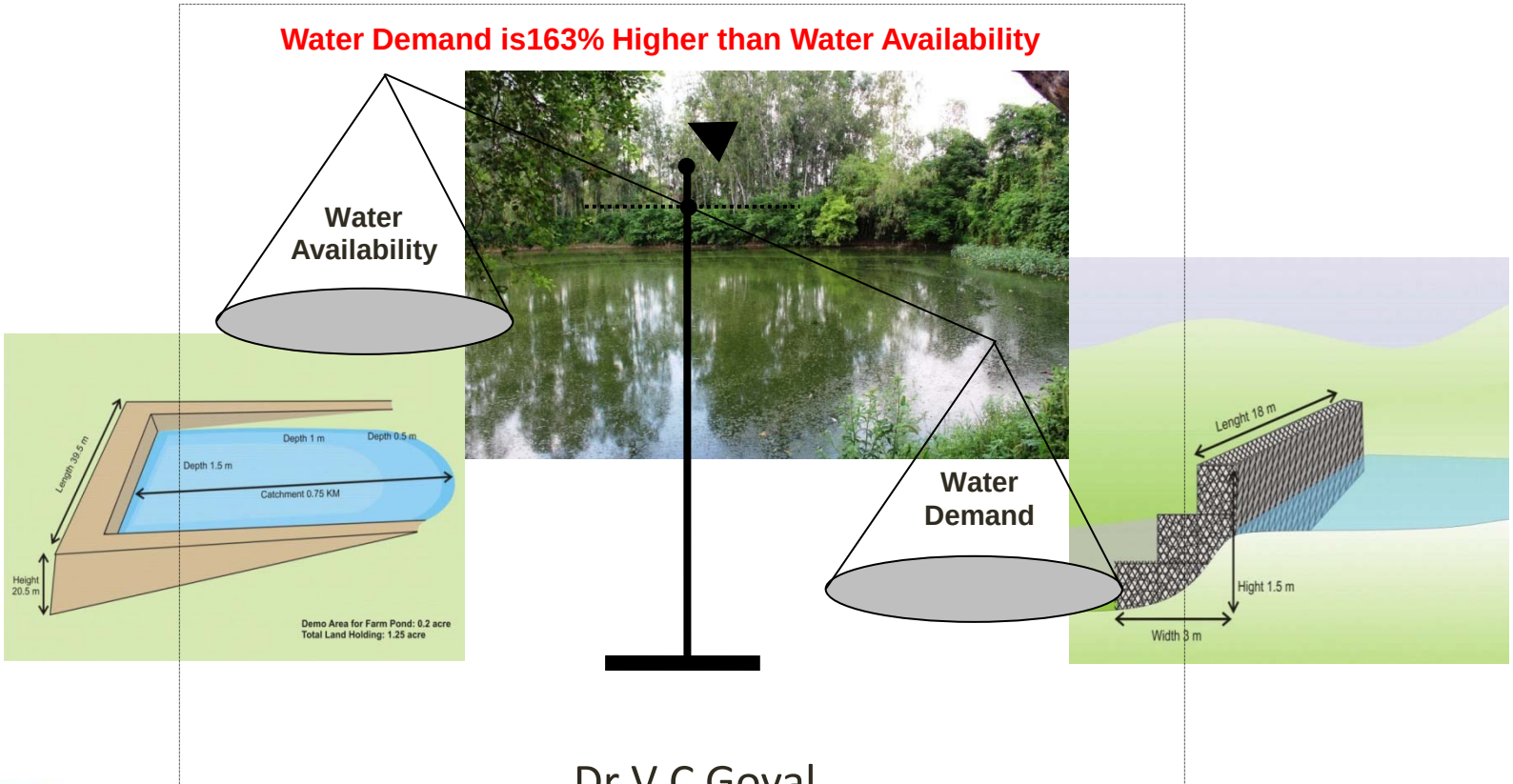
Integrated Water Resources Management (IWRM) for Water Security



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Structure

- SDGs and SDG 6 of United Nations (UN)
- Water Security
- IWRM Concept
- “Local IWRM”
- IWRM at District Level
- Case Study: Watershed in Bundelkhand
- Way Forward

United Nations Educational, Scientific and Cultural Organization

Indian National Committee on International Hydrological Programme

Sustainable Development Goals (SDGs)

आपो हि ष्ठा मयोभुवः

Agenda 2030: SDGs are also known as **"Transforming our World: the 2030 Agenda for Sustainable Development"**. Goals were developed to replace the Millennium Development Goals (MDGs), which ended in 2015.

✓SDGs cover a broad range of social development issues.

✓A collection of 17 interrelated global goals set out by the UN.

✓Each goal has several targets. Total number of targets is 169.

United Nations Educational, Scientific and Cultural Organization

Indian National Committee on International Hydrological Programme

SUSTAINABLE DEVELOPMENT GOAL 6

National Institute of Hydrology

आपो हि ष्ठा मयोभुवः

Ensure availability and sustainable management of water and sanitation for all

- ✓SDG-6 has eight targets and 11 indicators that will be used to monitor progress toward the targets.
- ✓Target 6.5: **By 2030, implement integrated water resources management (IWRM) at all levels, including through transboundary cooperation as appropriate.**
- ✓Indicator 6.5.1: Degree of IWRM implementation.
- ✓Indicator 6.5.2: Proportion of transboundary basin area with an operational arrangement for water cooperation.

The Problem..

Issues related to Water Resources Management in India (as per National Water Policy)

Growing pollution of water sources

Rising water stress situation (more demand that supply)

Wastage and inefficient usage of water

Inequitable exploitation of ground water without any consideration to its sustainability

Lack of inter disciplinary approach to water management

Water Security

- **Securing drinking water supply,**
- **Securing food supply:** thru more efficient mobilization and use of water & more equitable allocation of water for food production,
- **Water for health:** providing safe water for domestic uses,
- **Protecting ecosystems:** integrity of ecosystems thru sustainable water resources management,
- **Managing risks:** security from floods, droughts, pollution and other water-related hazards,
- **Water for cities:** urban areas are increasingly the focus of human settlements and economic activities,
- **Water for industry:** focuses on industry needs.

Objectives of Water Management

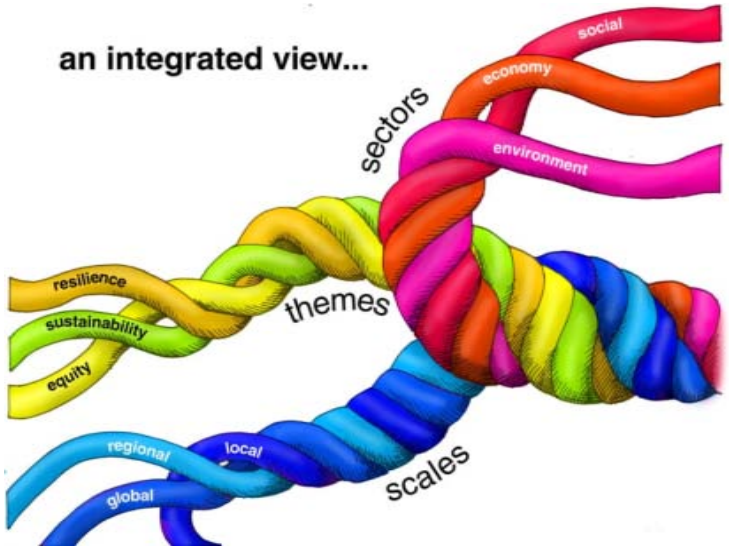
- Efficient and gainful utilization of water and other natural resources
- Healthy living for human and cattle resources
- Livelihood options for all
- Preparedness for disasters/calamities

Integrated Water Resources Management (IWRM)

