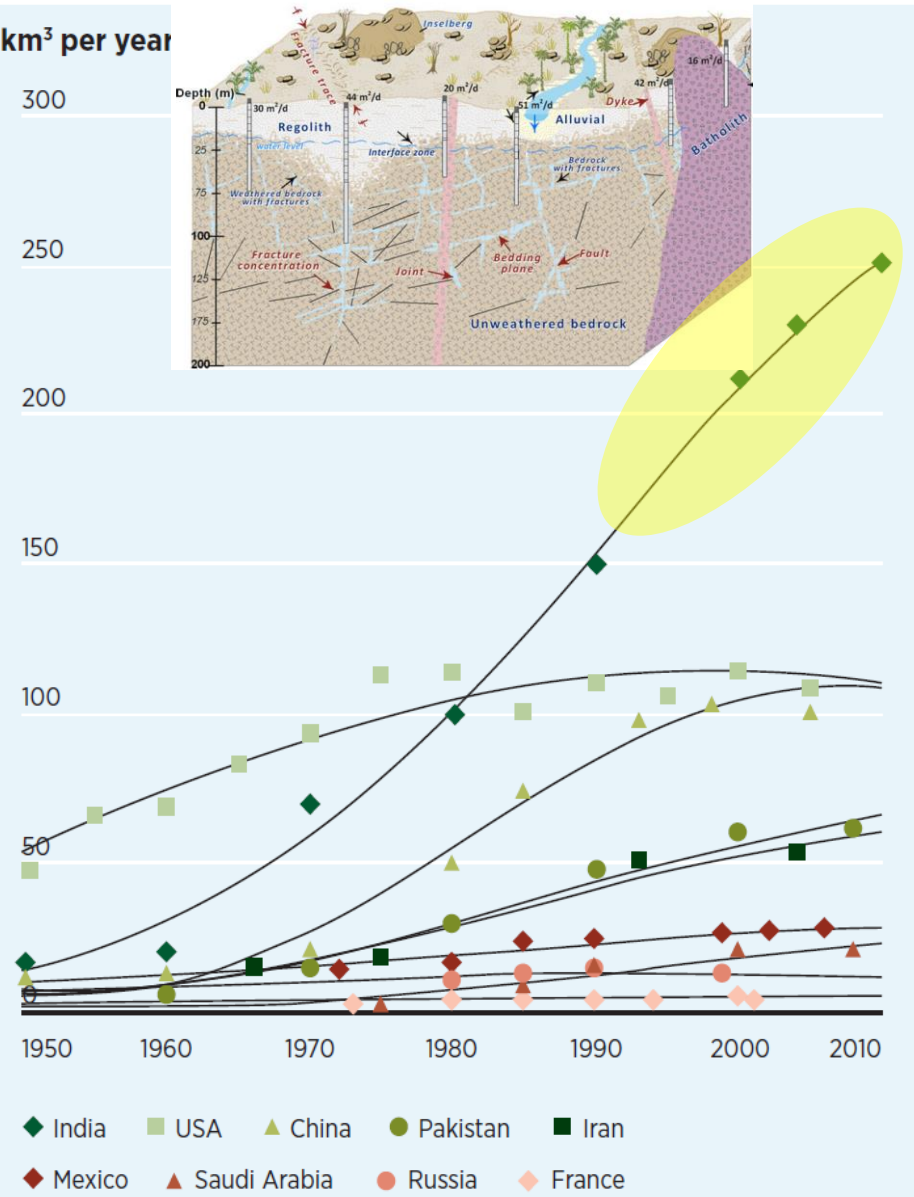


***Détection et caractérisation des cultures irriguées à partir d'une série
d'images radar et optique à haute résolution spatiale et
temporelle :
Application au site expérimental du Berambadi en Inde.***

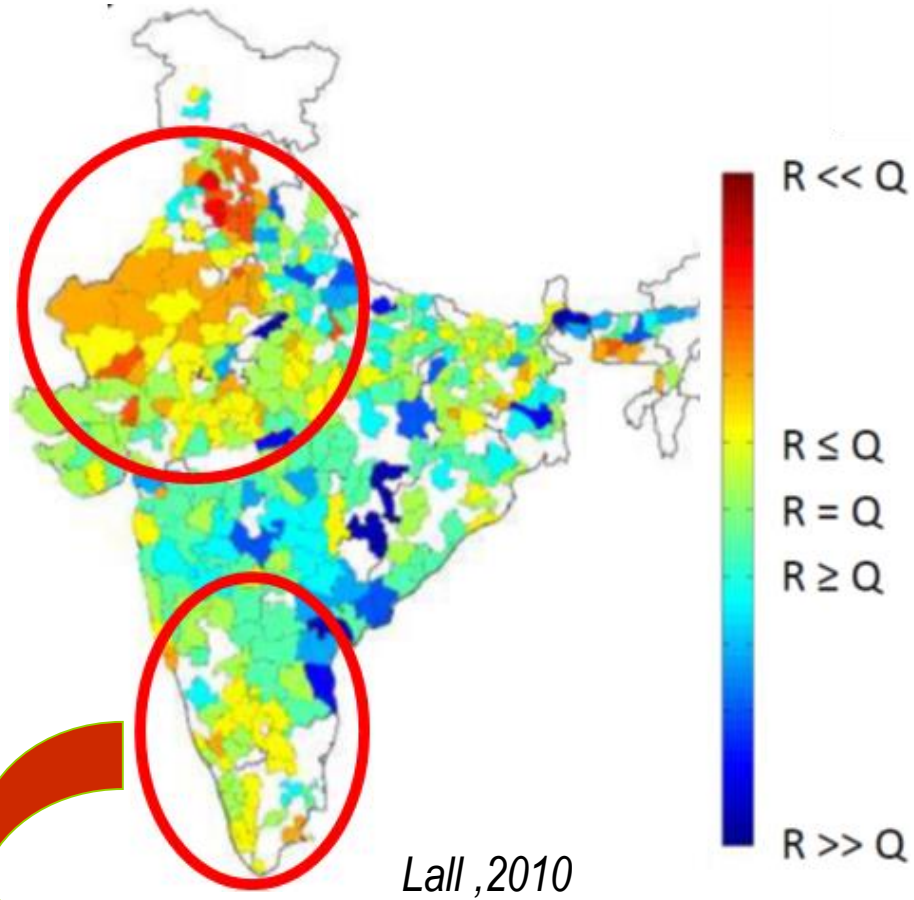


Groundwater abstraction trends in selected countries (in cubic kilometres per year)



UNESCO (2012)

Groundwater resources



- Thrust areas :-
- Improved & managed recharge.
 - Groundwater quality protection.
 - Climate change effects.

Introduction

- Monitoring of cropland in irrigated agriculture watershed is an important stake from an environmental perspective.
- Intra-annual crop monitoring requires for to understand the spatially distributed irrigated and non-irrigated cropland at watershed scale for a given year.
- Remotely sensed data are largely used to monitor cropland for large areas, small parcel size (<0.5 ha) and high crop diversity, make them difficult to identify at field scale.

