) in Europe. Some smaller hosts have disappeared, like Spidel and Samsom. Some newer host systems are developing well (e.g. the international Scientific and Technical Network, STN), or moving to the USA (e.g. Pergamon Infoline, now ORBIT-Infoline).

There are changes in their pricing structure: one has to pay less for connect-time, but more to display retrieved information.

Databases are disappearing (e.g. Delft Hydro) or becoming available on a public host (e.g. the West German database Hydroline on FIZ/Technik) or moving to the USA (e.g., Aqualine).

A large part of the information on water-related subjects is scattered over many databases and information sources.

In the following, we will briefly discuss the main developments in the international information systems and (possible) effects on the use or availability of information. The scope will be mainly on bibliographic information; numeric databanks and hydrologic data collections are not discussed in detail.

In the field of national information systems, written information is lacking; although there are plans in several countries to develop at least general information systems, we will not discuss these plans in detail. In the Philippines, Sri Lanka, Thailand, Argentina, Brazil, Peru, Algeria, Burkina Fasso (CIEH), Morocco, Tanzania, Tunisia, Ethiopia, and Yugoslavia (the YUWAT system), water-related information systems are already existing or in an advanced stage of development. In some cases there are only manual systems, but for a number of them, there are plans for a transfer to computerized form.

A separate and important development is the INFO-IMPACT initiative under which plans are made to set up a number of information centres dealing with water supply and sanitation. This programme is more or less a continuation of POETRI. The International Reference Centre for Community Water Supply and Sanitation in The Hague plays a central role in these plans. Details can be found in the report of the last meeting (IRC, 1988).

On the other hand, the cooperation in the field of documentation between five main institutions dealing with water supply in the Netherlands (SALIWA) has been stopped due to a lack of funds.

Main developments can be summarized as follows:

- development of intelligent interfaces to facilitate searching in databases by end-users,
- use of intelligent terminals (PC's) to make searching in databases by intermediaries more efficient,
- changes in charges made by the database producers and host systems,
- use of local databases on microcomputers versus host computers,
- decreasing number of bibliographic databases,
- the move from bibliographical towards full-text databases,
- availability of databases on optical storage media like the CD-ROM,
- electronic publishing,
- use of electronic mail (e-mail) and file transfer.

Accessibility of existing online information

Computer networks and telecommunications

In the field of telecommunications, the drive is on among the developed countries to help for instance Africa with financial and technical support to redress the imbalance

of the global telecommunications network. For instance, Canada has projects worth US\$ 200 million in Africa; also India, ranked as a developing country itself, provides consultancy services and carries out feasibility studies there. A number of African countries have spent foreign currency to build ground stations to gain access to the INTELSAT system. Developments are also reported from Malaysia, Thailand, Burma, and China, but the priority is certainly not the transfer of (bibliographical) information. (Bridging the telecommunications gap, Communications International, 1986, September, pp. 32-51, 8 pp.)

Already in 1980, telecommunications were seen as an essential tool in the social, cultural, and economical development, as stated in the report of the MacBride Commission of UNESCO, called 'Many Voices, One World.' More recently, studies have been executed by the International Telecommunications Union (ITU) in Geneva, like the 'Maitland Commission', which concludes that the information gap is still growing (Hudson, 1987).

Existing computer-networks are growing and improving, but they remain mainly limited to the 'Western' world. Connections are for instance possible in countries having national networks:

Brazil, Colombia, Mexico, and Barbados in the Latin-American region;
 Indonesia in the Asian region;
 Gabon and the Ivory Coast in the African region.

In some countries, multiplexers or concentrators are linked with for instance Italcable, like in Morocco, Kuwait, or the Peoples Republic of China. Cuba has a satellite connection with Russia. From Russia (VINITI, Moscow) there is a connection over Czechoslovakia with Austria (IIASA, Laxembourg), which allows a two-way traffic to Austria, but not from Austria.

Possibly the INTERNET Steering Committee, working in the framework of PGI, and financed by UNDP, will find possibilities to improve this situation; participating countries are Austria, Bulgaria, Hungary and Yugoslavia (UNESCO Newsletter 225, 7 March, 1988, p. 6).

Hosts

Some host-services have taken special measures to make it easier to access and use the information in the databases; these efforts are mainly directed towards end-users (not skilled searchers). Dialog introduced the Knowledge Index, using a limited number of databases and a simplified search language. BRS has its After Dark and BRKTHRU (USA only) facilities which operate with a menu-driven system. The ESA/IRS experiment with searching using natural language, Quest Quorum, has been stopped, but ESA/IRS is investigating the possibilities of creating an 'intelligent interface' (see also next paragraph).

Next to commercially available software on microcomputers for (tele)-communication, most hosts also offer this type of software. Use is, however, still limited to experienced users.

The same goes for developments, which facilitate the use of multiple databases with one and the same search-strategy. Onesearch on Dialog searches the selected databases one after another. Cluster searching at ESA/IRS searches the selected files simultaneously and gives a stronger reduction in search/connect time.

The plan of European hosts to cooperate to form the EHN, European Host Network, has only been realized in the connection between ESA/IRS and Infoline. This connection allows users of one of the hosts to enter and use a number of databases on the other host, without special login-procedures. Due to the gradual move of databases from Pergamon-Infoline to ORBIT-Infoline in the USA, the real value of this connection is diminishing.

Gateways

A gateway is any computer service that acts as an intermediary between a user and the databases resident on the computers of one or more other organizations. There are several classes of gateways. Some gateways are also online services, i.e. they have also databases resident on their own computers. From an online user's point of view, gateways represent a potentially important trend, one that offers the promise of helping individuals and institutions to access the growing number of databases available through many and varied online services.

Intelligent interfaces

Already before the wide-spread use of microcomputers, there were developments to facilitate searching in online databases by end-users. From the field of artificial intelligence came the development of expert systems. Although there are a number of more or less experimental systems in the field of information retrieval working, the problems of translating the way in which skilled searchers are actually searching, have not yet been solved.

Existing front-end systems and gateways facilitate the procedure of connecting to hosts through telecommunications, and of selecting the right database. In some cases, these systems are search-language independent. Most of these systems consist of a software package for a microcomputer, like IT. Other systems are located between the system of the user and the host systems. For instance, EasyNet offers this kind of service on a commercial basis. Recently, the 'ii' of Infotap, Luxembourg, developed with a grant of the EEC, is being offered in Europe (Information World Review, 25 April, 1988, p. 7); it is connected to the Geonet electronic mail network. None of these systems, however, have persuaded large quantities of end-users to use online information systems more frequently. The price for information still seems to be one of the problems for this category of (potential) users (Situation in the USA, Nachrichten für Dokumentation, 39, 1988, pp. 83-86).

The use of microcomputers

The use of microcomputers as intelligent interfaces/terminals is mainly limited to skilled searchers. The main effect is a reduction of mean search (=connect) time. The microcomputer can store telephone numbers, NUA's (network addresses), passwords, etc., to make a connection with the selected host through the existing networks more or less automatically, using suited communications software and an auto-dial modem. After selecting the proper database(s), a prepared search can be executed.

