



DHI CASE STORY

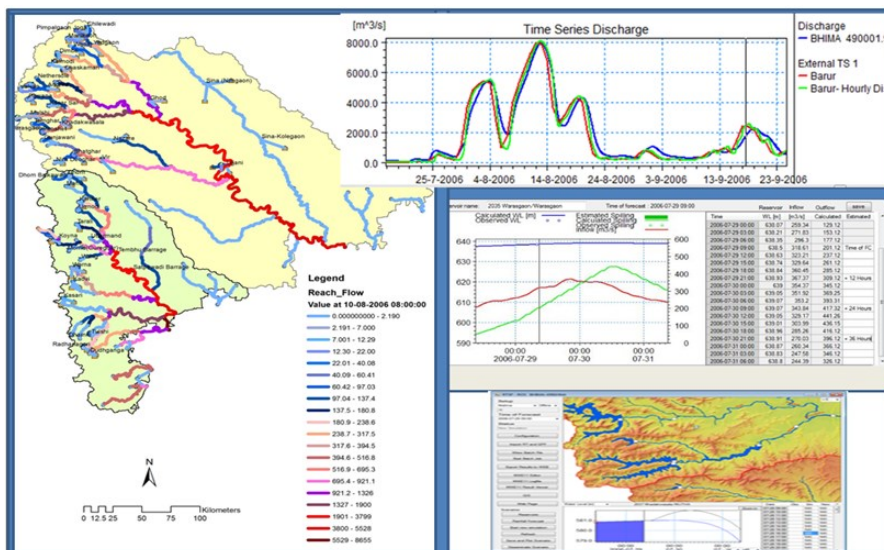
IMPROVING RESERVOIR OPERATION IN THE KRISHNA AND BHIMA RIVER BASINS

Effective flood management with our RTSF & ROS

Highly variable rainfall in different areas of the western Indian state of Maharashtra made integrated operation of the 46 reservoirs in the Krishna and Bhima River Basins difficult. Combined with delays in receiving up-to-date data, this made efficient flood management problematic for the Water Resources Department (WRD) of Maharashtra. To help them, we developed the Real-Time Streamflow Forecasting and Reservoir Operation System (RTSF & ROS) – a real-time Decision Support System (RTDSS). Our RTSF & ROS uses data collected from 300 stations to provide water authorities with accurate hydro-meteorological information. Now Maharashtra's WRD can optimise the operation of the area's reservoirs and improve flood management significantly.

DIFFICULTY IN MAKING OPERATIONAL DECISIONS

There are 46 reservoirs in the Krishna and Bhima River Basins in the western Indian state of Maharashtra. These reservoirs are used for hydropower generation and irrigation, as well as for domestic and industrial uses. However, rainfall in these basins is highly variable – ranging between 6 m of rain in the upper catchments to as little as 40 cm of rain in the lower ones.



Real-Time Streamflow Forecasting and Reservoir Operation System for the Krishna and Bhima river basins

SUMMARY

CLIENT

Water Resources Department (WRD),
Government of Maharashtra

CHALLENGE

- Difficulty managing floods due to delays in receiving flood forecasts and warnings
- Inability to operate multiple reservoirs in the Krishna and Bhima River Basins optimally and in an integrated manner, due to rigid operation schedules
- Lack of a Knowledge Base System (KBS) to aid in operational planning

SOLUTION

- A real-time Decision Support System (DSS) that utilises hydrological rainfall-runoff and hydraulic river routing models (MIKE 11) to forecast reservoir inflows and floods
- A KBS – driven by MIKE CUSTOMISED by DHI – with historical hydrological and GIS data

VALUE

- Improvement in flood management in the Krishna and Bhima River Basins
- Enabling integrated reservoir operation
- Development of a hydrological KBS that generates scenarios which can be used for short- and long-term flood management, water planning and reservoir operations

LOCATION / COUNTRY

Maharashtra, India

The large variability in rainfall throughout the 69,967 km² area of the basins made flood management difficult. As a result, the area regularly experienced flooding events. In 2005 and 2006 alone, extreme flooding in the areas around the basins caused loss of lives and extensive property damage.