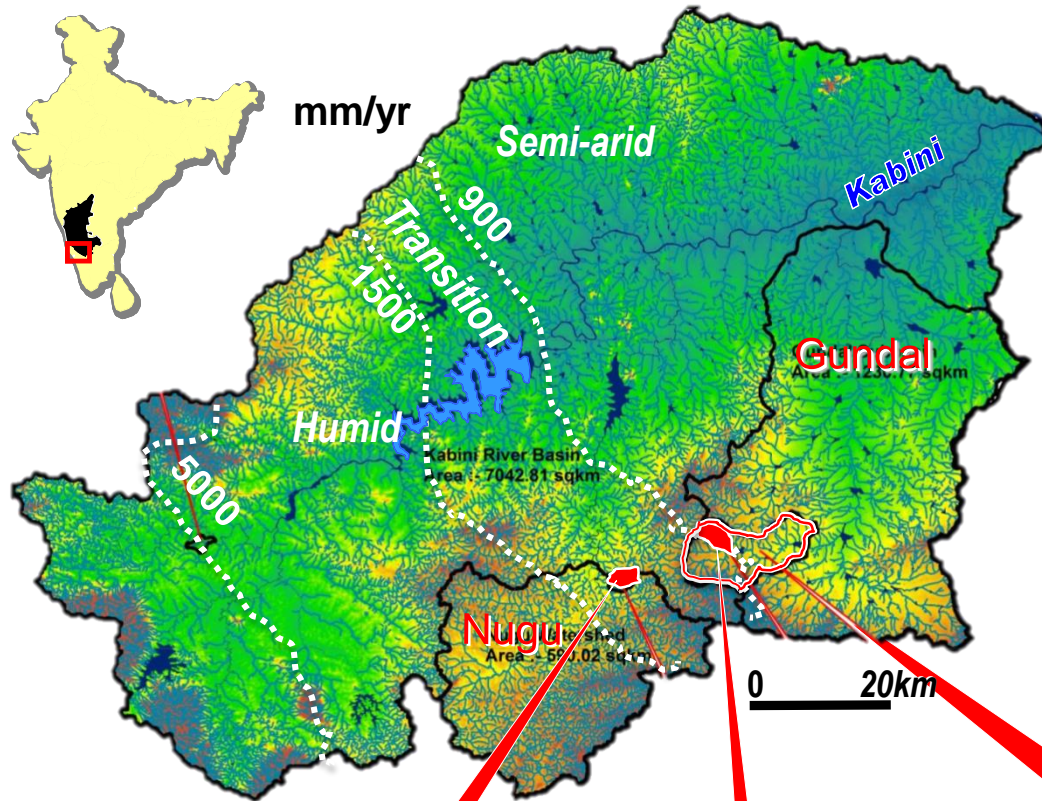
Monitoring of irrigated crops in India

- Groundwater is the principal irrigation resource for crops in several parts of the world including India.
- Excess use of this resource for irrigation has led to widespread depletion of GWL, it affects crop yields and water quality
- A difficult task where two or three months of cloudy conditions during the monsoon period can hinder crop growth.

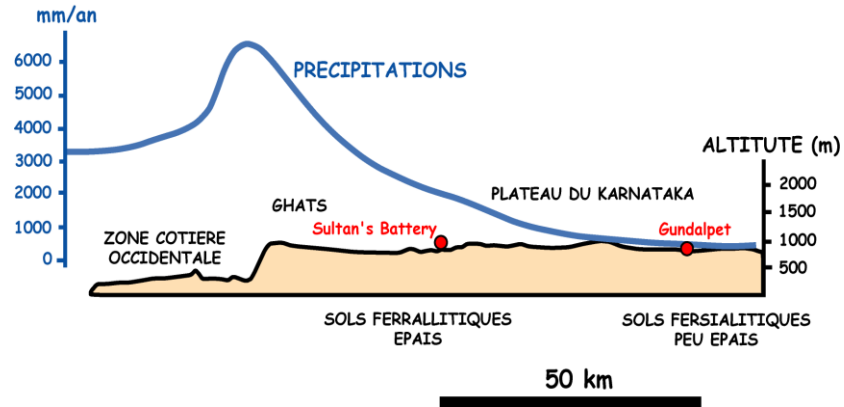
Land use characterization

- Historical evolution of irrigated cropland (1990-2016)
 - Combination of various vegetation and moisture indices
- Evolution of monsoon irrigated cropland (2011-2014)
 - Decomposition of Radarsat-2 Quad-pol SAR
- Crop type classification (2014-15)
 - Chaos based supervised classification
 - Observed LAI – Decomposition relation
- Groundwater quality and Irrigation history
 - R^n between groundwater contamination and evolution of irrigation

The Kabini Critical Zone Observatory



- Contrasted land use and land cover
- Highly disturbed hydrosystems
- Unique climatic and geomorpho gradient



Mule Hole (2003-)
Forested
4.3km²

Maddur (2005-)
Cultivated
7.1km²

Berambadi (2008-)
Cultivated
84km²

Environmental Observatory

CHALLENGES :
Data collection

**ENVIRONMENTAL
MONITORING**



Atmosphere

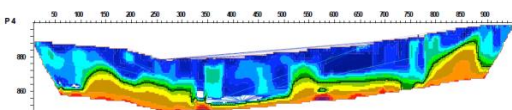
water

Geochemistry



Figure 9 : Geonics EM31 conductivity meter

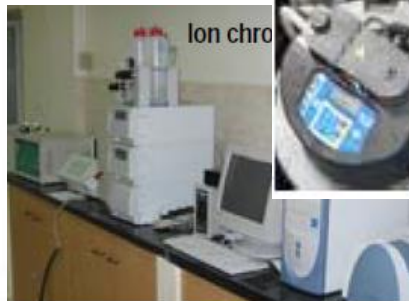
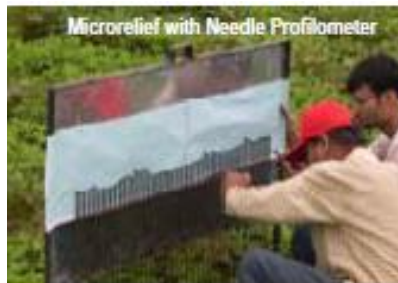
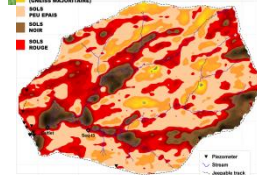
Geophysics



Soil

Socio economic Surveys

agriculture



Diversity of crops/land uses, soils types



Crops



Irrigation



Soils

High spatio-temporal changes at different scales

Summer Season

- Cabbage
- Beetroot
- Onion
- Vegetables
- Watermelon
- Ext. Sugarcane
- Ext. Banana

Kharif Season (Monsoon)

- Turmeric
- Sunflower
- Maize
- Marigold
- Sorghum
- Onion
- Beetroot
- Chilli
- Zinger
- Country Beans
- Ragi
- Ext. Sugarcane
- Ext. Banana

Rabi Season (Post-monsoon)

