Need for Harnessing the Data Revolution in Irrigation & Drainage

Seminar on
“Meeting Water and Food Security Challenges for Sustainable Development”

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Hydro-Meteorological Data Components

<table>
<thead>
<tr>
<th>Hydrological Parameter</th>
<th>Meteorological Parameters</th>
<th>Water Quality Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge</td>
<td>Rainfall</td>
<td>Physical</td>
</tr>
<tr>
<td>Discharge</td>
<td>Temperature</td>
<td>Chemical</td>
</tr>
<tr>
<td>Sediment</td>
<td>Sunshine</td>
<td>Bacteriological</td>
</tr>
<tr>
<td></td>
<td>Evaporation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wind speed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wind Direction</td>
<td></td>
</tr>
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</table>
### WMO Norms for Hydro-met Network

<table>
<thead>
<tr>
<th>#</th>
<th>Physiographic Region</th>
<th>Precipitation Station</th>
<th>Evaporation Station</th>
<th>Stream flow Station</th>
<th>Sediment discharge and sedimentation</th>
<th>Water Temperature (Water Quality Station)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Non-recording</td>
<td>Recording</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Coastal</td>
<td>900</td>
<td>9,000</td>
<td>50,000</td>
<td>2,750</td>
<td>18,300</td>
</tr>
<tr>
<td>2.</td>
<td>Mountainous</td>
<td>250</td>
<td>2,500</td>
<td>50,000</td>
<td>1,000</td>
<td>6,700</td>
</tr>
<tr>
<td>3.</td>
<td>Interior Plains</td>
<td>575</td>
<td>5,750</td>
<td>50,000</td>
<td>1,875</td>
<td>12,500</td>
</tr>
<tr>
<td>4.</td>
<td>Hilly/Undulating</td>
<td>575</td>
<td>5,750</td>
<td>50,000</td>
<td>1,875</td>
<td>12,500</td>
</tr>
<tr>
<td>5.</td>
<td>Small islands</td>
<td>25</td>
<td>2520</td>
<td>50,000</td>
<td>300</td>
<td>2,000</td>
</tr>
<tr>
<td>6.</td>
<td>Polar/arid</td>
<td>10,000</td>
<td>100,000</td>
<td>100,000</td>
<td>20,000</td>
<td>200,000</td>
</tr>
</tbody>
</table>

### Purposes for Data Collection

- Formulating National Water Policy
- Assessment of basin wise water availability and management
- Planning and design of water resources projects
- Study of effect of climate change on water resources
- Flood forecast
- Flood management
- Reservoir inflow forecasting
- Water quality assessment
- Sediment assessment
- Morphological studies
Purpose for Data Collection

- Assessment of navigational potential for inland waterways
- Resolving inter-state or international water disputes
- Study of the effect of nature and human interference on surface water availability and its distribution
- Research purposes
- Estimation of periodical flow distribution during various seasons
- Other purpose

Role of Central Water Commission

- Central Water & Power Commission (CWPC), a national organisation was created in 1950 with a mandate for surface water resources evaluation and management and provide flood warning services among its other defined duties.
- In response to the requirements, CWPC and its successor, Central Water Commission (CWC), established an organisation for collection and evaluation of surface water data.
- CWC now operates networks of 878 hydrometric stations on all major rivers of India. These observation sites are generally located with a view to evaluate the water resources of a basin.
- Operates a network of 878 Hydro-meteorological Observation Station in various river basins in the country.
- Water quality parameters observed at 396 stations and suspended sediments Parameter are observed at 250 stations.
- Also operates 76 exclusive meteorological stations.
- Out of above, 445 have telemetry system for automatic data collection.
- In addition, 236 stations have been closed in past decade due to various reasons.

