About NIH

National Institute Of Hydrology (NIH) Roorkee is the Nodal Agency for the development of DSS (P), which includes Surface water planning, Integrated operation of reservoirs, Conjunctive surface water and ground water planning, Drought monitoring, assessment and management of both surface and groundwater quality.

Dr. R. D. Singh, Director NIH
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About DHI

DHI are the first people you should call when you have a tough challenge to solve in a water environment.

In the world of water, our knowledge is second-to-none, and we strive to make it globally accessible to clients and partners.

So whether you need to save water, share it fairly, improve its quality, quantify its impact or manage its flow, we can help. Our knowledge, combined with our team's expertise and the power of our technology, hold the key to unlocking the right solution.

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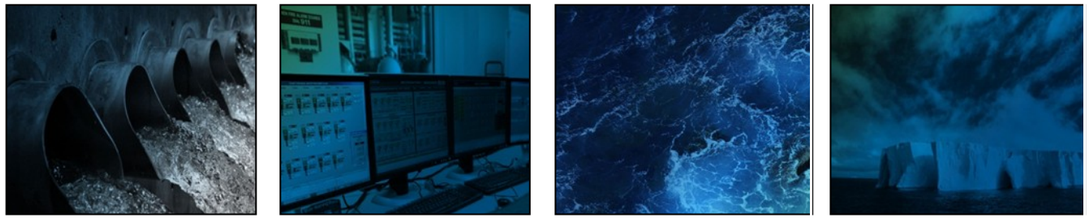
Implementing States	Central Agencies
Andhra Pradesh	National Institute of Hydrology (NIH)
Chhattisgarh	Central Water Commission (CWC)
Gujarat	India Meteorological Department (IMD)
Karnataka	Bhakra Beas Management Board (BBMB)
Kerala	Central Pollution Control Board (CPCB)
Madhya Pradesh	Central Groundwater Board (CGWB)
Maharashtra	Central Water and Power Research Station (CWPRS)
Odisha	
Tamil Nadu	



DECISION SUPPORT SYSTEM (PLANNING) FOR INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT IN INDIA

Decision Making - Makes Fast, Flexible and Focused

Project implemented under Hydrology Project-2,
Funded by World Bank
August 2013

Decision Support System (Planning)

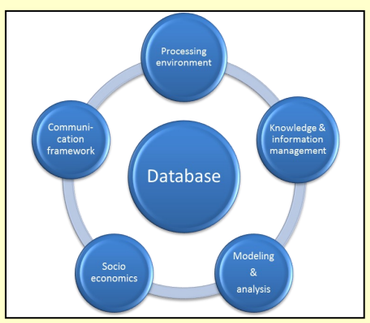
The Decision Support System (Planning) project has been implemented by the National Institute of Hydrology in India (NIH) as a part of Hydrology Project-II. The project objective was to develop a decision support system, the DSS (P), for integrated water resources development and management, customized to meet the requirements of the implementing agencies, particularly the nine participating states. The DSS (P) has been developed to assist states in developing water management plans given current and future pressures and drivers affecting water quantity and quality within basins. The software includes a range of tools to process and analyses time series and GIS information designed to a greater awareness of current conditions in order to better understand and quantify current water management issues. The NIH is implementing this project in cooperation with DHI, Denmark, and nine participating states in order to address key water resources issues with in the following five components:

- Surface Water Planning.
- Integrated operation of reservoirs
- Conjunctive Use of surface water and ground water .
- Management of both surface and ground water quality .
- Drought monitoring, assessment and management .

DSS (P) is a framework that links together

- ♦ data base and processing environment,
- ♦ knowledge and information system,
- ♦ modeling and analysis framework,
- ♦ socio-economic analysis framework and a communication framework

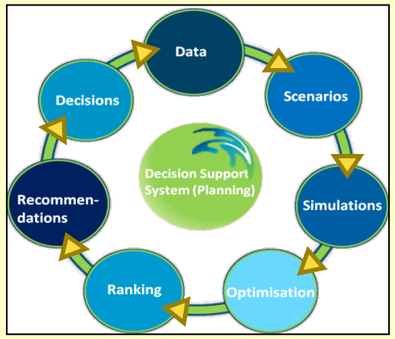
Such sets of tools are seamlessly linked and tailored to the context. A DSS (P) has an open interface and can access models from different suppliers, which enable the DSS (P) to access prepared input data and model parameters and store relevant model results.



