Water Resources Information System of India

India-WRIS WebGIS

Generation of Database and Implementation of Web Enabled Water Resources Information System

A joint project of
Central Water Commission
&
Indian Space Research Organisation

www.india-wris.nrsc.gov.in/webgis.php

India-WRIS WebGIS - An Introduction

The project "Generation of Database and Implementation of Web Enabled Water Resources Information System in the Country" short named as India-WRIS WebGIS is a joint project of the Central Water Commission (CWC), Ministry of Water Resources, Govt. of India and Indian Space Research Organisation (ISRO), Department of Space, Govt. of India, as per the Memorandum of Understanding (MoU) signed on December 3, 2008 between the two departments for a period of four years - January 2009 to December 2012. The current version 2.0 has spatial layers and attributes as per data collected till November 2011. Further updating the attribute data and new spatial layers are being generated by the India-WRIS project team.

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 standardized national GIS framework (WGS-84 datum and LCC projection) with tools to search, access, visualize, understand and analyze the data for assessment, monitoring, planning, development and finally for Integrated Water Resources Management (IWRM).

The project has following objectives:

a. To collect available data from varied sources, generate database of country's water resources, organize in standardized GIS format and provide a thin client scalable web-enabled information system

b. To provide easier, faster access, sharing of nationally consistent and authentic water resources data through a centralized database and application server to all water resources departments / organisations as decided by CWC

c. To provide tools to create value added maps by way of multi-layer stacking of GIS database so as to provide integrated view to the water resources scenarios

d. To provide foundation for advanced modeling and Spatial Decision Support Systems (SDSS) including automated data collection system

Based on the data type and availability, the present portal contains 12 major info systems, 35 sub info systems having 108 spatial layers along with large attribute data of the water resources assets and temporal data of 5-100 years. Based on the National Map Policy (2005) and CWC data dissemination guidelines, the public domain version has been developed and complies with both.

India-WRIS WebGIS Portal

The India-WRIS WebGIS Portal Version 2.0 has been designed and developed keeping in view multi-users from all sections of society, varied and multi-source data input, current map policy, existing guidelines, requirement of regular updates, near real time data accessibility, data security domains and scale of information. Further there are three user categories for access of GIS data and value added products as per map policy and data dissemination guidelines, and are as follows:

- All General Users (public domain fast track system) - Users can visit web Portal and get the snapshots of the data sets on reduced scale of selected database and tools
- Premium Users - Users can access the India-WRIS web application data sets in detail and tools by registration and password
- CWC Intranet Users - These privileged users are able to get the full access to the India-WRIS web application and database. All the facilities developed are accessible by these users

The information system on water resources has four key elements besides other facilities namely:

1. Data input/entry/collection system
2. Interactive system for geo-visualization and temporal analysis
3. Data storage, analysis, and transformation into 'user friendly' information
4. Information dissemination system in public domain as downloads and further processing tools for value addition and customization

India-WRIS User Interface

Considering large number of factors such as type and volume of data, number of different users, ease of handling, diverse nature of internet connectivity in the country, information requirement by the users and available technologies, utmost care has been taken by the WRIS team to design the user interface of the portal.

1. Main Menu Toolbar

The main menu has six modules namely, WRIS Info Discovery, WRIS Explorer, WRIS Connect, Input Data Builder, Share Success Story and Create Your WRIS.This is the heart of India-WRIS information system where all the major links to the various WebGIS modules are provided in a rich Graphical User Interface (GUI) assisted format for easy access and use.

1.1 WRIS Info Discovery & Data Catalog

This module provides the user in discovering information contained in India-WRIS of a particular geographic area. The user can select area of interest based on the Administrative units, Hydrological units or Constituency wise and is presented with a condensed list of all the information available in India-WRIS for the area.

1.2 WRIS Explorer

This is the core module of India-WRIS WebGIS where all the data can be explored and viewed using the various tools available for the purpose.

- Geo-Visualization - This section provides basic facility to visualize all the layers together in any combination by turning layers on and off as per the requirements.

