Satellite data based inputs for Irrigation Scheduling for a Narayanpur command area

Project Execution Team:

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Project Director: Dr. V. V. Rao

Webinar Overview

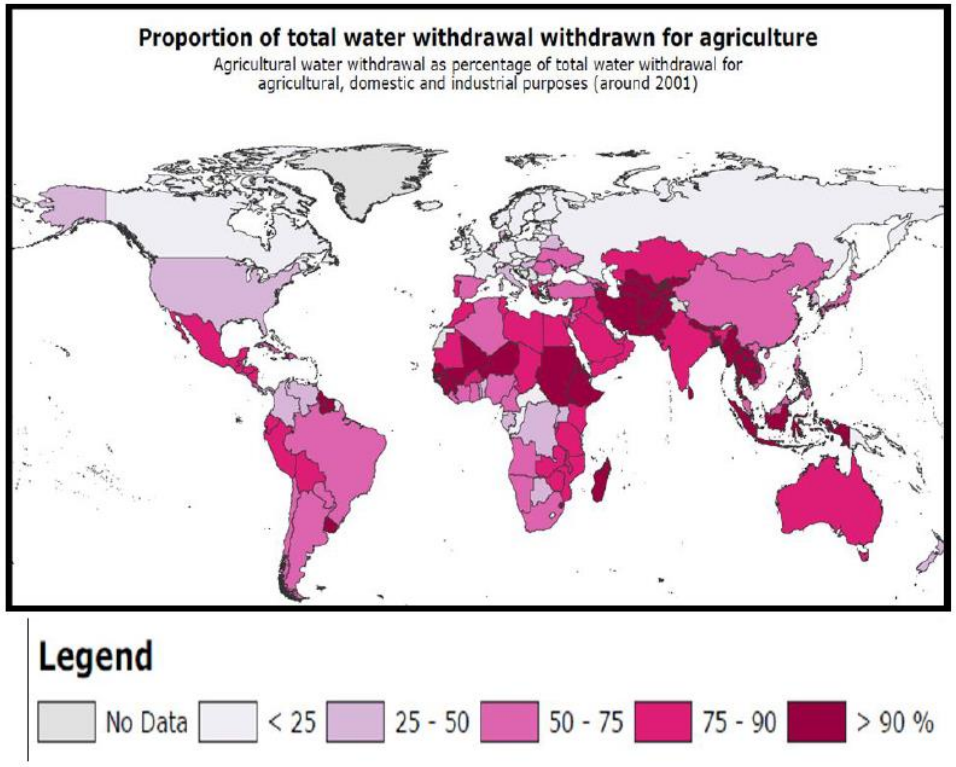
- Role of RS and GIS in irrigation management
- Need for a Decision Support System in irrigation Management
- Scope of soil moisture based irrigation scheduling
- Project Objectives
- Working of Decision Support System
- Crop Map Generation
- Infield Irrigation Requirement Estimation
- Canal Level Irrigation Requirement Estimation
- Experimental Results
  - Rabi Season 2020-2021
  - Kharif Season 2021
- Value Addition to Existing SCADA System
- Way Forward

Role of RS and GIS in irrigation management

- *Irrigation Infrastructure creation status and progress monitoring*
- *In-season crop mapping*
- *Mapping of salt affected and waterlogged areas*
- *Performance Assessment & Monitoring (Seasonal & temporal)*
- *Impact assessment of interventions/developmental projects*

Need for Irrigation Decision Support and Information System

- About 80 % of total water withdrawn is for irrigation in India
- Efficient Irrigation is an effective means to enhance crop productions
- Irrigation water needs to be supplied accurately, taking into account its availability, crop requirement and land size, irrigation systems, and crop productivity and feasibility

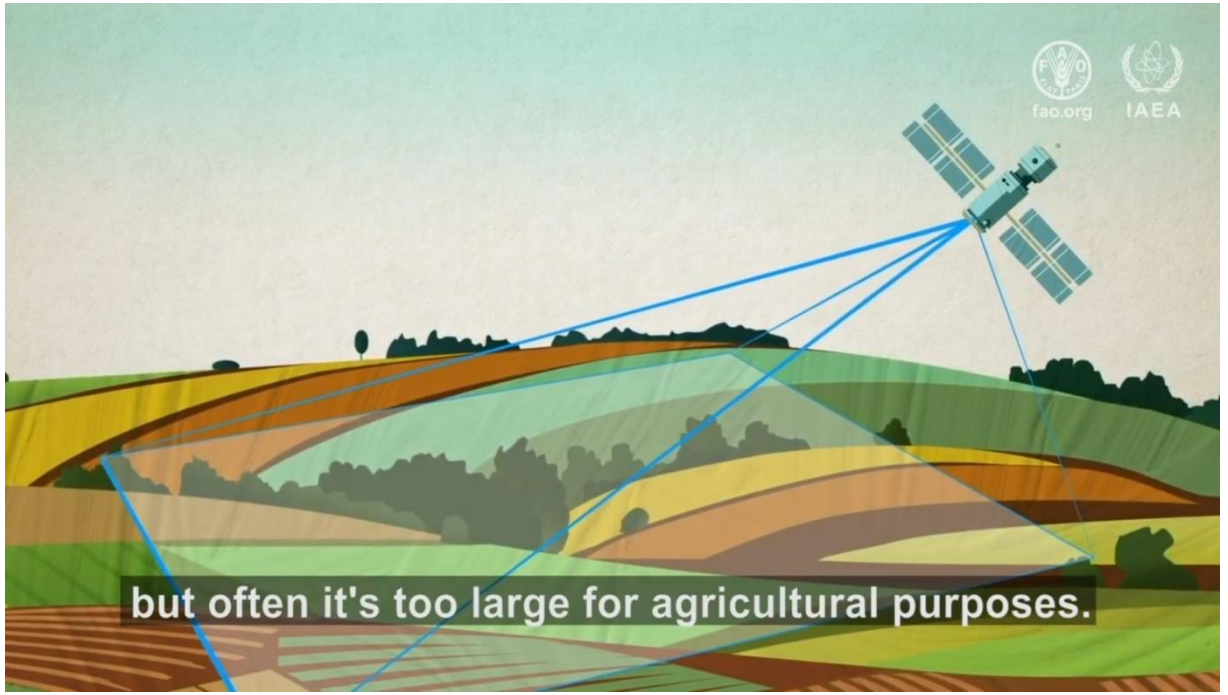


When?

Where?

How much?

Irrigation Decision Support System



Source: FAO

Satellite Data Application in Irrigation Management

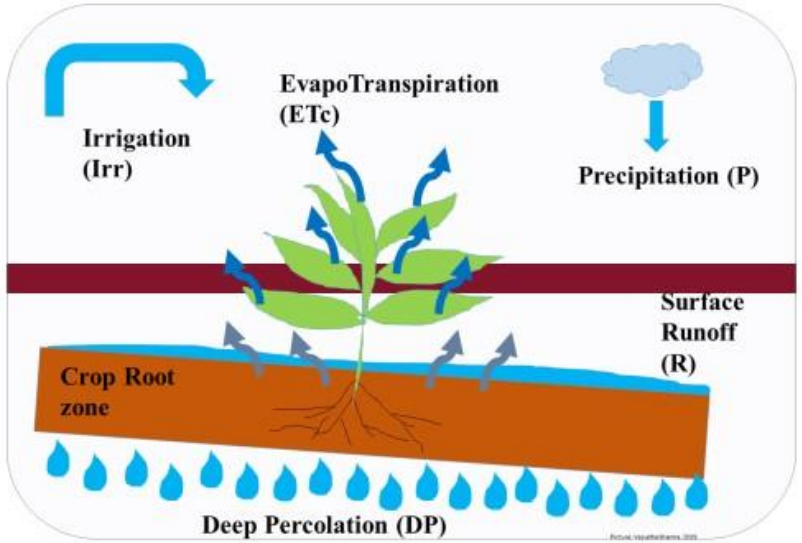


Figure 1. Soil water balance components.

Source: www.farms.com

- Medium Resolution multi spectral /SAR data at high temporal frequency
- Mapping of cropping pattern on a near real time basis through the season
- Soil Water Balance models
- Field irrigation estimation
- Performance Assessment

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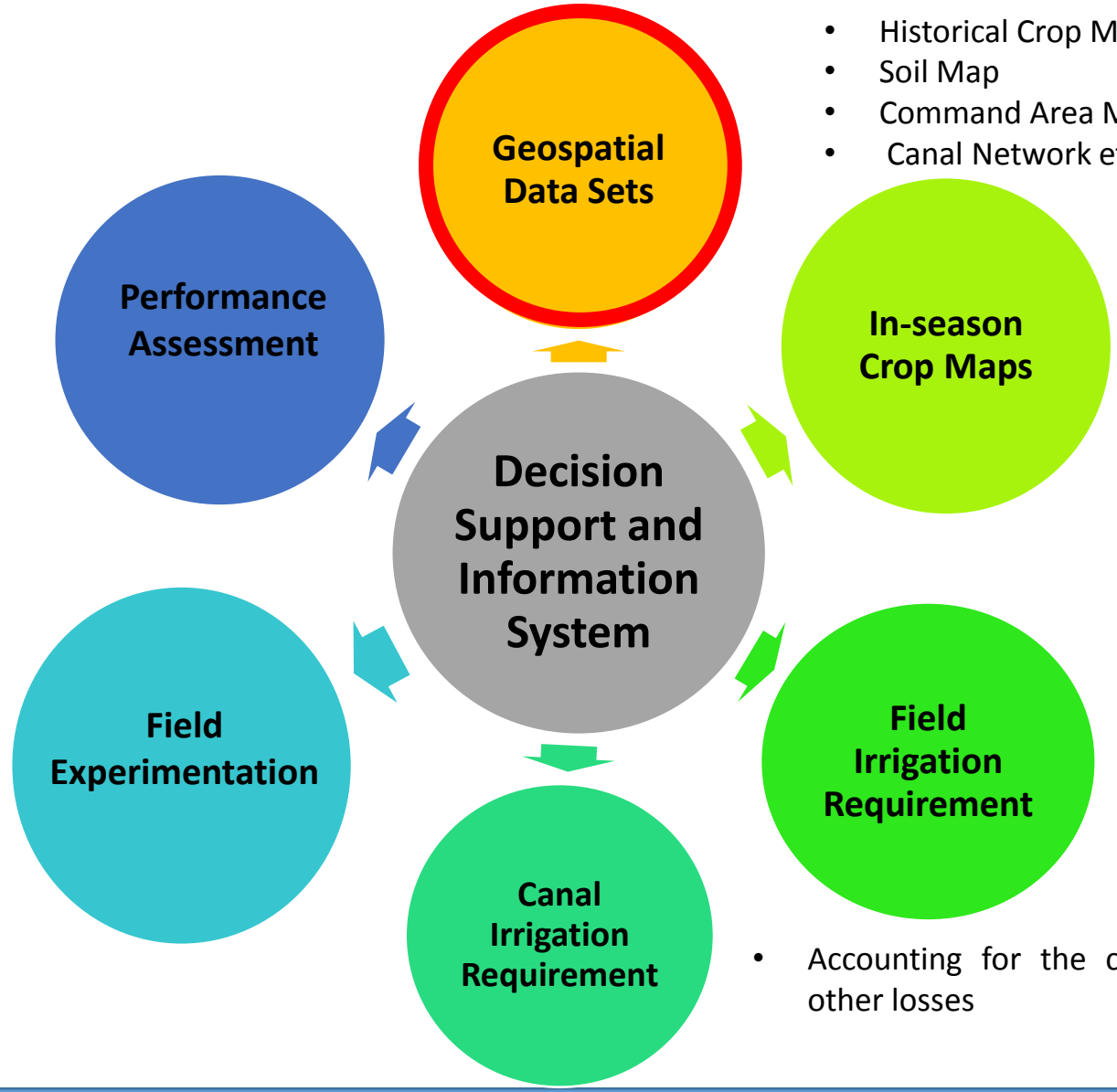
Project Objectives



- Historical Crop Maps
- Soil Map
- Command Area Map
- Canal Network etc.