The results can be downloaded and stored on the computer's hard disk. In this way, a limiting factor in connection speed (baud rate) can be eliminated, namely the relatively slow printer used to record the results. The electronically stored results can be printed after the search session, after disconnecting, or they can be edited, or be used to build a private, local database with suited text-retrieval software, for instance Micro-CDS/ISIS (which is distributed by UNESCO-PGI); a difficulty in this last way of working is the conversion of files from the host format to a format suited for the local microcomputer software.

A short informative seminar on the use of Micro-CDS/ISIS for organizing and storing water-related non-numeric information was organized by the Yugoslavian National Committee for IHP in 1988. In the University Library of the Vrije Universiteit Brussel, the co-authors of this document have installed Version 1 and later Version 2.3 of Micro-CDS/ISIS, to test its suitability; up to now, the information intermediaries as well as the end-users manage downloaded bibliographic files with programs for word processing (particularly Microsoft Word is heavily used on IBM microcomputers and compatibles, as well as on Apple Macintosh microcomputers).

A critical overview of the software available for information and documentation work on IBM microcomputers and compatibles has been published by Nieuwenhuysen (1988); this includes software for communications with external, remote computers, as well as programs for the local creation, storage and retrieval of text-oriented information.

Water-related databases*Non-bibliographic databases*

Before considering the publicly accessible online available databases, a special light should be thrown to non-bibliographic databases. The Inventory of Data Sources in Science and Technology - A Preliminary Survey (CODATA and UNESCO, 1982) has been prepared by the Committee on Data for Science and Technology (CODATA) of the International Council of Scientific Unions (ICSU) under a contract from UNESCO within the General Information Programme (UNESCO-PGI). It represents an attempt to identify data sources in selected fields of basic, technical and applied

science, e.g. water-related science for each country. Its aim is to refer organizations and individuals needing numerical or factual data, especially those in the developing countries, to basic data sources which are relevant to their scientific problems. In the area of hydrology, the following data are considered: water stages, discharge measurements, surface water qualities, sedimentation transport, sedimentation of reservoirs, piezometric heads, water table characteristics, groundwater qualities, unsaturated zone data, thermal water data.

Numerical and factual data are increasingly requested by all types of information users who find that access to the primary and secondary literature cannot fully satisfy the needs for information arising from their work (Schwarz *et al.*, 1985). Therefore, some numerical water-related databases are included in the Appendix about online public-access water-related databases.

Some databases are online available and publicly accessible (see Appendix), while others serve only to produce printed compilations, data bulletins, periodical reports, or magnetic tapes. More information can be acquired by contacting the specialized hydrological agencies of each country.

Apart from the efforts of CODATA and UNESCO, annual hydrological yearbooks and international data publications (e.g. studies and reports in hydrology published by UNESCO) are available. However, the implementation of a numerical information network is not of primary concern to the project related to scientific and technical documentary information in the framework of UNESCO-IHP III 17.1.

Online water-related databases

In the Appendix, we present a brief overview of water-related, online available databases; it is mainly based on the Directory of Online Databases published by Cuadra/Elsevier (1988). The water-related subjects dealt with are indicated with descriptors, i.e. words and phrases from a predefined list which is included also in the Appendix.

Note also that only specific databases are mentioned, related some way or another, with water information. More general databases as Science Citation Index, national bibliographies, Books-in-Print,... are not included. However, these can contain valuable water-related information.

The online available water-related databases differ in a number of ways: by subject, scope, geographical and chronological coverage, information added by the database producer, frequency of updating, ...

We consider two types in the Appendix, reference and source databases, as defined in the following.

Reference databases refer or point users to another source (e.g. a document, an organization, or an individual) for additional information or for the complete text. In this category, we distinguish bibliographic and referral water-related databases. Bibliographic databases contain citations, sometimes with abstracts, of the printed literature, e.g. journal articles, reports, patents, dissertations, conference pro-

ceedings, books, or newspaper items; referral databases contain references, sometimes with abstracts or summaries, to non-published information (for instance organizations, individuals, audio-visual materials, and other non-print media).

Source databases contain original source data, the full text of original source information or materials prepared specially for electronic distributions. We distinguish numeric, textual-numeric and full-text water-related databases. The numeric ones contain original survey data and/or statistically manipulated representations of data. These are generally in the form of time series, which represent measurements (e.g. tons, \$, etc ...) over time for a given variable. The textual-numeric water-related databases are generally databases of records consisting of a number of data elements or fields, some of which contain numeric data; this category includes those databases with dictionary or handbook-type data, typically of chemical and physical properties. The full text water-related databases contain records with the complete text of an item, newspaper article, a specification, a court decision or a newsletter.

The producers of water-related databases

Databases are developed by so-called producers.

In the case of reference databases, most producers are primarily publishers of printed index and abstract journals. These organizations acquire, screen, select, index and sometimes abstract or summarize the primary literature.

Source databases, on the other hand, are produced by a number of different types of organizations, e.g. publishers of reports, research, consulting and advisory services, or governmental agencies which have a responsibility for the dissemination of information collected in the area of water-related information.

Some producers process and package data into databases that were originally collected by some other source. In their packaging, these producers frequently bring together data from a number of different sources and sometimes increase the value of a collection by including additional data.

Most producers license their water-related databases to one or more other organizations, called online services or host computer services, which provide the computer, software and telecommunications support, that enable remote users to access the databases. In this way, the producers can distribute their databases online.

Commentary on water-related bibliographic databases

The number of publicly available bibliographic databases on hosts is in general not growing, but slowly decreasing; in the business field, new databases are becoming available. Dialog is growing in this way; ESA/IRS is stationary; Orbit-Infoline and STN are growing rapidly, but in fact this reflects only a movement of databases from Pergamon Infoline and INKA respectively; so the number of databases on these last two hosts is, of course, decreasing rapidly.

A recent survey of updates on ESA/IRS shows a considerable time lag, considering the dates of the last updates, for a large number of databases. Although the cause is not fully clear, most probably database producers have problems in keeping the databases up-to-date. A private in-depth survey of a limited number of databases showed that abstracts from some essential periodicals are lagging more than two years behind.

The databases closely related to water are spread over a number of hosts. On Dialog we find the databases Aquaculture, Aquatic Sciences and Fisheries Abstracts (ASFA, produced with FAO), Waternet, and FLUIDEX. ESA/IRS has recently added ASFA next to the databases AFEE, Delft Hydro (no longer updated, last update 86/12), and FLUIDEX. Orbit-Infoline has exclusively Aqualine and Waterlit. FIZ-Technik has recently brought Hydroline publicly online as a part of the Geoline database.

Each database has its advantages and disadvantages. Water Resources Abstracts is very complete in coverage, but is rather slow; Waterlit has not been updated for two years (checked at the end of 1987) and has no abstracts; AFEE also has no abstracts.

Nevertheless, the end-user may search for water information related only to his own country. A few databases such as Georef, Geobase, and CAB have adapted a country-based search strategy.

Each database has its unique literature sources, but still there is an overlap in coverage between all of them. For instance, Delft Hydro and FLUIDEX suffer from a considerable overlap; attempts to cooperate in order to reduce the overlap failed however. There is also an overlap between Water Resources Abstracts, Waterlit, Waternet, Aqualine and Delft Hydro, especially when one considers the abstracted/scanned periodicals; the cooperation between the last two database producers has been established during 1987, to reduce the overlap and exchange abstracts; some 700 abstracts from Delft Hydro have been entered in Aqualine; this agreement however lost its value because Delft Hydro is discontinued now.