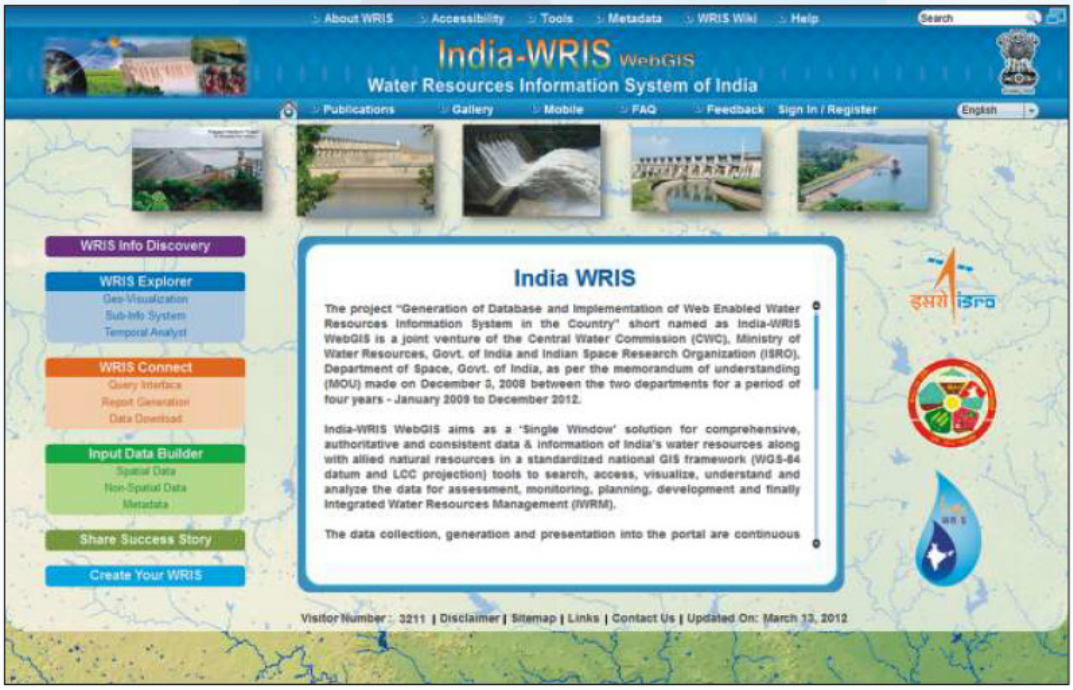
- Sub-Information Systems - There are 12 major information systems namely, base data, surface water, ground water, hydro-met, water quality, snow cover/glacier, inland navigation waterways, inter-basin transfer links, hydro-met extremes, land resources, water tourism and socio-economic. These have been further divided into 35 sub-information systems. Each sub-information system is based on a particular theme. It contains relevant layers and specially created tools to make the best use of the data.

- Temporal Analyst - A large amount of water resources and related data regarding hydrological, meteorological, pollution etc. are temporal in nature. In order to represent these datasets, a separate module has been created where facilities are provided to represent the time series data using suitable charts, animations and to compare the data across stations or years.

1.3 WRIS Connect

The sub-modules in WRIS Connect are:

- Query Interface - User queries are answered directly through WRIS Explorer and associated available tools. To explore more details, user can fire queries through Query Interface that contains set of fixed queries on various hydrological parameters. The answers are generated through different permutations and combinations of these fixed queries. The result of a query is displayed in spatial as well as non-spatial formats.



Home Page & Front GUI of India-WRIS WebGIS

- Report Generation - This section has the utility to automatically generate report of the user defined area / region containing the data into tables and maps and allows *Save As* and *Download* in .pdf format.

- Data Download - Apart from viewing the available data, the user may also wish to take the data and perform analysis / add value. This link allows the download of GIS layers and associated attributes.

1.4 Input Data Builder

This module aims at keeping the data content of the various layers of India-WRIS up to date by providing facilities to the data providing sources to ingest the current attribute data directly into the relevant layers. The authorized users can enter the respective spatial and non-spatial data in the specified format into the information system through this facility. The three sub-modules of Input Data Builder are Spatial, Non-spatial and Metadata Input Builder.

1.5 Share Success Story

The purpose of this module is to connect people for water resources planning and management by providing platform to upload the success stories so that others can view, interact and practice.

1.6 Create Your WRIS

This module provides facilities to the user to have further analysis of the downloaded data, adding new datasets using available general hydrology tools and generate report of the area.

2. Universal Toolbar

Universal toolbar is present at the top of the home page and has two sections.