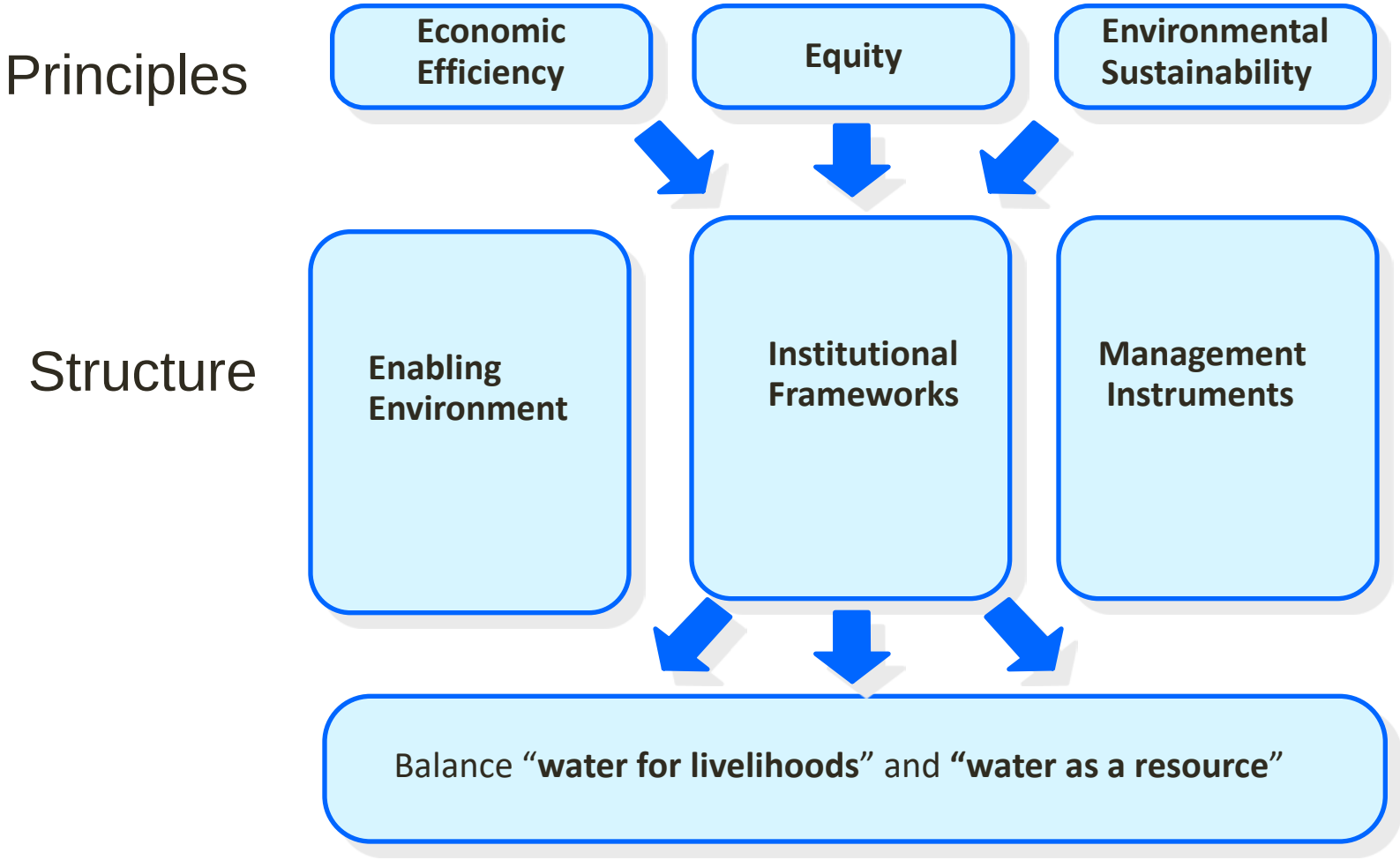
"is a process that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems"

(Global Water Partnership)

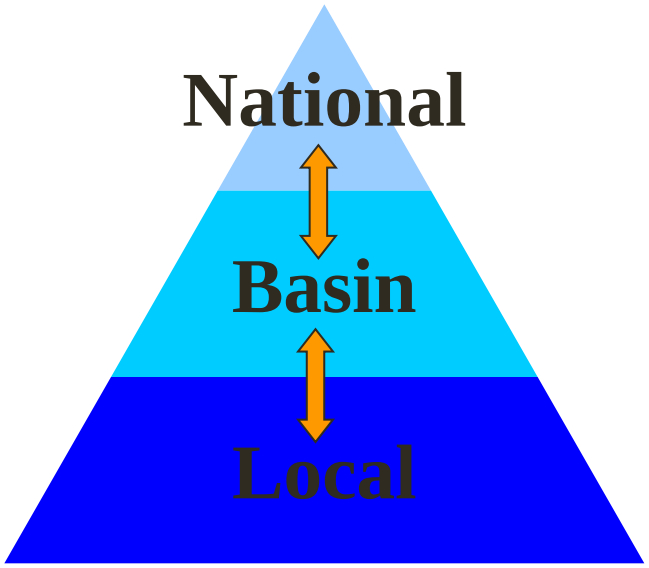
- More coordinated development and management of:
  - Land and water
  - Surface water and ground water
  - Upstream and downstream interests

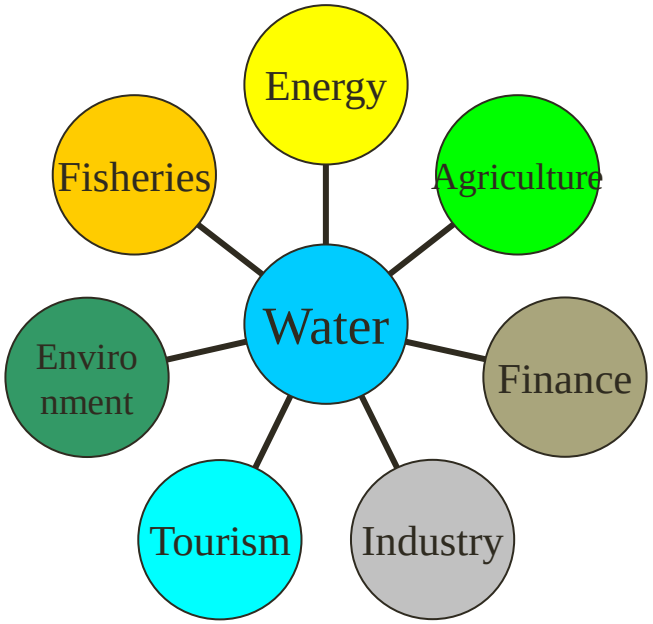


IWRM Perspective



Integrating across scales and sectors

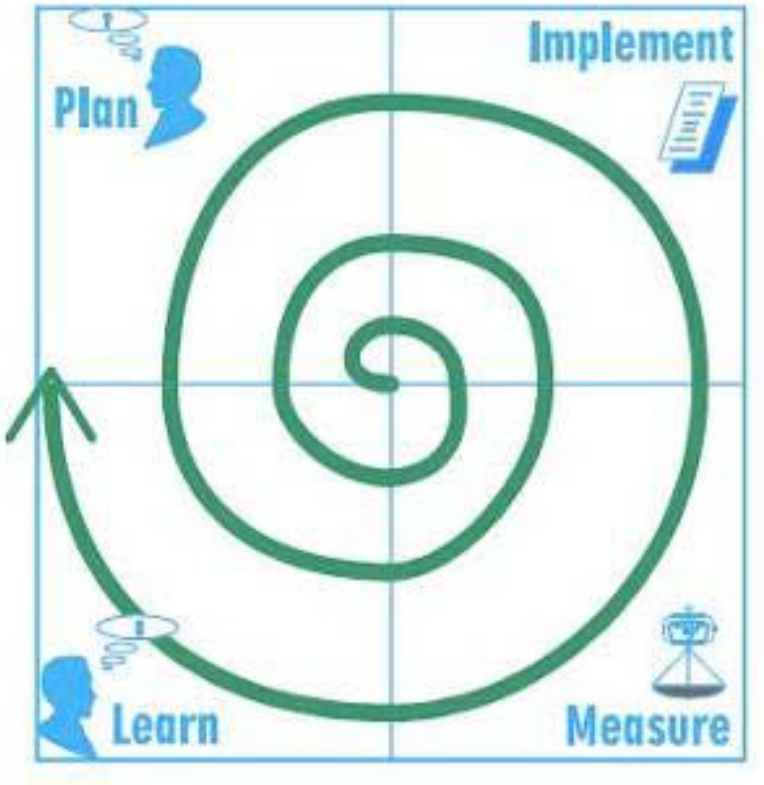




IWRM is not a fixed prescription but an iterative process

This means that the specific form IWRM takes will vary from country to country and from region to region.

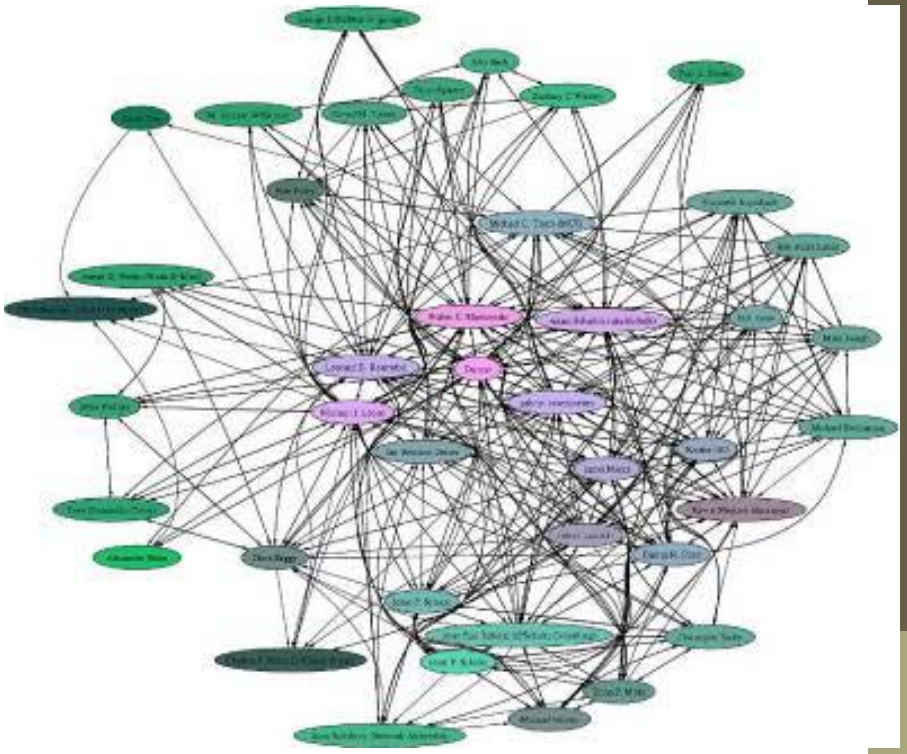
It also means that **IWRM is an inherently adaptive approach – one that can accommodate emerging challenges, local constraints and changing social priorities.**