- Derived from satellite imagery acquired through the season

- For near real time and forecasted meteorological conditions

- Accounting for the conveyance and other losses

- Ground Crop Information
- Canal Information

- Vegetation Index
- Evapotranspiration

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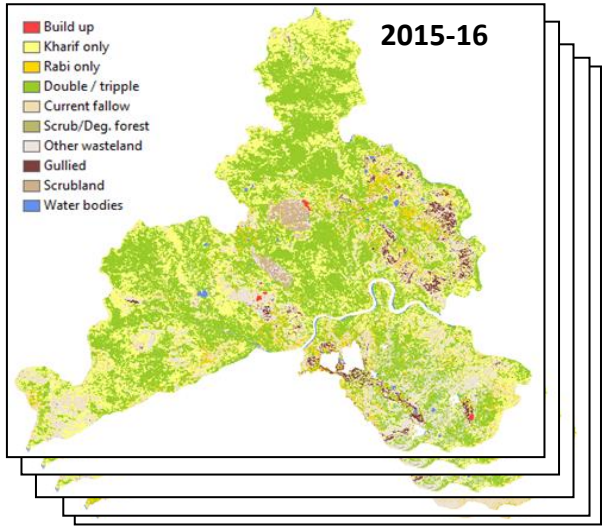
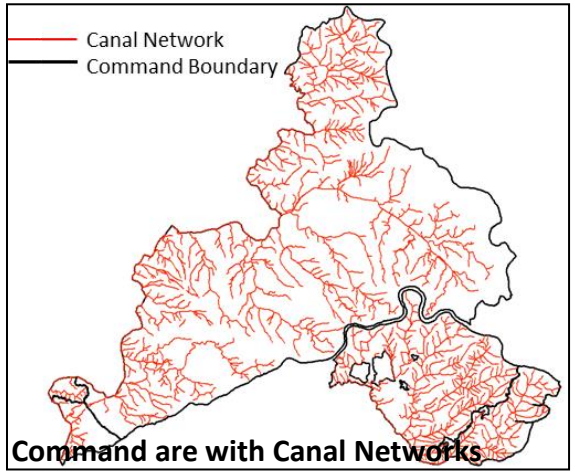
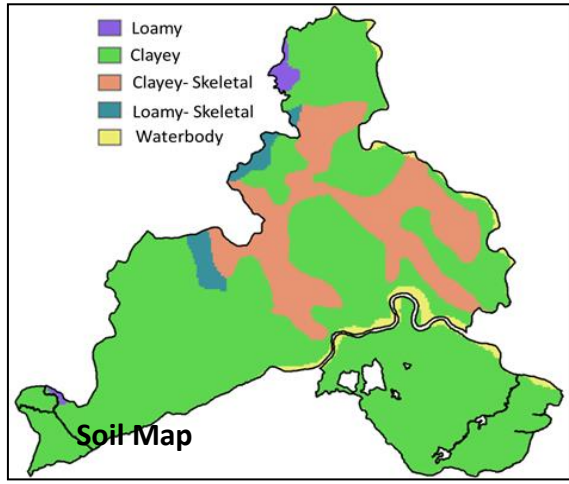
Geospatial Data sets

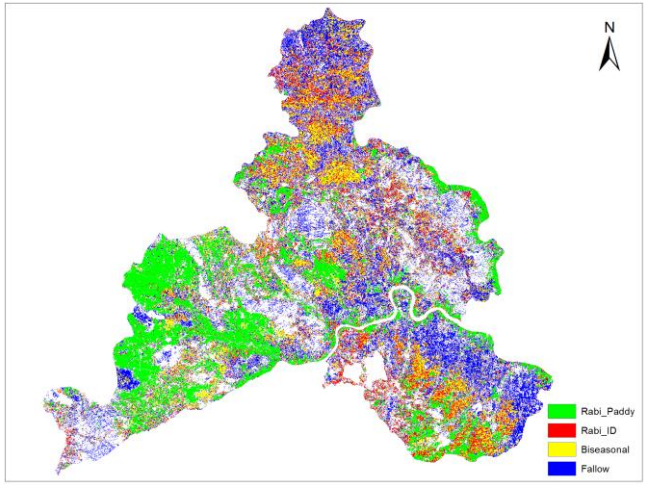
- **Command Area Boundary**
- Total Command
- Branch Canal Level
- Distributary Level
- **Canal Networks**
- Up to Minors
- **Soil Map**
- NBSSLUP : 1:250K
- Karnataka Sate Soil Map: 1:50K
- **Land Use Land Cover Maps**
- NRC LULC 1:250K- 2004-05 to 2018-19
- **Historical Cropping Pattern**
- Kharif and Rabi seasons 2011-12 to 2016-17



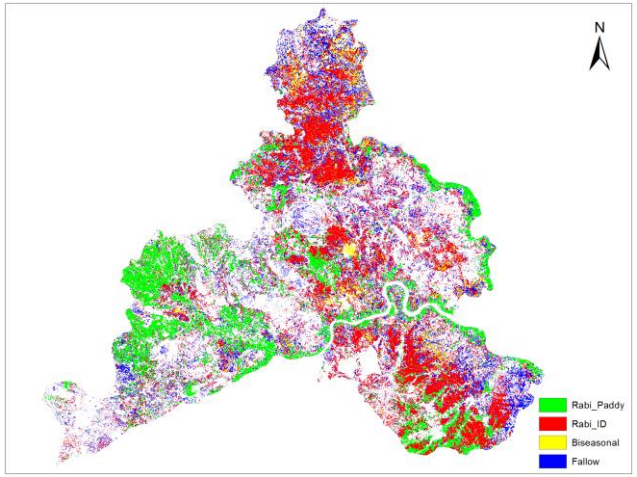
Land Cover Maps : 2004-2016





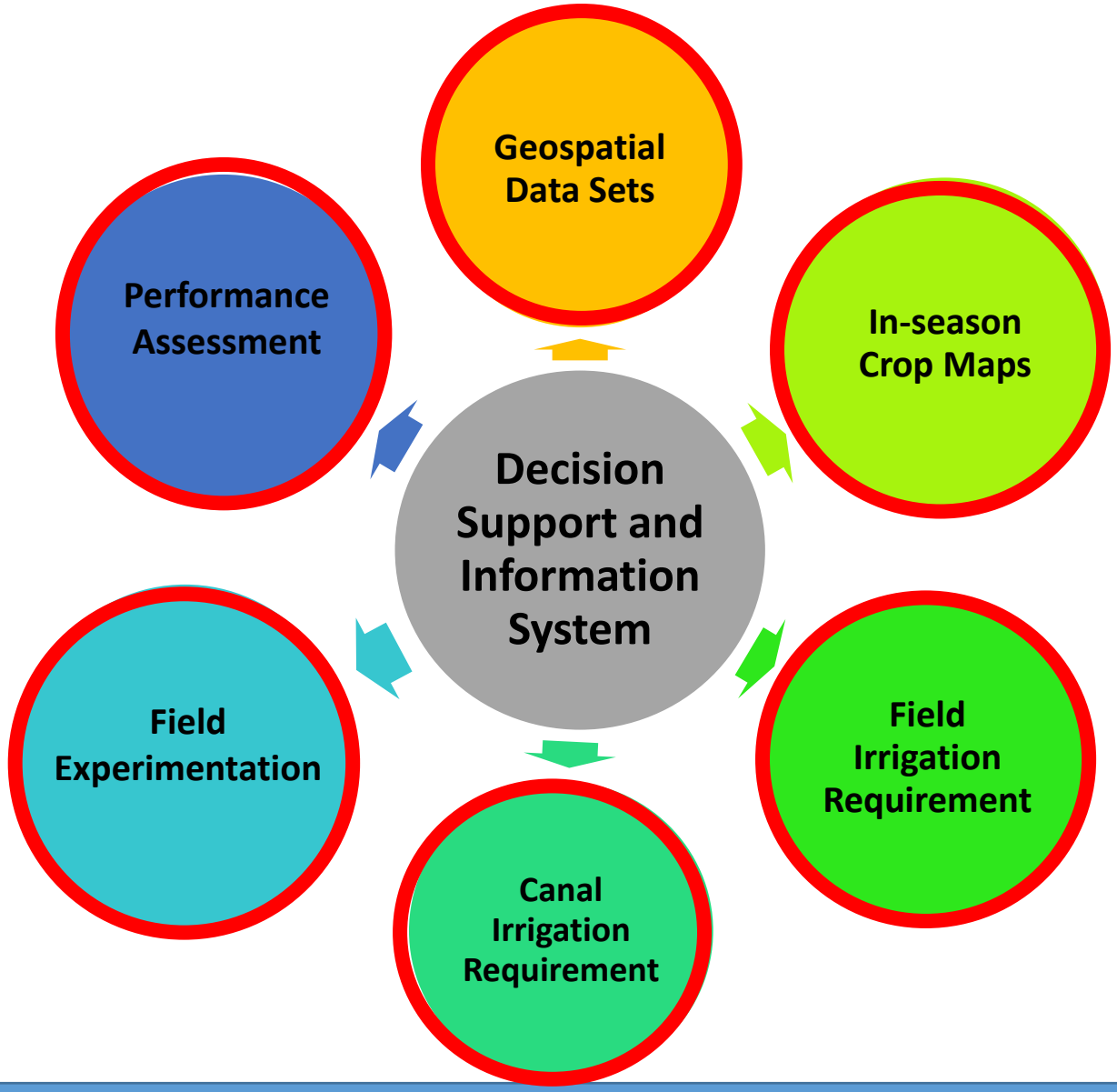


Cropping Pattern 2012-13



Cropping Pattern 2017-18

Project Objectives



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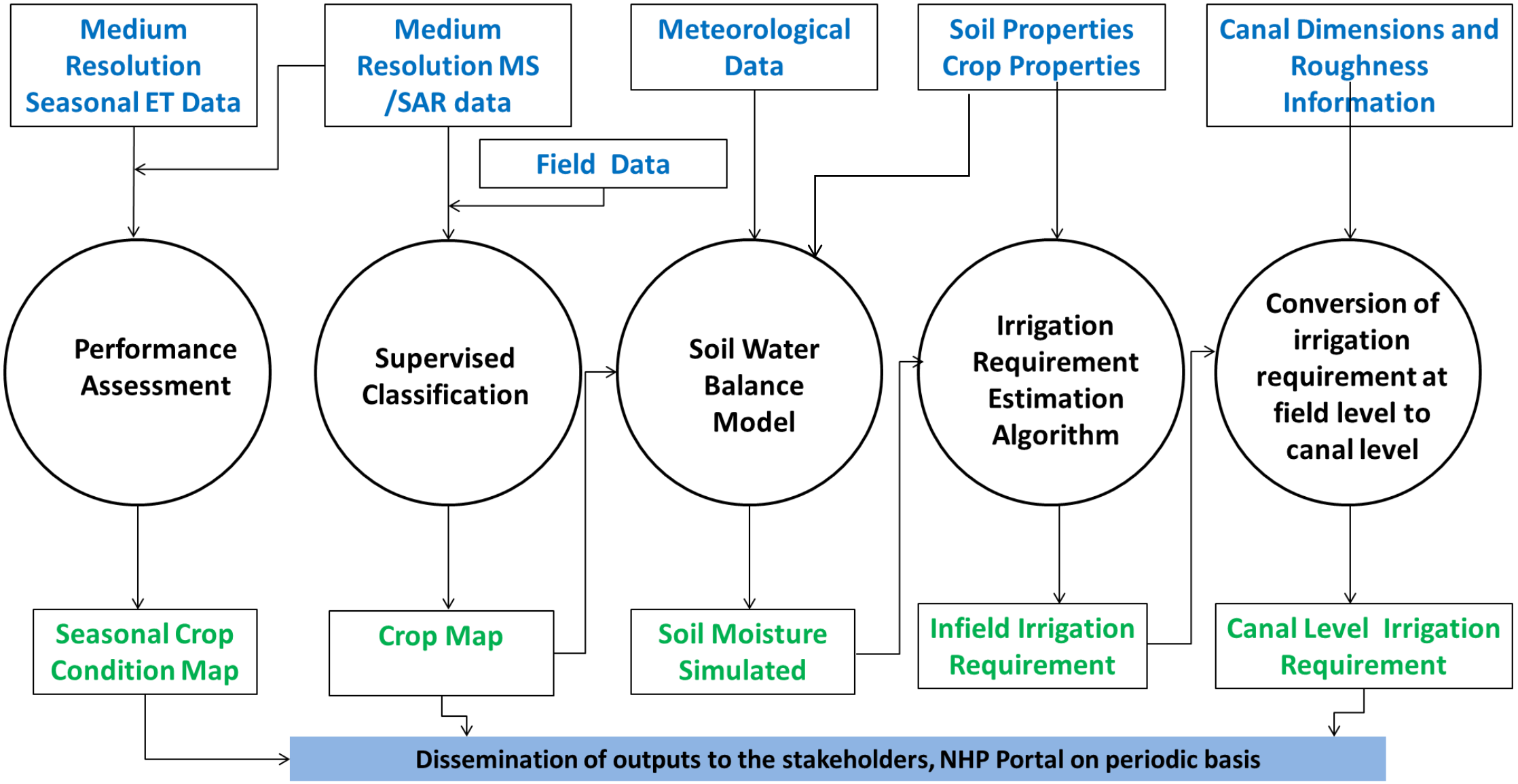
Decision Support and Information System



Satellite data based inputs for Irrigation Scheduling Narayanpur Command Area

Decision Support System Working Timeline

	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16
In- Season Crop Area Assessment	Initiate procurement and processing of in-season satellite images								In-season Cropped Area			Revised In- Season Cropped Area				Crop Condition Map
In- Season/ Forecast Meteorological Data	Weekly rainfall data analysis and spatial rainfall maps published every week															
Field Irrigation Requirement Estimation	Field irrigation requirement estimated for every week based **on historical cropping pattern** for forecasted rainfall conditions								Revised Field irrigation requirement estimated for every week based on **in-season cropping pattern** for forecasted rainfall conditions							
Canal Releases Estimation	Releases estimated for every canal in the system for the estimated for revised FIR and published								Releases estimated for every canal in the system for the estimated for revised FIR and published							
Performance Assessment														System Performance assessed based on crop condition and estimated and actual releases		