First section - The toolbar at the top of the page contains the links to popup window having information required by the user at any point and toolbar is visible at all times. The links in this toolbar are:

- About WRIS - This page contains a brief overview of India-WRIS project including its history, scope, vision, goals, deliverables and time-frame for completion

- Accessibility - This provides information for navigating through India-WRIS like screen resolution, keyboard shortcuts for easy navigation etc

- Tools - Numerous tools along with symbols for easy access are described in this part

- Metadata - This link leads the user to the Metadata Explorer which provides comprehensive information of the source of spatial and non-spatial data

- WRIS Wiki - Comprehensive information for the water resources assets and projects of the country is made available through WRIS Wiki application.

- Help - A comprehensive and universal help is documented in this section assisted with diagrams, screenshots and short videos

- Search - Consolidated search into the complete information system is provided

Second section - The advanced information toolbar is available right below the banner. It contains links to pages containing detailed information that a user requires when visiting the home page but may not require while exploring the other sections of the information system. The links available in this toolbar are:

- Home - This link leads to the main page of India-WRIS Portal

- Publications - Various documents generated for India-WRIS are made available and reports being generated would be available to the users through this link

- Gallery - This section presents the user with an image gallery of events related to development of India-WRIS project

- WRIS Mobile - A mobile version of India-WRIS is being developed for smart phone and hand held devices

- FAQ - This section contains answers to common questions and queries about the project and outcome

- Feedback - Provides interface to post user suggestions and feedback

- Sign In / Register - This section provides provision for new user to register and get connected to India-WRIS portal for updates. For downloads and providing data inputs, login with password is provided based on user categories