- Gram
- Maize
- Garlic
- Horsegram
- Beans
- Sugarcane
- Banana
- Ext. Turmeric

2 or 3 crops per year

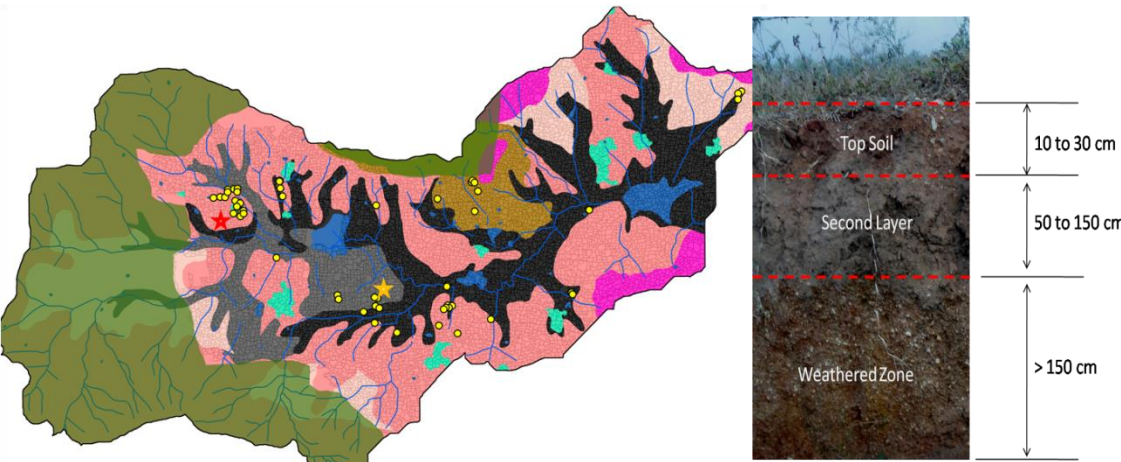
Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan.

Ground observed and Satellite Dataset

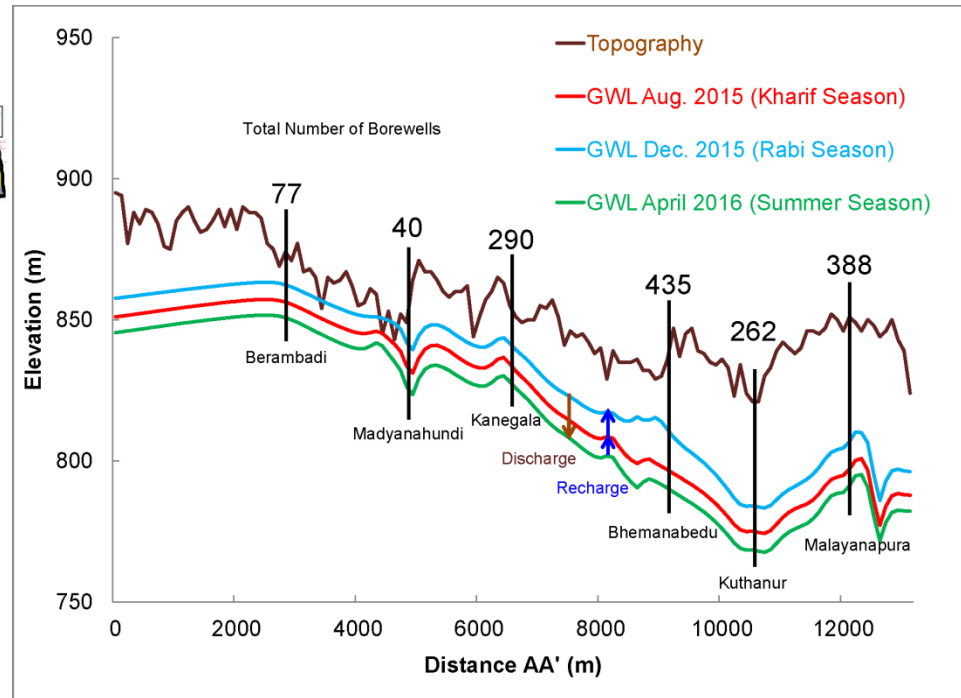
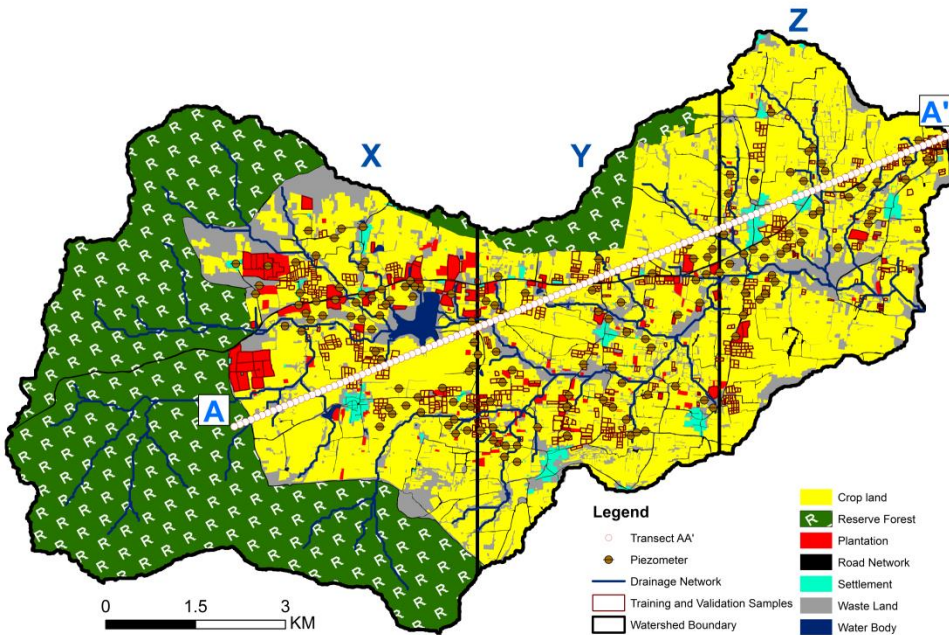
- ✓ Crop type GCP's (2011-15)
- ✓ Surface soil Moisture (2011-15)
- ✓ Biomass (2012-14)
- ✓ LAI Licor (2012-15)
- ✓ Aerial Survey and GPR (2014)

Optical data long-term (1990-2016) and short term (2014-16)

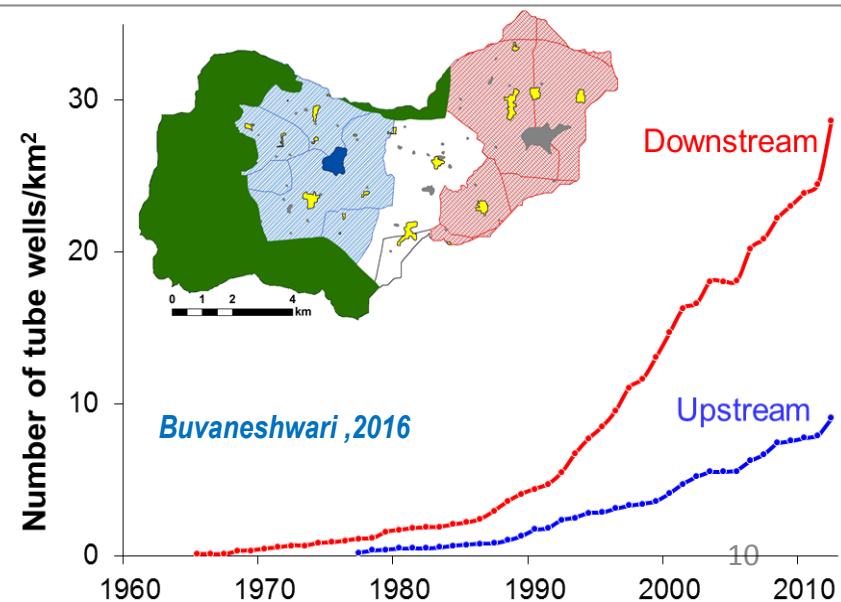
- ✓ LS-5(TM), 8 (OLI), EO1-ALI, IRS-LISS III and IV, SPOT5-Take5 (CESBIO)
- ✓ Multi-temporal data acquisition during all three seasons.