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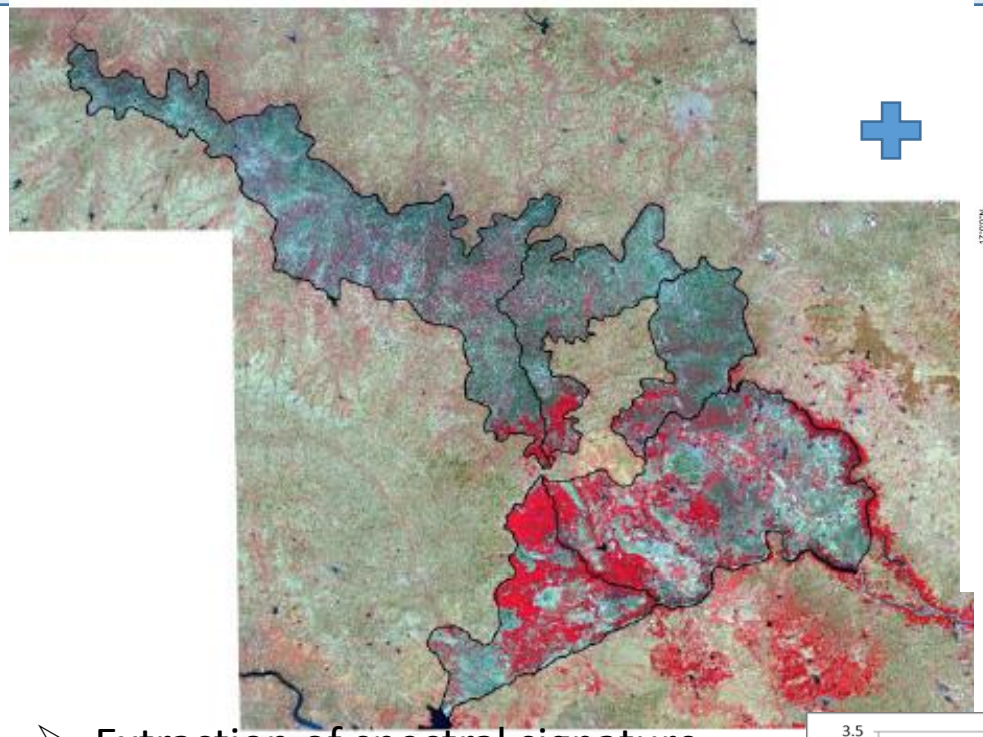
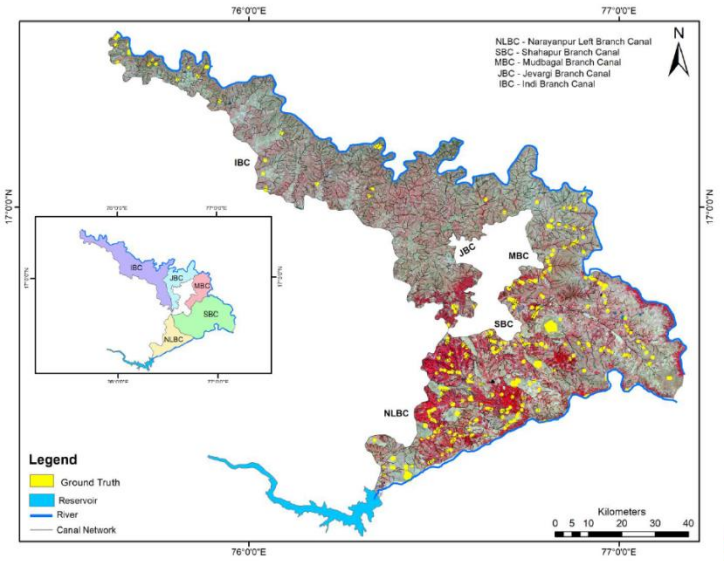
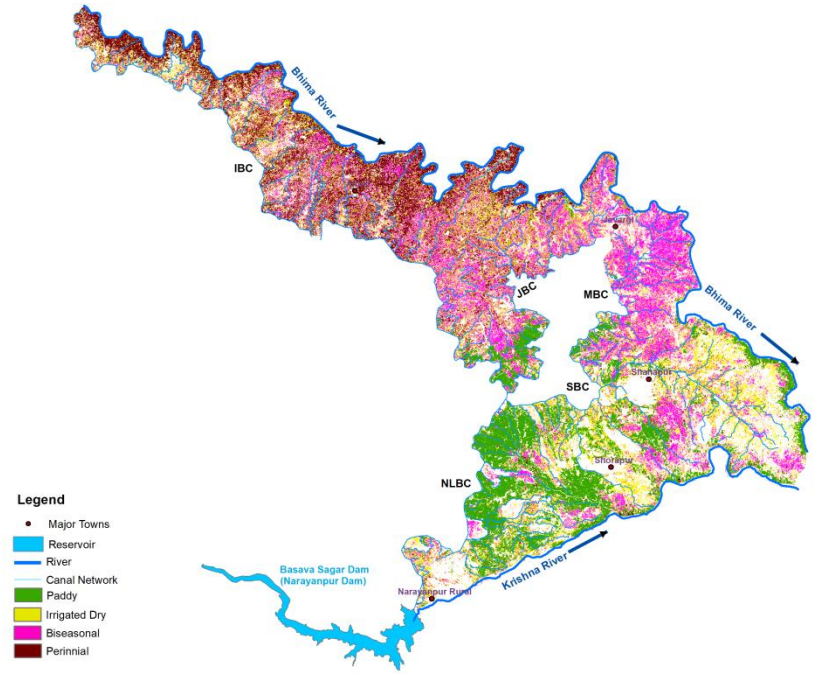
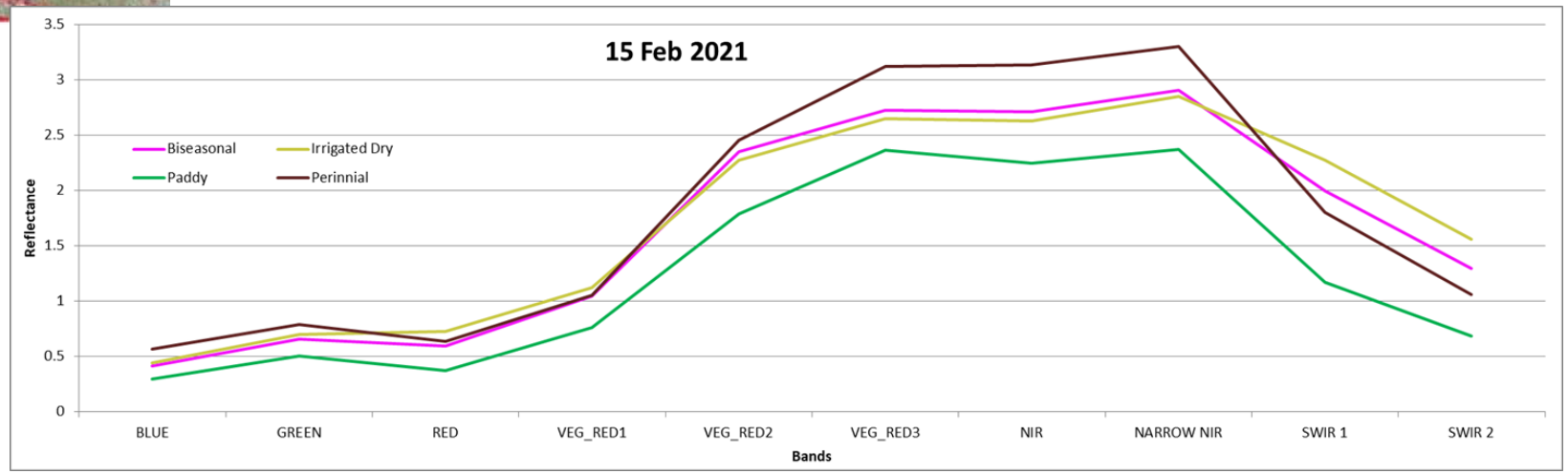
In-season Crop Map Generation





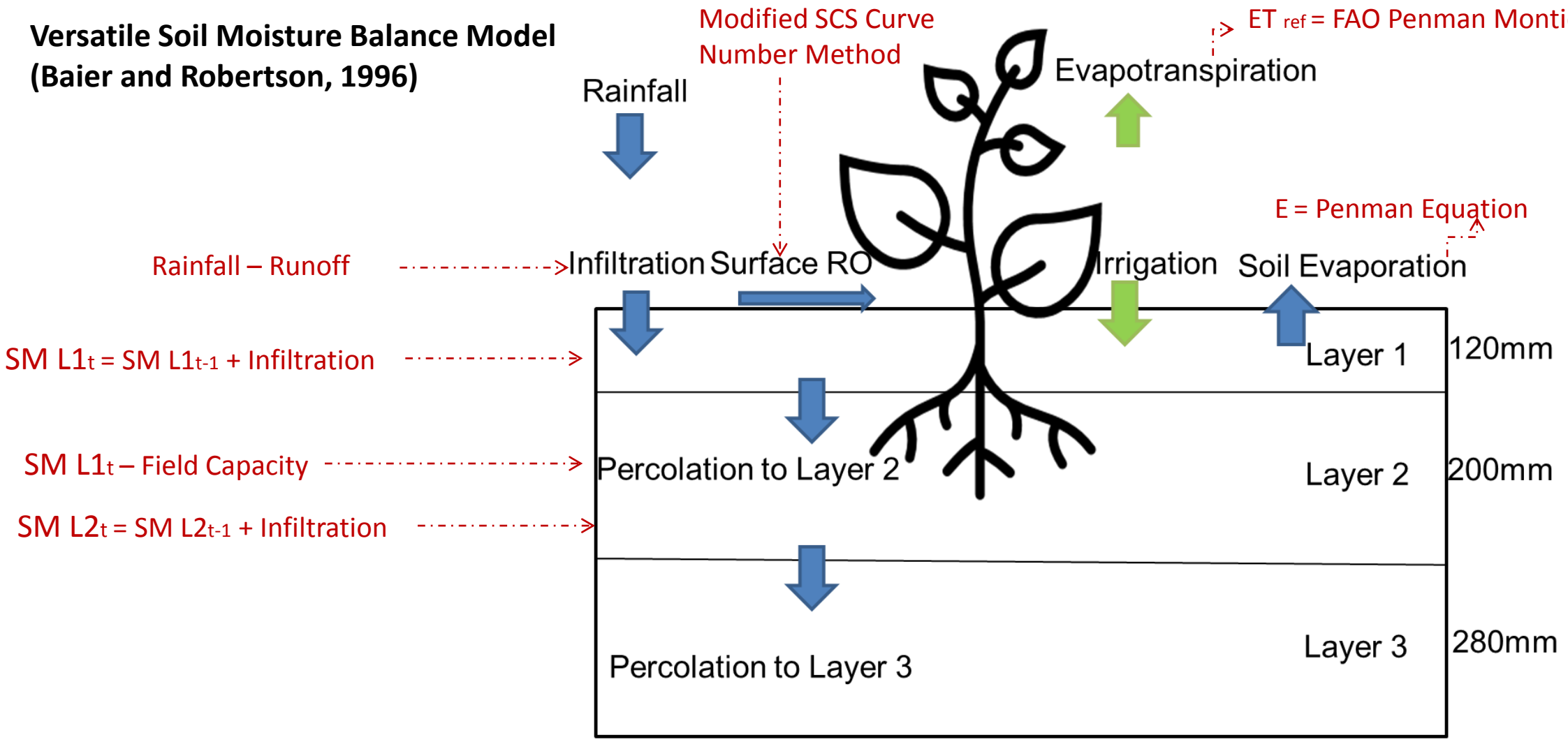


- Extraction of spectral signature
- Separability Analysis
- Supervised Classification:
  - Maximum Likelihood Classification
  - Random Forest Classifier
- Accuracy Assessment



Infield Irrigation Requirement Estimation

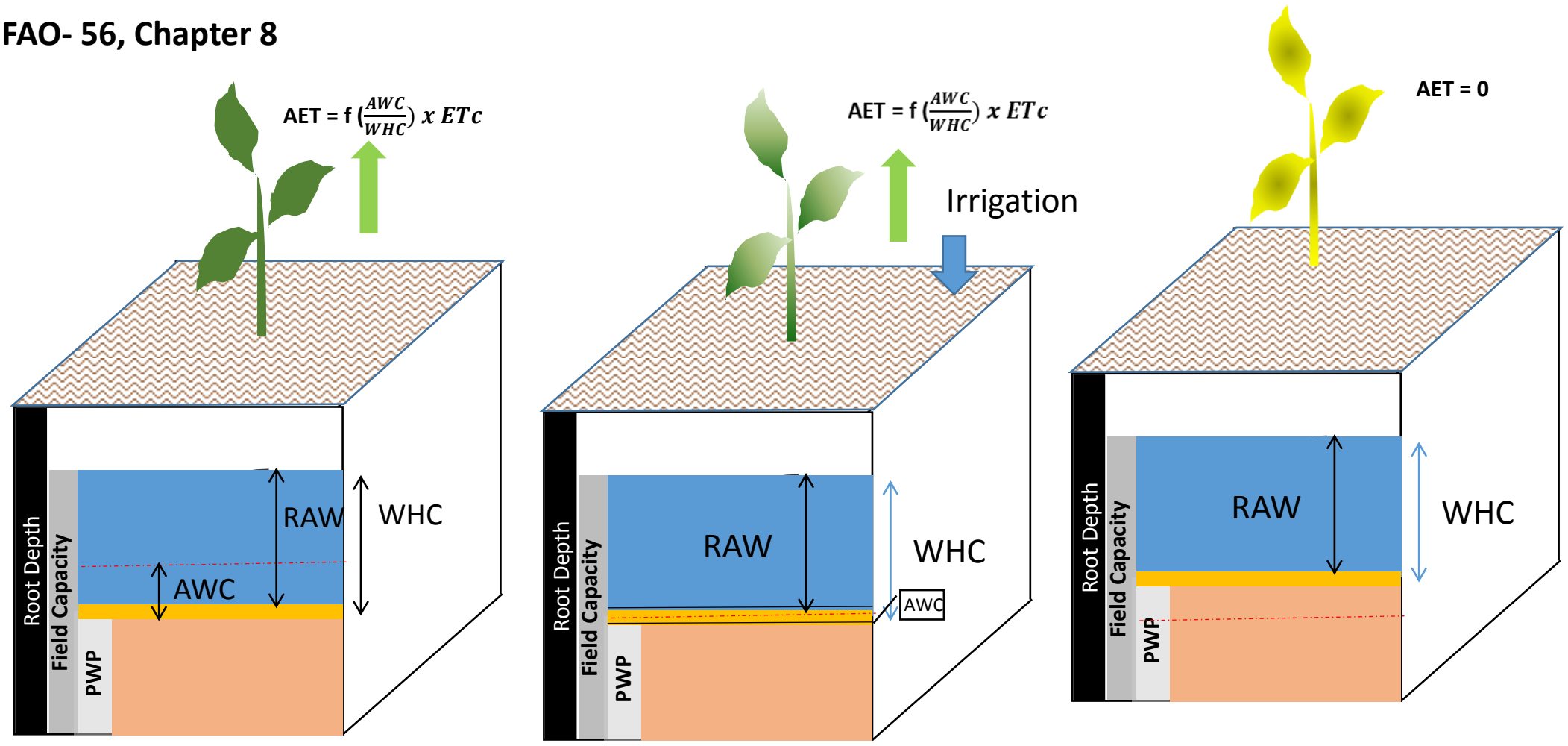
Versatile Soil Moisture Balance Model (Baier and Robertson, 1996)