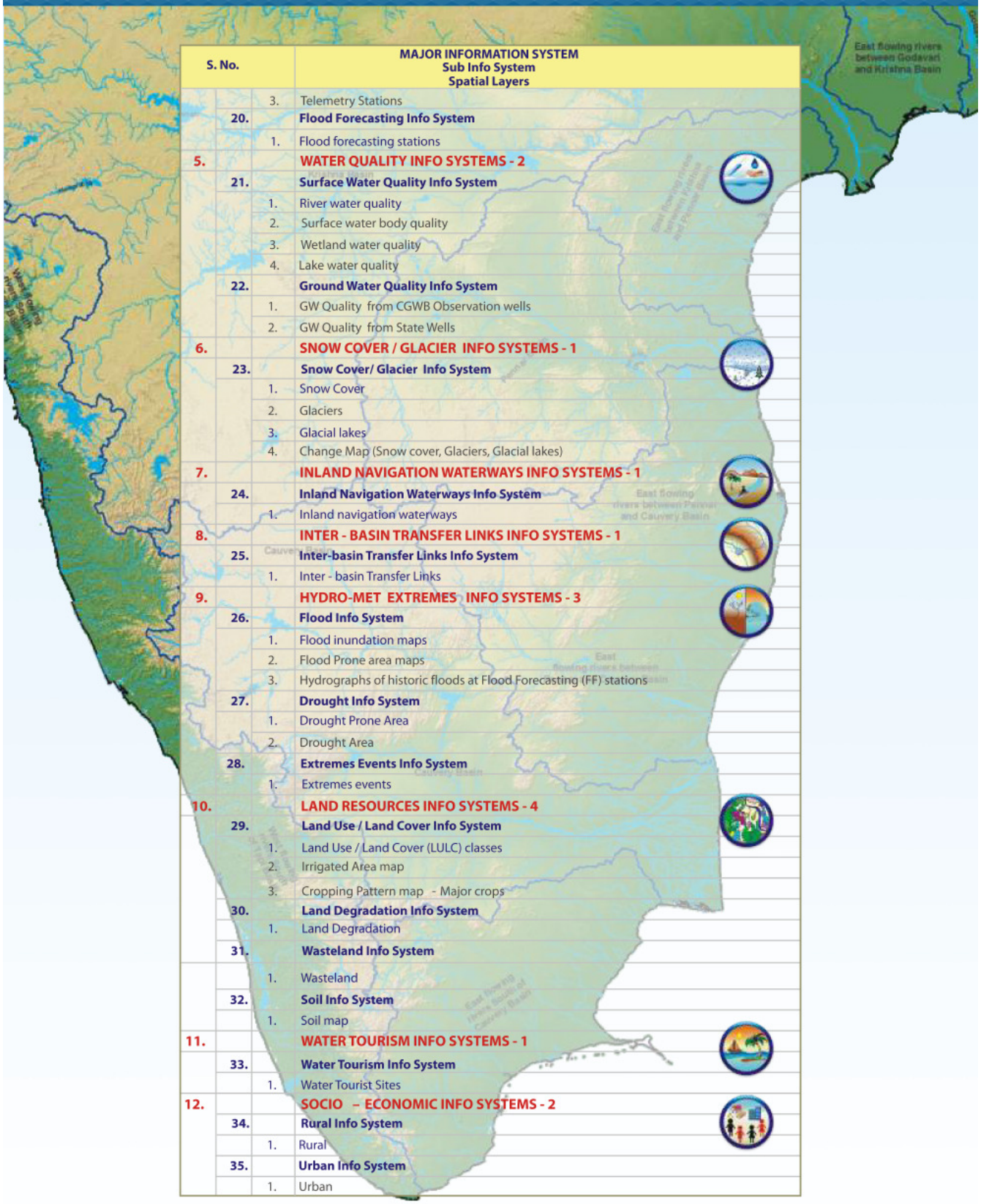
3. General Information Toolbar

This toolbar is available in the lower section of the home page and provides links to general information about India-WRIS as Visitor Number, Disclaimer, Sitemap, Links, Contact Us and Last Updated.

Scope and Dataset

S. No.			MAJOR INFORMATION SYSTEM Sub Info System Spatial Layers
1.			**BASE DATA INFO SYSTEMS - 4**
	1.		**Administrative Info System**
		1.	International India boundary
		2.	State boundary
		3.	District boundary
		4.	Tehsil boundary
		5.	Urban Centres - Location, extent / boundary & classification
		6.	Block boundary
		7.	Revenue village boundary
		8.	Assembly & Parliamentary Constituency
		9.	Panchayat boundary
		10.	Villages - Location, extent, boundary & classification
	2.		**Regions Info System**
		1.	Forest Cover / Forest Region
		2.	Agro climatic regions
	3.		**Infrastructure Info System**
		1.	Railway Network
		2.	Road Network
		3.	Water ways
		4.	Airports
		5.	National Power lines
	4.		**Terrain Info System**
		1.	DEM-SRTM
		2.	Hillshade (90m)
		3.	Elevation Zones
2.			**SURFACE WATER INFO SYSTEMS - 9**
	5.		**Water Resource Division Info System**
		1.	Major Water Divisions
		2.	Water Resource Regions
	6.		**Basin Info System**
		1.	Basin delineated under India-WRIS project
		2.	Basin – CWC
		3.	Basin – NCIWRDP
		4.	Basin – AIS&LUS (SLUSI)
		5.	Basin – CGWB
		6.	Sub – Basin (with derived parameters)
	7.		**Watershed Info System**
		1.	Watershed
		2.	Sub-Watershed (U,M,L)
		3.	Micro - Watershed
	8.		**River Info System**
		1.	River Network
	9.		**Surface Water Body Info System**
		1.	Surface Water body
		2.	Wetlands
		3.	Lakes
	10.		**Water Resources Projects Info System**
		1.	Dam
		2.	Barrage / Weir / Identified Anicut
		3.	Reservoir
		4.	Major and Medium Irrigation Projects

S. No.			MAJOR INFORMATION SYSTEM Sub Info System Spatial Layers
		5.	Lift Irrigation Projects
		6.	HE Projects
		7.	Hydro Electric Regions
		8.	Hydro Electric Basins
		9.	Powerhouses
		10.	ERM Projects
		11.	Multipurpose Projects
		12.	Flood Control Structures
		13.	Seismic Zones
	11.		**Command Area Info System**
		1.	Irrigation Command Boundary (a. Major and b. Medium)
		2.	Major Projects (Waterlogged, Salt affected & soil samples)
		3.	Medium Projects (Waterlogged, Salt affected & soil samples)
		4.	Ground water fluctuation (Pre and Post monsoon)
	12.		**Minor Irrigation Info System**
		1.	District wise absolute number of Minor Irrigation(MI) schemes
		2.	District wise number of Ground Water & Surface Water MI schemes
		3.	District wise number of 5 types of MI schemes
		4.	Potential Created
		5.	Potential Utilized
		6.	Ultimate Irrigation Potential
	13.		**Canal Info System**
		1.	Canal
		2.	AIBP
3.			**GROUND WATER INFO SYSTEMS - 3**
	14.		**Aquifer / Litholog Info System**
		1.	Basin wise litholog data - CGWB
		2.	Litholog Data from states
	15.		**Ground Water Level Info System**
		1.	GW Level from CGWB observation wells
		2.	Water Level Contour
		3.	Fluctuation (Pre & Post monsoon)
		4.	Ground Water Flow Gradient
		5.	Ground Water Level from States
	16.		**Ground Water Potential Info System**
		1.	Toposheet wise maps (as .pdf format)
4.			**HYDRO-MET INFO SYSTEMS - 4**
	17.		**Meteorological Info System**
		1.	Meteorological Divisions of IMD
		2.	IMD Sites with Weekly Data
		3.	IMD Sites with Monthly Average Data
		4.	CWC Sites and Observations
		5.	DRMS (District - wise Rainfall Monitoring Stations)
		6.	Spatial Distribution of WMO recognized IMD Sites
		7.	Spatial Distribution of AWS locations of ISRO, IMD and CWC
	18.		**Climate Info System**
		1.	Climate Related Layers (Gridded Data)
		2.	District wise Normals
		3.	Isopluvial
		4.	District wise monthly average meteorological data
		5.	Interpolated and value added layers (Isohyets, Isotherms, Isobars etc.)
	19.		**Hydro-Observation Info System**
		1.	Hydro-observation and sedimentation stations of CWC
		2.	Wireless Stations