DSS (P) framework/Components

The DSS (P) provides easy access to data and information and enables analysis of water management options. The main components of the system are:

- Database and associated tools to display, manage, and analyse GIS and time series data and provide easy access to this information for water managers and professionals at all levels
- Modelling tools to analyse water management options and extract key results for decision makers
- Web tools to easily upload data and information on the water resources situation, water management plans, etc. to external stakeholders



DSS (P) COMPONENTS

WATER RESOURCES CHALLENGES IN INDIA

- Scarce water resources
- Drought, Floods
- Inefficient Water Management
- Increasing Demand for water and competition for water among the different sectors

Solution

DSS (P) to make the right decisions for optimal utilization of available water Resources through:

- Surface water and Ground Water planning
- Integrated operation of reservoirs
- Conjunctive use of surface water and ground water
- Drought monitoring, assessment and Management
- Water Quality

Value OF DSS (P)

- Comprehensive information Management
- Simulation of river basin hydrologic processes
- Address water resources issues with alternative solutions for decision making
- Integrated solution for water resources
- In-built tools for spatial and temporal data analysis

changing the cropping pattern.

- Conjunctive use of surface and ground water to improve the efficiency of water utilisation in Hirakud command area.
- Changing cropping patterns to increase benefits for the farmers without increasing water abstraction in hirakud command area.
- Drought monitoring in upper tel basin

A range of training courses have been conducted during the project for the selected staff from the Implementing Agencies. Emphasis has been on the modeling, which requires skills in data processing, model setup and calibration, and model use.

Training in the GIS and time series tools, which can be beneficial for all staff working with water resources, was offered to a larger group in each state at the time of DSS (P) installation.

A set of tutorials have been prepared and handed over to facilitate further internal training in the states.

For more details please contact Hydro meteorological Department, Data Centre, Govt. of Odisha

TAMIL NADU

The state of Tamil Nadu has selected three basin, the Vaippar, the Agniyar, and Tamiraparani basin. Very little rainfall occur, particularly in the first two basins. A major effort is being made to assess accurately the water availability and its variation before analyses can be made with the DSS (P) of the potential of various measures to improve conditions in the areas. These include improving the efficiency of water management in general, de-siltation of tanks, conjunctive water use, and artificial recharge. A special study is being made in parallel to quantify the infiltration possible through different methods of infiltrating additional surface water to the groundwater storages. Advanced hydrological modelling is applied as part of this.

For more details please contact State Ground Water and Surface water resources, Data Centre, Govt. of Tamil Nadu

Email: cegwch@dataone.in

DSS (P) is ready

After the introduction under HP I of new software to manage collected data, the DSS (P) now introduces additional tools to perform detailed analysis, provide easy access to data and information, create awareness in the public on important water issues, and apply models for short- and long-term planning.

For the states to fully benefit from DSS (P), the following is recommended:

- Use the DSS (P) as the central hub for water resources data and information of the state. Let all relevant state staff have easy access to the DSS (P) from a PC in or near their office.
- This requires LAN connections in the building, where the DSS (P) database server is located, and safe internet connection from other buildings and towns.
- Maintain the knowledge and skills within the organizations though internal training.
- Use the DSS (P) models for long-term planning one of water resources development and management to assess benefits and adverse impacts of potential changes
- Use it also for short-term planning and predictions, so that timely decisions may be taken.

The DSS (P) is specifically designed to enable water engineers/scientists/managers to generate various options for decision makers and is a useful tool to make objective decisions.

For further information contact Director R.D. Singh, NIH, or Team Leader Hans .C. Ammentorp, DHI.