As water is an inherent part of the real world, the scope of water-related subjects could be widened in several directions. This kind of information can be found either in large multi-disciplinary database like Compendex, NTIS, Pascal, or Chemical Abstracts, which are available on many hosts, or in specialized databases on the environment (Environmental Bibliography, Enviroline, Pollution Abstracts, etc.), on biology (Biosis), on geology including hydrology (Geoarchive, Geoline, Georef, etc.), on oceanography (Oceanic) and so on, which are available sometimes on one host only.

Information on irrigation can be found in a number of agricultural databases like Agricola, AGRIS, CAB and TROPAG which are available on Dialog, INIS computer (also through ESA/IRS), ESA/IRS, and ORBIT-Infoline resp. To search these databases, four different search languages have to be used. The information however will mainly be dealing with water demand and not with irrigation engineering or availability of water resources.

We conclude that information on water-related subjects, for instance hydrology, or transport, or irrigation, is scattered over many databases and information sources.

The picture becomes even more complicated, when one takes into consideration that there are a number of abstract journals, which have no online equivalent, like Irricab produced in Israel, or Civil Engineering Abstracts produced in Ireland, or the West German Dokumentation Wasser.

Crucial is the fact that all databases mentioned are produced in the 'developed' part of our world, using in majority sources produced in the same area. A lot of unnecessary duplication is present between all the databases, but information from developing countries is lacking in many cases. According to Gottschalk (1984), of all internationally available databases at that time, less than 1% was produced in developing countries. An exception is for instance the database Asian Geo, which is produced in Thailand and distributed by ESA/IRS.

The database of the International Reference Center (IRC) for Community Water Supply and Sanitation in The Hague deals with appropriate technology in the field of water supply and sanitation. Up to now, it is loaded only in-house using the software Minisis on an HP computer.

Solutions could be found in stimulating developing countries to either enter their material in an existing database or build databases themselves.

The cooperation between Delft Hydro and the water-related local information system in Belgrado, YUWAT, has been set up as a pilot project to exchange material in a machine-readable form, to serve as a model for developing countries. WRC, the producer of Aqualine, is investigating this way of working also with ENSIC (Bangkok). The IRC is also investigating this possibility. On the other hand, ESA/IRS has already in 1984 expressed its willingness to load databases from developing countries (UNISIST Newsletter, 12, 4, 1984, p. 55). Pergamon Infoline has also shown interest in this matter.

Recent developments

Optical storage media

Among the new optical storage media, CD-ROM (Compact Disk - Read Only Memory) is the most developed one. A number of encyclopedias (full-text), but also a number of databases, for instance ASFA, are available in this form.

The main advantages of the present-day CD-ROM are:

- it has a very large storage capacity (about 600 million characters per disk),
- it is standardized,
- readers are available at moderate prices (about \$1500),

- software for retrieval with a microcomputer is available, which allows command-driven and/or menu-driven searching, which is in general more user-friendly than the interface offered by the great host systems.

Disadvantages are:

- a slow response when searching, compared with other media,
- up to now single user only,
- change of database means change of disk.

A microcomputer with a CD-ROM reader and adequate software may offer appropriate technological solution for providing information in developing countries: no special connections are needed to search databases then, neither are passwords, and the disks are not very sensitive to disturbances (Harteveld, 1987).

A further development is the WORM-disk (Write Once Read Many), which combines the properties of the CD-ROM and the 'conventional' hard disks. Response when using WORM-disks is much quicker compared with CD-ROM, and updates can be made on the same disk; however, this technology is not yet standardized.

Full-text databases

The increased processing speed of computers as well as the extended possibilities of digital storage, and the lowering of the prices of information technology hardware, have made it possible to load the full-text of periodical publications in a database, and to provide a full-text retrieval and display. An advantage of full-text databases is that more relevant documents can be found (Tenopir, 1985). Full text databases can be found for instance in chemistry; also the text of newspapers like the Financial Times is available online. Up to now, full-text databases are not available in the water-related field.

Electronic mail

All hosts have some sort of electronic mailbox, which can be used to send messages from the user to the host, from user to user in the case of Dialog, from user to user within user groups in the case of ESA/IRS. With Dialog the DialMail system can also be used to speed-up the delivery of off-line prints, instead of using conventional mail.

Next to host oriented systems there are commercial e-mail systems, like the already mentioned Geonet, or networks in the scientific field, like the European Academic Research Network (EARN), which allows to send messages or files from one computer (user) to another one. Next to connections in almost all European countries, there is also a link to Ivory Coast and to the BIXNET in the USA. The use of this kind of networks is growing.

In the future it will also be possible to obtain the information content of documents through this kind of networks.

Electronic publishing

Everybody seems to have a different definition of what electronic publishing is. Some people see the distribution of databases on CD-ROM as a form of electronic publishing, others think the publishing of full-text databases is only one step away of distributing information in electronic form only. It is inevitable that all publishers of printed products are investigating the possibilities of dropping the final steps in publishing, without losing their present markets. At present, a number of projects are running in which the feasibility of electronic document delivery is investigated. One of the projects is supported by the EEC; in this particular case, primary documents are first converted to bit-maps.

The action plan: concrete recommendations for UNESCO-IHP

Introduction

This chapter comes closest to the official title which was given in 1984 to the part of UNESCO-IHP Phase III dedicated to scientific and technical documentary information:

UNESCO-IHP Phase III, 17.1: "ELABORATION OF PRINCIPLES AND GUIDE-LINES FOR THE ESTABLISHMENT OF NATIONAL INFORMATION CENTRES AND SYSTEMS AND THEIR LINKING WITH REGIONAL AND INTERNATIONAL SYSTEMS."

Note that the role of UNESCO is always to promote international cooperation, but not to replace it.

The following recommendations are based on the more general suggestions made above on how to improve the existing (water-related) information system. The priorities (not necessarily the estimated importance) of the recommendations are indicated with High, Medium, or Low priority, preceding the text of the recommendation.

The start of WRINGS (Water-related Information Network on a Global Scale)

A global sensitizing meeting

(High priority)

UNESCO-IHP should organize a meeting or seminar related to documentary information, preferably at the Council Meeting of the National Presidents of the International Hydrological Programme in Paris. The aims:

- making these hydrologists, managers, and others in the water science field, aware
 - of the importance of water-related information, and
 - of actions related to documentary information, which are or should be undertaken in the framework offered by UNESCO-IHP as suggested below;
- sharpen the ideas of the contributors to this project.

In the period between the formulation of this suggestion to the secretariat of UNESCO-IHP in 1987 and the publication of this document, the Principal Rapporteur of this project was already offered the opportunity to present a brief summary of this document to the National Presidents of the International Hydrological Programme at the occasion of their meeting in Paris in 1988.

Regional, national, and local sensitizing meetings

(High priority)

Regional or more local meetings should take place for water-related managers, decision makers, professors, ..., including round table discussions; the aims here are the same as mentioned above for the global sensitizing meeting. (By regions we mean Africa, Europe, South-America, etc. ...). Ideally, such meetings should be accompanied by good demonstrations of applications of information technology in the domain of water-related information and documentation.