Groundwater measurements



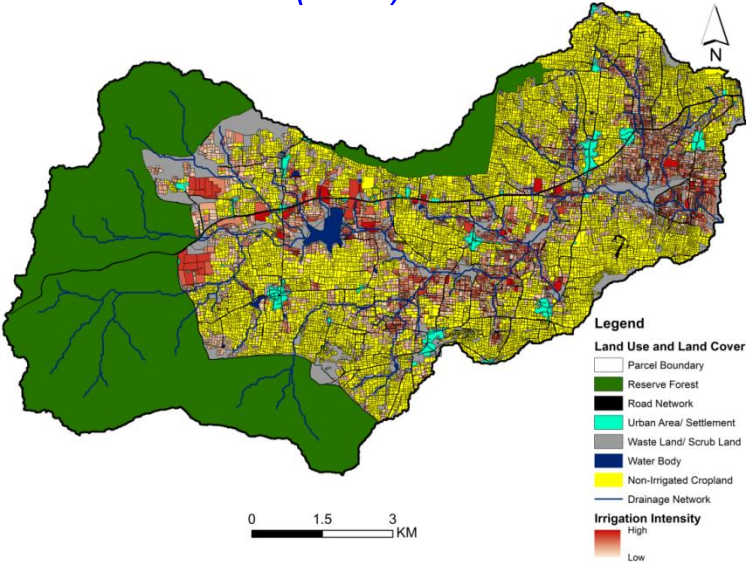
- 2-3 crop/year resulting exponential increment in borewell numbers and high impact on groundwater (yield and quality)
- Farmers interest to switch from traditional crops towards cash crops



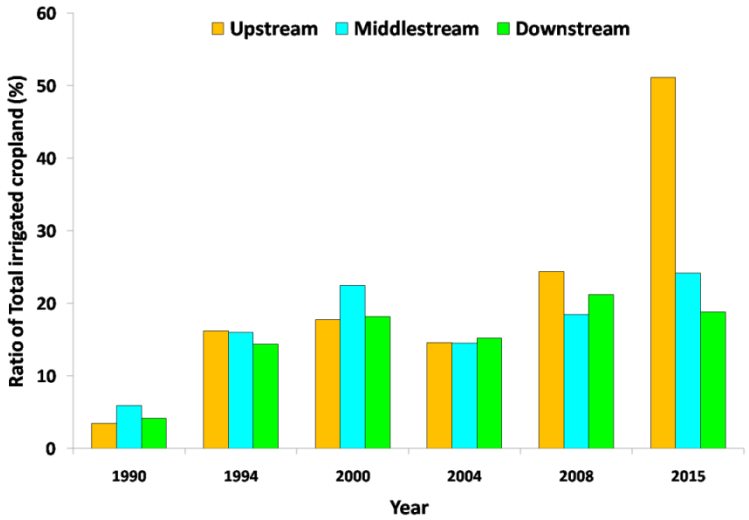
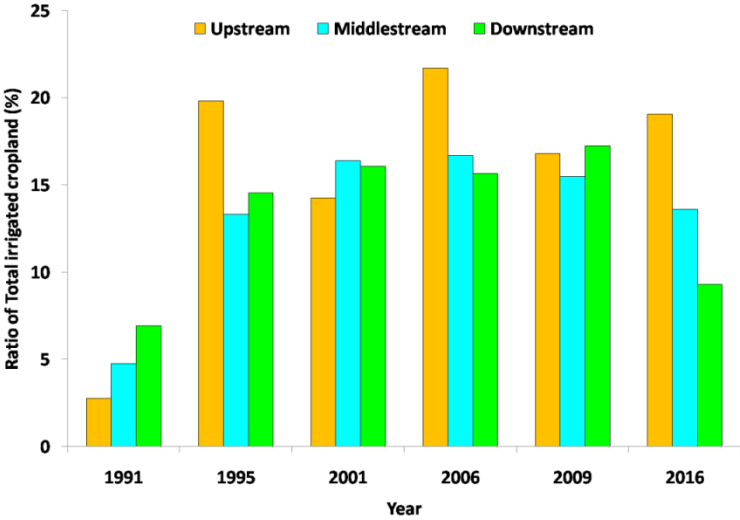
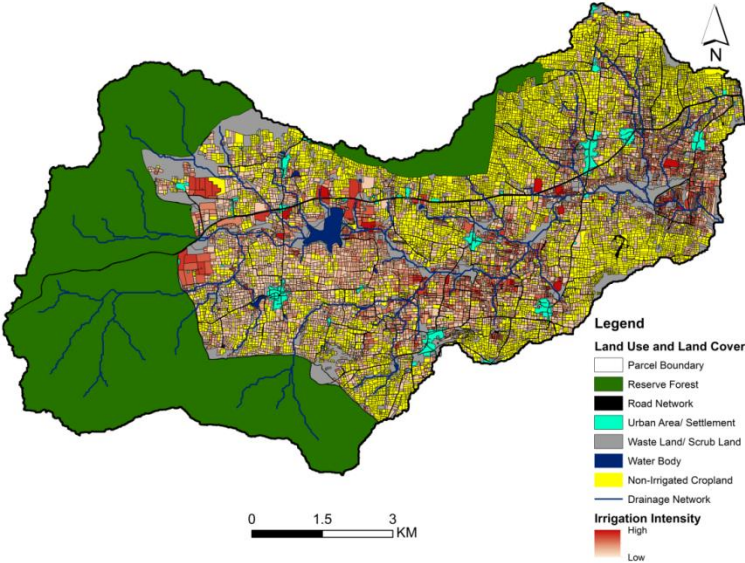
Historical evolution of irrigated cropland (1990-2016)

Irrigated cropland evolution (1991-2016)