For more details please contact Department of Irrigation, Govt. of Kerala, and Ground water Department, Govt. of Kerala

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MADHYA PRADESH

The Upper Wainganga catchment in Madhya Pradesh includes two major irrigation projects and a number of medium and minor schemes. Additional large projects are under construction. The basin has been selected as a DSS (P) case study area to support efficient utilization of this infrastructure and to help analyse the potential benefit of strengthening the maintenance of this to reduce losses. Analysis of changes in the cropping pattern within the area has also been proposed. As a prerequisite for this, MP is processing available hydrological and meteorological data to obtain improved knowledge of the water resources availability and its variation in time and space.

- Assessment of water resources availability to obtain a better basis for the water management and planning.
- The assessment of the impact of rehabilitating the water infrastructure.
- Identification of efficient use of water by the projects, which are existing and under construction.
- Crop selection and the corresponding water requirements, particularly in dry years.

For more details please contact Water Resource Department, Data Centre, Govt. of Madhya Pradesh

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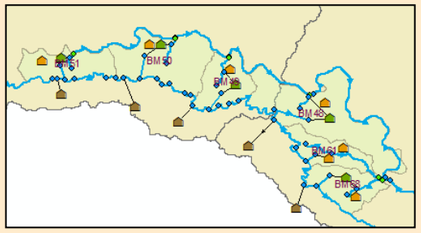
MAHARASHTRA

A river basin model has been developed for Upper Bhima in order to analyze surface and ground water management options within this basin. The availability of water within each of the 30 sub-catchment have been assessed on a daily basis for a period of 39 years, including periods of drought and flood. A range of planning and management decisions may be tested in the model to help in identifying the most appropriate way forward. Selected examples, which have been defined in cooperation with Maharashtra State, are given here:

- Surface water and Ground Water seasonal planning
- Linking of reservoirs
- Integrated Reservoir Operation
- Impacy of Pipeline from Pawana Dam to PCMC
- Artificial recharge
- Conjunctive Use



For more details please contact Chief Engineer (Planning & Hydrology) Or Director, Ground Water Department, Govt. of Maharashtra

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hp2.gsda@gmail.com

ODISHA

Focusing on the Mahanadi basin, Odisha has selected two very different areas for DSS (P) application. The Hirakud command area, mainly to study the potential of increased conjunctive use with surface and groundwater and the Upper Tel River basin for drought study. The latter is drought prone, and although some water transfer from a neighboring basin is taking place, additional measures will be required to ensure sustainable water use in the area and limit the recurring migration of local farmers to urban areas, whenever crops fail. Potential applications of the DSS (P) include assessing the effect of constructing minor reservoirs in the area

DSS (P): Contents and Capabilities

The DSS (P) is designed to meet the requirements of complex water resources planning. It provides diverse toolsets for data processing, modeling, scenario management, optimization and multi-criteria decision making. It offers tools for integrating environmental, social and economic objectives thus greatly facilitating multi-sector water resources planning at river basin level.

The DSS (P) is a generic system that can be applied at different scales – at national as well as trans-boundary levels. It can be installed both within an institutional setup, thereby allowing multiple access to its central database and toolset, and also as a standalone solution.

Key Functionalities of the DSS (P)

Comprehensive Information Management:

The DSS (P) has an integrated comprehensive database coupled with a suite of statistical and other data management tool for analysis, visualization and archiving of diverse types of data. It has integrated metadata capability designed to support and auditing of data stored in the database. Its GIS functionality enables users to analyse and generate spatial and geo-referenced datasets.

Simulation of river basin hydrologic processes:

The DSS (P) offers integrated modeling tools for simulating water balance, water allocation at varying scales. Its modeling environment allows investigation of impacts of existing and anticipated different types and scales of water infrastructure investment and water uses.