Change in Soil Moisture = P + I – RO – ET - Per

Infield Irrigation Requirement Estimation

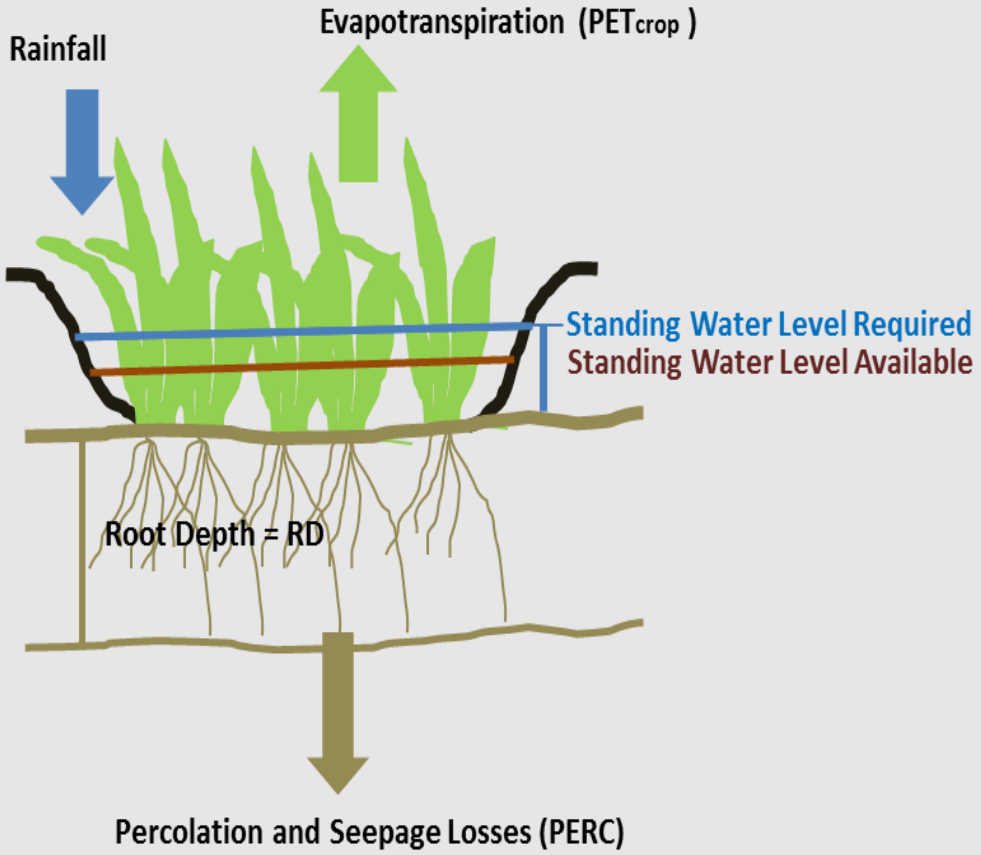
FAO- 56, Chapter 8



Depth of Irrigation = FC - AWC

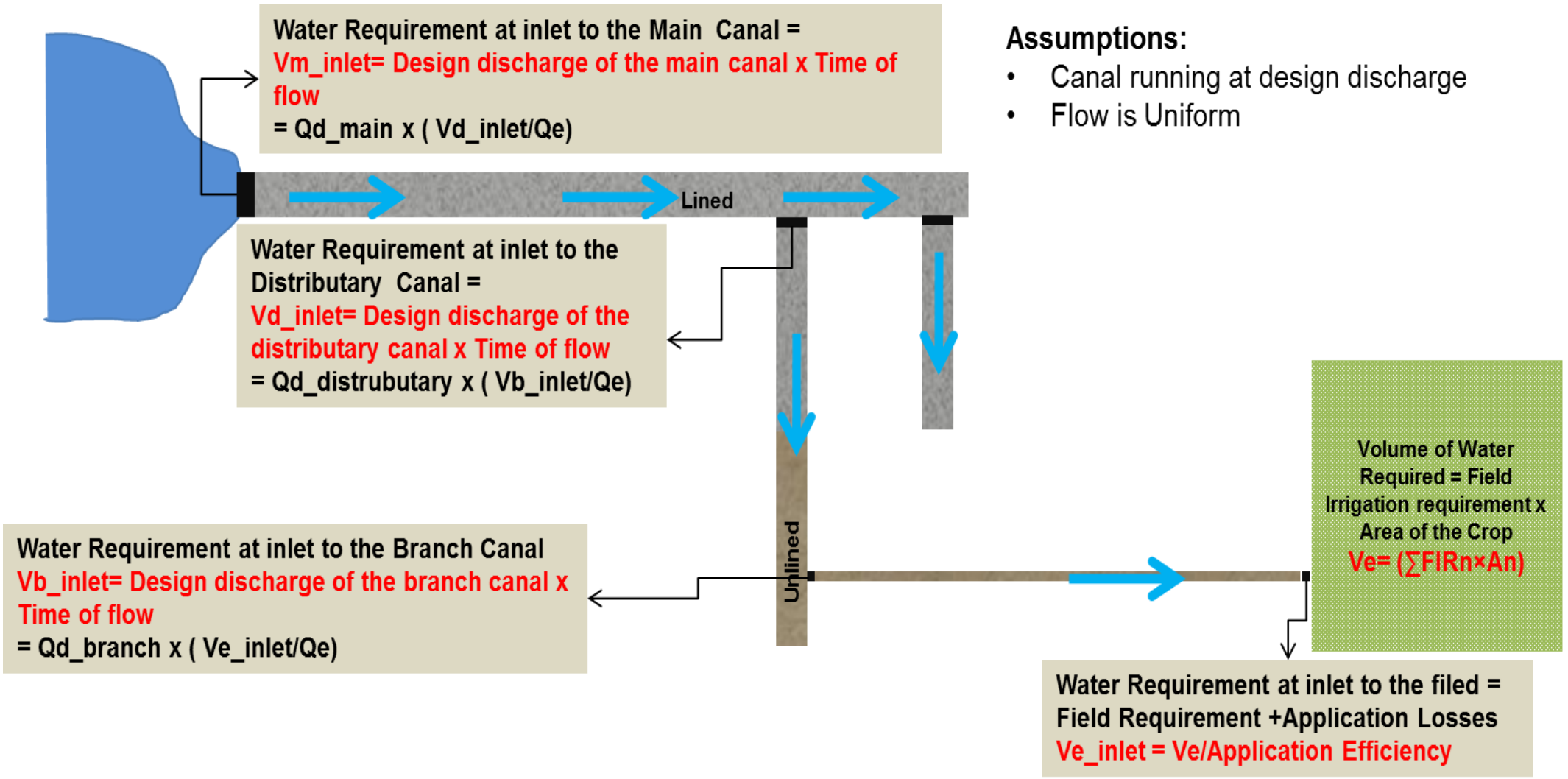
Infield Irrigation Requirement Estimation: Paddy

FAO, Chapter 4



Irrigation Required (IR) = PETcrop + (SLrequired - SLavailable) + PERC -ER

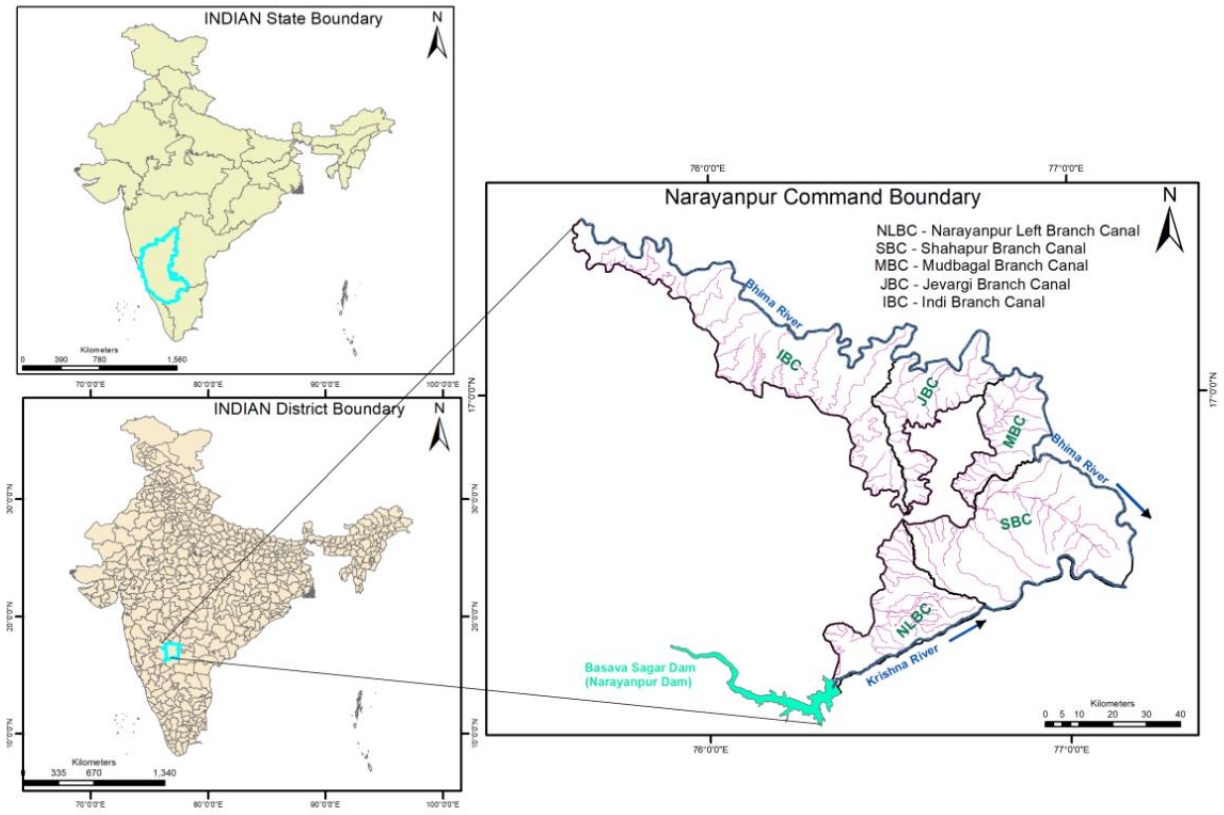
Canal Level Irrigation Requirement Estimation



Assumptions:

- Canal running at design discharge
- Flow is Uniform

Narayanpur Command Area



- Narayanpur Command was selected as study area because of the well established SCADA system available

Predominant soil type: Black Cotton and Red Soil
GCA: 5,70,000 ha
CCA: 4,15,000 ha
Mean Annual Rainfall: 640 mm
Maximum Temperature: 39°C
Minimum Temperature: 22°C

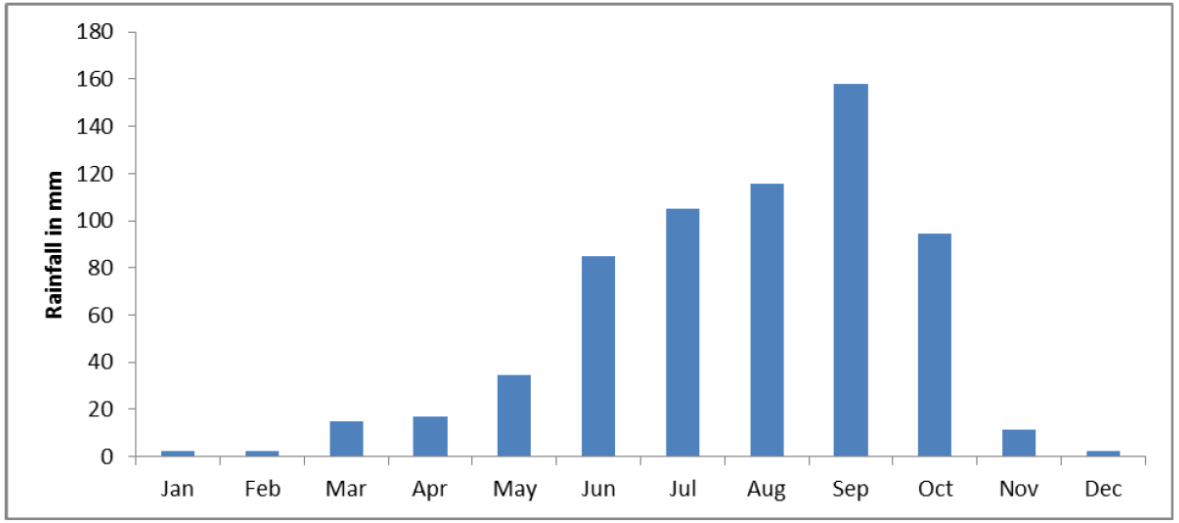


Figure 2: Mean Monthly Rainfall in Narayanpur Command Area (2000-2019)

