HYDROLOGY PROJECT

World Bank & Government of The Netherlands funded

Training module # SWDP - 01

Understanding HIS concepts and its set-up

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with
HALCROW, TAHAL, CES, ORG & JPS

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1. Module context

While designing a training course, the relationship between this module and the others, would be maintained by keeping them close together in the syllabus and place them in a logical sequence. The actual selection of the topics and the depth of training would, of course, depend on the training needs of the participants, i.e. their knowledge level and skills performance upon the start of the course.

2. Module profile

Title	:	Understanding HIS concepts and its set-up
Target group	:	Assistant Hydrologists, Hydrologists, Data Processing Centre Managers
Duration	:	One session of 60 min
Objectives	:	After the training the participants will be able to*:* • know the objectives of HIS • know the set-up of HIS • appreciate the need & scope of data processing under HIS
Key concepts	:	• observational network • hydrological data • historical data • raw and processed data • hydrological data processing • hydrological data users • hydrological information system
Training methods	:	Lecture
Training tools required	:	OHS
Handouts	:	As provided in this module
Further reading and references	:	

3. Session plan

No	Activities	Time	Tools
1	***What is a Hydrological Information System (HIS)?*** • Introduction • The hydrological cycle show but don't discuss • Sketch of "Everest climber" • HIS definition • System outline of hydrological cycle	10 min	 OHS 1 OHS 2 OHS 3 OHS 4 OHS 5
2	***Why a Hydrological Information System?*** • Need for HIS	5 min	 OHS 6
3	***The Hydrology Project and Hydrological Information Systems*** • HP & HIS • Aims of HP • HP States • HP agencies	5 min	 OHS 7 OHS 8 OHS 9 OHS 10
4	***The scope of Hydrological Information System*** • Scope (role) of a HIS • Text	5 min	 OHS 11 OHS 12
5	***Who needs a Hydrological Information System?*** • HDUGs	5 min	 OHS 13
6	***Setting-up of a Hydrological Information System under Hydrology Project*** • HIS structure at state/regional level	10 min	 OHS 14
7	***Use of computers in hydrological data processing*** • Computers in HIS	5 min	 OHS 15
8	***Wrap up***	15 min	

4. Overhead/flipchart master

5. Handout

Add copy of Main text in chapter 8, for all participants.

6. Additional handout

These handouts are distributed during delivery and contain test questions, answers to questions, special worksheets, optional information, and other matters you would not like to be seen in the regular handouts.

It is a good practice to pre-punch these additional handouts, so the participants can easily insert them in the main handout folder.

7. Main text

Contents

Understanding HIS concepts and its set-up

1. What is a Hydrological Information System (HIS)?

The principles of a **Hydrological Information System** are implied in the words of the title.

Hydrological: **Hydrology** is the science of water in the hydrological or water cycle and is concerned with its states, storages and fluxes in location, time and phase. **Hydrometry** is the sister science of hydrology which is concerned with the measurement of these states, storages and fluxes in the water cycle. It is a **science** because it is concerned with the scientific principles of repeatability and that measurements may be checked and validated.

Information Information is **data** which has been manipulated and processed to give them meaning and purpose. By definition, **information** serves a function and is created not simply because it is there to be measured or because of our curiosity alone. Unlike the mountaineer, we are not climbing Everest simply because it is there to be climbed - but because there is someone on the top who needs help. Function is important, not only in establishing the contents and structure of the information but also as a motivation for all involved in the development and maintenance of the HIS.
Three key features of information are: **reliability, availability** and **presentation**.

System The HIS is not simply a data collection or archive although it incorporates an archive. It is a logical and structured system to collect data which are subsequently entered into the computer , checked and stored and where also data may be compared, associated, related and combined to provide information in a form suitable to users. A system may also be seen as the integration of the user and the machine.