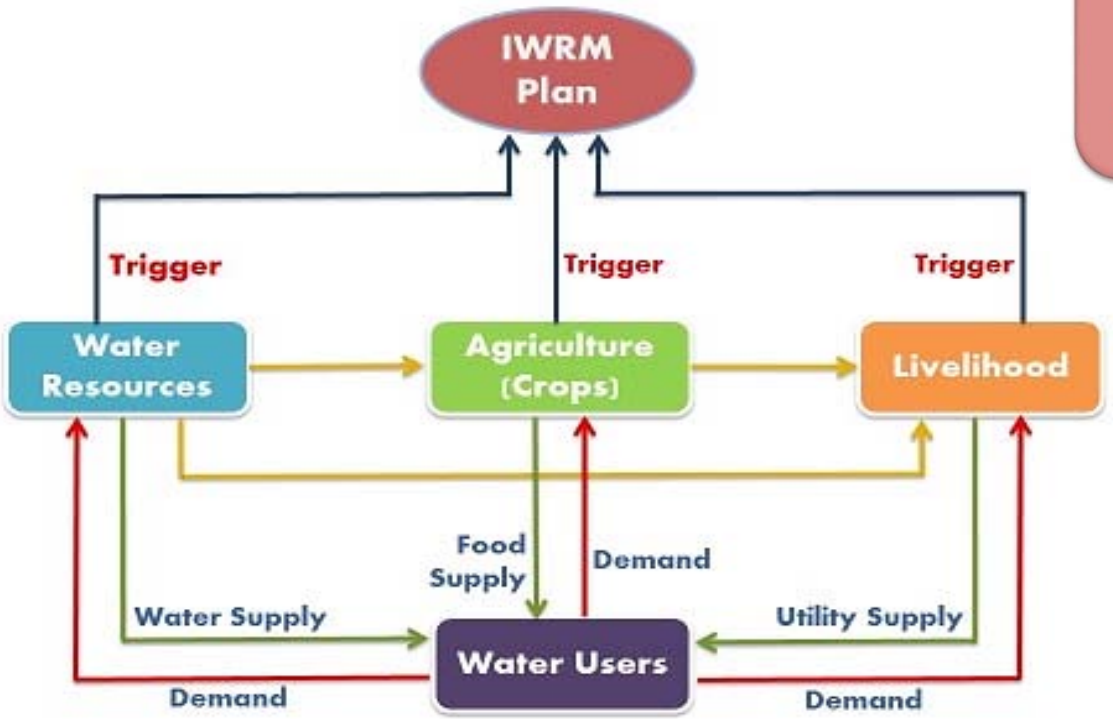
Putting IWRM into practice

Trying to establish management relations between too many variables risks getting mired in complexity at the expense of effectiveness.

When putting IWRM into practice it's important to think strategically about where and to what degree coordination and new management instruments are necessary.



What IWRM Deals with?



"Local IWRM" & Practical Approaches

- **Prioritize local needs**
  - Drinking
  - Livestock
  - Irrigation
  - Livelihood: enterprises: dairy, fishery, WADI, floriculture, food processing

- **Available local resources**
  - Human and livestock
  - Natural: water, land, forests,
  - Physical infrastructure: road, energy, school, market, research institutions
  - Governance: district govt, GP, NGOs, SHGs

- Combination of ITK and modern science & technology
- Local implementation mechanism; convergence of schemes
- Participatory mode
- Visibility of results and achievements

IWRM: Action Research Activities

- Water budgeting
- Water demand and availability: gap estimation
- Water allocation planning for different uses
- Water quality assessment
- Wastewater management planning
- Protection and rejuvenation of water bodies (e.g. ponds, lakes)
- Water harvesting measures: identification of suitable sites and appropriate structures
- Groundwater recharge measures
- Crop planning: soil health assessment; water-efficient crops; efficient cropping practices (e.g. SRI)
- Field demonstrations
- Income optimization scenarios
- Capacity building of stakeholders

IWRM Plan at District Level?

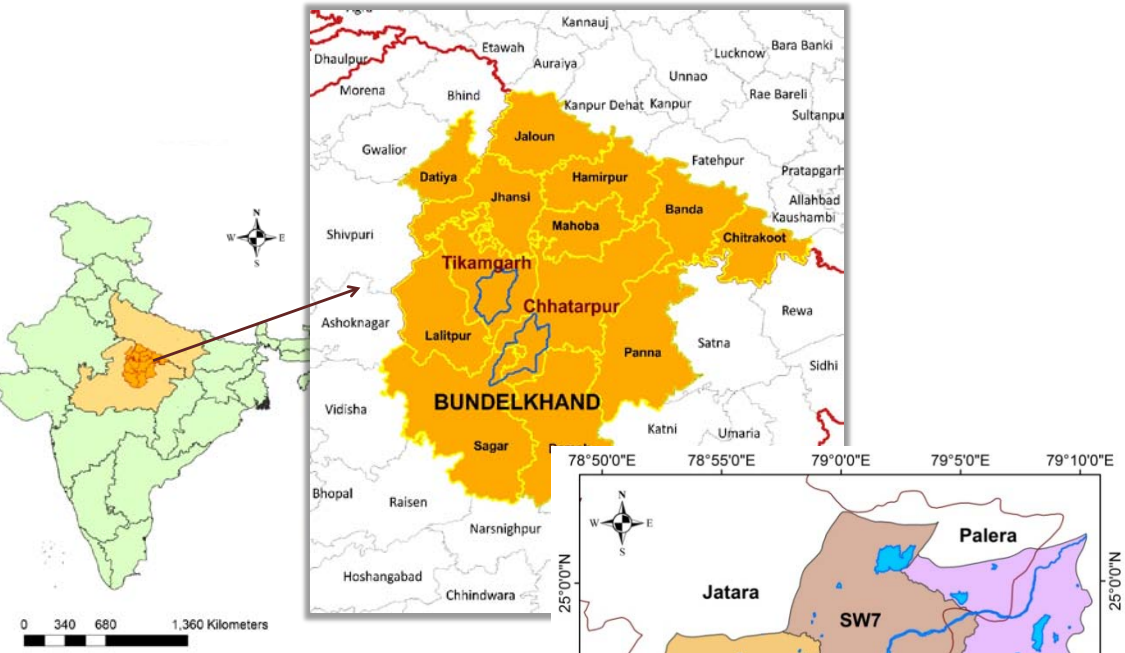
- All federal and State government funding is available at districts
- District is the administrative unit where implementation is planned
- “Integration” is best possible at district level (DC/DM is the single authority)
- Conflicts are less/avoidable
- Identified needs are better addressed according to availability of resources
- Institutional frameworks and management instruments are feasible
- Stakeholders’ participation is feasible
- “Local/light” IWRM can be adapted as per felt needs
- Upscaling to basin level or downscaling to village government level is possible & feasible

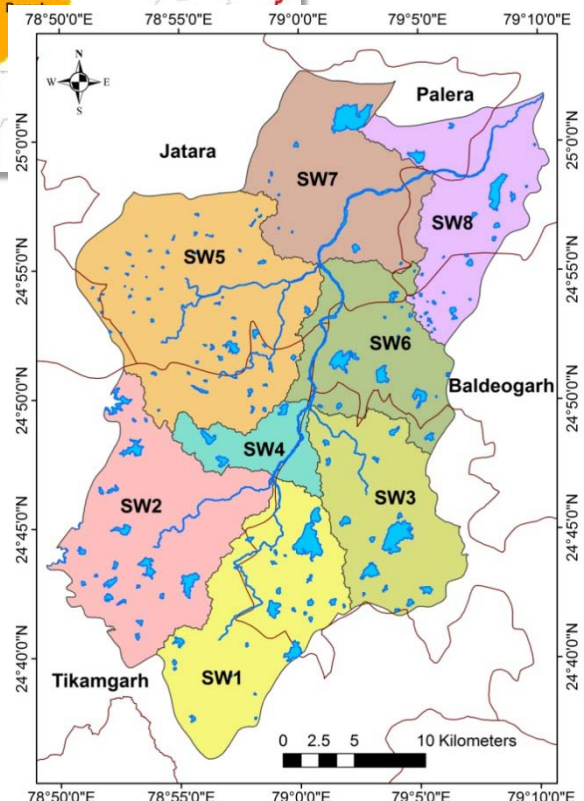
Stages of IWRM Plan (IP) Development

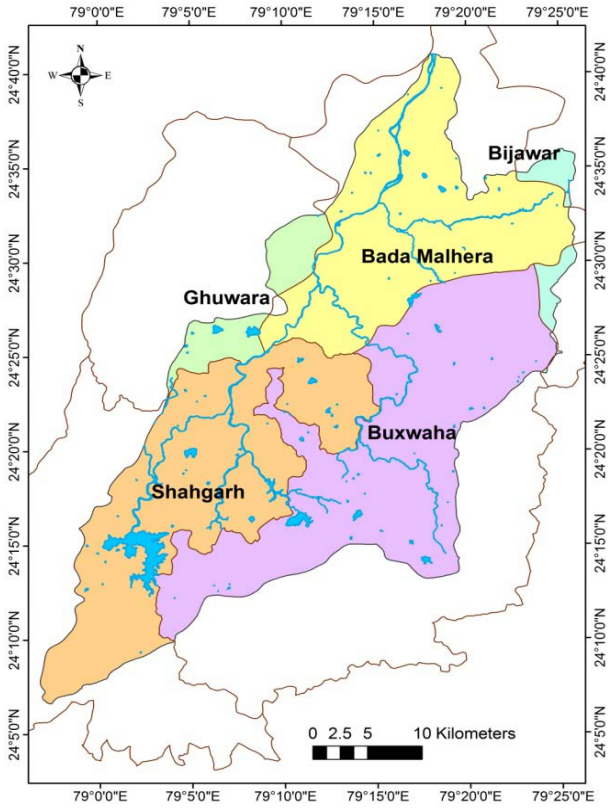
1. Stakeholders' consultation-1: identification of needs
2. Development of IP modules by GIS/IT professionals
3. Creation of database (thru secondary sources and field surveys)
4. Data analysis & interpretation by specialists
5. Field verification of suitable WH sites & structures
6. Pilot field demonstrations of BMPs
7. Documentation
8. Stakeholders' consultation-2: Draft IP is shared & suggestions obtained
9. Capacity building and awareness creation activities
10. Stakeholders' consultation-3: Handover of IP to district authorities
11. Handholding of district authorities for IP implementation