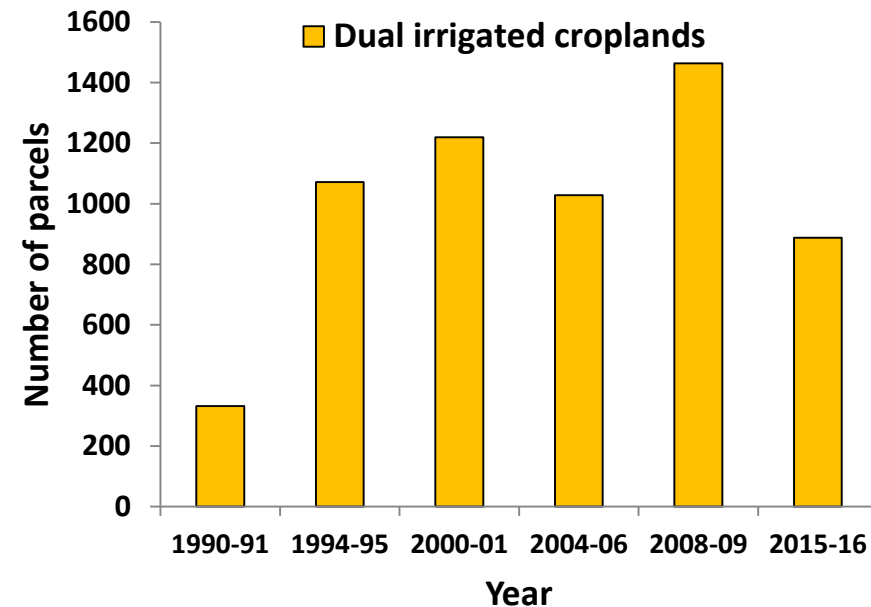
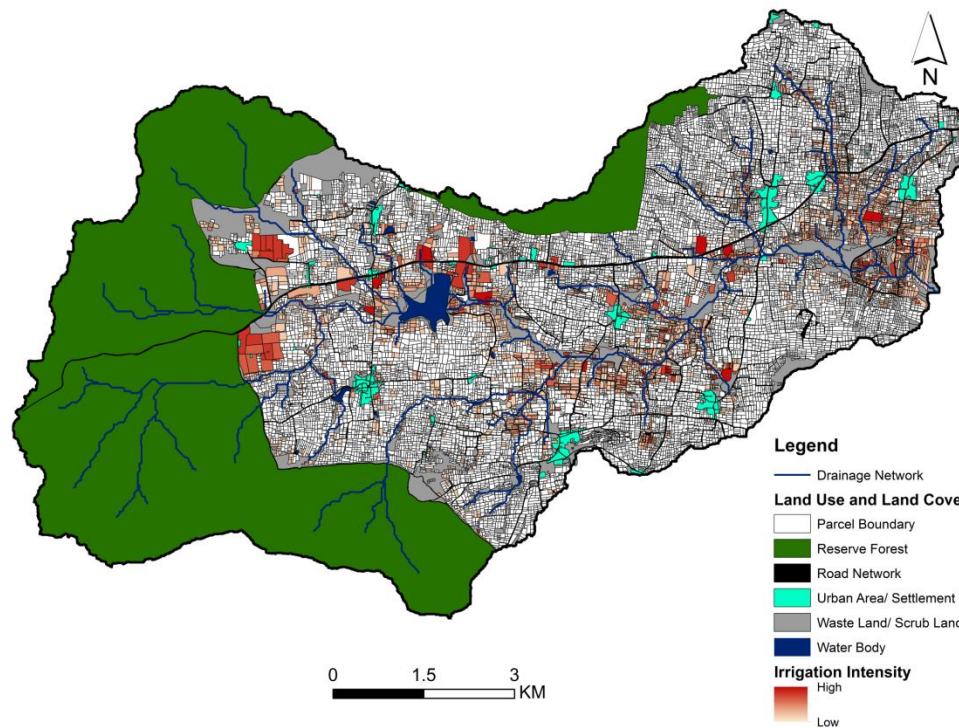
Summer (Zaid) season



Post-monsoon (Rabi) season



Dual season (Rabi + Summer) irrigated cropland (1990-2016)



- Summer season irrigated croplands are clustered in the valleys of the watershed.
- Rabi season irrigated croplands are shifting towards upstream of the watershed.
- Now all water bodies are fully dried due to intensive groundwater pumping and insufficient recharge.
- Dual irrigated cropland are triple croplands, as kharif season (monsoon) 100% farmers are cultivating crops.

Evolution of monsoon irrigated cropland (2011-2014)

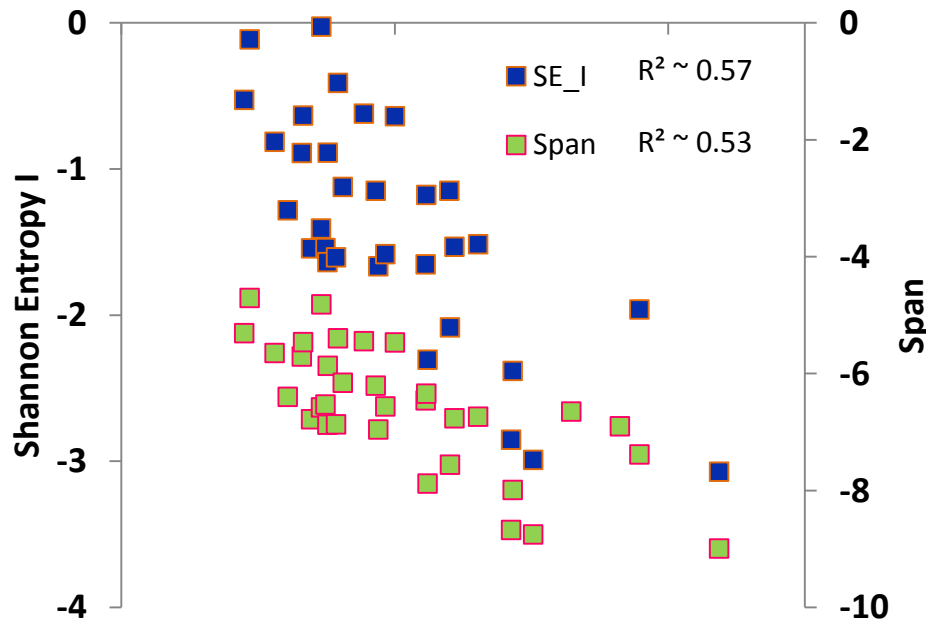
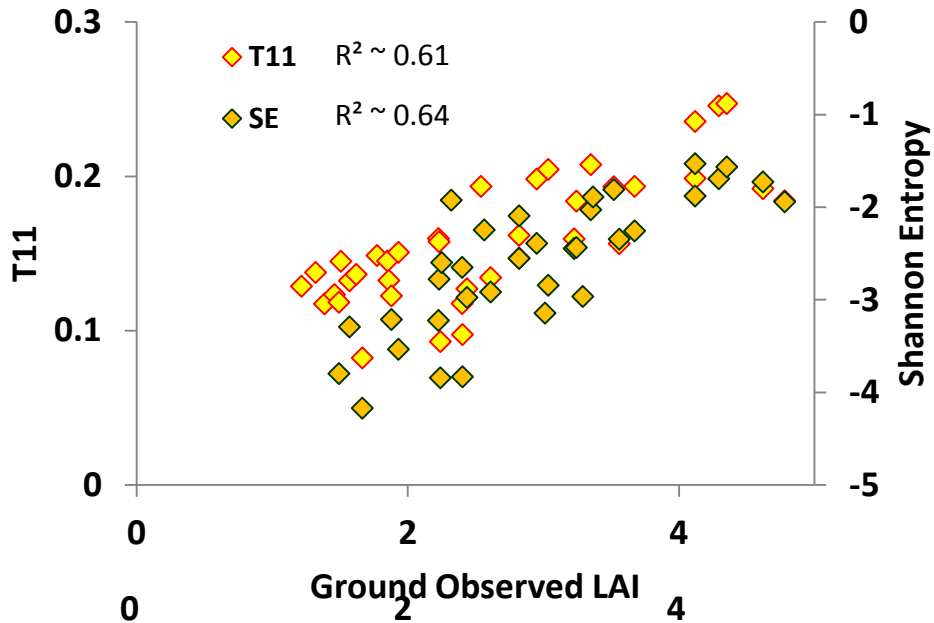
Radarsat-2 SAR Satellite Images