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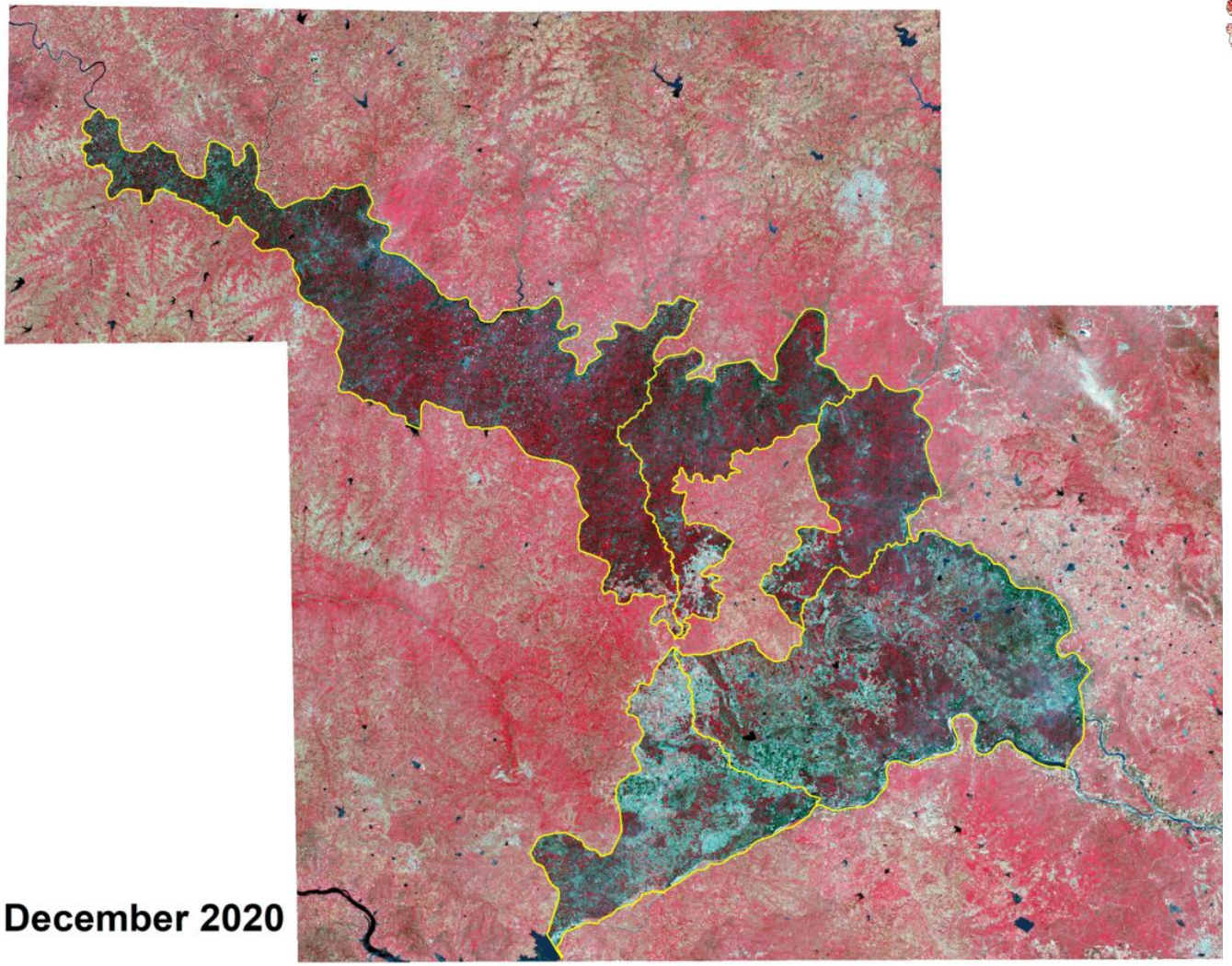
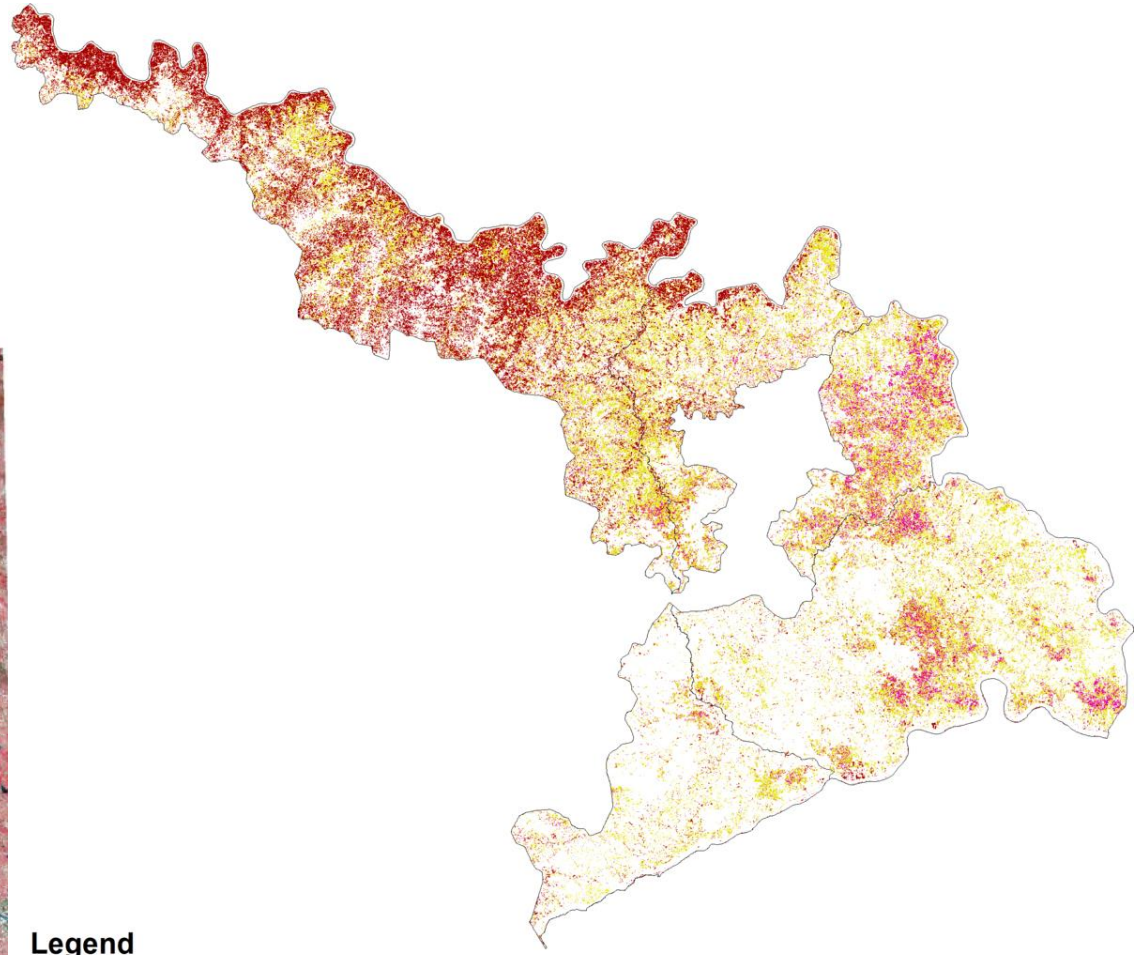
Rabi Season – December 2020-April 2021



02 December 2020

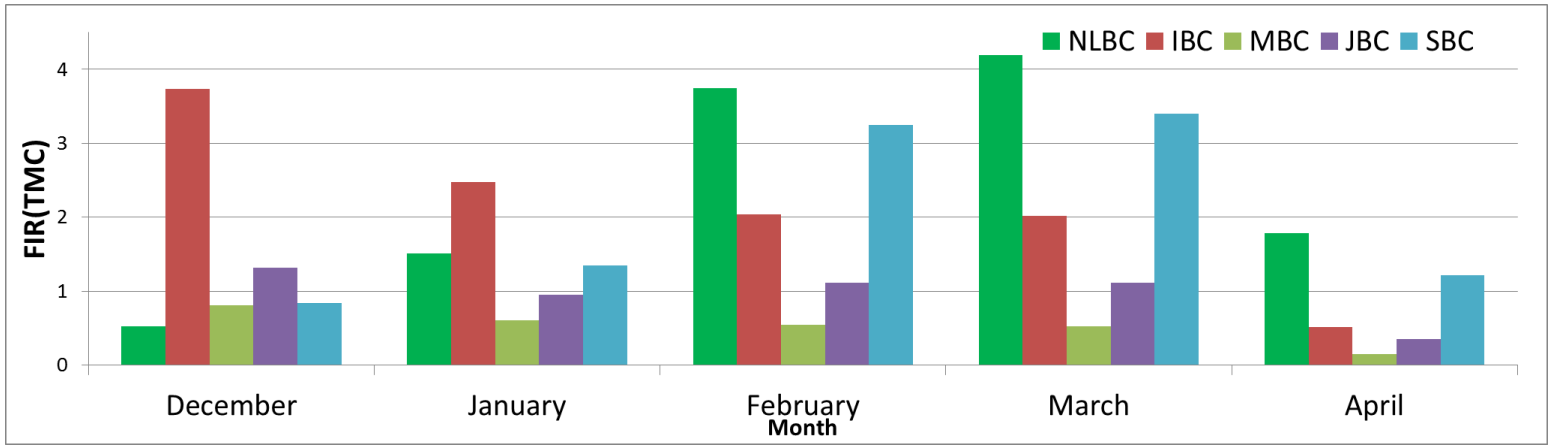


Legend

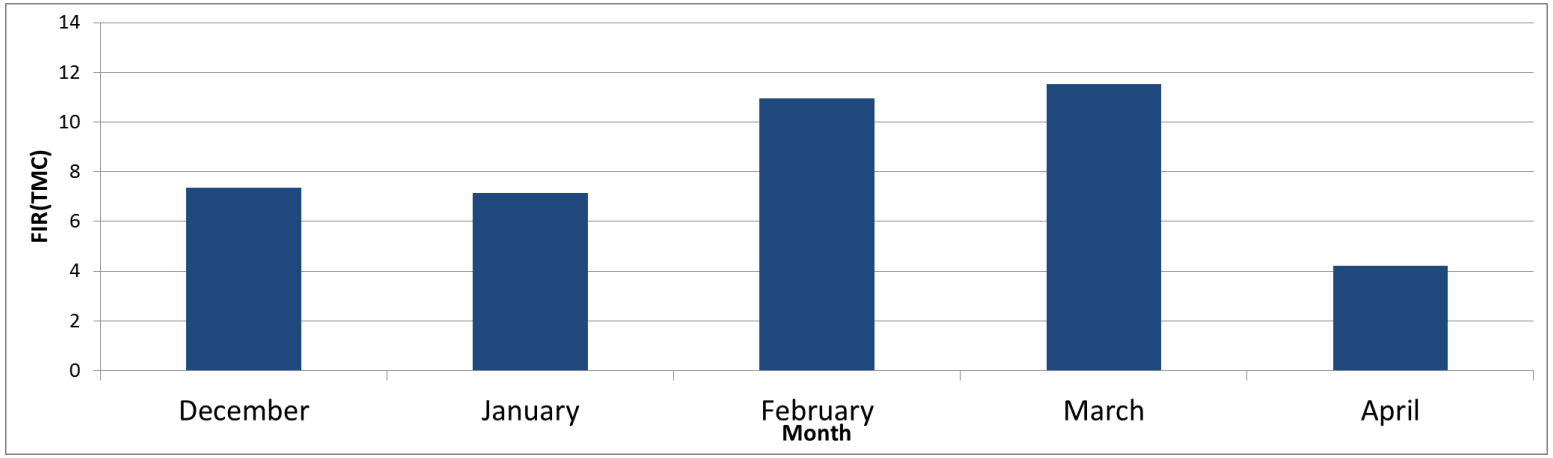
- IRRIGATED DRY
- BISEASONAL
- PERINNIAL

02 December 2020

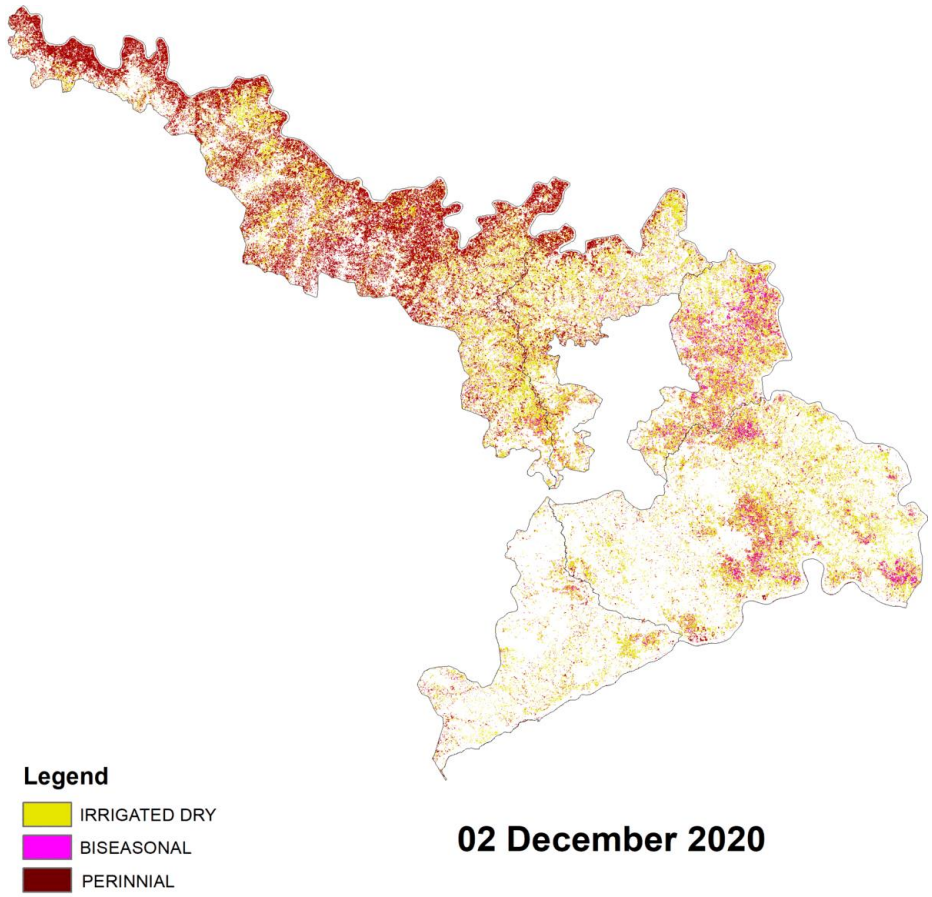
Satellite data based inputs for Irrigation Scheduling Narayanpur Command Area