A Case Study from Bundelkhand

Study watersheds in Bundelkhand, India







Situation Analysis of Livelihood

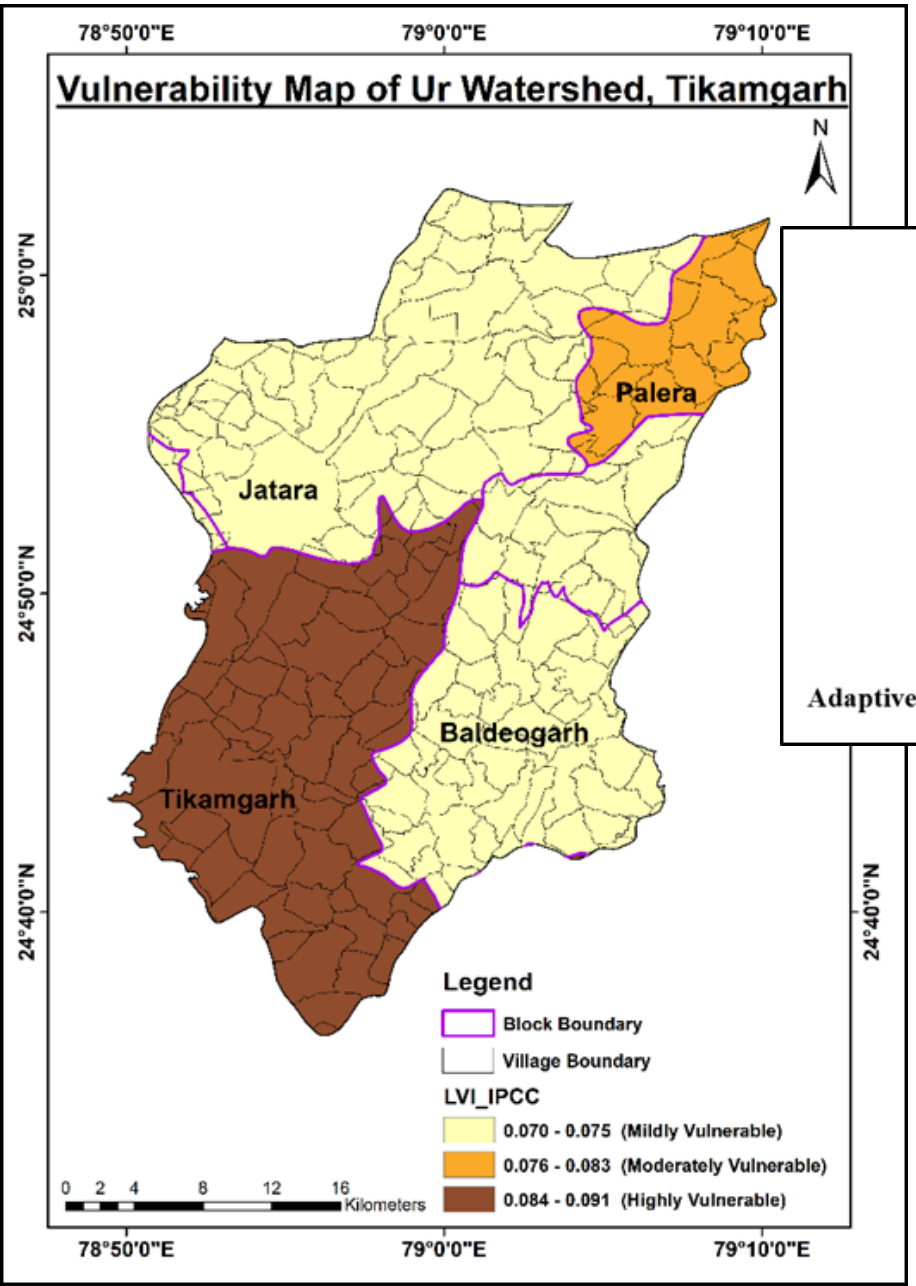
Acute water shortage

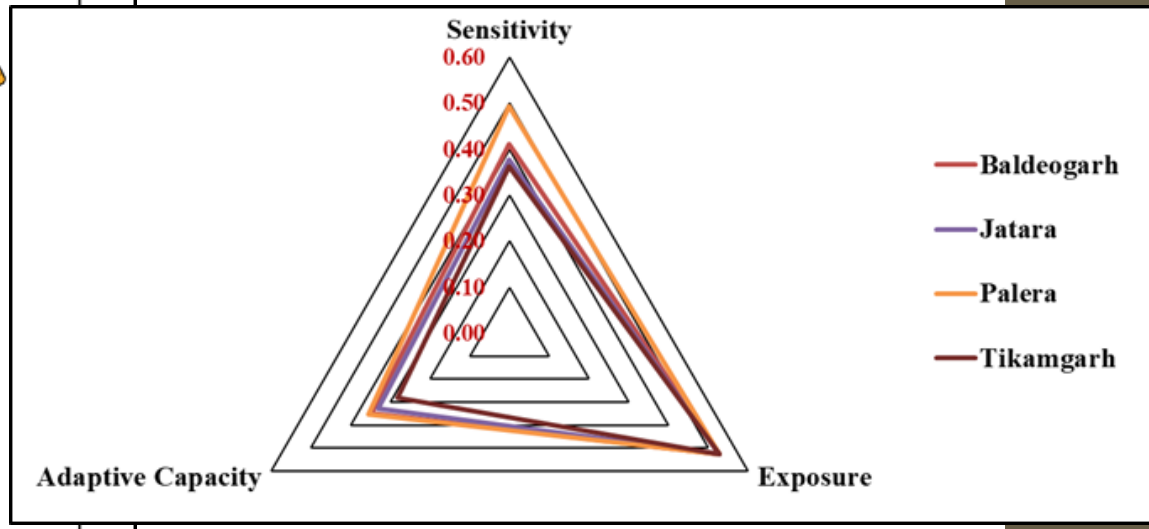
Decreasing agricultural production

Poverty issues

Rising socio-economic issues

Livelihood Vulnerability





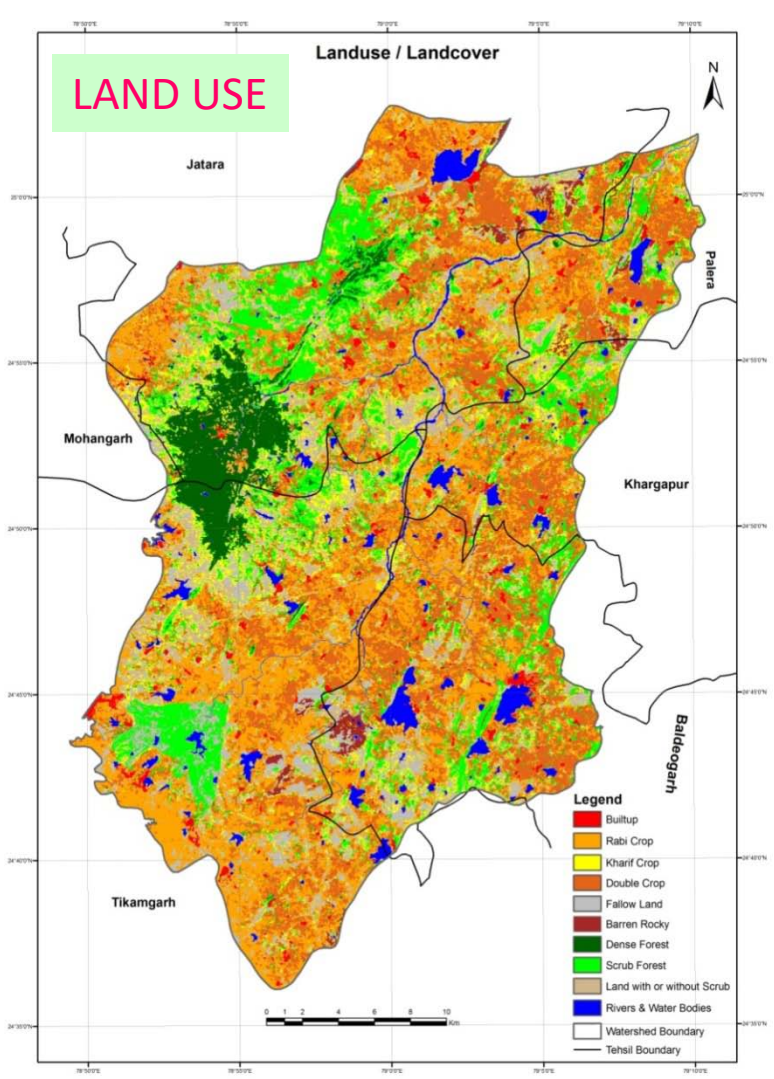
Tikamgarh > Palera > Jatara > Baldeogarh