S. No.			MAJOR INFORMATION SYSTEM Sub Info System Spatial Layers
		3.	Telemetry Stations
	20.		**Flood Forecasting Info System**
		1.	Flood forecasting stations
5.			**WATER QUALITY INFO SYSTEMS - 2**
	21.		**Surface Water Quality Info System**
		1.	River water quality
		2.	Surface water body quality
		3.	Wetland water quality
		4.	Lake water quality
	22.		**Ground Water Quality Info System**
		1.	GW Quality from CGWB Observation wells
		2.	GW Quality from State Wells
6.			**SNOW COVER / GLACIER INFO SYSTEMS - 1**
	23.		**Snow Cover/ Glacier Info System**
		1.	Snow Cover
		2.	Glaciers
		3.	Glacial lakes
		4.	Change Map (Snow cover, Glaciers, Glacial lakes)
7.			**INLAND NAVIGATION WATERWAYS INFO SYSTEMS - 1**
	24.		**Inland Navigation Waterways Info System**
		1.	Inland navigation waterways
8.			**INTER - BASIN TRANSFER LINKS INFO SYSTEMS - 1**
	25.		**Inter-basin Transfer Links Info System**
		1.	Inter - basin Transfer Links
9.			**HYDRO-MET EXTREMES INFO SYSTEMS - 3**
	26.		**Flood Info System**
		1.	Flood inundation maps
		2.	Flood Prone area maps
		3.	Hydrographs of historic floods at Flood Forecasting (FF) stations
	27.		**Drought Info System**
		1.	Drought Prone Area
		2.	Drought Area
	28.		**Extremes Events Info System**
		1.	Extremes events
10.			**LAND RESOURCES INFO SYSTEMS - 4**
	29.		**Land Use / Land Cover Info System**
		1.	Land Use / Land Cover (LULC) classes
		2.	Irrigated Area map
		3.	Cropping Pattern map - Major crops
	30.		**Land Degradation Info System**
		1.	Land Degradation
	31.		**Wasteland Info System**
		1.	Wasteland
	32.		**Soil Info System**
		1.	Soil map
11.			**WATER TOURISM INFO SYSTEMS - 1**
	33.		**Water Tourism Info System**
		1.	Water Tourist Sites
12.			**SOCIO – ECONOMIC INFO SYSTEMS - 2**
	34.		**Rural Info System**
		1.	Rural
	35.		**Urban Info System**
		1.	Urban

Note: *1 - Spatial layers (in blue colour) completed as per data made available till November 2011; would be further added as per data availability*
2 - Spatial layers (in black colour) being developed as per data availability