Water authorities in Maharashtra had been operating the basins on rigid schedules and as single entities based on historical hydro-meteorological data and previous experience. This method did not allow for the efficient integrated operation of multiple reservoirs. There was also a considerable time lag between data observation in the field and decision makers receiving it. This left little time to develop flood forecasts. As such, it was difficult to make optimal operational decisions, especially related to flood management.

ENABLING INTEGRATED OPERATION

To help the Water Resources Department (WRD) of Maharashtra improve flood management operations, we developed the Real-Time Streamflow Forecasting and Reservoir Operation System (RTSF & ROS). The web-based and user-friendly real-time Decision Support System (RTDSS) – developed using our MIKE 11 software (part of our MIKE by DHI software suite) as its foundation – includes:

- a hydrological rainfall-runoff model
- a hydraulic river routing model based on a fully dynamic solution of St. Venant’s equations (used to model transient open-channel flow and surface runoff)

Combined with information and communications technology, our state-of-the-art RTDSS can help water authorities:

- analyse complex hydrological -meteorological problems
- manage the water resources of the river basins
- manage flood risks

Our RTSF & ROS utilises the information collected from 300 telemetry stations in the Krishna and Bhima River Basins. These stations provide real-time data on:

- rainfall
- reservoir water levels
- gate positions
- river water levels and discharge
- other climatic parameters

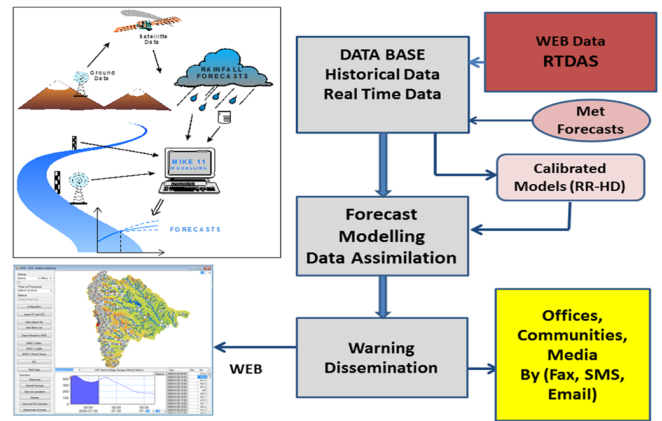


Reservoir water level sensor (RADAR)

The system’s hydrological, hydrodynamic and real-time flood forecasting modules then utilise the collected data to help authorities:

- monitor and forecast streamflow
- manage the operations of the 46 reservoirs in the basins

As part of the project, we also developed a Knowledge Base System (KBS) – driven by MIKE CUSTOMISED by DHI – for the Krishna and Bhima River Basins. Fully integrated with our RTSF & ROS, the KBS includes comprehensive historical hydrological and GIS data. The KBS imports and validates the real-time data. It then converts the data into time series formats to run our reservoir operation and forecasting models. These are then archived in the KBS for future use.



Overview of the Real-Time Streamflow Forecasting and Reservoir Operation System

SUPPORTING EFFECTIVE FLOOD MANAGEMENT

The forecasting system can also run different scenarios offline so that water authorities can compare historical floods forecasted in hindcast mode with current hydrological events. This data can be used in climate change models as well as to aid in operational decision making.

After a successful test of the RTSF & ROS with Maharashtra’s WRD in 2013, water authorities in the Krishna and Bhima River Basins will use the system during the 2014 monsoon season. The ability to operate the reservoirs in an integrated manner will ensure the optimal use of water resources for power production, irrigation and water supply. It will also minimise flood risks in flood-prone urban and rural areas.

In addition to the RTSF & ROS, we also developed a communication and information management system for the basins. It consists of three main components:

- flow/flood warning reports (disseminated by SMS and e-mail)
- the RTDSS website
- Krishna Bhima Online – the main communications web portal

The system allows water authorities and decision makers to quickly and easily access the latest data, enabling them to make sound flood management decisions. It also helps water authorities disseminate information to disaster management agencies as well as to the wider community.

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