Identified Problems

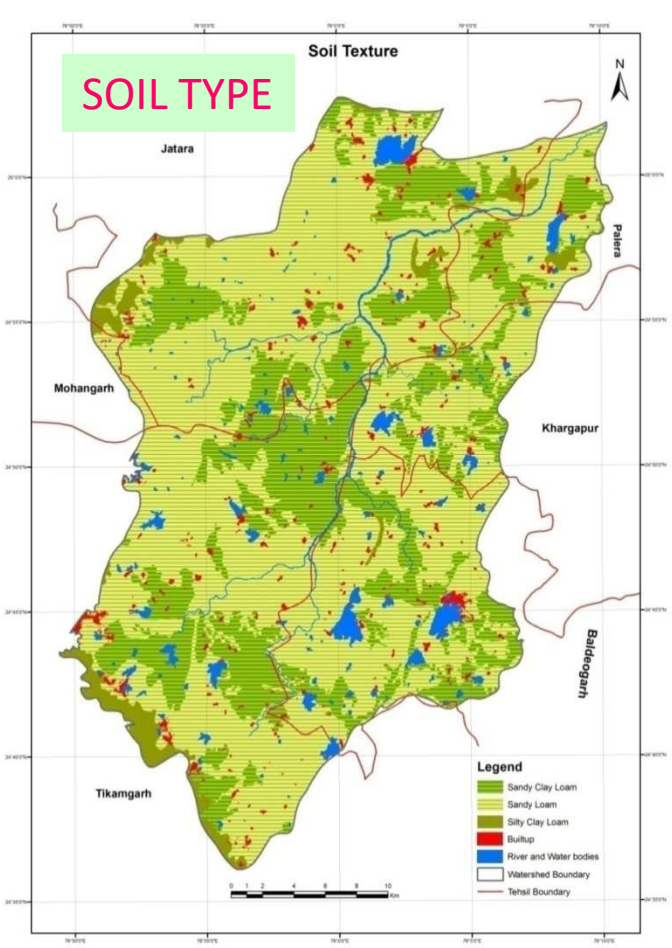
- Low income diversification
- Low Income , High Expenditure
- High Migration
- Low Crop Productivity
- Scarcity of Water Resources
- Electricity Issues
- Less health infrastructures
- Sanitation and Health problems
- Livestock Health Issues

Stakeholders Consultation

LAND USE



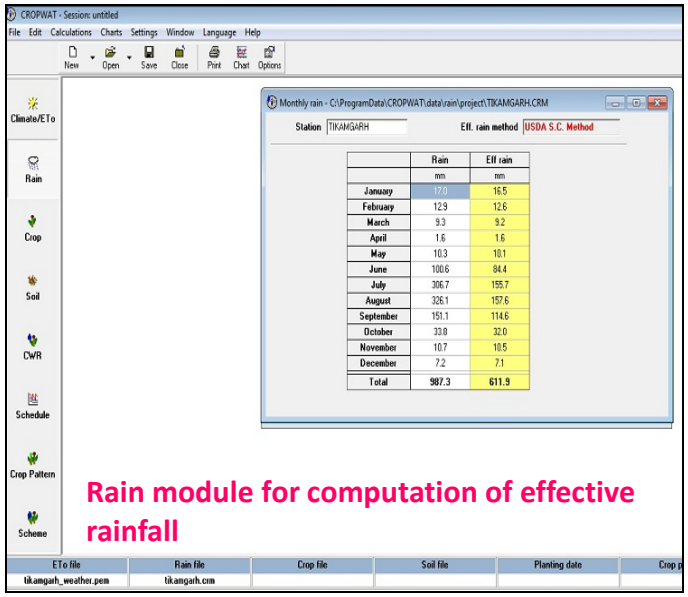
SOIL TYPE



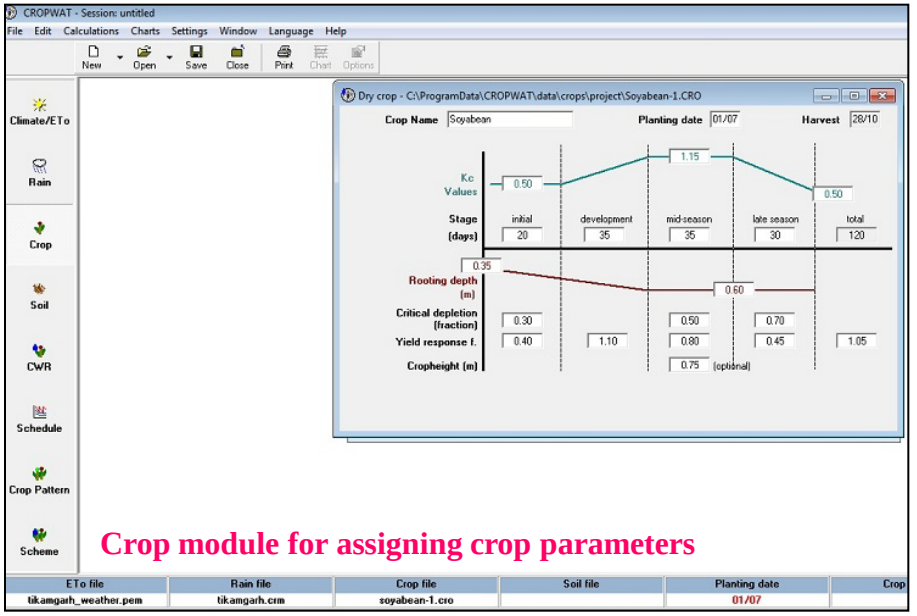
Class	Area in km2	Area In %
Built-up	19.97	2.02
Kharrif Crop	104.37	10.54
Rabi Crop	246.14	24.85
Double Crop	230.10	23.23
Fallow Land	69.25	6.99
Scrub Forest	131.18	13.25
Dense Forest	44.56	4.50
Rivers & Water Bodies	34.47	3.48
Barren Rocky	11.17	1.13
Land with or without Scrub	99.38	10.03

Soil type	Area (km^2)	Area in (%)
Sandy clay loam	266.38	28.53
Sandy loam	635.46	68.05
Silty clay loam	31.98	03.42

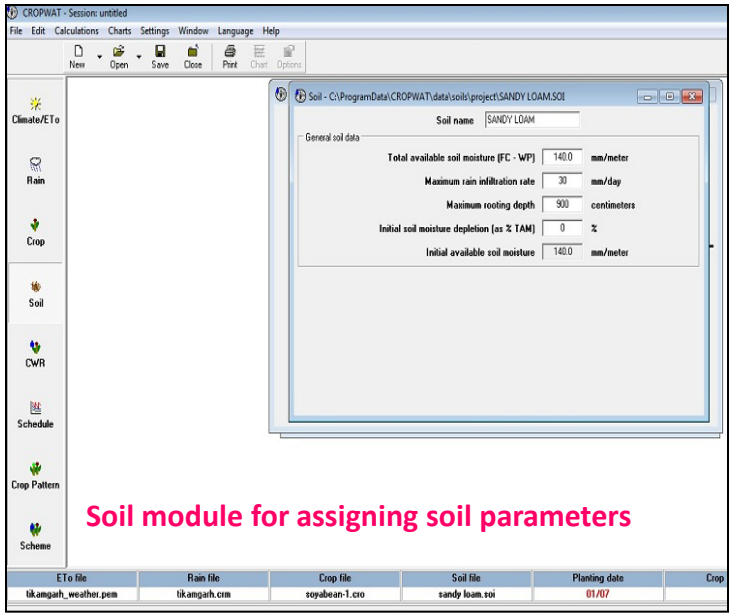
Estimation of crop water requirements



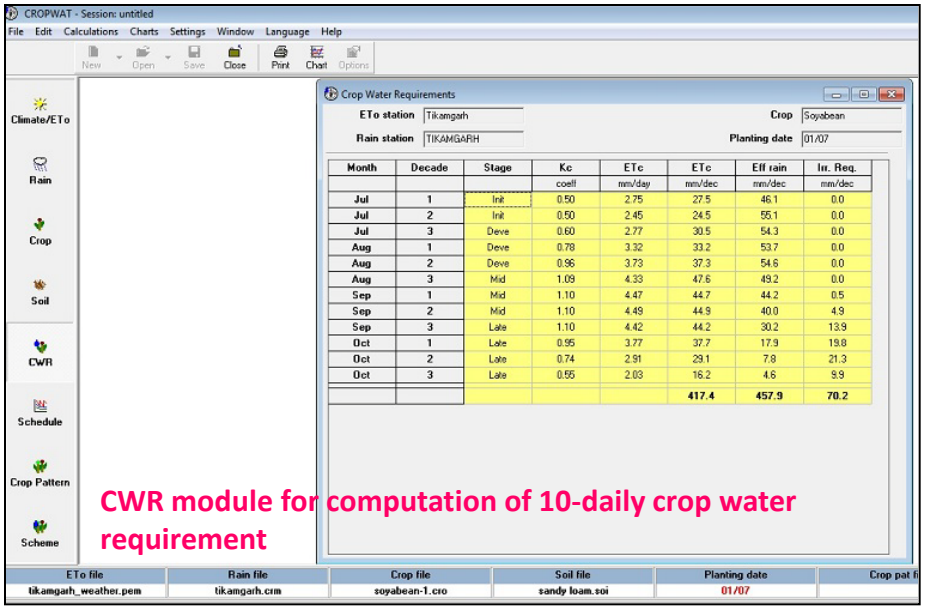
Rain module for computation of effective rainfall