Monthly Field Irrigation Requirement Branch Canal Wise



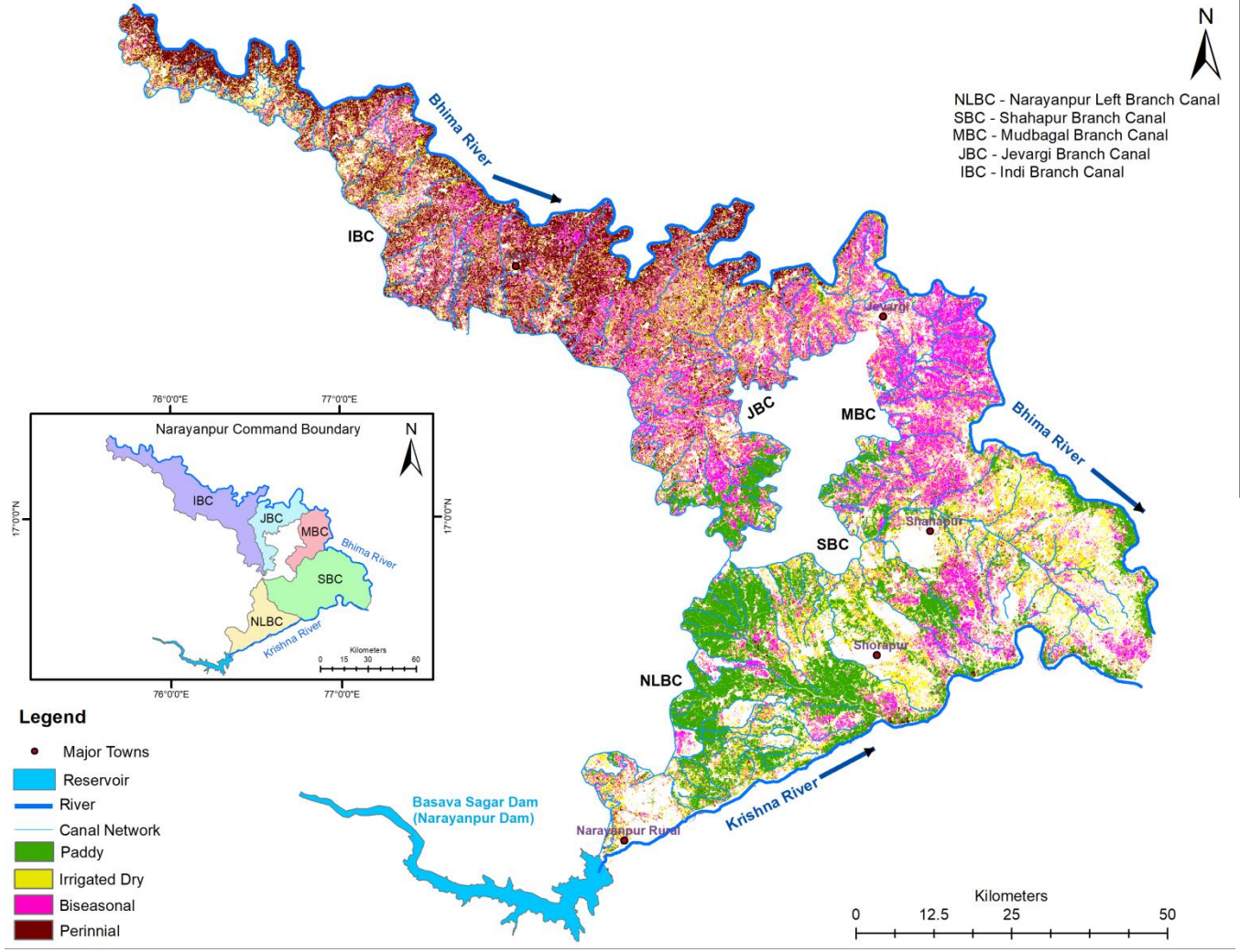
Monthly Field Irrigation Requirement Main Canal