2. Why a Hydrological Information System?

The need for information

The planning, design and management of water services - for domestic, industrial, agricultural and power uses - and protection from the vagaries of floods and droughts, requires information on storages and fluxes in water for safe and economic design and operation. The need is growing with a growing population.

The variability of occurrence

The occurrence of water shows great variability in space and time and requires that adequate measurement networks are established to define spatial variability and that they are maintained over a sufficient period of time to define temporal variability of a water variable.

The inadequacy of existing systems

Systems currently exist but do not meet current needs in terms of reliability, availability and presentation, even where the networks themselves are of adequate density. Current systems in India are operated by a number of Central and State, surface water and groundwater agencies and are not standardised either in operational practice or in methods of processing and management. They may provide information of varying reliability, they may duplicate information and activities and there are often long delays between observation and dissemination of information

3. Hydrology Project and the Hydrological Information System

Hydrology Project aims at developing and improving the existing set-up of hydrological information systems available in various state and central agencies for the eight states of **Andhra Pradesh, Gujarat, Kerala, Karnataka, Madhya Pradesh, Maharastra, Orissa and Tamil Nadu**. This will assist in the development of more reliable and spatially intensive data on the quantity and quality of water resources, and in making information available, from computerised databases, for planning, designing and management of water resources and water use systems. Special attention will be paid to standardisation of procedures for the observation of variables and validation of information so that it is of acceptable quality and thus compatible between different agencies and states. Adequate facilities will be built up for proper storage, archival and dissemination of data for the system to be sustainable for the long-term use. Infrastructural development and implementation of the proposed HIS in the project area is vested with the relevant Central and State agencies operating in the project area. These Central agencies are the Central Water Commission (CWC) and Central Ground Water Board (CGWB) and the State agencies are the Irrigation (or Water Resources Departments) and Ground Water Departments of the respective States.

4. Who needs a Hydrological Information system?

If a Hydrological Information System is understood as providing information for specific and definable uses, then users must have a central role in the content of the system. The current major data users are also the major data providers and have tailored the content and structure of existing systems to meet their own needs. However, current practice does not generally even meet current needs. Other users may find that data, if available, are in the wrong form, of varying reliability and may take a long time to obtain.

For example, agencies concerned with the construction and maintenance of roads and railways are required to build bridges and culverts to convey flood flows safely and require data on flood flows with a given probability of occurrence as a basis for design. Inadequate data may result on the one hand in costly construction with an unnecessary margin of safety or on the other with the equally costly consequences of failure. Such agencies currently do not maintain their own networks and depend on others to supply information with acceptable reliability and timeliness.

In an efficient and effective system, there must be a strong linkage between data/information producers and users, both those within the same department and legitimate external users from other departments and agencies, consultants, universities for research, etc.

5. Scope of the Hydrological Information System

The Hydrological Information System (HIS) comprises the infrastructure of physical and human resources to collect, process, store and disseminate data on (geo-)hydrological and hydrometeorological variables. The physical infrastructure includes observation networks, laboratories, data processing and data storage centres and data communication system. The human resource is the well-trained staff with a variety of skills to carry out the desired tasks for different operations of the system. Huge public funding and effort is required for the operation of a hydrological information system. And therefore, the efficiency of the system should be such that more and more data users make use of the reliable hydrological data so that the resources spent are utilised in an optimal manner.

The primary role of the HIS (see Fig. 5.1) is to provide reliable data sets for long-term planning, design and management of water resource and water use systems and for research activities in the related aspects. It is also desired that the system will function in such a manner that it provides the information to users in time and in proper form. The scope of HIS is not extended to provide data to users on a real-time basis for short-term forecasting or operational purposes.