Crop module for assigning crop parameters

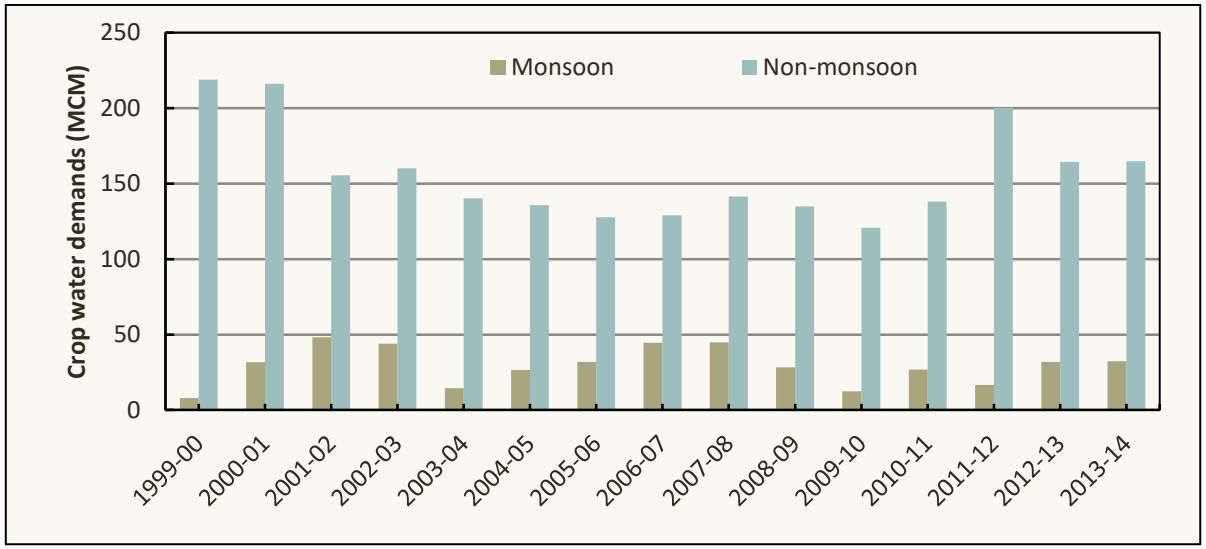


Soil module for assigning soil parameters

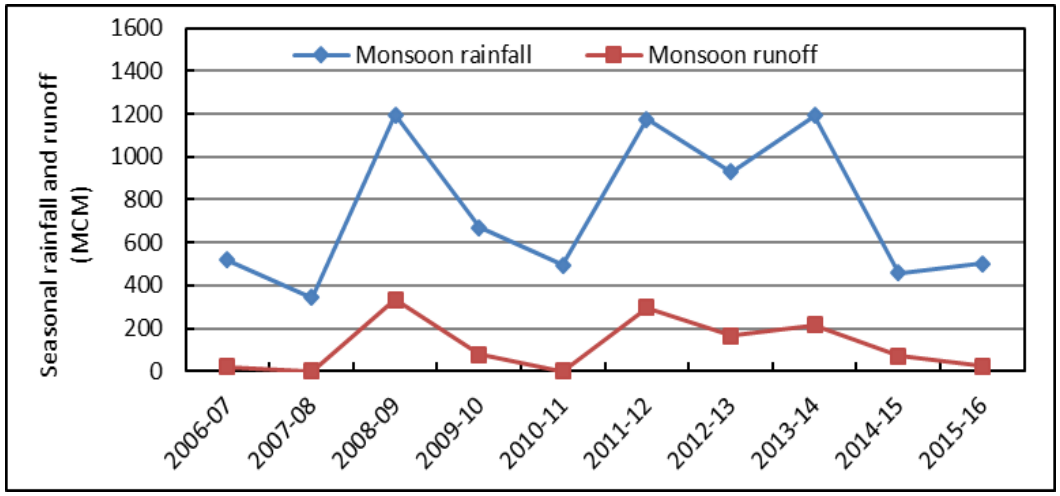


CWR module for computation of 10-daily crop water requirement

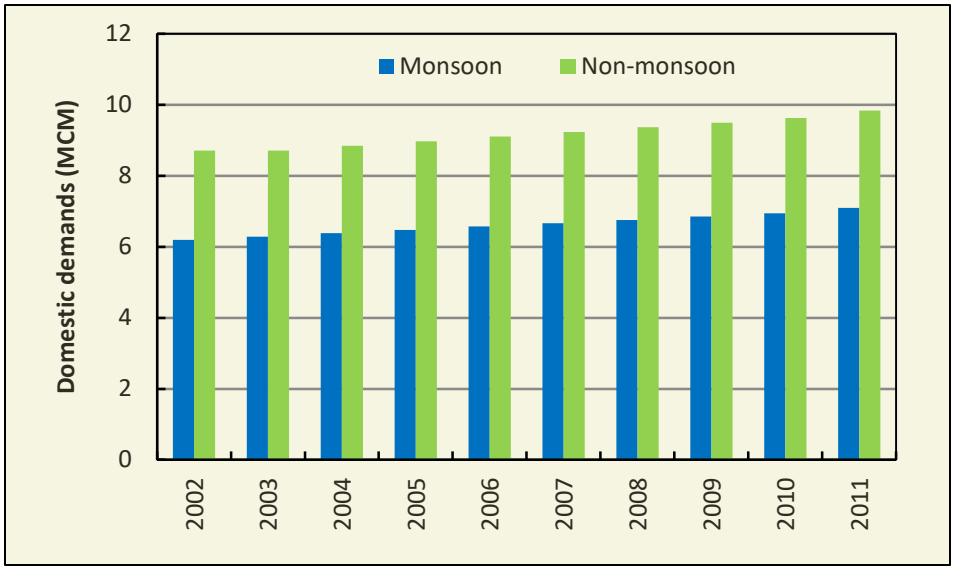
Agricultural Demands in monsoon and non-monsoon season



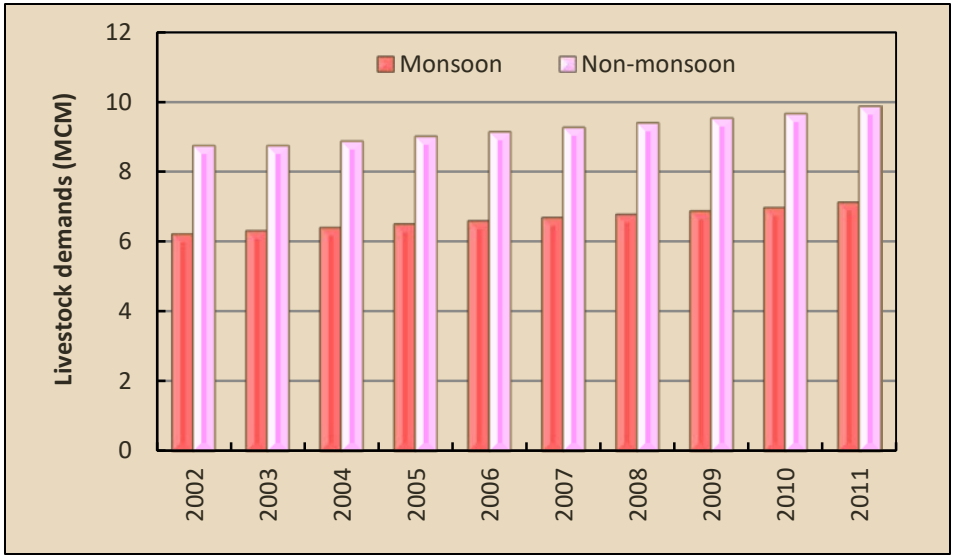
Comparison of seasonal rainfall and runoff in Ur river watershed