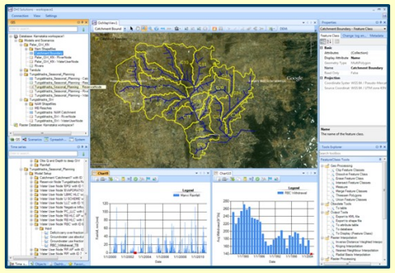
For large river basins, where a range of modeling tools to be used, DSS (P) provides alternative modeling tools with a built-in model linking/nesting facility. This facility allows users to seamlessly integrate various modeling approaches in relevant parts of a basin there capturing complexities of catchment processes in a holistic and integrated manner.

Scenario analyses and management:

scenarios, any water resources planning tool cannot be complete. The DSS (P) provides a versatile facility for creating, editing, simulating and analyzing water resources development and management scenarios. The DSS (P) scenario comparison tool helps users compare different scenario in terms of parameters selected by the user.

The DSS (P) is an integrated solution with flexible/scalable architecture

The various components of the DSS (P) are interconnected- any component of the DSS (P) has
access to any data set used or generated by another component. The DSS (P) can be extended with new toolset without the need for a major change to the program code thereby making it easily adaptable to address emerging needs of users.



DSS (P)

Inbuilt tools for spatial and temporal data analysis

A GIS and Time Series tool inside the DSS (P) offers flexibility in analyzing the spatial as well as temporal data. These tools are accessible through the Tools explorer of the DSS (P), which is context sensitive and shows available tools associated with the particular data type the user is interested in.

The GIS manager with its toolset provides the necessary tools for processing of Spatial data. Tools are provided for, among others, editing spatial data themes, geo-processing, catchment delineation, spatial interpolation, and zonal statistics.

The user interface of the DSS (P) provides a consistent way of visualizing various types of data

IMPLEMENTING AGENCIES

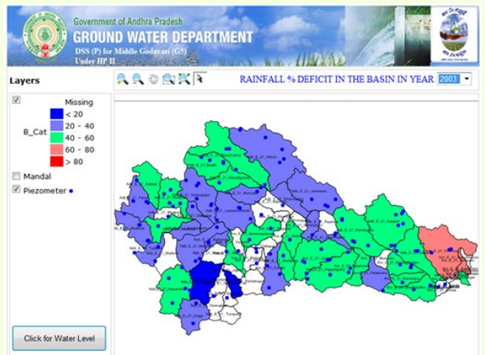
Nine states participated in the implementation of the Decision Support System (Planning) for integrated water resources management in India. Each of the nine participating state has selected one or more case study areas as pilot basins and are applying the DSS (P) to solve the specific problems in each of the basins.

ANDHRA PRADESH

Applications of the DSS (P) are made within the Godavari 5 (G-5) basin, but also include the parts of the Sri Ram Sager Project (SRSP), which lies outside G-5. A River Basin Model has been set up for the SRSP area to evaluate the impact of changes to the system. The model also helps in seasonal planning of water allocation from the reservoirs in the command area.

Various applications have already been made to illustrate the potential of the DSS (P) and associated models. Using long series of historical inflow, extended through hydrological models, the performance of the SRSP has been simulated for scenarios with and without the new and on-going extensions of the system. The application carried out in the state are

- seasonal planning for SRSP reservoir
- Alternative cropping pattern in the reservoir command area
- Integrated reservoir operation



For more details please contact Surface water Department, Andhra Pradesh

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The groundwater analyses have focused on drought prone areas, mainly the Gandlapet catchment in Nizamabad, where groundwater is overexploited. Analyses of possible artificial recharge have been made, and the model has been set up to enable predictions of the regional groundwater depth in dry seasons, as a function of natural drainage and groundwater abstraction. This is now being expanded to other parts of G5. The main applications carried out in groundwater department are

- conjunctive use surface and ground water use
- Artificial recharge

For more details please contact Ground water Department, Andhra Pradesh

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CHHATTISGARH

The Seonath basin, selected by the Chhattisgarh state, contains a number of small reservoirs or tanks, which are supplying water for domestic and agricultural use. The main aim of the DSS (P) applications is to identify improved efficiency in the operation of these tanks and increase, if possible, the amount of water available in the summer period before the next monsoon. For non -irrigated areas, the focus is on improving management of groundwater, particularly during drought. The work carried out to enable these analyses also aims at better estimates of the water availability. The applications developed to resolve hydrological issues are:

- Seasonal planning of major tanks in Tandula reservoir complex.
- Conjunctive use of surface and ground water in Tandula command areas.
- Inter basin transfer.
- Benefits of changing in cropping pattern.