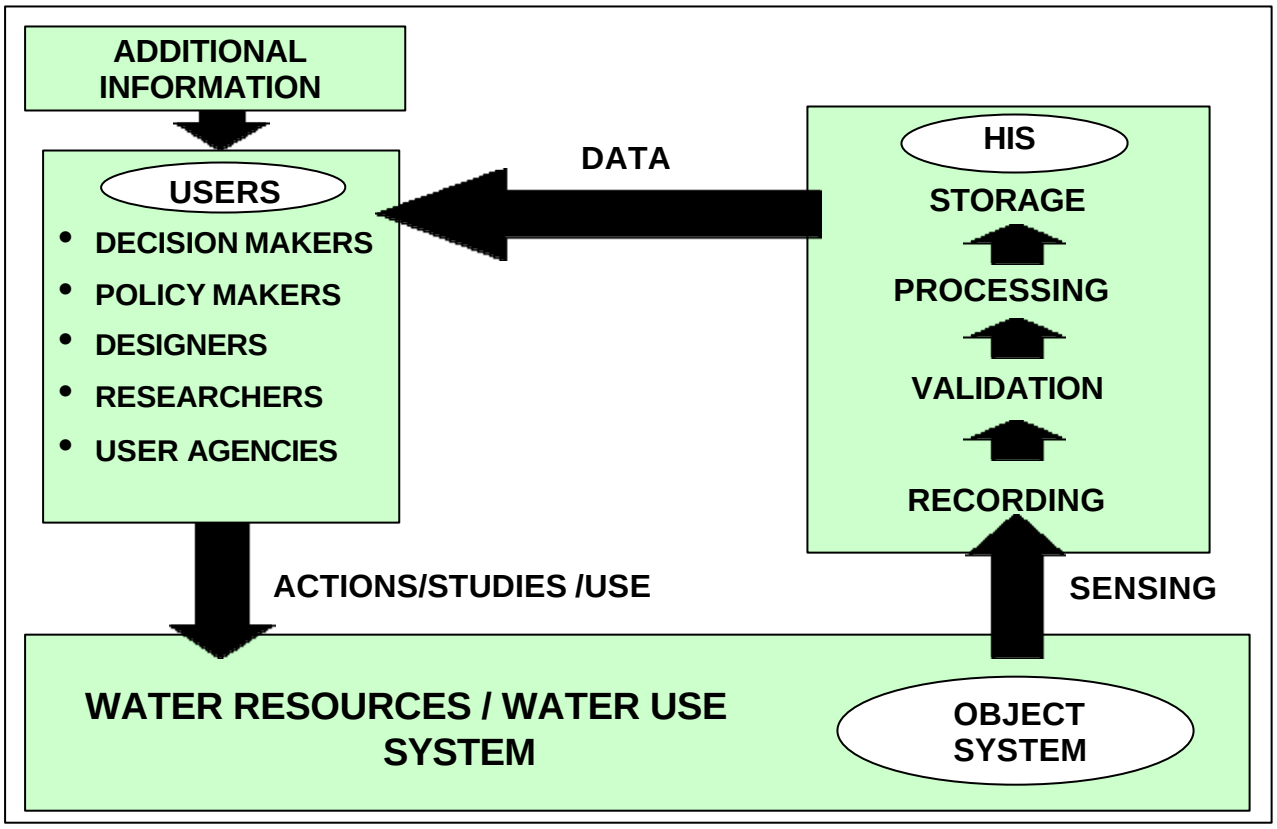

Fig. 5.1: Role of Hydrological Information System

To be able to provide this information the first step is to obtain the information on the temporal and spatial characteristics of this object system by having a network of observational stations. The basic data collected for different hydrometeorological phenomenon through this observational network is called the raw or observed data. Such observed data have to be processed to ensure the reliability of the resulting information. Both raw and processed data sets have to be properly stored, processed data for dissemination and raw data to permit inspection and revalidation in response to queries from users.