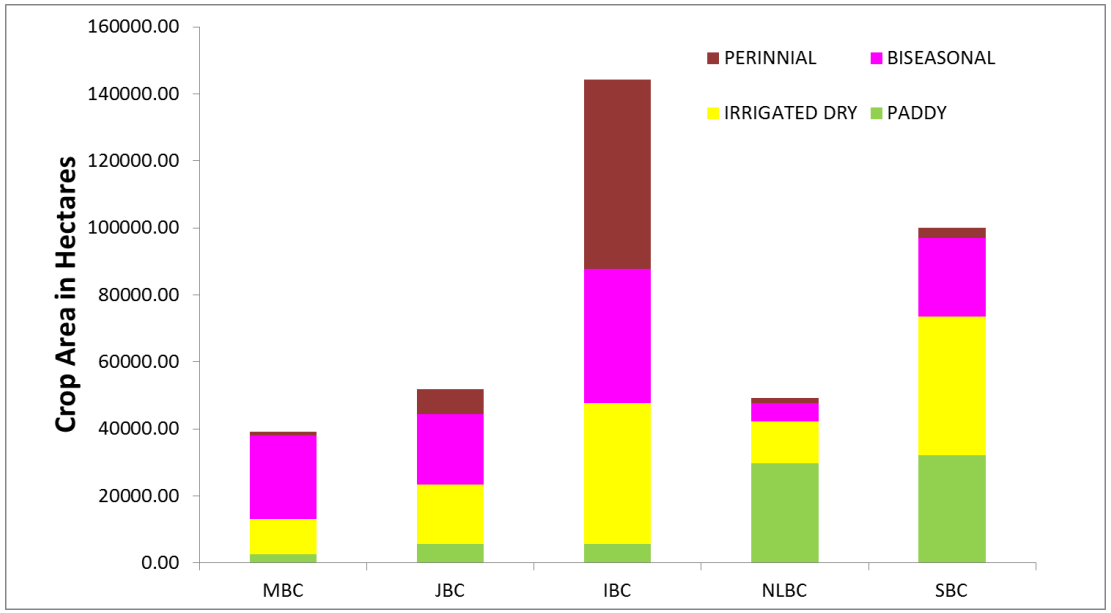


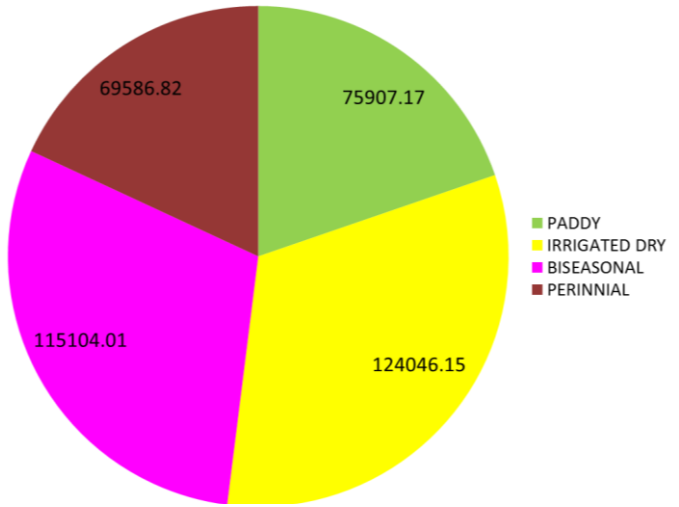
Check GIF in office

Satellite data based inputs for Irrigation Scheduling Narayanpur Command Area

Seasonal Crop Area





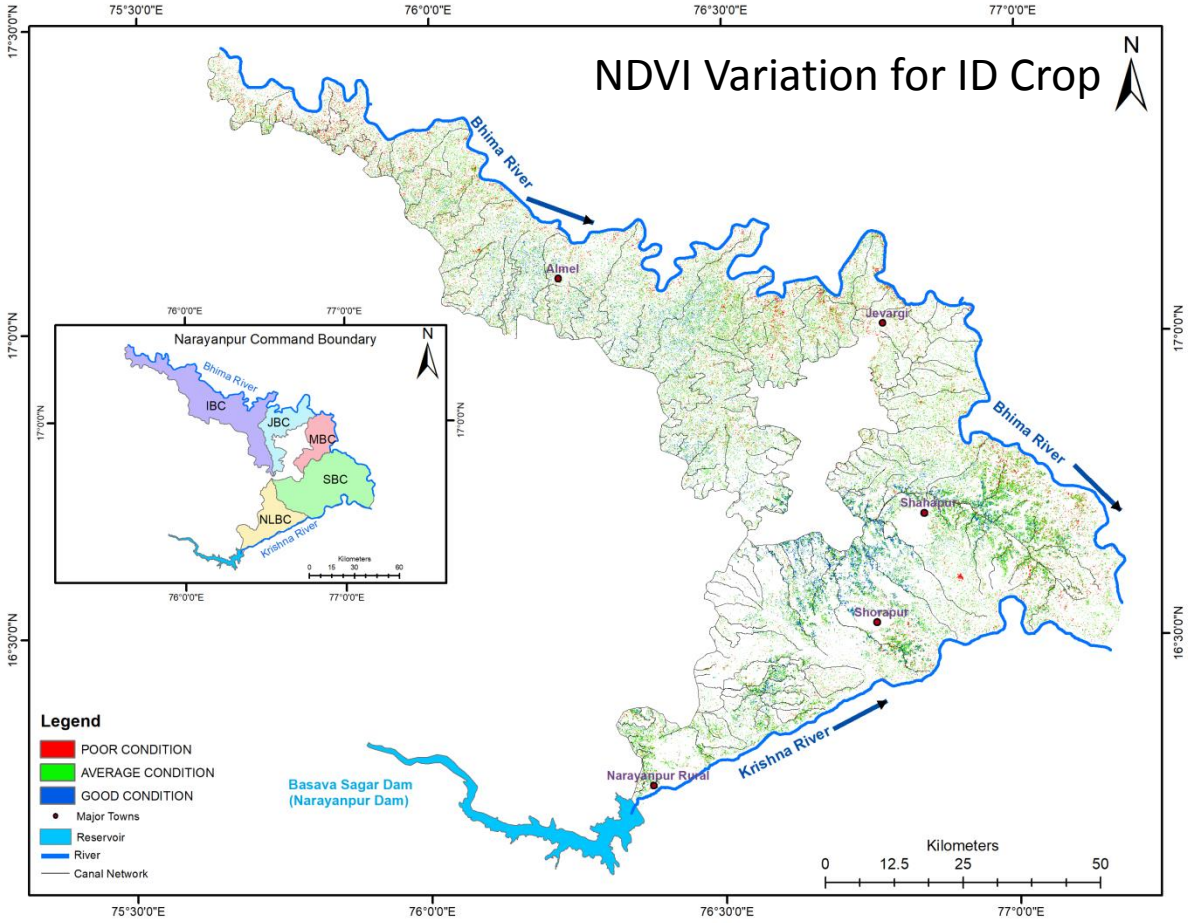


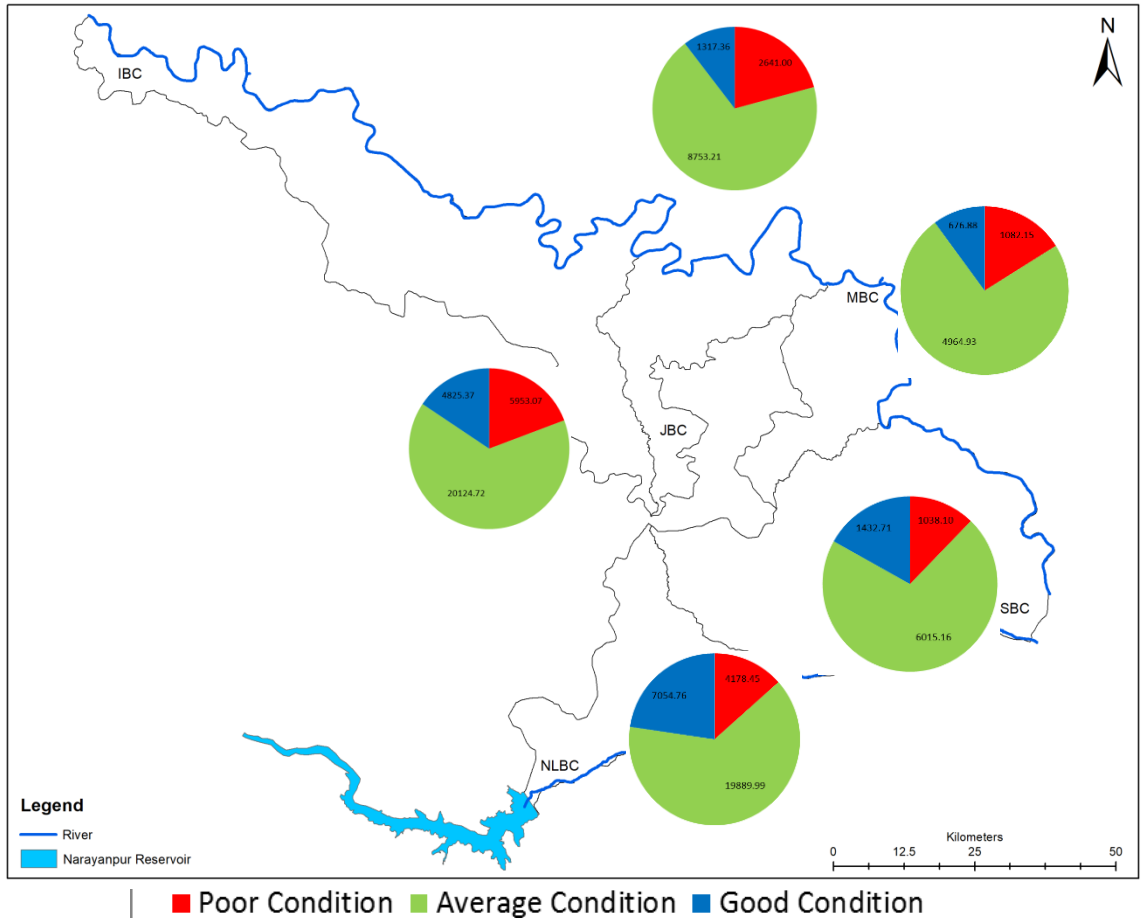
Performance Assessment

Crop Condition – Vegetation Index

$$NDVI = \frac{NIR_{ref} - Red_{ref}}{NIR_{ref} + Red_{ref}}$$

Representative index for the vigor of the crop



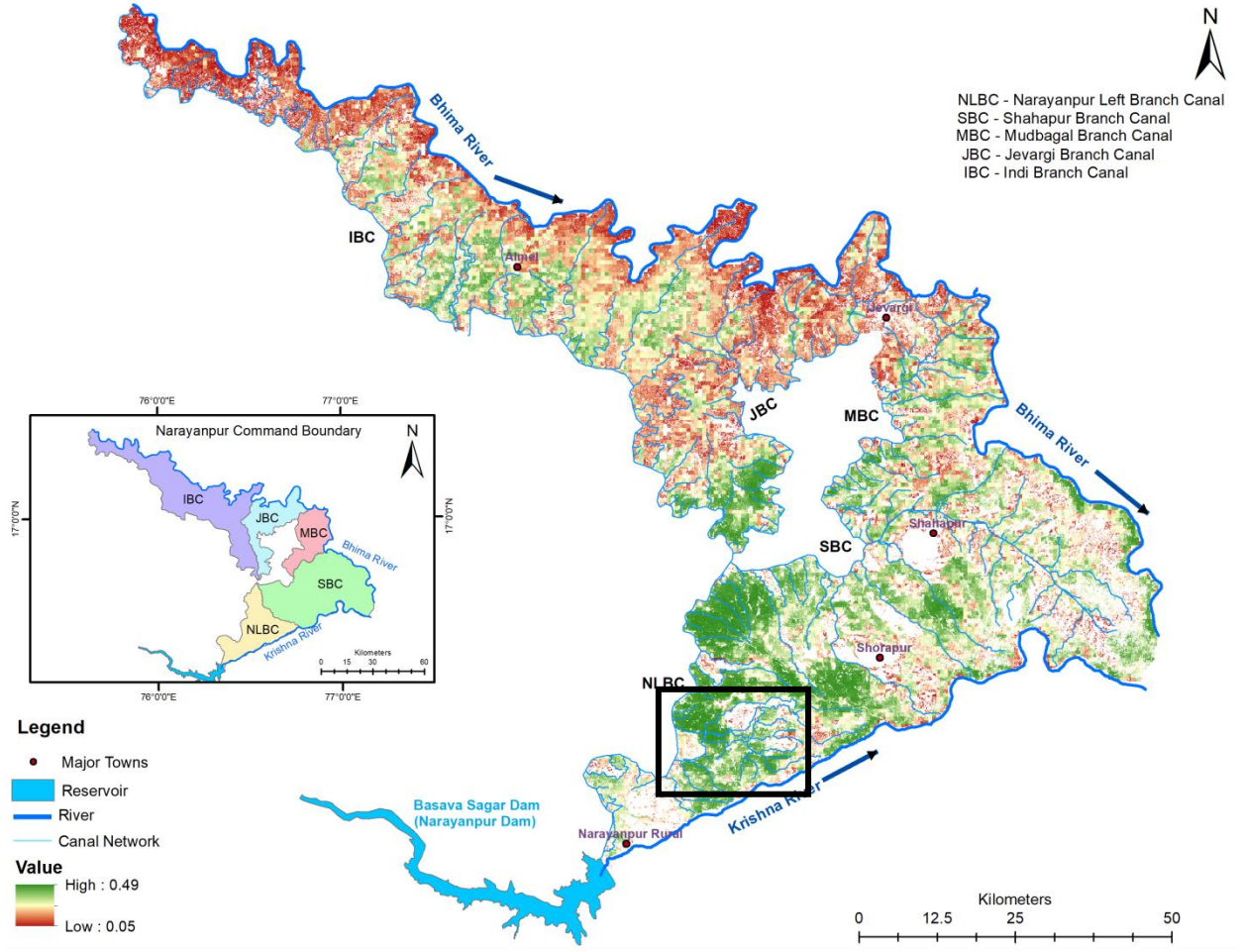


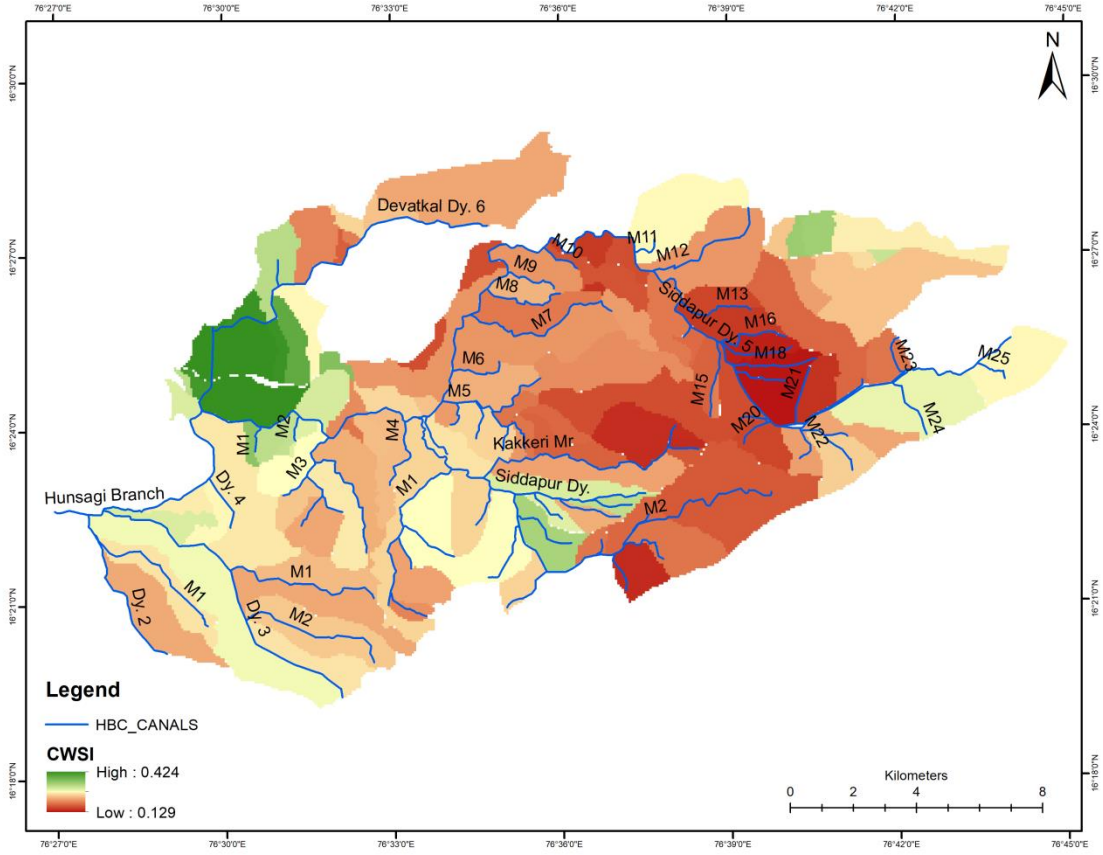
Performance Assessment

Crop Condition – Evapotranspiration

$$\text{CWSI} = \frac{Actual\ Evapotranspiration}{Potential\ Evapotranspiration}$$