A national Belgian meeting has already taken place in Brussels, stimulated by the activities concerning documentary information in the UNESCO-IHP. The proceedings have been published as a UNESCO-IHP Technical Document (Nieuwenhuysen, editor, 1989) and can be obtained free of charge from the UNESCO-IHP Secretariat in Paris, as long as copies are available.

A meeting of water-related information specialists

(High priority)

A meeting of information specialists also is recommended. This can be held in the form of a workshop lasting one or more days, at the occasion of another professional meeting, e.g. prior or after an international conference about the use of microcomputers in information, documentation in libraries, the International Online Meeting in London, or the yearly Online Meeting in New York.

The meetings outlined above

- can be organized by the UNESCO-IHP Working Group on water-related information and the UNESCO-IHP secretariat in Paris, and
- should be subsidized by UNESCO-IHP Paris, and by the National Committees for UNESCO-IHP.

Establishment of the WRINGS Advisory Group

(Medium priority)

An international WRINGS Advisory Group should be established. The aim of the WRINGS Advisory Group would be to animate and aid national centres. The core of this group already exists: the members of the UNESCO-IHP secretariat in Paris and the authors of this document. The members of the Advisory Group should assist countries in the selection of national water-related information centres. If a country needs assistance in the field of water-related information, then the Advisory Group should follow up the request.

Supporting a network of water-related information centres

(High priority)

Concerning intermediary institutions, one or several expert institutes (already existing institutes which can act as intermediary) are welcome to cooperate with all interested people, institutions, centres,... UNESCO can announce on a global scale that such expert institutions are willing to assist other institutions and interested persons on a global scale.

A person working at such an institution should be identified who can and wants to act as an information intermediary for a few years at least, who is an expert in the retrieval of information related to water sciences. In the initial stage, such an expert will work only occasionally as intermediary in the WRINGS project. If this part of WRINGS would turn out to be successful, this function can perhaps be fulfilled on a half- or full-time basis. More concretely, the authors of this document from the University Library of the Free University Brussels want to perform online searches for water-related bibliographic information for all interested users, as announced in the IHP Newsletter in May 1989. Therefore a simple pricing scheme and a request form has been developed, which is included at the end of this document.

The function of these water-related information centres can later be expanded, for instance to the collection of water-related documents and to the development of water-related local or national databases.

If enough institutes are interested, UNESCO-IHP can support a network of a few regionally oriented centres, the national centres and more local centres.

UNESCO-IHP have therefore foreseen financial support for the following themes in IHP-IV:

M.2.1 : support to create national water-related information systems
(including databases);

M.2.2 : support to use internationally available water-related information systems.

Preferably, two projects related to the establishment of local and/or national water-related, bibliographic databases can be considered now: one in a region with relatively advanced infrastructure and one in a less developed region.

Some final remarks on the creation of the network:

- A strict hierarchy seems not necessary.
- A bottom-up approach seems better here than a top-down approach.

Training the (potential) users of water-related information and documentation systems

Training of (potential) end-users

(High priority)

The IHP should support training of (potential) end-users.

Training of end-users should be performed on every possible occasion and in particular when courses, seminars, conferences, etc. take place, which are supported by UNESCO. UNESCO-IHP can formulate this as a prerequisite when subsidizing and/or supporting a training in water-related science; as examples of such courses, we can mention here

- the Inter-university Postgraduate Programme in Hydrology, IUPHY, at the Free University of Brussels in Belgium (here, the curriculum includes a half-day seminar on water-related documentary information);
- the summer schools at the 'Jaroslav Cerni' Institute for the Development of Water Resources, in Belgrado, Yugoslavia (here, the curriculum includes a few days of study and practical exercises in the area of water-related documentary information).

Training of information specialists

(High priority)

The present and future information intermediaries should receive support to be trained in water-related information systems. Bilateral agreements can be useful here. To save money, training sessions can take place at the same location as some important professional meeting, for instance before or after

- one of the international conferences about the use of microcomputers in information, documentation in libraries,
- the International Online Information Meeting in London, yearly in December, or
- the yearly Online Meeting in New York,
- some water-related meeting of interest to information professionals, or
- some meeting in the framework of UNESCO-PGI (= General Information Programme).

This training can be supported by the establishment of one or more guides for water-related information intermediaries, proposed also in this document.

Cooperation between the sections of UNESCO-IHP related to education and documentary information

(High priority)

UNESCO-IHP should aim at an integration of, on one hand, the sections/themes which are concerned with educational aspects in the field of water/hydrology and, on the other hand, the training of end-users and information intermediaries in the field of water-related documentary information. As mentioned higher, UNESCO can strongly suggest to organizers of courses, that a part on (water-related) documentary information be included.

We think that the suggestions above concerning training agree with the principles of the action of UNESCO's General Information Programme, which were briefly outlined by Courier (1987).

Creating guides and directories in the domain of water-related documentary information

Creating a directory of water-related information intermediaries

(High priority)

The creation of a directory of water-related information intermediaries (institutes as well as individuals) seems a very useful task. Ideally, a private consultant or a member of an information centre should be hired by UNESCO-IHP to produce a draft copy of this directory. This draft can then be reviewed and criticised by a group of experts in this domain.

The resulting directory can then be offered to the (potential) end-users; it will help them to find the required information.

UNESCO-IHP can also help the intermediaries to perform their function better by presenting them the same directory. This will help to improve contact between the intermediaries themselves. The directory will stimulate discussions, meetings, symposia, and cooperation among information intermediaries.

This directory can also give the UNESCO-IHP a better idea about the availability and expertise of intermediaries in the world. Countries lacking suited intermediaries can receive special attention. It can also help organizing meetings of water-related information intermediaries, as suggested above.

Creating an overview of water-related information products for intermediaries

(High priority)

Ideas should be transferred between this Working Group and/or the Advisory Group and the many other water-related information intermediaries distributed all

over the world. The Advisory Group can give advice and can create guidance material to ease setting up national intermediaries. The guidance material should explain practical and theoretical aspects relevant to the creation and operation of a national institute acting as a water-related information intermediary.

One guide may consist of

- a comprehensive overview of water-related information products, including accessible databases.
- an explanation of methods to acquire, use and handle these available information products.

Of course, ideally such a guide should be kept up to date. This material will help the intermediaries to build up their collection of documents (primary as well as secondary and tertiary information). The directory of databases can also give the Advisory Group a better idea of the current situation concerning available databases; this is useful in view of the required cooperation between local, national and regional databases and the international databases, as discussed elsewhere in this chapter.

Ideally, the role of an information intermediary is not only to help in locating bibliographic references (secondary information), but also to assist in searching for information in non-bibliographic databases, e.g. in full-text source databases or in more numerically oriented databases. Although the creation of numerical databases is not of primary concern here, the intermediary should at least be informed about the already existing numerical databases concerning water-related information. The intermediary should also be aware of the water-related expert systems being created.

We have already carried out a first step towards the identification of internationally available water-related databases (see the Appendix).

This guidance material should be prepared by at least two consultants, specialists in the field of water-related information. UNISIST/PGI, the division of UNESCO, can perhaps help with this work. The draft version of the guide should be reviewed by members of the WRINGS Advisory Group and other persons at a workshop supported by UNESCO, which should last for a few days.