The activities under HIS can be broadly classified in the following categories:

- Assessing the needs of users
- Establishment of an observational network
- Management of historical data
- Data collection and transfer
- Data processing, analysis and reporting
- Data Exchange and reporting
- Data storage and dissemination
- Institutional and human resource development

5.1 Assessing the needs of users

The importance of considering user needs has already been discussed above. For this purpose, Hydrological Data User Group (HDUG) for each state and for the central agencies have been constituted. Potential hydrological data users and the members of HIS implementing agencies are represented in these HDUGs. The main aim of such HDUGs is to review hydrological information needs and, on a regular basis of about 3-4 years, identify shortfalls and make suggestions and proposals for improvements. This will then require the supplementing agency to reconsider its mandate and HIS objectives and incorporate improvements where possible.

5.2 Establishment/review of observational networks

After the objectives of the system are laid down, the observational network has to be accordingly planned, designed and established. It is also important to ensure that the observational networks of different agencies are properly integrated so that duplication is avoided. The equipment as per the revised objectives and design are installed at the observational stations. The process may be repeated after a periodic review of requirements for data.

5.3 Management of historical data

State and central agencies have maintained observational networks for many years and voluminous records are held, the majority on manuscript or chart records, which are not readily accessible for use and are of variable quality. A program of historical data entry will require to be established in each agency holding such data, although priority in the first instance will be given to ensuring that current data are entered validated and stored effectively.

5.4 Data collection:

Institutional, human and budgetary supports are a prerequisite for smooth operation and maintenance of the observation stations and the associated collection of data. The established network has a number of observation stations and at each station a number of variables is observed at a specified frequency. The observations are taken manually or automatically depending upon the type of instrument available at the station. Suitable number of persons having skills appropriate to their job requirement (e.g., Supervisors, Technicians, Observers, Helpers etc.) are engaged and materials are provided at the observation sites for carrying out day-to-day data collection work and also for regular maintenance.

5.5 Data processing, analysis and reporting:

Data processing is a broad term covering all activities from receiving records of observed raw data to making them available in a usable form. The raw data are in a variety of formats such as hand-written records, charts and digital records. Raw data as observed and recorded may contain many gaps and inconsistencies. These raw data are passed through a series of operations, typically:

- Data entry
- Making necessary validation checks,
- In-filling missing values in a data series,
- Processing of raw data to estimate required variables,
- Compilation of data in different forms and
- Analysis of data for commonly required statistics etc.

Most of the data processing activities are to be accomplished with the help of computers using dedicated hydrological data processing software. Of particular importance is assuring the quality and reliability of the data provided to users through the application of a variety of validation procedures and the flagging of suspect data. The user must be informed of the quality of the data supplied and whether the values are estimated or observed.

Reports are prepared to bring out the salient characteristics of the hydrological regime of the region for each year or season. Special reports are also prepared as and when required for attracting the attention of the users towards unusual events, major changes in the hydrological regime or to disseminate important revised long term statistics regularly.

5.6 Data exchange and communication:

Data processing activity is planned to be carried out at more than one level within each agency and this makes it essential to have adequate data communication links between them. The requirement for communication is to be based on a low frequency and high volume of communication. There is need for exchange of information between various agencies for the purpose of data validation as surface and groundwater networks are operated by different state and central agencies.

5.7 Data storage and dissemination:

All available data sets are to be maintained in well-defined computerised databases using an industry standard database management system. This is essential for the long-term sustainability of the data sets in proper form and their dissemination to the end users. Both, raw and processed data sets are be properly stored and archived to specified standards so that there is no loss of information. All agencies will have standard procedures for the dissemination of data to the users from the computerised databases.

5.8 Institutional and Human Resources development:

Since HIS is a vast system, the aspect of institutional and human resource development needs to be given proper emphasis. The institutions supporting the implementation of HIS must be developed in such a manner that the system is sustainable in a long run. The staff required to carry out different activities under HIS are to be made available and very importantly they must all be trained to carry out the desired tasks. Such training support is to be ensured on a sustainable basis since there will always be a need for training more staff.