Representative index for water requirement of the crop satisfied by irrigation





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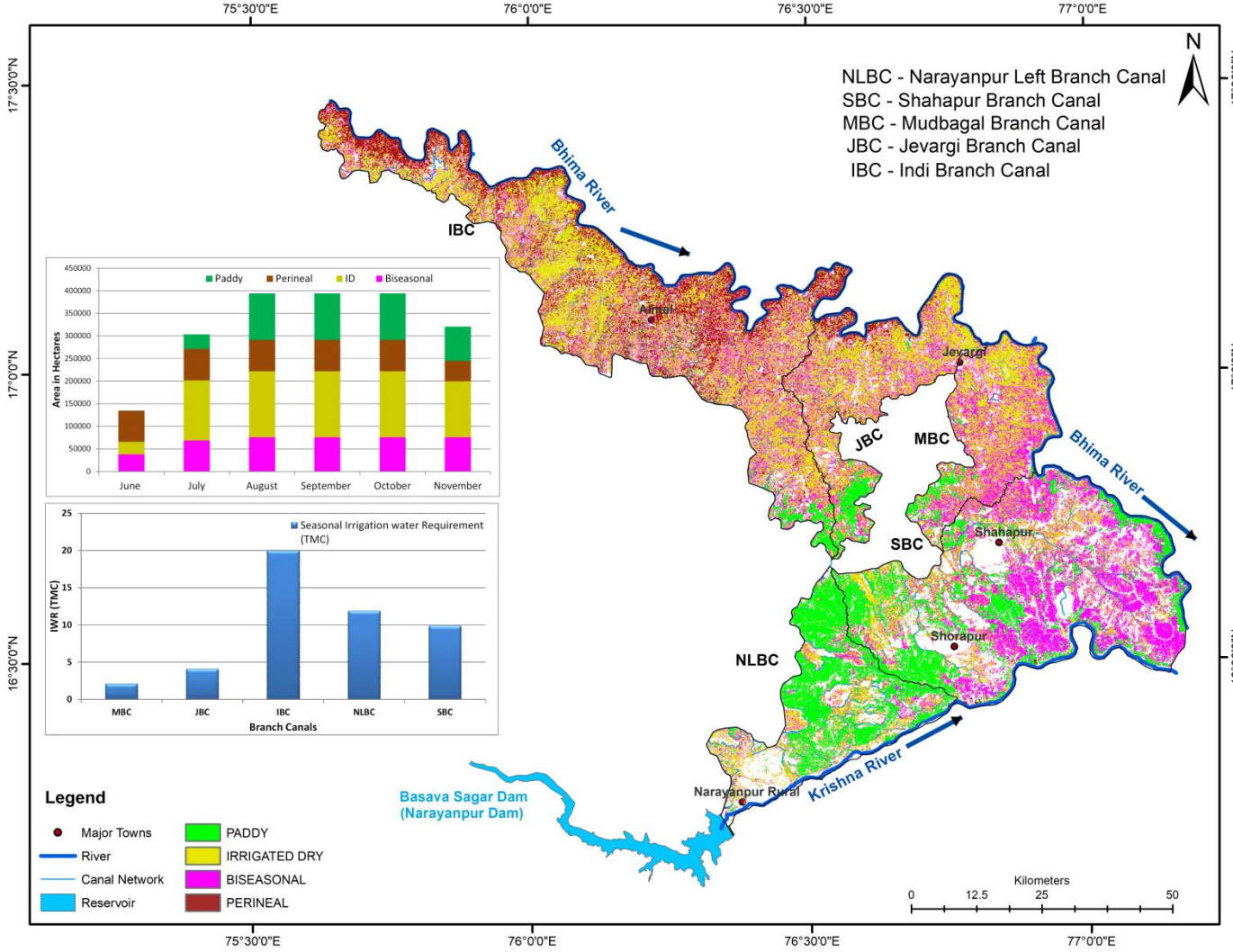
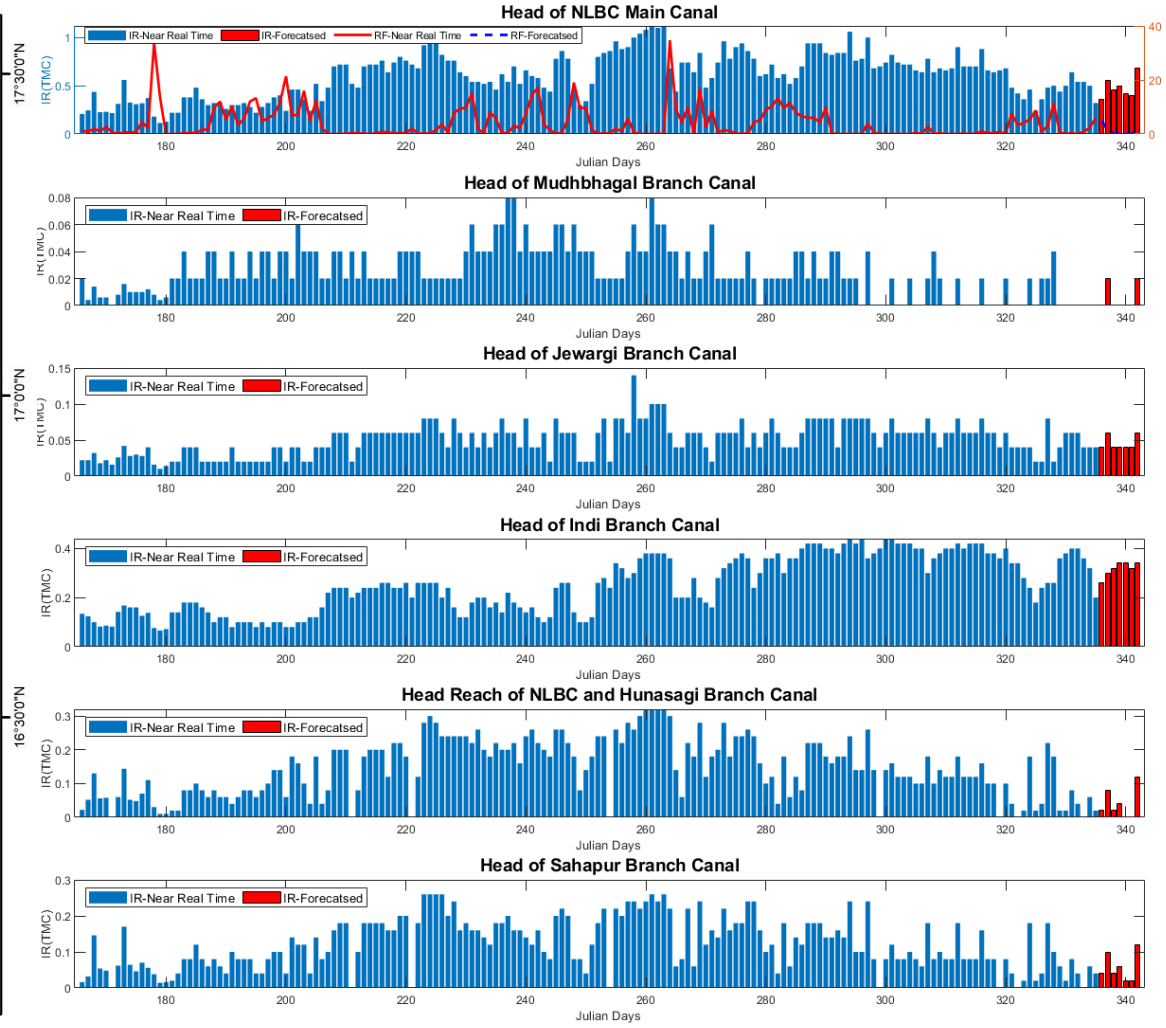
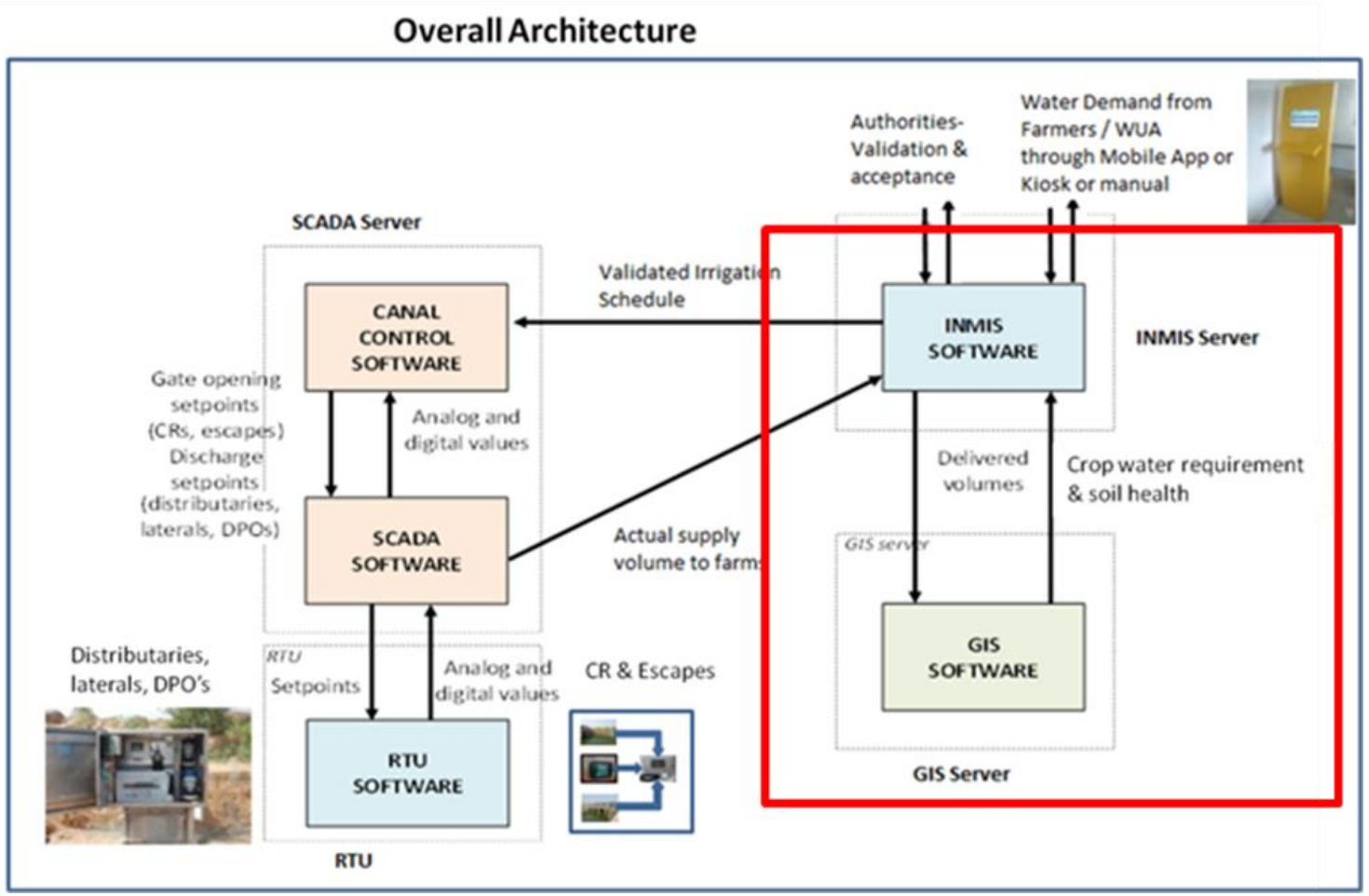
Kharif Season (June October 2021)





Value Addition to Existing SCADA system



Current Status:

Notional Irrigation releases decided, based on the area of crops entered by the farmers in Kiosks.

Estimation of irrigation requirement for

- *Existing crop area derived from satellite data*
- *Forecasted Meteorological Conditions*

Way Forward

- Validation of the outputs with the field data in collaboration with Krishna Bhagya Jal Nigam
- Near Real Time implementation for the forth coming season
- Development of Decision Support System incorporating all the algorithms developed
- Expansion to other command areas

THANK YOU

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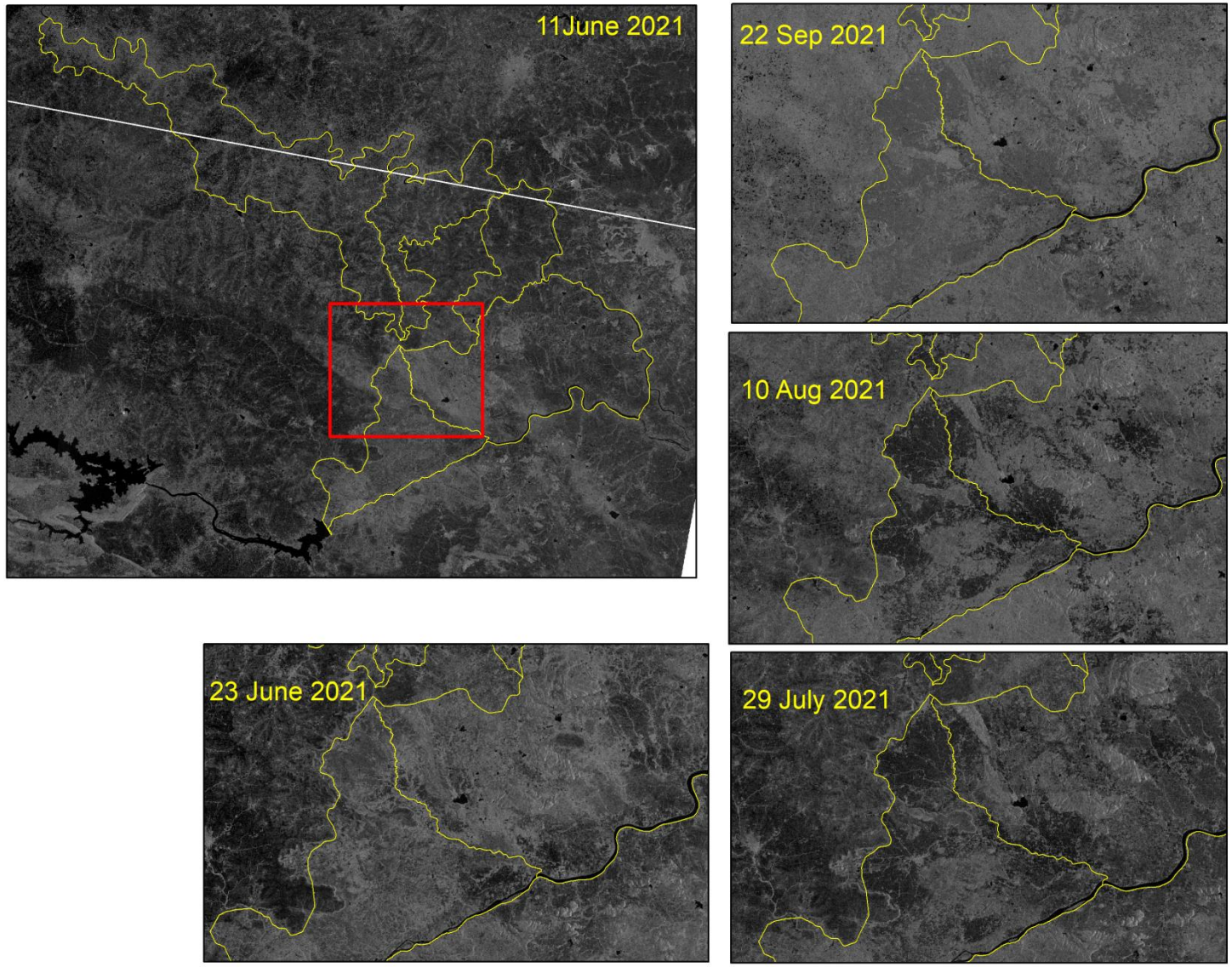

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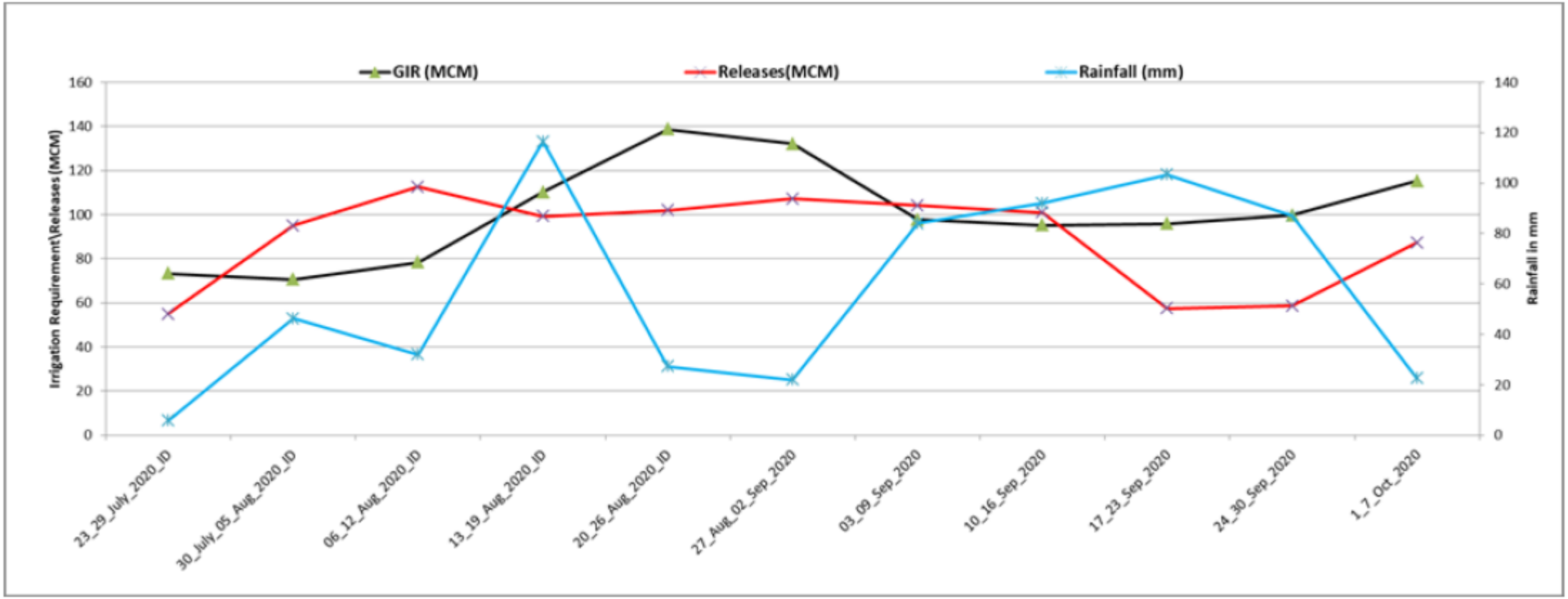

Kharif 2020