**Data Collection Network of CWC**

![Bar chart showing the distribution of data collection stations across different categories.](chart.png)

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge</td>
<td>878</td>
</tr>
<tr>
<td>Discharge</td>
<td>573</td>
</tr>
<tr>
<td>Sediment</td>
<td>250</td>
</tr>
<tr>
<td>Water Quality</td>
<td>396</td>
</tr>
<tr>
<td>Rainfall</td>
<td>421</td>
</tr>
<tr>
<td>Climatic</td>
<td>285</td>
</tr>
<tr>
<td>Flood Forecast</td>
<td>175</td>
</tr>
<tr>
<td>Snow</td>
<td>7</td>
</tr>
</tbody>
</table>
Future Expansion

- Working Group on “Water Data Base Development and Management” assessed Hydro-meteorological network requirement in the country.
- Recommended requirement of about 5000 HO & FF Stations across the country.
- Hydro-meteorological stations are also maintained by the various States and other organizations.
- Accordingly CWC plans to setup 1917 new HO stations (including Snow and Met. Stations) covering all rivers of significance in India.
- 800 sites are planned to be opened during XII Plan period.

State-wise proposed CWC stations

![Graph showing proposed HO sites across different states](image-url)
State-wise proposed CWC stations

PROPOSED SITES-12TH PLAN (800)

STATES

- AP
- Aru P
- Assam
- Bihar
- Chhattisgarh
- Delhi
- Gujarat
- Haryana
- HP
- J&K
- Jharkhand
- Karnataka
- Kerala
- Lakshadweep
- MP
- Maharashtra
- Meghalaya
- Mizoram
- Nagaland
- OR
- PL
- Sikkim
- TN
- Tripura
- UP
- UK
- WB

NO OF SITES

- New Delhi
- 35
- 35
- 13
- 5
- 8
- 26
- 33
- 29
- 18
- 94
- 52
- 42
- 24
- 24
- 47
- 33

AP: Arunachal Pradesh
AS: Assam
BIH: Bihar
CH: Chhattisgarh
DL: Delhi
GJ: Gujarat
HR: Haryana
HP: Himachal Pradesh
JK: Jammu and Kashmir
JH: Jharkhand
KA: Karnataka
KL: Kerala
LA: Lakshadweep
MP: Madhya Pradesh
MA: Maharashtra
MG: Meghalaya
MZ: Mizoram
NL: Nagaland
OR: Odisha
PI: Puducherry
SA: Sikkim
TN: Tamil Nadu
TR: Tripura
UP: Uttar Pradesh
UK: Uttarakhand
WB: West Bengal

Proposed Hydro-Meteorological Station (1917)
Other Water DataCompiled by CWC

- Daily Storage in important reservoir
- Inventory of Large Dams
- PMP Atlases
- Information on Glacial lakes
- Information on Major and Medium Projects
Data Dissemination

- MoWR adopted Hydro-meteorological Data Dissemination Policy in 2013
- Two categories of data identified
  - Unclassified data – to be provided in public domain
  - Classified data – to be provided for specific purpose/study on non-transferable basis
- A web enabled India-WRIS was launched in 2009 for the dissemination of data and other water related information with the help of ISRO.
- A National Water Informatics Centre is under constitution for operation of the India-WRIS.

India-WRIS

The project “Generation of Database and Implementation of Web Enabled Water Resources Information System in the Country” short named as India-WRIS (WRIS) is a joint venture of the Central Water Commission (CWC), Ministry of Water Resources, Govt. of India and Indian Space Research Organization (ISRO), Department of Space, Govt. of India, as per the Memorandum of Understanding (MoU) signed on December 1, 2008 between the two departments for a period of four years - January 2009 to December 2012.

India-WRIS WebGIS aims as a 'single window' solution for comprehensive, authoritative and consistent data & information of India’s water resources along with allied natural resources in a standardised national GIS framework (ISO-9408:2000 and ISO-19125:2008) lends to search, access, visualize, understand and analyze the data for assessment, monitoring, planning, development and finally integrated water resources management (IWRM).

The data collection, generation and presentation into the portal are continuous activities. The current version India-WRIS WebGIS (Version 4.5) has spatial layers and attributes as per data collected till April 2012. Further updating the
**India-WRIS**

- A WebGIS aims as a ‘Single Window’ solution for comprehensive, authoritative and consistent data & information of India’s water resources
- Contains 12 major info systems, 35 sub info systems having 95 spatial layers along with large attribute data of the water resources assets and temporal data of 5-100 years
- Has six major sections namely WRIS Info Discovery, WRIS Explorer, WRIS Connect, Share Success Stories, Water Resources Planning and Management and Input Data Builder.
- Studies for ILR Projects Planning for Mahanadi-Godavari and Ganga-Damodar-Subernrekha has been done using data from the platform.