Creating guidance material on database building for water-related information intermediaries

(High priority)

One of the guides to be created should explain to information intermediaries how good existing databases and their methodology can serve (after adaptation) as national water-related database systems, especially for those countries willing to construct a national database concerning water-related information. Note that international cooperation is highly recommended here. In particular, the water-related information centres at national level should be recommended and stimulated to contribute at least parts of their databases to one or a few internationally available computerized water-related databases which contain bibliographic references to existing documents. In other words, parts of the national bibliographic databases

should ideally be merged with one international database such as AGRIS, Aqualine, Geobase, Geoline, Georef, Geoarchive, Pascal, Streamline, and/or others, including those mentioned in the Appendix. A high degree of compatibility between the national and international databases should be ensured for an efficient international cooperation; therefore a new guide should make suggestions concerning the use of one or more common

- computer programs for the management of text-oriented databases (and the required hardware),
- database structures supported by those programs,
- classification and keyword or thesaurus systems.

If possible, no new systems should be created, but one or more existing ones should be adapted.

In view of the important consequences for the national centres, in particular for the creation or further elaboration of their national database systems, the identification of suited international databases and the establishment of cooperation should be executed as soon as possible, but with great care; this is the essence of a separate proposal in this chapter.

Concerning the software used for the databases, the usefulness of the package CDS/ISIS in the framework of UNESCO-IHP should be considered with care and in detail by one or more experts; the reasons for this are

- the software package is designed specifically for information storage and retrieval (i.e database building);
- at least Version 2.3 is distributed up to now by UNESCO (PGI) in Paris for free to non-profit institutions;
- Version 1 has a modular design in order to allow working with it on relatively small microcomputer systems, which is interesting for institutes with limited funds; Version 2.3 is an integrated package which requires more RAM;
- the program has already been used for storage and retrieval of information using the optical CD-ROM as storage and distribution medium instead of magnetic disks;
- the quality and power of the software is high; this can be concluded from a comparative evaluation of available software packages for information storage and retrieval on magnetic disks (Sieverts et al., 1988).

More details about the history, development, distribution and applications of CDS/ISIS can be found in several publications (for instance, Pobukovsky; Jacsó et al., 1986; Chaudbury and Shukla, 1988; Gimilio, 1988; Lim, 1988).

It may even be efficient if the creation of the proposed guide would run parallel with concrete consulting work in a project aimed at the establishment of some national intermediary. The experience of the consultants can then be incorporated immediately in the guide and the value of the draft version of the guide can be assessed in such a project. The consultants in the project can be the same persons as those who establish the guide, but this is not necessary.

The creators of the guidance material can perhaps contribute to training sessions of information intermediaries, suggested elsewhere in this chapter.

Creation of a guide for end-users of water-related documentary information

(Medium priority)

In relation to our proposal (with high priority) to support the education of potential end-users of water-related documentary information, the creation of guidance material for these users is also recommended. The contents should not be as technical and detailed as the contents of the guidance material directed towards the information intermediaries, which is the subject of other proposals in this chapter. The primary aim of this kind of guide is making end-users more information minded. The importance and priority of this work is low in comparison with the work directed towards the intermediaries, because the working of these intermediaries seem to form a bottle-neck between the end-user and the information products which are (in principle) already available.

Elaboration of cooperation between national and internationally available water-related databases

(High priority)

A feasibility study should be supported of a cooperation between on one hand local, national and regional databases, and on the other hand the internationally available water-related databases.

As mentioned already above in the proposal to create guidance material on local and national database building, parts of the national bibliographic databases should ideally be merged with an international database; here we can already mention AGRIS (which is supported by FAO), Aqualine, Geobase, Geoline, Georef, Geoarchive, Pascal, Streamline, and/or others, including those mentioned in the Appendix. The suitability of an international database depends on the specific aims and contents of each local, national or regional database.

If the creators of the locally and/or nationally available water-related databases want to cooperate on an international level, but when parts of the databases cannot be incorporated in an existing internationally available database, only in that case the data should ideally be incorporated in a new internationally available database, accessible on some public host (e.g. ESA/IRS, DIALOG, BRS, Data-Star, or one of the computers which form together STN, ...).

If cooperation is possible, then agreements should be made on the languages used in the databases (English only?).

Considering the proposal on the network of cooperating centres, elsewhere in this chapter, and the latter proposal: one of the centres in the network of cooperating information centres should merge the separate, growing databases of a more local or

national nature. This can be carried out on a regular basis. The merged data can then be transferred to the members of the network for local use, for instance on a local microcomputer. All the members would benefit from such an arrangement. This method can be a solution to the question of how to make the smaller local databases generally available, when some cooperation with an existing international database is not (or not yet) possible.

Supporting water-related information centres which make their databases internationally available

(Medium priority)

Local, national and regional centres which contribute to some kind of international database cooperation (recommended elsewhere in this chapter) should be given support by UNESCO-IHP.

Collaborators of the national and regional centres should be stimulated and offered the opportunity to meet, to exchange ideas and to make agreements.

A particular concrete project could be the support of a common multilingual water-related thesaurus, mentioned elsewhere in these recommendations; more than one particular national centre could benefit from such a thesaurus.

Supporting a water-related multilingual thesaurus

(Low priority)

In a later stage, after the elaboration of a cooperation with internationally available databases, UNESCO-IHP can perhaps support the creation of a multilingual water-related thesaurus or the continuous adaptation of one or more existing ones. Thesauri can be used by the supported international database(s) and by the cooperating national databases. The selection of keywords is related to the scientific or technical domain (e.g. hydraulics, erosion and sedimentation transport, water supply, ...). This ad hoc approach is preferable here; the creation of an independent thesaurus without direct relation to an existing database system seems less efficient.

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Appendix: Online publicly accessible water-related databases

Criteria for inclusion in this overview

The following selection criteria were applied for inclusion in our overview of water-related databases in this Appendix:

- Coverage of water-related subjects. (The short list below of descriptors, i.e. words and phrases, has been made and applied, to describe the subject contents of each database).
- Availability online for use in an interactive mode.
- Availability to the public, or to organizations that can establish their eligibility through subscriptions, membership or other stated qualifications.
- Accessibility through an online service organization that is connected to one or more international data communication networks and/or to networks that serve one country or a limited set of countries.

The information presented in this overview is mainly based on the Directory of online databases (Anonymous, 1989).

Note that many multidisciplinary databases with a broad subject scope are not included here, although they can contain water-related information; for instance,

Books in Print

British Books in Print

Conference Papers Index

Dissertation Abstracts Online

Scisearch, the online equivalent of the Science Citation Index

Furthermore, many library catalogues can be accessed online from a remote location. This appendix is not aimed to be complete.

The subject descriptors used

Words and phrases used to describe the subject content of the water-related databases:

- Drainage
- Environment
- Erosion and sedimentation transport
- Groundwater
- Hydraulics
- Hydrometry
- Irrigation
- Standards, laws and specifications
- Surface hydrology
- Urban hydrology
- Water management
- Water quality
- Water treatment
- Watershed management

The water-related databases

ACID RAIN

Type: Reference (bibliographic).

Major subjects: The impact of acid rain on aquatic systems.

Coverage: International.

Online: ESA-IRS.

Descriptors: environment, surface hydrology.

AFEE

Type: Reference (bibliographic).