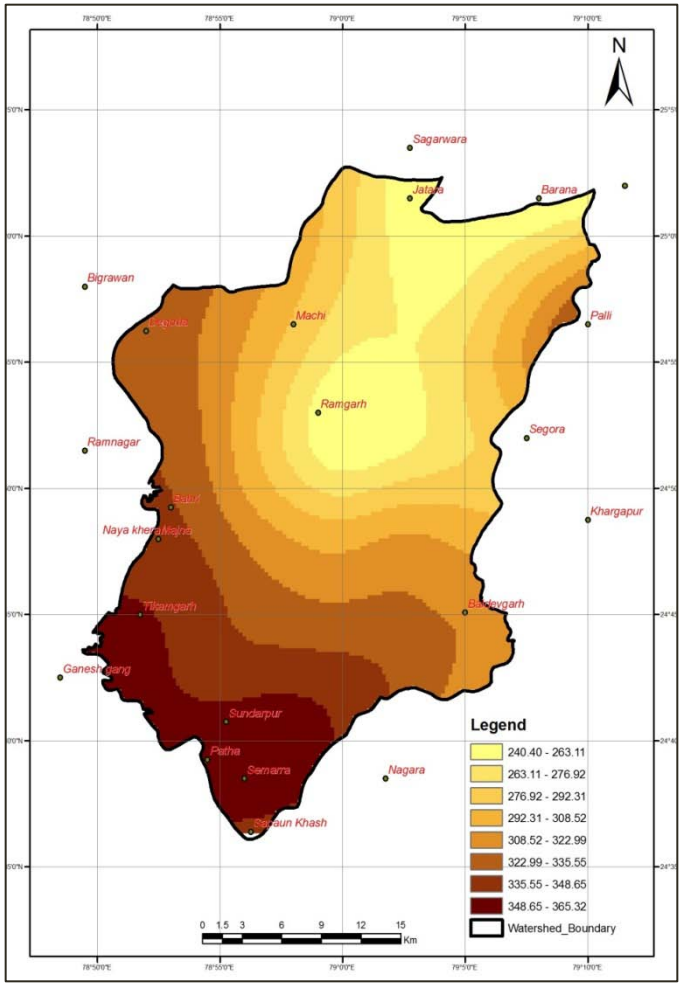
Domestic water demands



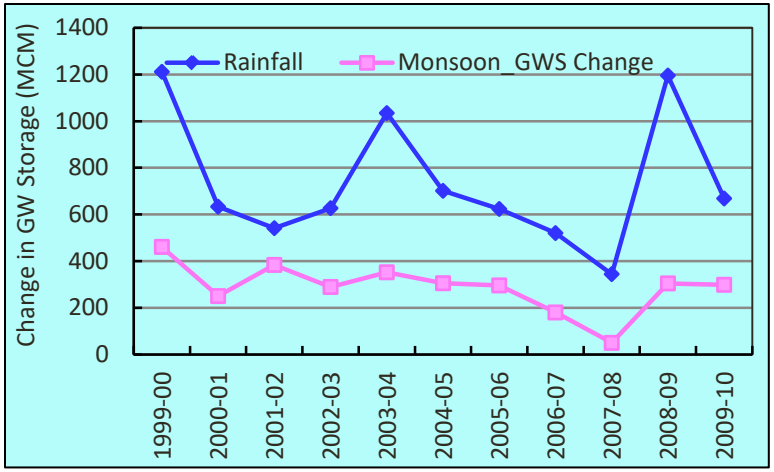
Livestock water demands



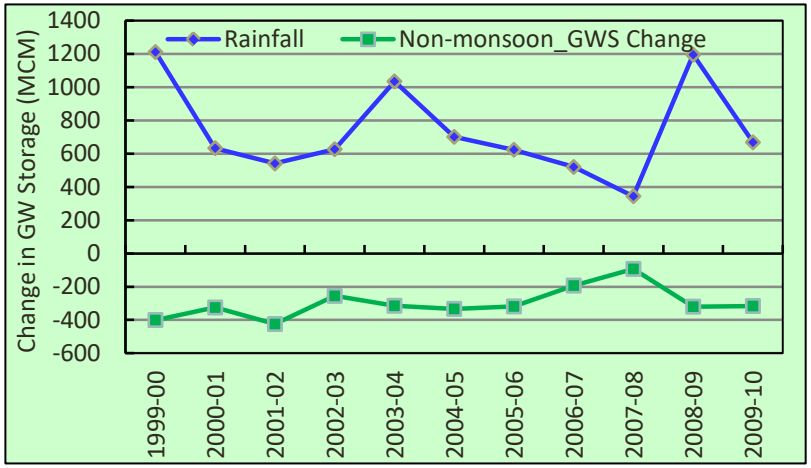
Groundwater level (Nov. 2005)



Change in GW storage (Monsoon)



Change in GW storage (Non-Monsoon)



Water Budget {जल बजट} (2002-03)		
Inflows	**Monsoon**	**Non-monsoon**
Rainfall (2002-03 mean areal)	627.01	25.54
Groundwater inflow	0.068	0.081
Outflows		
Domestic (135 L/C/day) census-2011	6.192	8.711
Livestock (40 L/C/day census-2007	1.736	2.405
Agriculture demand	43.90	160.24
Surface runoff	108.52	0.00
Forest	126.58	149.64
Evaporation from tanks	1.99	2.05
Groundwater outflow	0.034	0.045
Change in Storage		
Change in Storage (GW)	289.24	-255.07
Change in Storage (SW)	33.69	-33.51
Unaccounted water	15.19	-8.90
Percentage Error	2.42	

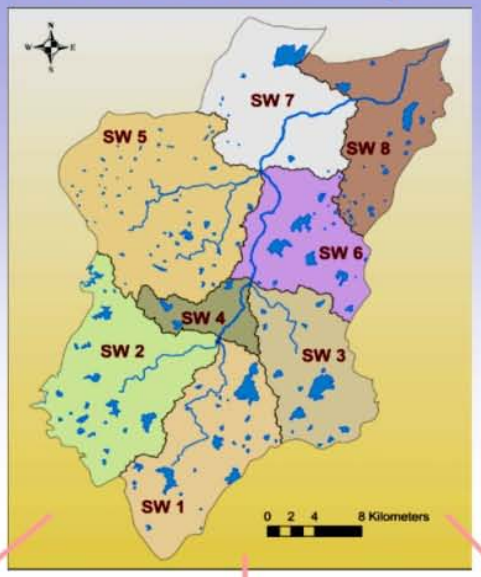
Units in MCM

IWRM Plan for Ur River Watershed

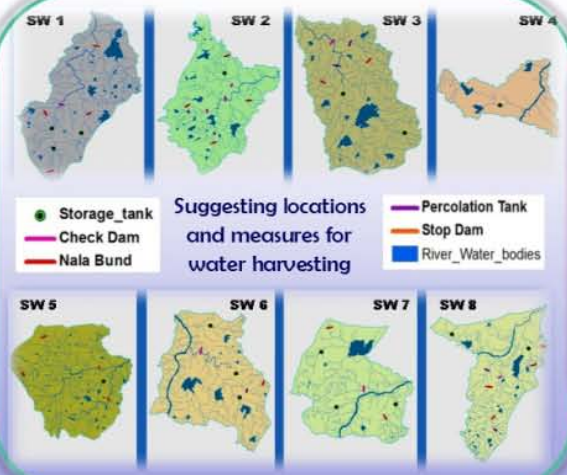
IWRM Plan for Ur River watershed in Tikamgarh district of Madhya Pradesh

Integrated Water Resources Management PLAN

A process of promoting coordinated development and management of water, land and related resources to sustainably maximize the economic and social welfare



1. Water Management



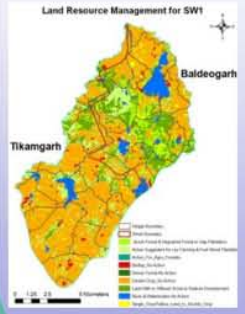
3. Livelihood Management

Identification of the most vulnerable areas and suggesting measures to improve their livelihood

- Promoting Wadi farming through capacity building programs
- Promoting off-farm and non-farm occupations (eg. Poultry farming, pisciculture, bee keeping, handicrafts etc.
- Raising awareness on climate change

2. Land Management

Suggestions regarding land use and agricultural pattern to enhance productivity and maintain soil health



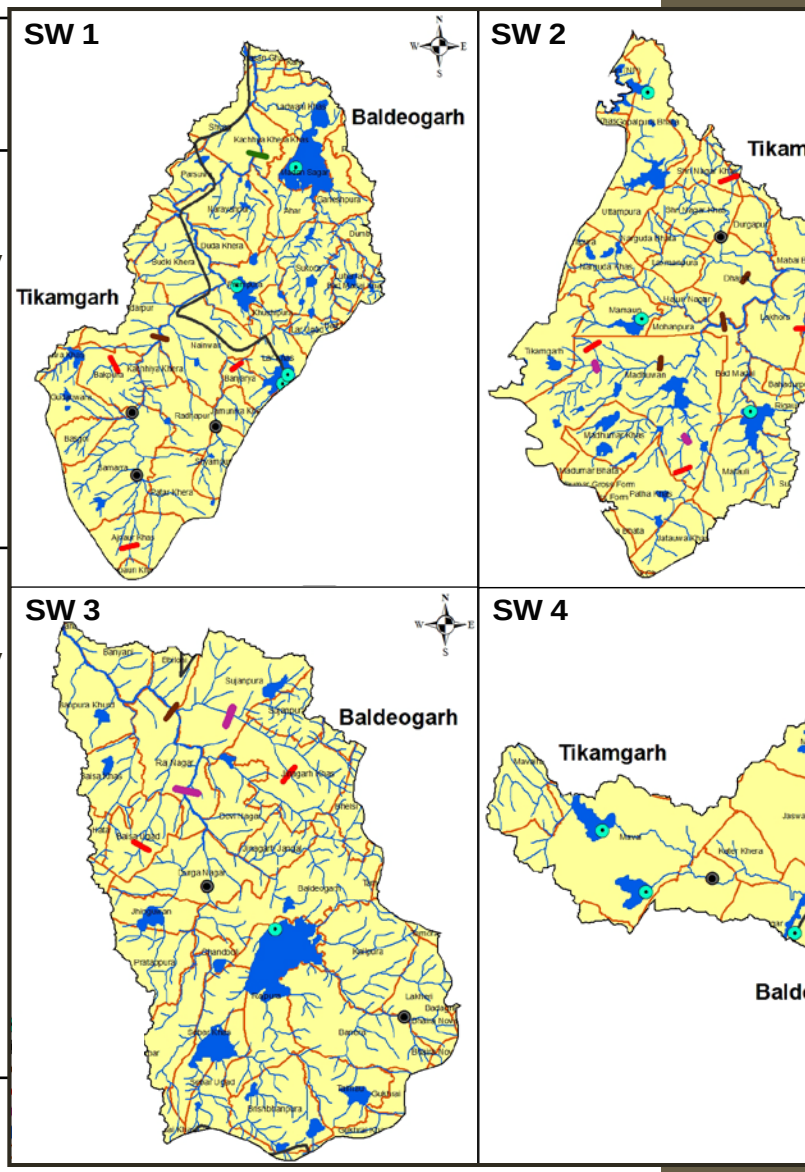
- **Efficient irrigation techniques**
- **Line sowing**
- **Crop diversification**
- **Crop rotation**

SWI, SRI, SCI, WADI (agri-horti model based), drip irrigation etc.