India's Water Wealth

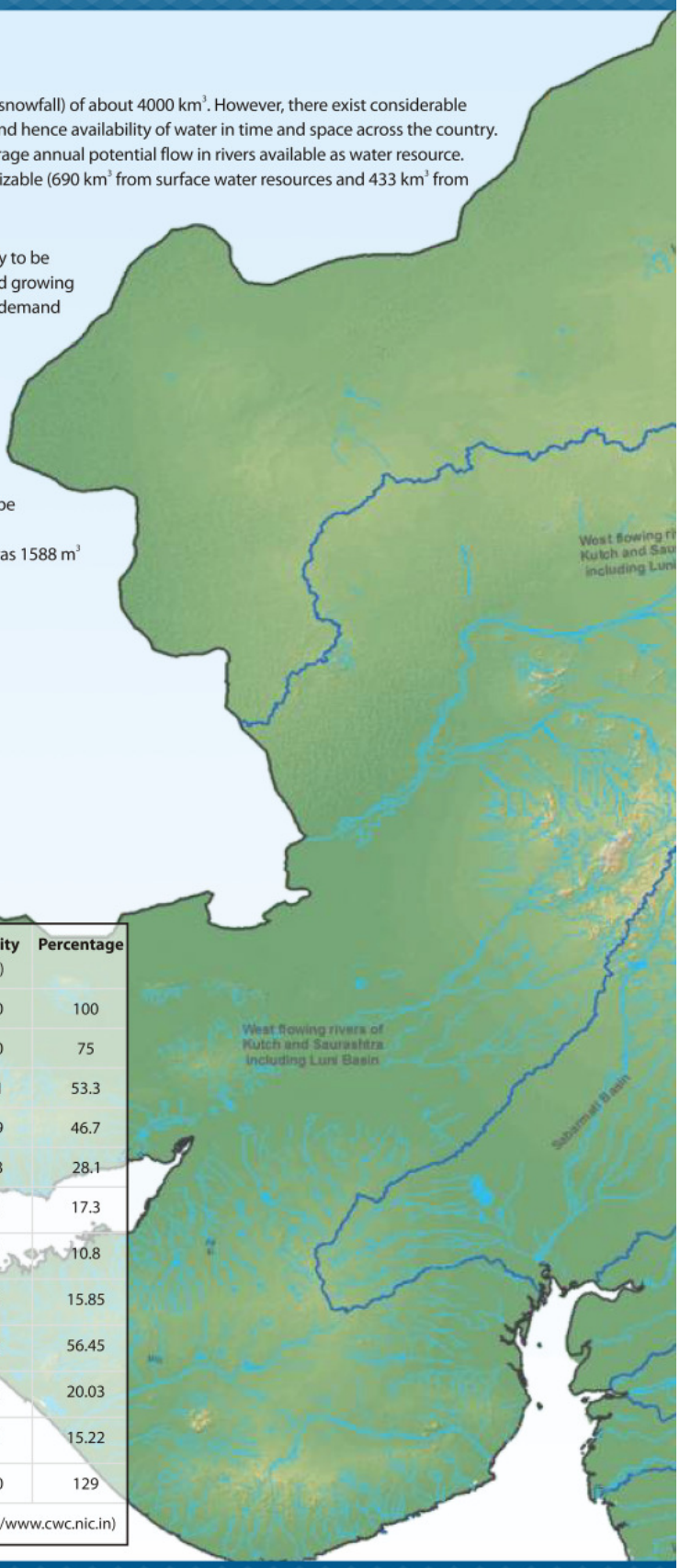
On an average, India receives annual precipitation (including snowfall) of about 4000 km^3. However, there exist considerable spatial and temporal variations in the distribution of rainfall and hence availability of water in time and space across the country. It is estimated that out of the 4000 km^3 water, 1869 km^3 is average annual potential flow in rivers available as water resource. Out of this total available water resource, only 1123 km^3 is utilizable (690 km^3 from surface water resources and 433 km^3 from ground water resources).

The water demand in the year 2000 was 634 km^3 and it is likely to be 1093 km^3 by the year 2025. Due to rapid rise in population and growing economy of the country, there will be continuous increase in demand for water, and it will become scarce in the coming decades. According to the international norms, a country can be categorized as 'water stressed' when water availability is less than 1700 m^3 per capita per year whereas classified as 'water scarce' if it is less than 1000 m^3 per capita per year. In India, the availability of water in the years 1991 and 2001 were 2309 m^3 and 1902 m^3, respectively. However, it has been projected that per capita surface water availability is likely to be reduced to 1401 m^3 and 1191 m^3 by the years 2025 and 2050, respectively. The per capita water availability in the country was 1588 m^3 in the year 2010 against 5200 m^3 in the year 1951.