Major subjects: Contains citations with abstracts to the world literature on fresh water research and technology. Covers surface and subterranean waters, sea, shore and coastal areas, water quality, pollution and treatment, distribution and uses, health, hygiene and safety, physical, chemical and microbiological analyses, water policy, planning and economy and legislation. Corresponds to Information Eau.

Coverage: International.

Online: ESA/IRS.

Descriptors: water treatment, water quality, water management, environment, surface hydrology, ground water.

AGRICOLA

Type: Reference (bibliographic).

Major subjects: Contains citations to the journal literature, government reports, serials, monographs, audiovisual resources, and pamphlets in agriculture and related areas that have been acquired by the National Agricultural Library (NAL) of the U.S. Department of Agriculture. Includes some topics on water-related information.

Online: Dialog, Knowledge Index, BRS, BRS After Dark, DIMDI, ESA-IRS.

Descriptors: environment, water quality, irrigation, drainage.

AGRIS (International Information System for the Agricultural Sciences and Technology)

Type: Reference (bibliographic).
Major subjects: Contains citations to the world-wide literature on all aspects of agriculture. Topics covered include geography and history, legislation, education, extension and advisory work, economics, development, marketing, rural sociology, plant production, protection of plants and stored products, forestry, animal production, veterinary medicine, aquatic sciences and fisheries, machinery and buildings, natural resources, food science, human nutrition, home economics, pollution.
Coverage: International.
Online: Dialog (only citations to non-U.S. documents are available), DIMDI, ESA-IRS.
Descriptors: environment, water quality, irrigation, drainage.

AGUAS

Type: Source (textual-numeric).
Major subjects: Contains descriptions of water wells in Spain. Includes hydrological measurements, geothermal and lithological data, chemical analyses and current use information.
Coverage: Spain.
Online: IGME (Instituto Geologico y Minero de Espana).
Descriptors: groundwater.

AIR/WATER POLLUTION REPORT

Type: Source (Full text).
Major subjects: Air, Water Pollution, Environmental laws of U.S.
Coverage: U.S.
Online: NEWSNET.
Descriptors: environment, water quality.

ASFA

See AQUATIC SCIENCES AND FISHERIES ABSTRACTS.

AQUACULTURE

Type: Reference (bibliographic).
Major subjects: Contains citations to literature on the growing of marine, brackish, and freshwater organisms. Subjects covered include disease, economics, engineering, feed and nutrition, growing requirements, legal aspects and life history.
Coverage: International.
Online: Dialog.
Descriptors: environment.

AQUALINE

Type: Reference (bibliographic).

Major subjects: Contains citations to the world-wide literature on every aspect of water, wastewater and the aquatic environment. Topics covered include groundwater, surface water, wastewater treatment, instrumentation, control and computing, resource development and management, water sampling and analyses, water treatment, distribution systems, drinking water quality, river management, sludge utilization, tidal waters, sewerage systems, and other water-related topics.

Coverage: International.

Online: ORBIT Search Service.

Descriptors: hydrometry, water quality, water management, water treatment, surface hydrology, ground water, urban hydrology, watershed management.

AQUAREF (Canadian Water Resource References)

Type: Reference (bibliographic).

Major subjects: Contains citations on Canadian water resources and other environmental topics.

Coverage: Canada.

Online: CISTI (accessible only in Canada), CAN/OLE (only accessible for Canadian users)

Descriptors: environment, water management.

AQUATIC SCIENCES AND FISHERIES ABSTRACTS

Type: Reference (bibliographic), source (textual-numeric).

Major subjects: Contains citations with abstracts to world-wide literature on the science, technology, and management of marine, brackish, and freshwater environments. Includes the following aspects: oceanography, coastal zone management, pollution and technology, meteorology, climatology, water pollution

Coverage: International

Online: BRS, CAN/OLE, Dialog, DIMDI, ESA-IRS

Descriptors: Water quality, Water management, Environment

BANQUE DES DONNEES DU SOUS-SOL FRANCAIS

Type: Reference (bibliographic), source (textual-numeric).

Major subjects: Contains geological and hydrological information of subsoil features in France and some overseas departments. Records include a detailed geological description of the section, stratigraphy, water level, and hydrochemistry, general description of the aquifers, quarries, mineral deposits and other mineral exploitations.

Coverage: France, the French Antilles, French Guyana and Reunion.

Online: Bureau de Recherches Geologiques et Minieres.

Descriptors: groundwater.

CA SEARCH, CA FILE, CAS, CHEMABS

Type: Reference (bibliographic).

Major subjects: Contains citations to the world-wide literature in chemistry and also environmental topics.

Coverage: International.

Online: BRS; BRS After Dark; BRS/Colleague; CISTI; CAN/OLE; Data Star; Dialog; ESA-IRS; JICST; ORBIT Search Service; STN International; Télésystèmes Questel.

Descriptors: environment, water quality.

CAB ABSTRACTS

Type: Reference (bibliographic).

Major subjects: Contains citations to the world literature in the agricultural sciences and related areas of applied biology. Subjects covered include some hydrological aspects.

Coverage: International.

Online: BRS, BRS After Dark, BRS/Colleague, CISTI, DIALOG, DIMDI, Knowledge Index, Tsukuba, ESA-IRS, JICST.

Descriptors: surface hydrology, irrigation, drainage, erosion and sedimentation, hydraulics, groundwater, water management, hydrometry, watershed management.

COMPENDEX

Type: Source (textual-numeric).

Major subjects: Contains citations to the world-wide literature in engineering and technology. The water-related topics are civil, water and waterworks, pollution, ocean and underwater technology, fluid flow.

Coverage: International.

Online: BRS (COMP), BRS/Colleague (COMP), Centre de documentation de l'armement (CEDOCAR), CAN/OLE, Data-Star, Dialog, ESA-IRS, Knowledge Index (Engineering Literature Index), Orbit Search Services.

Descriptors: surface hydrology, environment.

DELFT HYDRO

Type: Reference (bibliographic).

Major subjects: Contains citations to the world-wide literature on civil and mechanical hydraulic engineering. Covers fluid mechanics and its applications in technology and engineering, including these topics: experimental techniques, instrument development, river, coastal and offshore engineering, physical and mathematical modeling of hydraulic phenomena, water quality management, dredging.

Coverage: International; not updated any more.

Online: ESA-IRS, QL Systems Limited.

Descriptors: hydrometry, surface hydrology, water quality.

DMS

Type: Source (numeric).

Major subjects: Contains hydrologic and water quality data collected from field work and laboratory tests by the U.S. Geological Survey, N.O.A.A. and E.P.A. Software systems allow users to analyze time series data, land segments hydrologic response, washoff and routing in channels and reservoirs.

Coverage: U.S.A.

Online: Hydrocomp, Inc.

Descriptors: surface hydrology, water quality, environment.

ECOTHEK

Type: Reference (bibliographic).

Major subjects: French literature on urban and regional planning and the local ecology of France including water-related subjects.

Coverage: France.

Online: Télésystèmes-Questel.

Descriptors: watershed management, environment.

ELECTRIC POWER INDUSTRY ABSTRACTS

Type: Reference (bibliographic).

Major subjects: Environmental effects of electric power plants that use hydroelectricity.

Coverage: U.S.

Online: Orbit Search Service (EPIA).

Descriptors: water management.

ELIAS

Type: Reference (bibliographic).

Major subjects: Covering water resources, pollution,...

Coverage: Canada.