2011 – 2012 – 2013 – 2014 - 2015

2011	2012	2013	2014	2015
26 th May, 2011	07 th July, 2012	08 th June, 2013	17 th June, 2014	28 th Aug, 2015
19 th June, 2011	31 st July, 2012	02 nd July, 2013	11 th July, 2014	20 th Sept, 2015
13 th July, 2011	24 th Aug, 2012	26 th July, 2013	15 th July, 2014	14 th Oct, 2015
06 th Aug, 2011	17 th Sept, 2012	19 th Aug, 2013	04 th Aug, 2014	07 th Nov, 2015
30 th Aug, 2011	11 th Oct, 2012	12 th Sept, 2013	28 th Aug, 2014	01 st Dec, 2015
23 rd Sept, 2011	04 th Nov, 2012	06 th Oct, 2013	01 st Sept, 2014	25 th Dec, 2015
	28 th Nov, 2012	10 th Oct, 2013	21 st Sept, 2014	
	22 nd Dec, 2012	24 th Oct, 2013	15 th Oct, 2014	
	15 th Jan, 2013	30 th Oct, 2013	08 th Nov, 2014	
		23 rd Nov, 2013	12 th Nov, 2014	
			02 nd Dec, 2014	
6 images FullPol	9 images FullPol	9 images FullPol	8 images FullPol	6 images UltraFine
		1 image UltraFine	3 images UltraFine	

- Ground observation was carried out at the time of Radarsat-2 pass.
- The spatial resolution of QuardPol (FullPol) and Ultrafine images are 5.8m and 2m respectively.

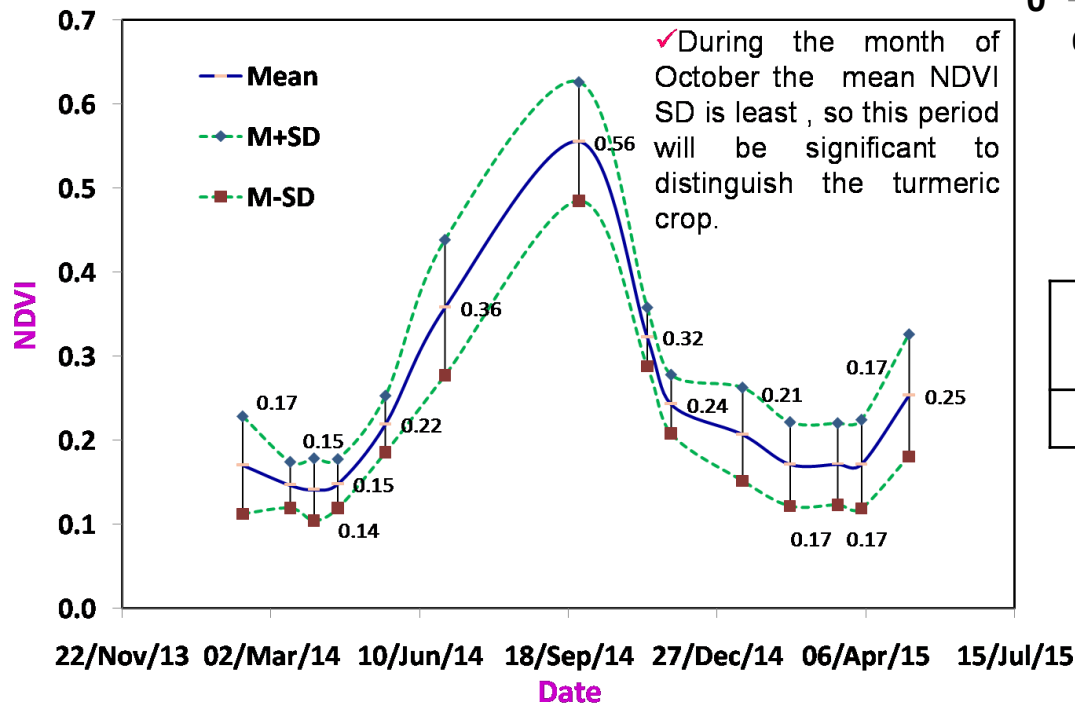
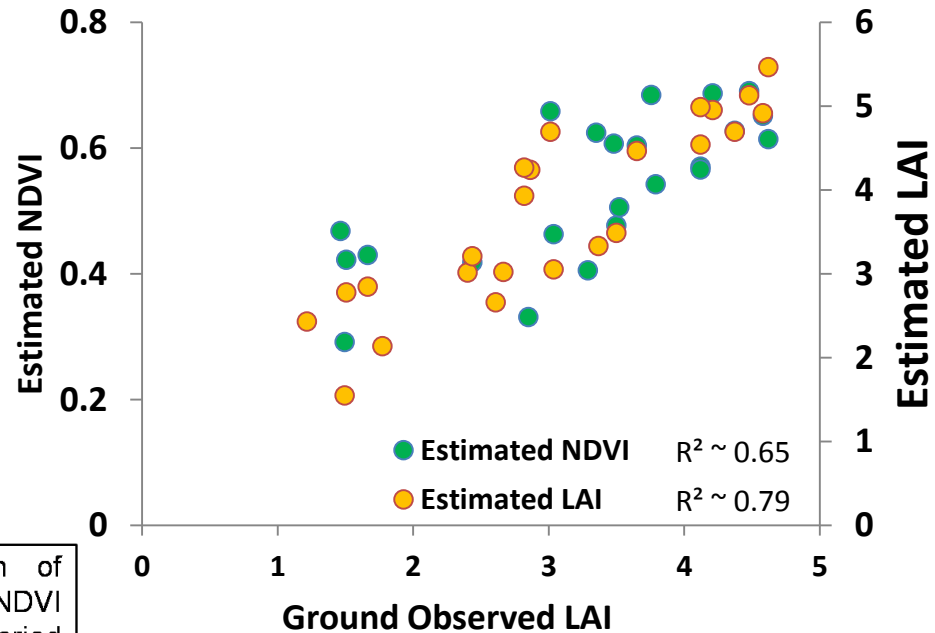
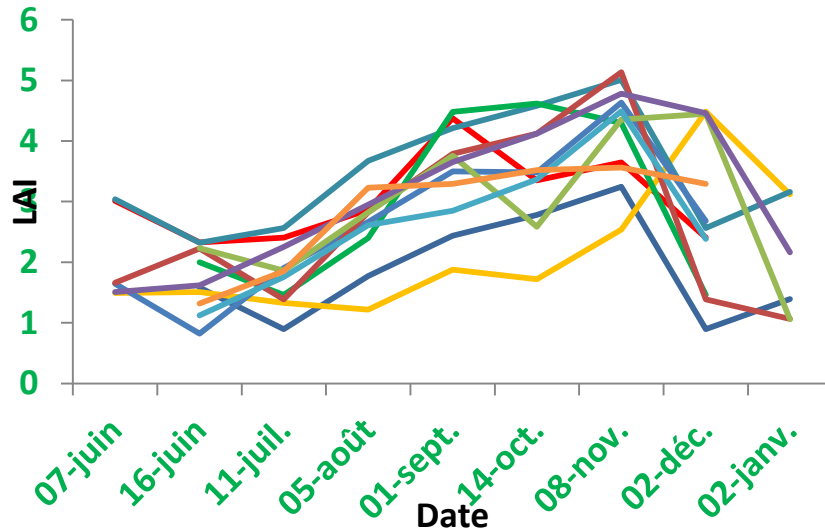
Relation between Ground Observed LAI and SAR derived indices (Turmeric crop)