**e-SWIS**

- CWC maintains a portal “e-SWIS” for entry and dissemination of latest data.
- The portal provides a platform for entry of hydrological Data (level and discharge) by the CWC field office on a near real time basis.
- The platform is being successfully utilised for issue of flood forecasts and bulletin.
- The information related to water level (current level as well as hydrograph) is available on public domain.
At the time of Independence, the quantum of surface and groundwater used for various purposes was relatively small.

Surface water came mostly from diversion canals in some major rivers and small tanks and diversion of local stream flow.

Groundwater extraction was mostly through manual or animal drawn lifts.

Water resource development has been an important component of post Independence development strategy.

Substantial development took place in form of major and medium storage projects.
Effective storage capacity which in 1951 was barely 12 bcm (most of it from minor works), increased to 62 bcm in the mid sixties and now stands at 304BCM (253 + 51) including under construction projects.

There has been an explosive growth in use of ground water.

Private sector, mostly farmers, have invested large amounts in developing groundwater.

The impact of increase in irrigation through both surface and groundwater has the greatest impact on agriculture.

According to official land use data, the extent of irrigated land has increased more than 2 and a half times; that of irrigated crop area nearly 3 and a half times.

Irrigated land as a proportion of total cultivated land has more than doubled over this period and has contributed to increasing cropping intensity, changing crop patterns and raising crop yields.

The bulk of the increase in the value of crop production, both the national level and in practically all states, has come from expansion of irrigated area and rising output value per hectare of irrigated area.
With time, rational and sustainable water management has become a far more complex and difficult task (technically, socially and politically) and is required to be handled in a scientific manner.

Many challenges are still to be solved
- Deceleration of irrigation growth and under utilization of potential;
- Rapid and widespread decline of groundwater water table.
- Productivity of irrigated lands much below potential.
- Efficiency of water use is low
- Stagnant productivity of rain-fed lands and widening disparities between rain-fed and irrigated land.
- Degradation of land as a result of over-irrigation, and adoption of far too intensive cropping systems in some areas

There is need for a special effort to investigate
- the relation between rainfall, local stream flow, groundwater recharge and soil moisture
- Yields under different rainfall regimes,
- Techniques (including watershed development) to augment the quantum
- Reliability of water for crops and other uses which is of special relevance to rainfed and water insecure areas.
- The impact of climate change
  - Systematically track changes in variations in temperatures and rainfall across and within seasons
  - The duration of dry spells and intense spells of rainfall extreme climatic events.
Development of basin-wise Extended Hydrologic Prediction model along with DSS (yield forecasting) for medium & long term forecast is needed

- The model will generate different scenarios for different seasons based on irrigation demand and availability of water.
- Demand for irrigation can be calculated using the model and can be used for finding the demand side of water balance.
- The model will also predict the development of water stress in parts of the command area and realistic requirements of the area in view of conflicting demands on a real-time basis.
- The approach will be useful in adjudicating amongst various states and regions for water allocation in real-time basis.

These are data-driven exercises and data revolution taking place will be very helpful.
TOTAL SITES - AFTER 12TH PLAN (1678)

<table>
<thead>
<tr>
<th>STATES</th>
<th>NO OF SITES</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>60</td>
</tr>
<tr>
<td>Arunachal</td>
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<tr>
<td>Assam</td>
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<tr>
<td>Bihar</td>
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<tr>
<td>Chhattisgarh</td>
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<tr>
<td>D &amp; NH</td>
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<td>Delhi</td>
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<tr>
<td>Goa</td>
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<td>Gujarat</td>
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<td>Haryana</td>
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<tr>
<td>J &amp; K</td>
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<td>Jharkhand</td>
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<td>Manipur</td>
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<tr>
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<td>Uttarakhand</td>
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</tr>
<tr>
<td>WB</td>
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</tr>
</tbody>
</table>

TOTAL SITES - AFTER 12TH PLAN (1678)