6. Setting-up of a Hydrological Information System under Hydrology Project

In order to provide timely and reliable data of the water resources/water use system, the HIS comprises the following components by Agency (see Fig. 6.1):

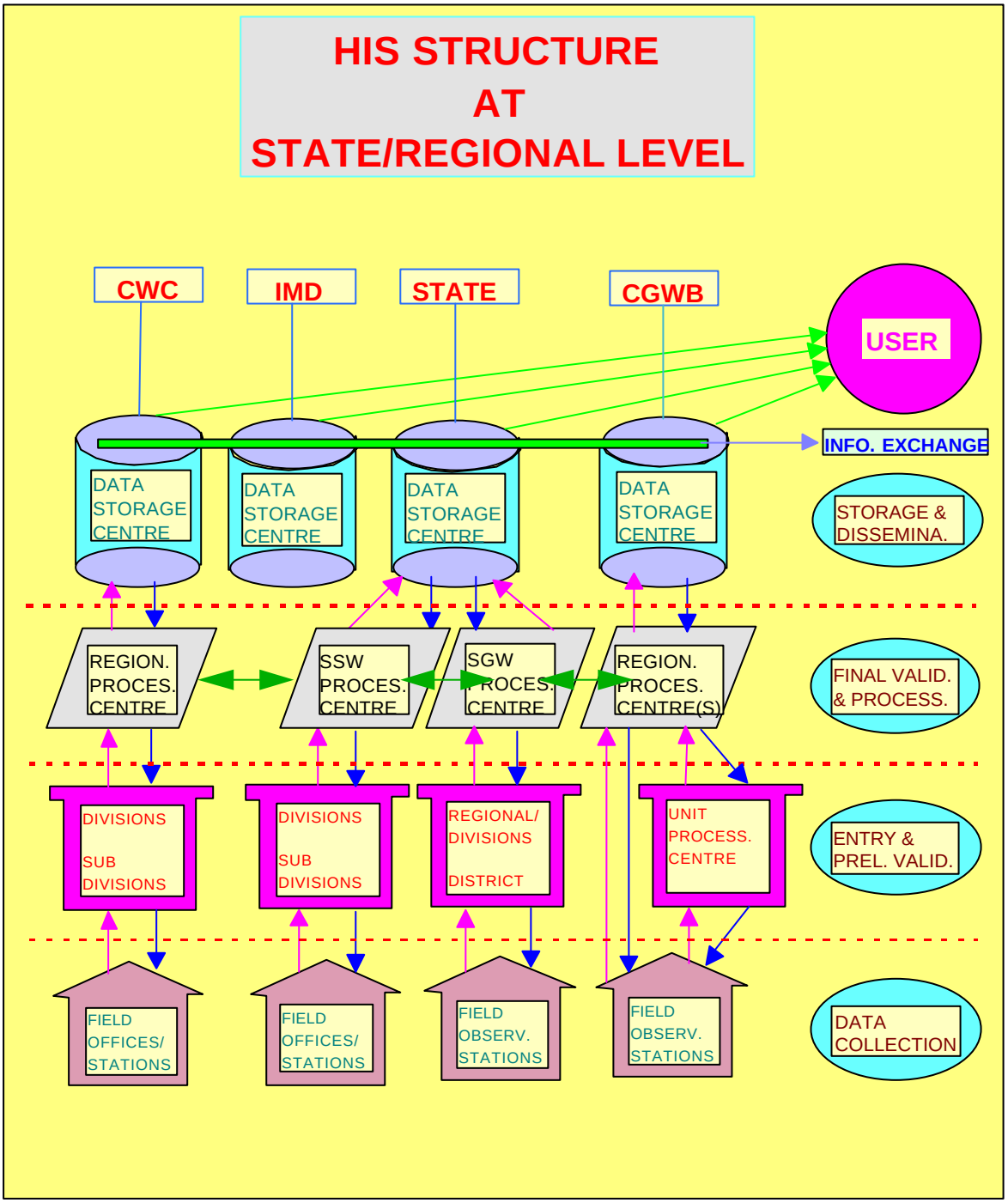

Fig. 6.1: HIS structure at State/Regional level

- **in each State**
  - Hydrometeorological, Surface Water and Ground Water Observation Networks,
  - Water Quality Laboratories,
  - Sub-divisional/District Data Processing Centres, one in each Sub-division/District,
  - Divisional/Regional Data Processing Centres, one in each Division/Region,
  - State Data Processing Centres, one in the State Surface Water Department and one in the State Groundwater Department, and
  - a State Data Storage Centre.