For more details please contact Water Resource Department, Chhattisgarh

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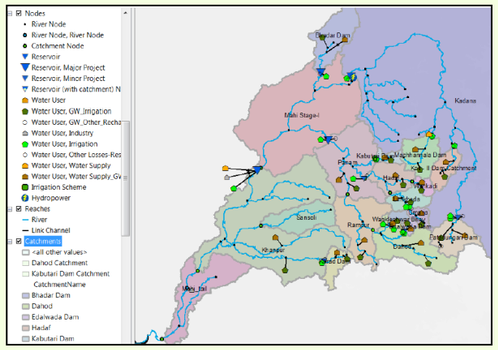
GUJARAT

A number of major and medium schemes are constructed in the Gujarati part of the Mahi River Basin, downstream of Rajasthan, and further development of water resources is taking place these years, within both surface and groundwater. While the competition for the available water resources among agricultural, domestic, and industrial users increase, the area is also prone to flooding from time to time. The DSS (P) is developed to address this multitude of problems and help analysing and clarifying management options for efficient utilization of the resources.

- Increased efficiency of water management in general considering present and future demands, water infrastructure, and the climatic variation. This may also include management of the water demands.
- Combined operation of the Kadana, Panam, and other reservoirs in dry, normal,and flood conditions.
- Improving conditions for the population in drought prone areas.
- Reduced periods of inundation in low-sloping command areas through conjunctiveuse, weather forecasts, or improved drainage.



For more details please contact Surface Water Department and Ground Water department, Gujarat

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KARNATAKA

Two case studies have been selected in Karnataka, i.e. the drought prone Palar basin and the Tungabhadra command area. The groundwater, which occurs in fractured zones in the underlying bedrock, is the main sources of water in the Palar basin, and this has been overexploited for many years resulting in significant drops in groundwater level. The major applications carried out in Palar basin are

- Sustainable Ground Water Abstraction
- Artificial Recharge
- Change in irrigation methods
- Impact of Climate Change on water Availability
- Dashboard for Groundwater Scarcity

For more details please contact groundwater department, Govt of Karnataka

Email: director.gw.hp2@gmail.com

The water resources issues identified for the Tungabhadra Command Area are water logging in head end of canal command, water scarcity for tail end users. Common practice is for the head users of the canal to take the water first, flooding the fields and leaving irrigators at the tail end of the canal with limited irrigation water. Tail end users use groundwater to augment crop water requirements when surface water is short which creates declining groundwater levels. The major applications carried out in Tungabhadra basin are

- Conjunctive use of surface water and ground water in the left bank canal command area
- Reservoir seasonal planning for Tungabhadra Reservoir

For more details please contact Surface water department, Govt. of Karnataka

Email: cehp@rediffmail.com

KERALA

Kerala state located in southern part of India and receives quite high rainfall with considerable variation in time and space. Though state receives a high rainfall across the state, there are still difficulties, particularly in dry years, to assure availability of water for all agricultural, domestic and industrial uses as these sectors are further exhibiting large variations in their water requirements. Groundwater levels are falling in some critical areas and the water quality of the river in the lower reaches is often outside acceptable limits during the low flow season. To address these issues, as a part of DSS (P) project in Hydrology Project-2 state has stressed on the applications related to surface water planning, drought mitigation, conjunctive , water quality and reservoir operation. The Bharathapuzha Basin has been selected as a pilot basin in the state for implementation of DSS (P) project. Different applications carried out in the state are

- Water availability in the Bharathapuzha basin
- Hydropower generation
- Inter sub-basin and inter basin transfer
- Conjunctive use
- Artificial recharge
- Water quality