Variable	R ²	Kappa coefficient
T33	0.78	0.95
HV	0.65	0.79
FD_Vol	0.65	0.75
Alpha	0.63	0.75
Shannon Entropy	0.61	0.76
T22	0.61	0.79
Entropy	0.60	0.80

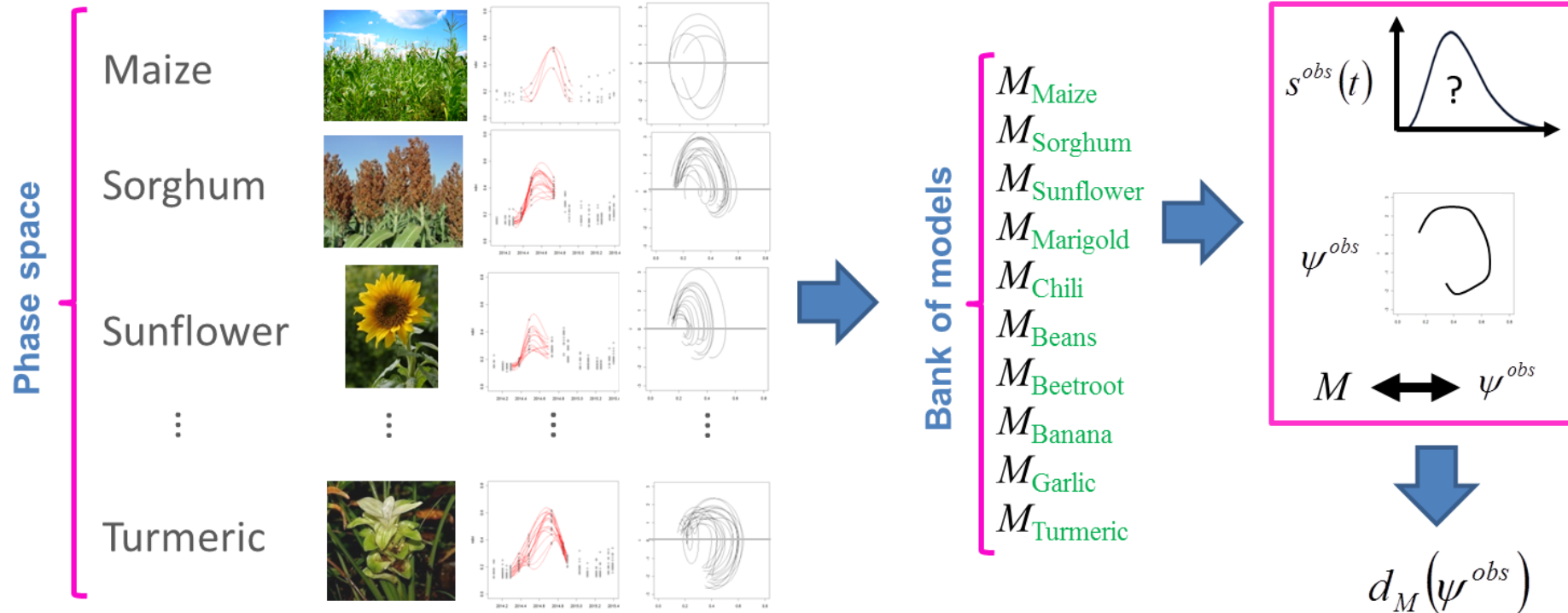
Crop type classification (2014-15)

Optical indices for crop detection (Turmeric crop)



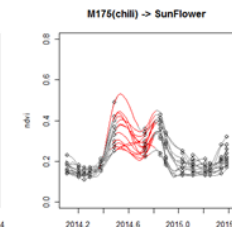
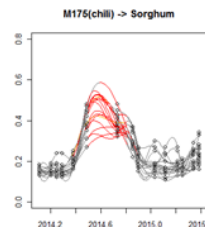
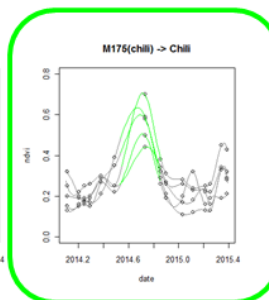
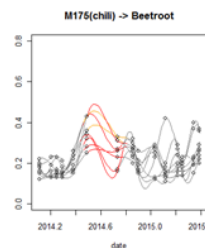
Variable	R^2	Kappa coefficient
LAI	0.77	0.87

Chaos modelling applied to crop detection



Example:

M_{Chili}



Detection



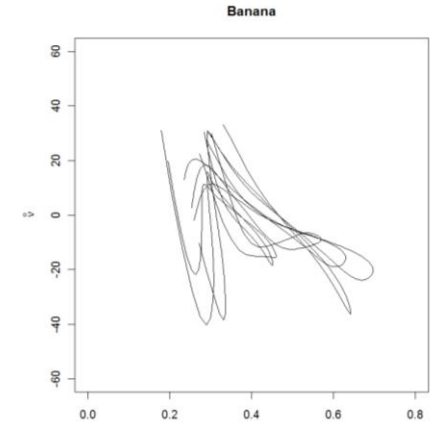
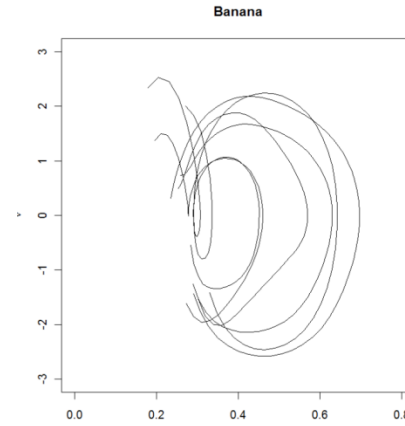
statistics

100% ok
(5/5)

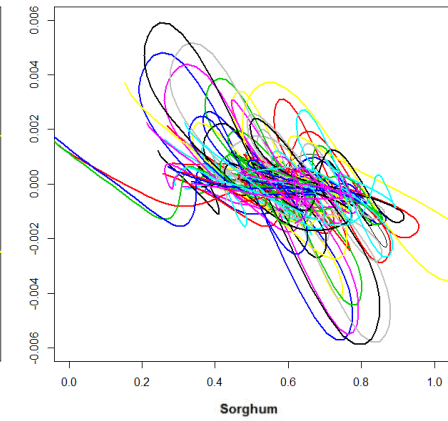
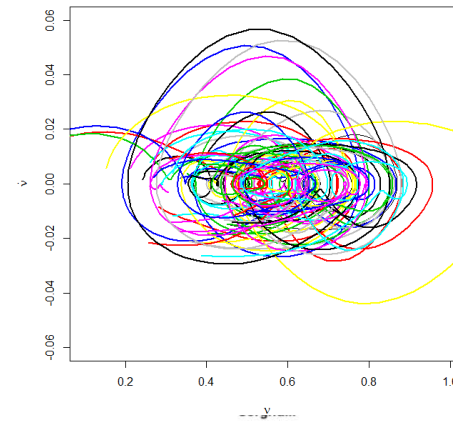
4% erroneous
(4/104)