National Institute of Hydrology, Roorkee

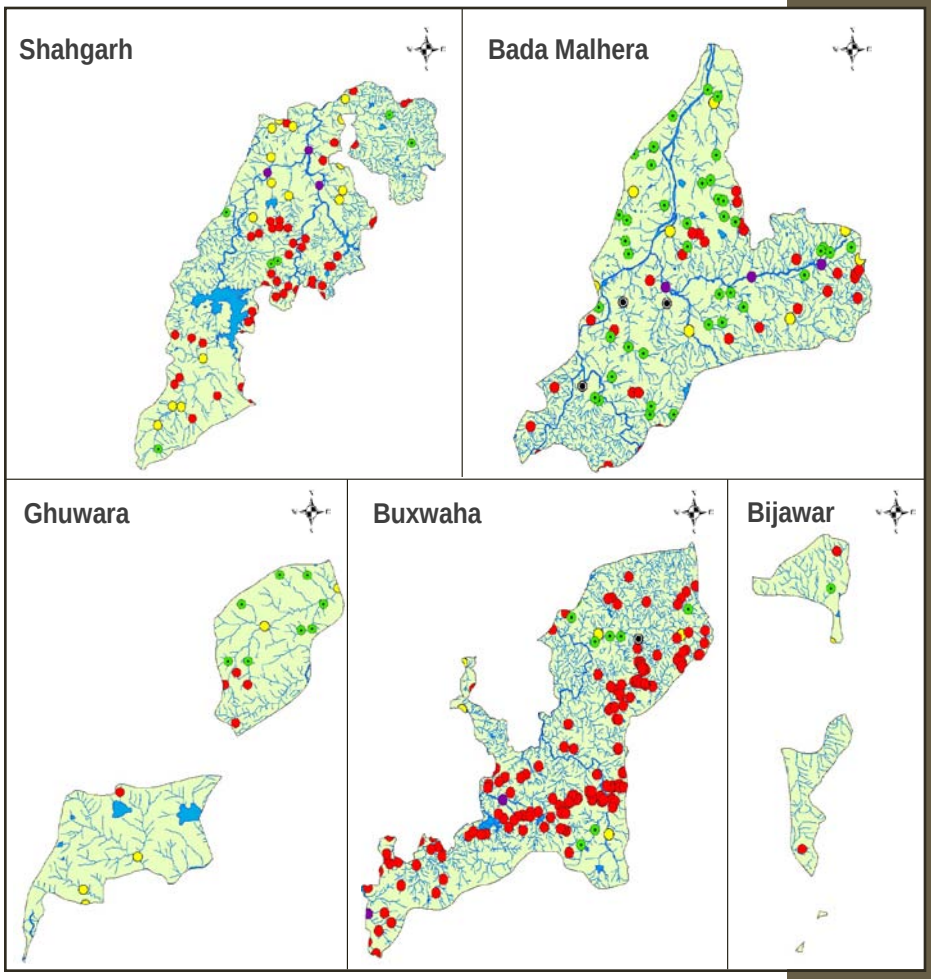
Water Management

Sub-watershed	Domestic/Drinking water demands	Irrigation/Surface water harvesting	Aquifer recharge
SW1	Rooftop rainwater harvesting in all schools, government buildings, hospitals, community centers, and pucca houses	Construction of farm ponds at both individual and community level to support irrigation as well as for surface storage of water Construction of 3 Storage tanks	For groundwater recharge purpose, the following structures may be constructed: 3 Nala bunds 1 Check dam 1 Stop dam
SW2	Rooftop rainwater harvesting for both rural and urban household population. Efficient water distribution system to avoid water loss and wastage Construction of STPs (Sewage Treatment Plants)	Construction of farm ponds in rural area and 1 Storage tank	For groundwater recharge purpose, the following structures may be constructed: 4 Nala bunds 3 Check dams 2 Percolation tanks



Check Dam
Nala Bund
Suitable for fishery
Percolation Tank
Storage Tank
Stop Dam

Block	Domestic/Drinking water demands	Irrigation/Surface water harvesting	Aquifer recharge
Shahgarh	Rooftop rainwater harvesting Efficient water distribution system to avoid water loss and wastage Construction of STPs (Sewage Treatment Plants)	Construction of 6 Farm Ponds at both individual and community level to support irrigation as well as for surface storage of water	For groundwater recharge purpose, 42 Gabion Structures 16 Percolation Tanks and 3 Check Dams may be constructed. Injection wells to recharge the aquifers through filter-pit design
Bada Malhera	Rooftop rainwater harvesting Efficient water distribution system to avoid water loss and wastage Construction of STPs (Sewage Treatment Plants)	Construction of 40 farm ponds and 4 storage tanks to support surface water harvesting	For groundwater recharge purpose, 26 Gabion Structures 7 Percolation Tanks and 3 Check Dams may be constructed. Injection wells to recharge the aquifers through filter-pit design



Land Management

<table>
<tr><th>Water Efficient Irrigation Technologies and Practices</th><th colspan="2">Crop Rotation</th></tr>
<tr><td>SRI (System of Rice Intensification) for Rice</td><td colspan="2" rowspan="3">Rice→Cowpea→Blackgram→Chili/Garden Pea→ Rice

Groundnut→Cowpea→Rice→Wheat→Groundnut

Soybean→Wheat→Blackgram→Mustard→Soybean</td></tr>
<tr><td>SWI (System of Wheat Intensification) for Wheat</td></tr>
<tr><td>SCI (System of Crop Intensification) for Maize, Sorghum, Mustard, Blackgram</td></tr>
<tr><td>Drip Irrigation for high value vegetable and fruit crops</td><td colspan="2">Crop Diversification</td></tr>
<tr><td>Irrigation at critical stages for Wheat (including crown root initiation and flowering stage), Soybean</td><td>Kharif</td><td>Rabi</td></tr>
<tr><td>Wadi (Agri-Horti based model) for fruit and vegetable crops</td><td>Maize + Blackgram + Groundnut + Maize + Okra + Pigeon Pea</td><td>Gram + Wheat + Chili/ Garden Pea + Mustard + Cowpea + Gram</td></tr>
<tr><td colspan="3">Line Sowing for crops such as Soybean, Blackgram, Groundnut, Rice, Wheat, Mustard, Maize</td></tr>
</table>

Also suggests areas suitable for:

- Conversion of wasteland
- Double cropping
- Fuelwood plantation
- Gap plantation
- Agro-forestry
- Agri-horti plantation (WADI model)

Livelihood Management

- Utilize locally available resources to create livelihood opportunities that ensure
  - food security and nutrition
  - curb poverty
  - provide sustainable agricultural practices
  - help in combating climate variability and related impacts, etc.
- Conventional livelihood practice has been agriculture, which as a result of climate variability and other crop failure consequences, has resulted in diminishing employment and financial gains
- A focus shift on non-agricultural, employment generating opportunities will help prevent people from migration, which is one of the biggest social challenges these watersheds are currently facing
- Variety of off-farm livelihood activities promoted: poultry, fishing, handicrafts
- Thru training programs livelihood activities related to handicraft, bee keeping, etc. demonstrated to the villagers

Summing Up

- Concept of “Local” IWRM applied to WCM planning in India
- IWRM Plan provides suggestions on activities of (1) water management, (2) land management, and (3) livelihood management
- Provides useful inputs to the District Irrigation Plan (DIP) of the Government, in terms of water supply and demand management synergized with the land management and livelihood improvement
- Advises district government to include water demand management measures to address water security challenges in DIP
- IWRM planning is shown to be a practical tool in district level planning
- Developed through a participatory approach, in consultation with local stakeholders
- Mostly secondary data was used in developing the plan
- Framework can be further downscaled to the village government (GP) level

Way Forward

- SDGs are in the latest monitoring agenda of UN
- India fares poor in the Water Security Index
- Water Security concerns both water quantity and water quality
- IWRM and Water Security are inter-related
- IWRM is a means of achieving water security
- IWRM is linked to sustainable development
- IWRM is not a one-size-fits-all prescription and cannot be applied as a checklist of actions
- IWRM is an iterative process and an adaptive approach
- IWRM is achievable on national, regional and local scales
- IWRM implementation must reflect the area's priorities
- Livelihood is an integral component of IWRM
- At district level, IWRM can be planned through convergence of various schemes

IWRM in practice

IWRM is a means not an end. Case studies are set out to solve particular water-related problems or achieve development goals by looking at water holistically within larger physical and development contexts.