Online: CISTI, CAN/OLE.

Descriptors: water management, environment.

ENDOC

Type: Reference (referral).

Major subjects: Contains descriptions of over 500 environmental information centres in the EEC.

Coverage: Europe.

Online: ECHO Service.

Descriptors: environment.

ENREP

Type: Reference (referral).

Major subjects: Contains descriptions of research studies on the environment being conducted in the EEC.

Coverage: EEC.

Online: ECHO Service.

Descriptors: environment.

ENVIRODOQ

Type: Reference (bibliographic).

Major subjects: Environmental aspects in Quebec. Major topics including water resources,...

Coverage: Canada (Quebec).

Online: IST-informatheque.

Descriptors: water management, environment.

ENVIROLINE

Type: Reference (bibliographic).
Major subjects: Topics related to the environment and the management and use of natural resources including water.
Coverage: International.
Online: Dialog, DIMDI, ESA/IRS.
Descriptors: environment, water management, water quality.

ENVIRONMENT REPORTER

Type: Source (full text).
Major subjects: Covering state and federal legislative regulatory, judicial, industrial and technical activities and development related to pollution control including water pollution.
Coverage: U.S.
Online: ESTI/HRIN, LEXIS Energy Library, LEXIS Environmental Library.
Descriptors: environment, water quality.

ENVIRONMENTAL BIBLIOGRAPHY

Type: Reference (bibliographic).
Major subjects: Contains citations to literature on the environment, including water.
Coverage: International.
Online: Dialog.
Descriptors: environment.

FLUIDEX

Type: Reference (bibliographic).
Major subjects: Contains citations to the world-wide literature related to the behaviour and applications of fluids in engineering. Including fluid mechanics, ports and harbours technology, flow meters and measurement, control of rivers and flood problems, flow dynamics, mixing and separation, energy storage and conversion, fluid power, dredging, civil engineering hydraulics, computational and mathematical techniques, jet cutting and clearing, fluid control and instrumentation, pumping and pipeline technology.
Coverage: International.
Online: Dialog.
Descriptors: hydrometry, hydraulics, surface hydrology, water quality.

GEOARCHIVE

Type: Reference (bibliographic).
Major subjects: Contains citations to the world-wide geo-science literature: geophysics, geology, paleontology, energy, exploration, mineral deposits, oceanography, petrology and water.
Coverage: International.
Online: Dialog.
Descriptors: groundwater.

GEOBASE

Type: Reference (bibliographic).

Major subjects: Contains citations to the world-wide literature on the earth sciences. Covers cartography, climatology, demography, ecology, environment, geography, geomorphology, geophysics, hydrology, mineralogy, natural resources, paleontology, planning, regional studies, remote sensing, sedimentology, stratigraphy, tectonics, Third world studies.

Coverage: International.

Online: Dialog.

Descriptors: surface hydrology, environment, erosion and sedimentation transport.

GEOLINE

Type: Reference (bibliographic).

Major subjects: Contains citations to the world-wide geo-science and hydrology literature. Covers hydrochemistry, hydrodynamics, hydrogeology, urban and rural water engineering and water management, geochemistry, geophysics, geodesy, mineralogy, petrography, mining, peat technology, paleontology, sedimentology, stratigraphy, tectonics, volcanology, coal, engineering, environmental, marine and petroleum geology.

Information of HYDROLINE is now contained in GEOLINE.

Coverage: International.

Online: FIZ Technic, INKADATA, STN International.

Descriptors: environment, ground water, water management, urban hydrology, erosion and sedimentation transport.

GEOREF

Type: Reference (bibliographic).

Major subjects: Contains citations to the literature of geology and geophysics: areal geology, economic geology, extra-terrestrial geology, geochemistry, geochronology, marine geology, mineralogy, paleontology, petrology, solid-earth geophysics, stratigraphy and structural geology.

Coverage: International.

Online: CISTI, CAN/OLE, Dialog, ORBIT Search Service.

Descriptors: environment, ground water.

GROUND WATER MONITOR

Type: Source (full text).

Major subjects: Contains full text of Ground Water Monitor, a newsletter on the protection of ground water resources. Provides news of state and federal legislation.

Coverage: International.

Online: Newsnet, Inc.

Descriptors: groundwater.

MARINELINE

Type: Reference (bibliographic).

Major subjects: Contains citations to the world-wide literature on marine research and technology. Covers oceanography, earth sciences and environmental protection, desalinization, raw materials and reserves,...

Coverage: International.

Online: INKADATA.

Descriptors: surface hydrology, environment.

NEDRES (National Environmental Data Referral Service)

Type: Reference

(bibliographic, referral).

Major subjects: Contains sources of publicly available environmental data from satellites, vessels, stations, buoys and environmental observers also covering hydrological data.

Coverage: Primarily U.S. and Canada and some international coverage.

Online: BRS, BRS After Dark, BRS/Colleague.

Descriptors: surface hydrology, environment.

NTIS (National Technical Information Service)

Type: Reference (bibliographic, referral).

Major subjects: Contains citations to unrestricted technical reports from U.S. and non-U.S. government-sponsored research, development, and engineering analyses. Major areas include the biological, social and physical sciences

Coverage: Primarily U.S. and Canada and some international coverage.

Online: BRS, BRS After Dark, BRS/Colleague, Knowledge Index, Dialog, STN International, CISTI, CAN/OLE, ESA/IRS.

Descriptors: surface hydrology, environment.

OCEANIC ABSTRACTS

Type: reference (bibliographic).

Major subjects: contains citations to the world-wide literature on oceanography and marine-related aspects of other sciences. Includes biology, geology and geophysics, meteorology, acoustics and optics, desalination, pollution resources, engineering, mining, ships and shipping, submersibles and buoys, government laws and regulations.

Coverage: International.

Online: Dialog, ESA/IRS.

Descriptors: surface hydrology, environment.

PASCAL: BATIMENT, TRAVAUX PUBLIC

Type: Reference (bibliographic).

Major subjects: Contains citations to the world-wide literature on building and public works. Covers also civil engineering related to bridges, dams, off-shore structures, sewerages, water supplies and waterways.

Coverage: Primarily Europe, with some international coverage.

Online: Dialog, ESA-IRS, Télésystèmes-Questel.

Descriptors: surface hydrology, urban hydrology, water management.

PASCAL GEODE

Type: Reference (bibliographic).

Major subjects: Contains citations to the world-wide literature on earth sciences. Covers also hydrology.

Coverage: International.

Online: Dialog, ESA/IRS.

Descriptors: surface hydrology.

POLLUTION ABSTRACTS

Type: Reference (bibliographic).

Major subjects: Contains abstracts, to the world-wide technical and non-technical literature on pollution research, sources, and controls. Covers air, water, land, thermal, noise and radiological pollution, pesticides, sewage and waste treatment, environmental action,...

Coverage: International.

Online: BRS, BRS/Colleague, Data-Star, Dialog, ESA/IRS, Tech Data, University of Tsukuba.

Descriptors: environment, water quality, urban hydrology.

POWER

Type: Reference (bibliographic).

Major subjects: Contains citations to monographs, conference proceedings and other materials in the book collection of the DOE Energy Library. Emphasis is on energy technologies, physical and environmental sciences, economics and also on energy and water resources

Coverage: International.

Online: ORBIT Search Service.