- **in the Central Water Commission**
  - Surface Water Observation Networks,
  - Water Quality Laboratories,
  - Divisional Data Processing Centres, one in each Division
  - Circle Data Processing Centres, one in each Circle,
  - for each Region a Data Processing and a Data Storage Centre, and
  - at National level a National Data Centre.

- **in the Central Ground Water Board**
  - Groundwater Observation Networks,
  - for each Unit a Data Processing Centre,
  - for each Region a Data Processing and a Data Storage Centre, and
  - a National Data Centre.
  - for data exchange within and between the states and central organisations a Communication System.

The HIS may also be viewed as operating at different levels of sophistication and complexity from simple measurement in the field to State and Agency Processing and Storage centres as follows:

- At the **observation stations/wells** in the hydrometeorological, surface water and groundwater observation networks field data and water quality samples are collected. The water samples are brought to the Water Quality Laboratories. At regular intervals (monthly/quarterly) the field data are submitted to the Sub-divisional/District Data Processing Centres.

- In the **Water Quality Laboratories**, besides the analysis of water quality samples, the analysis results are entered in the computer and subjected to primary validation. At regular intervals, the laboratory passes the information on to the nearest Divisional or Regional Data Processing Centre.

- In the **Sub-divisional/District Data Processing Centres** all field data are being entered in the computer and stored in a temporary database. Next, primary validation (entry control and reach checks) takes place on the data and feedback is given to the field stations. The computerised data are passed on to the Divisional/Regional Data Processing Centre immediately after finalisation of the primary processing. For purpose of validation and analysis of groundwater data the District Data Processing Centre also makes use of the data collected by CGWB, these are retrieved regularly from the Data Storage Centre.

- In the **Divisional/Regional Data Processing Centres**, given their larger spatial coverage, more advanced secondary data validation is carried out. The data are stored in temporary databases. After validation, the surface water and groundwater data are transferred to their respective State Data Processing Centres.

- In the **State Data Processing Centres**, after reception of the data from its Divisions/Regions, a copy of the field data is transferred to the State Data Storage Centre. The main activity of the State Data Processing Centre is final data validation, completion, analysis and reporting. Here, the data are stored in temporary databases. At the end of the hydrological year, once the data have been properly validated, the (authenticated) processed data is transferred to the State Data Storage Centre. To improve the effectiveness of the final validation, in the State Centres use is also made of the relevant data collected by the Central Agencies.

- The **State Data Storage Centre** stores and administers the storage of all field and (authenticated) processed hydrological data collected in the State, and makes the data available to authorised Hydrological Data Users. As a State archive, it also maintains an HIS-Catalogue of all data stored in its own database and those stored in the databases of the other states and of the Central Agencies.

7. Use of computers in hydrological data processing

The rapid advance in computer technology, in hardware speed of operation and data storage capacity as well as the capability of hydrological software has greatly simplified the management of large quantities of hydrological data and has rendered obsolete those time-consuming manual methods which were formerly the norm. Computer-based hydrological information systems offer the following advantages:

- They permit and promote the standardisation of processing, validation and reporting procedures
- Very large amounts of data can easily be handled
- They greatly speed up the progress from data collection to completion and storage
- Users can be provided with data in the required tabular or graphical format
- Their use promotes staff interest by removing the tedium of manual handling and allowing results to emerge quickly

Such a computerised data processing system, maintained on a continuous basis, can now be considered as an essential component of the hydrological information system.