Chaos implementation for precise crop classification

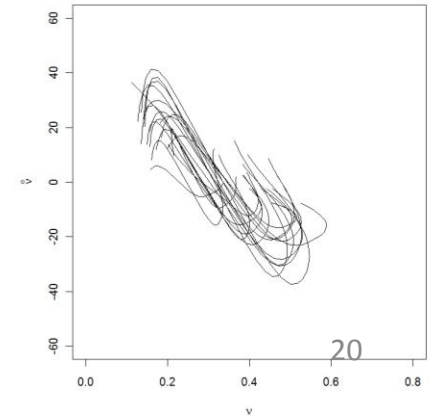
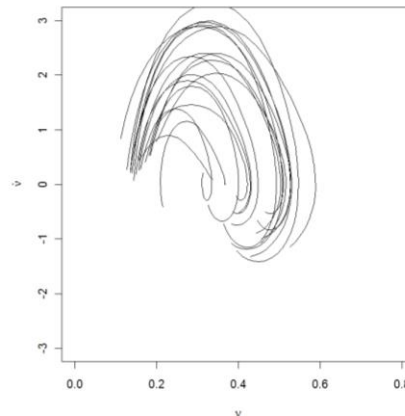
Banana



Turmeric



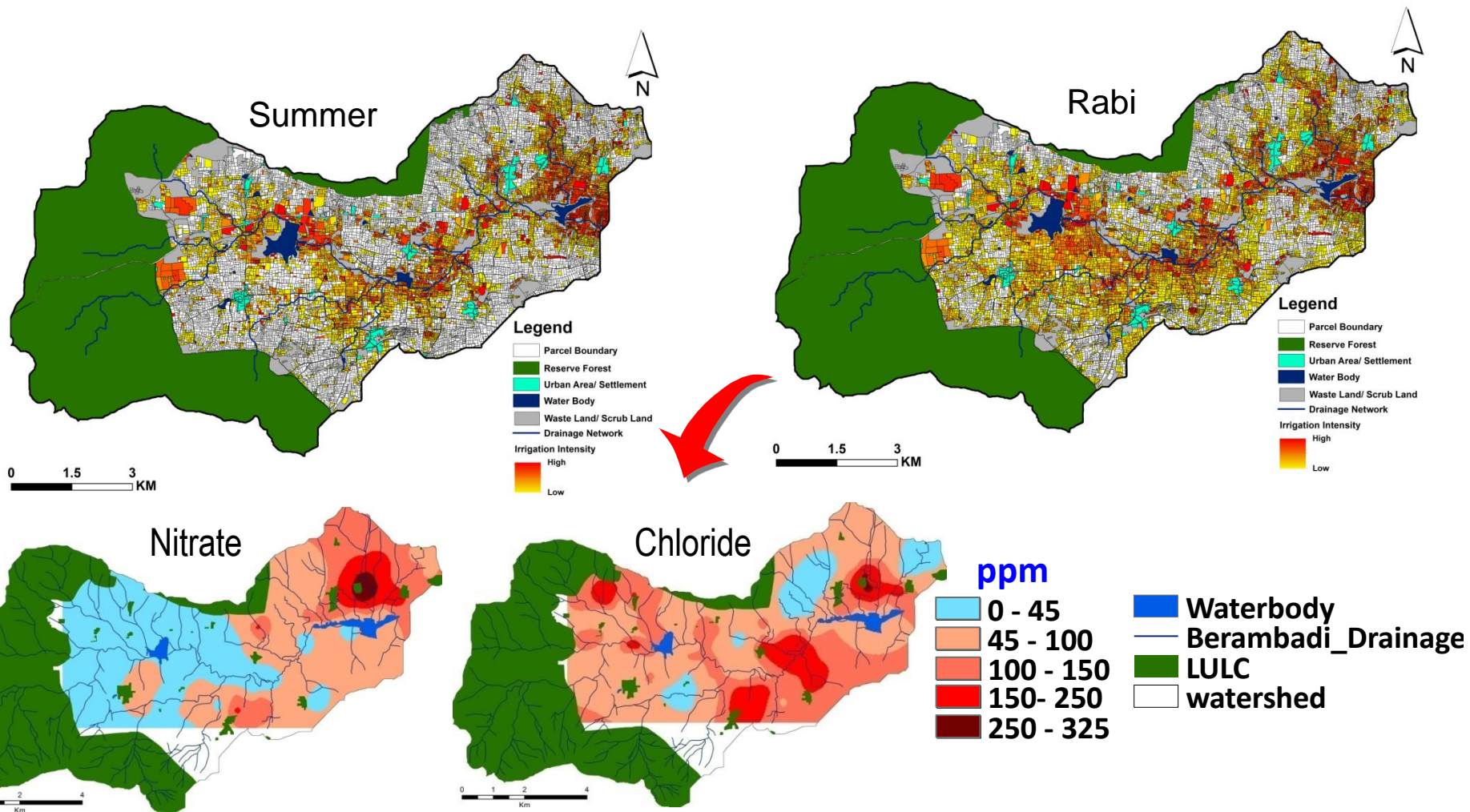
Sorghum



Groundwater quality and Irrigation history

Links between Land-use and GW Quality

Buvaneshwari ,2016



- ✓ Annual application in the watershed is more than 12tonnes of nitrogen/km2
- ✓ Application in the irrigated area is twice more than the rainfed area

Summary

- Intensive irrigation (2-3 crops per year) in the watershed forces farmers to pump huge amount of groundwater, which impacts on it's yield and quality.
- Excess use of this resource for irrigation has led to widespread depletion of GWL and it affects crop yields.
- Due to extensive use of inorganic fertilizers, many farmlands became saline.
- A difficult stack where two or three months of cloudy conditions during the monsoon period can hide crop growth.



Field survey under project : Irriga-Detection (TOSCA)

- 11th – 14th June, 2017 (4 Days)
 - Radarsat-2 pass
 - Crop survey
 - Farmer survey
 - SSM
 - LAI
 - 24th – 29th July, 2017 (5 Days)
 - Radarsat-2 pass
 - Crop survey
 - SSM
 - LAI
 - 21st – 25th Aug, 2017 (5 Days)
 - Radarsat-2 pass
 - Crop survey
 - SSM
 - LAI
- Transportation - 270
 - Hotel - 110
 - Food - 100
 - Helper- 50
 - Others – 20
 - **Total – 550**
-
- Transportation - 250
 - Hotel - 80
 - Food - 80
 - Helper- 40
 - Others – 25
 - **Total – 475**
-
- Transportation - 250
 - Hotel - 80
 - Food - 80
 - Helper- 40
 - Others – 25
 - **Total – 475**





Merci de votre attention !

http://geowww.agrocampus-ouest.fr/web/?page_id=1800

<http://bvet.obs-mip.fr/>

<http://ambhas.com/>