Descriptors: environment, water management.

SERIX

Type: Reference (bibliographic, referral).

Major subjects: Contains citations with abstracts to research reports on environmental issues in Sweden. Topics covered include water, air and soil pollution.

Coverage: Sweden.

Online: ARAMIS.

Descriptors: environment, water management.

SIGLE (System for Information on Grey Literature in Europe)

Type: Reference (bibliographic).

Major subjects: Contains citations to the grey literature (e.g. reports, conference papers, and other non-conventional literature issued informally and not available through normal channels) published in most European Community member countries. Covers also some aspects of water-related sciences

Coverage: Europe.

Online: BLAISE-LINE, STN.

STREAMLINE: Water Information Database

Type: Reference (bibliographic).

Major subjects: Contains citations to Australian literature and research projects on all aspects of water, waste water and the aquatic environment. Covers water quality and supply, water and the land environment, wastes, research and development, water planning, design and engineering.

Coverage: Australia.

Online: ACI Computer Services, CSIRO AUSTRALIS.

Descriptors: water management, water quality, water treatment.

TROPAG

Type: Reference (bibliographic).

Major subjects: Contains citations, with abstracts to the world-wide literature on the practical aspects of tropical and subtropical agriculture.

Coverage: International

Online: ORBIT Search Service.

Descriptors: Irrigation, drainage, environment, water management

UMWELTFORSCHUNGS- DATENBANK (UFOR)

Type: Reference (bibliographic).

Major subjects: Contains citations also about water pollution, environmental aspects of the agriculture,...

Coverage: Austria and Federal Republic of Germany.

Online: Data-Star.

Descriptors: water management, water quality, environment.

UMWELTLITERATUR- DATENBANK (ULIT)

Type: Reference (bibliographic).

Major subjects: Contains citations to primarily German-language literature on environmental topics including water pollution.

Coverage: Federal Republic of Germany.

Online: Data-Star.

Descriptors: environment, water quality.

VANYTT

Type: Reference (bibliographic).

Major subjects: Contains literature on the environment and environmental technology including water pollution, water supply and treatment, sewage systems and treatment, industrial waste and waste water,...

Coverage: International.

Online: The Swedish Institute of Building Documentation (BYGGDOK).

Descriptors: environment, water quality, urban hydrology.

WASTE MANAGEMENT AND RESOURCE RECOVERY

Type: Reference (bibliographic).

Major subjects: Contains citations to the world-wide literature covering nuclear waste management, water quality, toxic substances, land reclamation and resources recovery. Emphasis is on air pollution, agricultural engineering, civil engineering, food science, geology and nuclear science.

Coverage: International.

Online: International Research and Evaluation.

Descriptors: environment, water quality.

WATER RESOURCES ABSTRACTS

Type: Reference (bibliographic).

Major subjects: Contains citations and abstracts to scientific and technical literature on the water-resource-related aspects of the physical, social and life sciences. Topics covered include the nature of water and water cycles, water supply augmentation and conservation, water quantity management and control, water quality management and protection, water resources planning and engineering works.

Coverage: International.

Online: Dialog.

Descriptors: environment, water quality, surface hydrology, water management.

WATERLIT

Type: Reference (bibliographic).

Major subjects: Contains citations to the world-wide literature on water and related subjects. Covers hydrology, limnology, ecology, wastewater and pollution, recycling, desalinization, engineering and construction, planning and management.

Coverage: International.

Online: Pergamon Infoline.

Descriptors: surface hydrology, water quality, water management.

WATERNET

Type: Reference (bibliographic).

Major subjects: Contains citations to literature on water quality and its testing, water and wastewater treatment and reuse, industrial and potable uses of water, environmental issues related to water and energy-related economics. Specific topics are drinking water industries, water pollution health effects, water rates, water conservation, energy cost and the history of water supply.

Coverage: Primarily North America, with some coverage of Europe, Australia and South Africa.

Online: Dialog.

Descriptors: water quality, water treatment, water management, environment.

WETLAND VALUES BIBLIOGRAPHIC DATABASE

Type: Reference (bibliographic).

Major subjects: Contains citations to literature on functions and values of wetlands in the U.S. Covers food chain, habitat, human use, hydrologic and water quality values, wetland assessment techniques, economic models and related bibliographies.

Coverage: Primarily U.S with some coverage of Canada.

Online: EG and G Idaho.

Descriptors: watershed management, water quality, surface hydrology, environment.

WORLD ENVIRONMENT REPORT

Type: Source (full text).

Major subjects: Contains full text of World Environmental Report, a newsletter covering environmental issues and trends worldwide. Topics include new methods of controlling air and water pollution, new methods for controlling toxic substances, waste management, land use planning and natural resources development.

Coverage: International.

Online: Newsnet, Inc.

Descriptors: environment, water quality, water treatment, water management.

List of abbreviations

- AFEE : Information System of the 'Association Française pour l' étude des eaux'
- AGRIS : International Information System for the Agricultural Sciences and Technology
- ASFA : Aquatic Sciences and Fisheries Abstracts
- BYGGDOK : The Swedish Institute of Building Documentation
- CAB : Commonwealth Agriculture Bureau
- CAN/OLE : Canadian Online Enquiry Service
- CEDOCAR : Centre de documentation de l' armement
- CIEH : Centre de documentation, Comité interafricain d'études hydrauliques
- CISTI : Canada Institute for Scientific and Technical Information
- CODATA : Committee on Data for Science and Technology of the International Council of Scientific Unions
- DIMDI : Deutsches Institut für Medizinische Dokumentation und Information
- EARN : European Academic Research Network
- ECHO : European Commission Host Organization
- EEC : now EC : European Community
- ENSIC : Environmental Sanitation Information Center
- EPA : United States Environmental Protection Agency
- ESA/IRS : European Space Agency / Information Retrieval Service
- FAO : Food and Agriculture Organization of the United Nations
- FIZ : Fachinformationszentrum
- Georef : Geological Reference File
- IATUL : International Association of Technological University Libraries
- ICSU : International Council of Scientific Unions
- IGME : Instituto Geologico y Minero de Espana
- IHP : International Hydrological Programme (UNESCO)
- INFOTERRA : International Referral System for Sources of Environmental Information
- IRC : International Reference Center for Community Water Supply and Sanitation in The Hague
- ISDN : Integrated Services Digital Network
- ITU : International Telecommunications Union
- IUPHY : Interuniversity Postgraduate Programme in Hydrology (at the Vrije Universiteit Brussel)
- JICST : Japan Information Center of Science and Technology
- NOAA : National Oceanic and Atmospheric Administration
- NTIS : National Technical Information Service (USA)
- PGI : General Information Programme (UNESCO)
- POETRI : Programme on Exchange and Transfer of Information
- SIGLE : System for Information on Grey Literature in Europe
- STN : Scientific & Technical Information Network

TROPAG : Tropical Agriculture
UAP : Universal Availability of Publications
ULIT : Umweltliteratur-Datenbank
UNDP : United Nation Developmental Programme
UNEP : United Nations Environment Programme
UNESCO : United Nations Educational, Scientific and Cultural Organization
UNISIST : United Nations System for Scientific and Technological Information
WORM : Write Once Read Many
WRINGS : Water Related Information Network on a Global Scale
YUWAT : Yugoslavian water-related information system

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