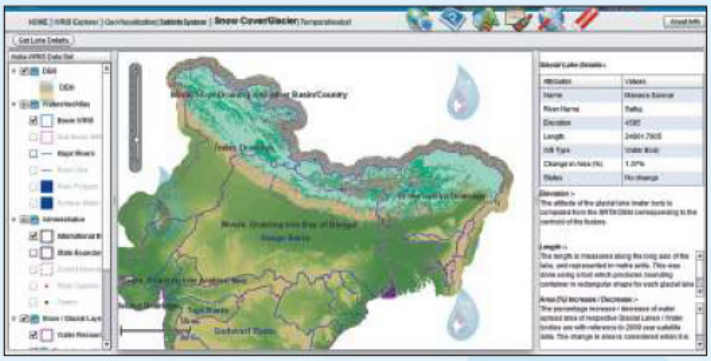
- Area of the country as % of World Area : 2.4%
- Population as % of World Population : 17.1%
- Water as % of World Water : 4%
- Rank in per capita availability : 132
- Rank in water quality : 122
- Average annual rainfall 1160 mm (world average 1110 mm)
  - Range of distribution: 150 -11690 mm
  - Range of Rainy days: 5-150, most rain 15 days in 100 hrs
  - Range PET: 1500-3500 mm
  - Per capita water availability (2010) in m^3:1588

S. No.	Water Resource at a Glance	Quantity (km^3)	Percentage
1	Annual precipitation (Including snowfall)	4000	100
2	Precipitation during monsoon	3000	75
3	Evaporation + Soil water	2131	53.3
4	Average annual potential flow in rivers	1869	46.7
5	Estimated utilizable water resources	1123	28.1
	Surface water	690	17.3
	Replenishable groundwater	433	10.8
	Current utilization of total	634	15.85
	Current utilization of utilizable water	634	56.45
	Storage created of utilizable water	225	20.03
	Storage (under construction) of utilizable water	171	15.22
6	Estimated water need in 2050	1450	129

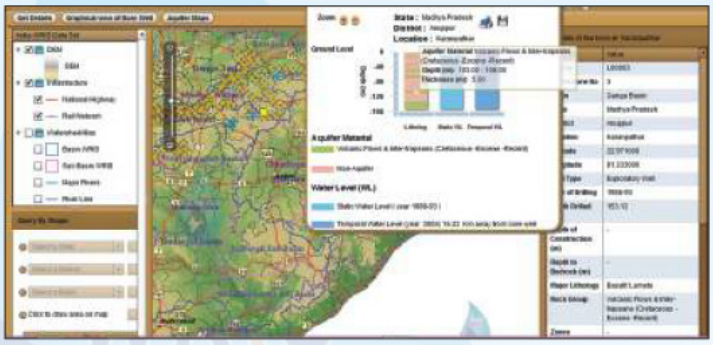
Source: Water Resources at a Glance 2011, CWC, New Delhi, (http://www.cwc.nic.in)



Info System Screenshots

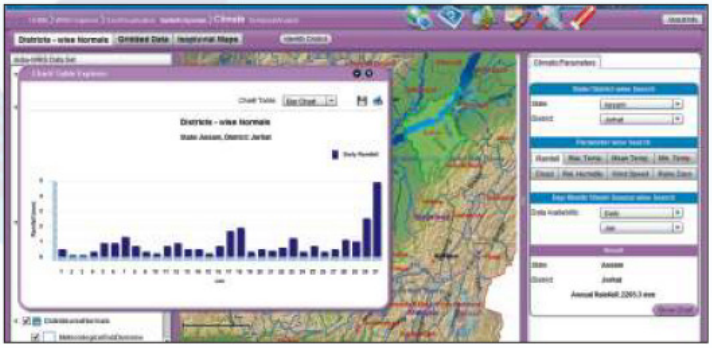


Snow Cover / Glacier Info System



Aquifer / Litholog Info System

Drought Info System



Climate Info System

India-WRIS WebGIS Application Architecture

The three major components in India-WRIS WebGIS application are:

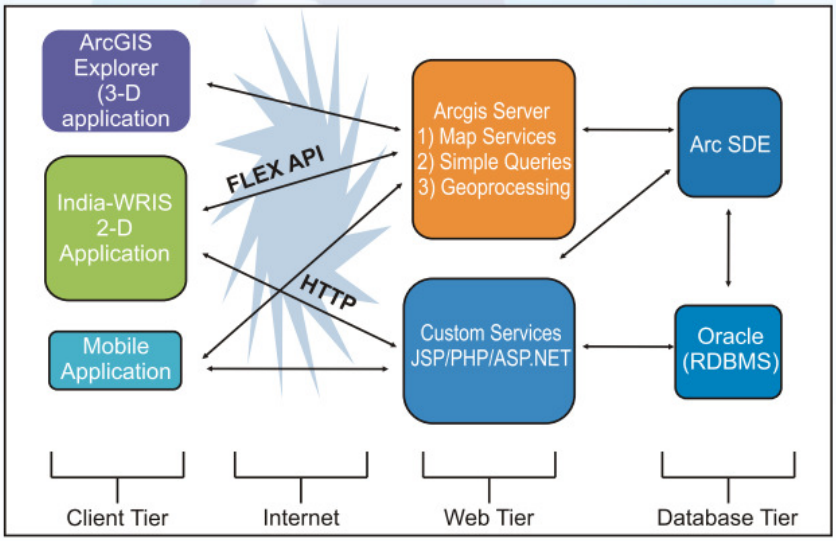
1. **Database Design & Generation**: The water resources data is highly complex with numerous sources involved. Large part of the data is spatial in nature but the amount of associated data is voluminous with many layers having time series component. This data is bound to increase exponentially with the passage of time. The creation and management of such data is a colossal feat in itself and requires state of the art tools. The database standards and relationship have been developed for all type of data. The database generation software used have the capabilities of creating maps, viewing or exploring data, editing data, storing, conflation (integrating datasets from different sources) and transforming into different coordinate systems etc.

   The database generation for India-WRIS has been done using the latest, state of the art software that are capable of handling complex data of large sizes in multi-user environment. This data resides in the form of geodatabase which is a Relational Database Management System (RDBMS) file format for GIS data and allows the India-WRIS database to be manageable, scalable, compatible and easy to write queries for fast retrieval of results through web based applications over internet.

2. **Web Application and User Interface Technology**: The major user requirement from the web portal is data dissemination; hence advance GIS data processing systems at the back end augmented with the best database connectivity over the internet is used so that the user is able to get intuitive and real time information.

   User has the facility for data visualization, analysis on the client side and use it further to create customized reports. Adobe Flex is able to deliver Rich Internet Applications (RIAs) across the enterprise and over the web efficiently. Using the freely available Flex API, India-WRIS combines GIS based Web services from ArcGIS Server with other Web content, which are displayed in simple, dynamic mapping applications over the Web. All the published map services are compliant with Open Geospatial Consortium (OGC) standards and the services can be accessed using Web Mapping Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS) and Keyhole Markup Language (KML) standard formats. India-WRIS system is using Oracle 11g, RDBMS which supports multi-user system. ArcSDE as well as Oracle together used to handle geospatial data and to create multiuser geodatabase

3. **Database Storage and Web Hosting:** In order to ensure reliable and secure, 24 x 7 availability of the WebGIS, a robust hosting architecture has been designed. The same has been replicated at three places namely, RRSC (West) - Jodhpur for the data generation and software development centre; NRSC - Hyderabad for web hosting and CWC - New Delhi for intranet users and data validation and updation.



India-WRIS Web Application Architecture

Tools

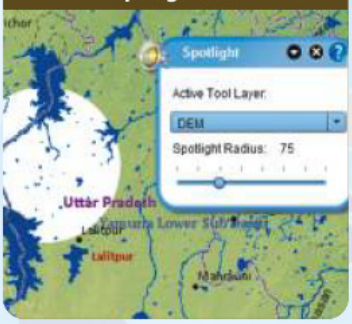
India-WRIS tools are organised into six categories:

- Navigation Tools
- Personalization Tools
- Display Tools
- Advanced Tools
- Search and Query Tools
- Sharing Tools

Snapshot of Selected Tools

Swipe Tool

Spotlight Tool

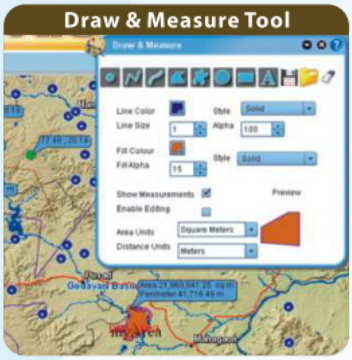


Magnifier Tool

Linked View

IFrame

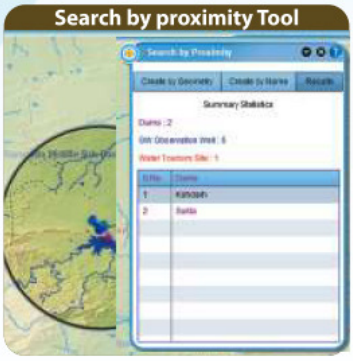
Draw & Measure Tool



Query Builder

Route Tool

Search by proximity Tool



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