



Remote Sensing-based Information and Insurance for Crops in Emerging Economy



**Application of Remote Sensing Technology
in Crop Insurance
Experience from RIICE project in Tamil Nadu, India**

Using remote sensing information in Crop Insurance

Bi-weekly information on crop growth status, derived by European and Indian cloud-free satellite data



Observation on delays in rice growing helps to guide decision on **Preventive Sowing/ On Account Payment Cover**



End-of-season yield estimation at village level can guide **Crop Cutting Experiments** (“Smart sampling”)

Leveraging new technologies

Turning the value chain of crop information digital

Large scale, high resolution SAR-RS of rice areas



Crop models adjusted by remote sensing



Smartphone based rapid data collection



Cloud platforms scalable, reliable and timely

All remote sensing data stored, processed and analyzed on the cloud.

All field data collected by mobile phone, sent to the cloud over mobile or Wi-Fi network.

Timely, detailed, and accurate information made available to the users.

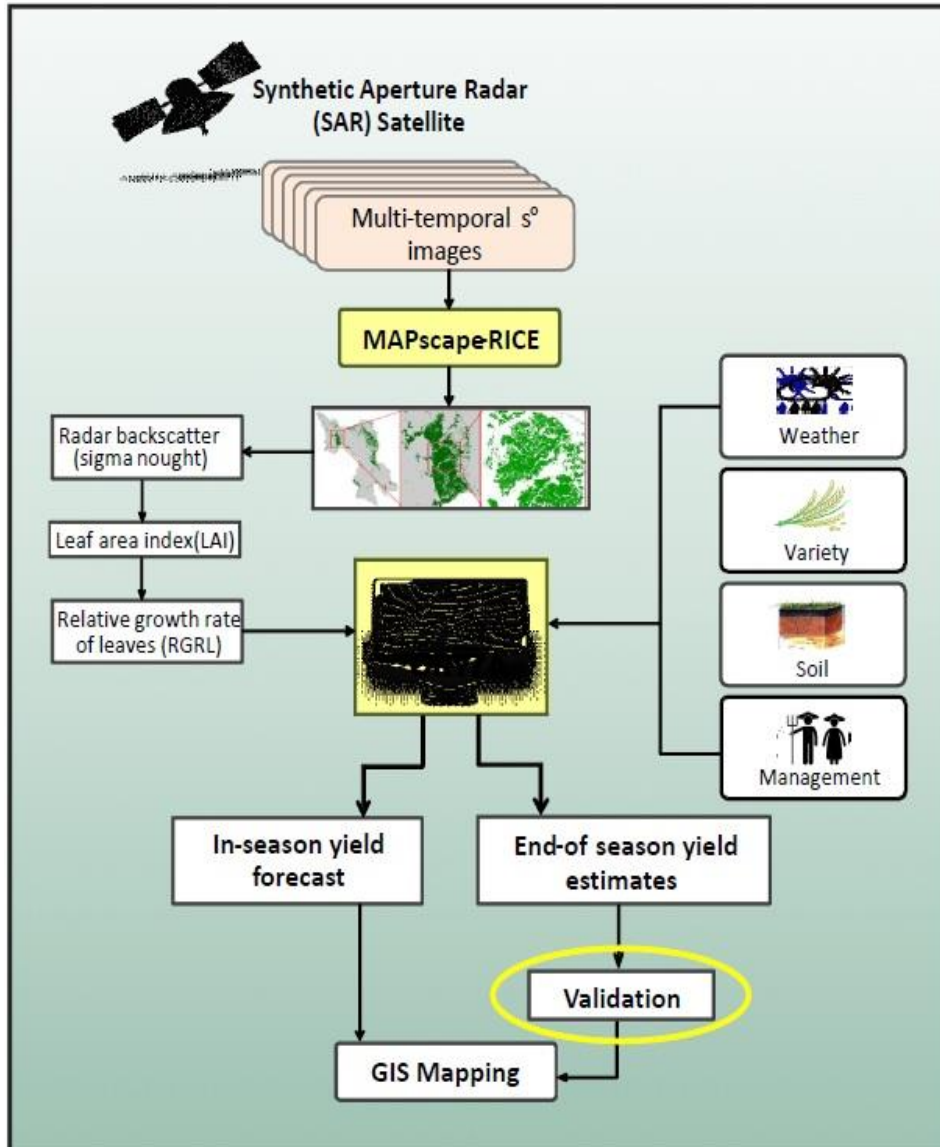




Information delivered through remote sensing analysis:

- How much area was planted this season in each district/block/village?
- What was the yield in each district/block/village?
- Was production more or less than last year?
- Was the harvest early or late?
- Adverse climatic conditions: flood or drought?
 - Where and how much area was affected?
 - How much yield was lost in such areas?

Methodology



Automated Processing chain MAPscape-RIICE

1. Automatic grouping of the data belonging to the same acquisition geometry
2. Slant range mosaicking
3. Multilooking
4. Coregistration
5. De-speckle filtering (Time series or Single date)
6. Geocoding
7. ANLD filtering








Overview of Sentinel 1A acquisition and coverage over TamilNadu

Copernicus Open Access Hub

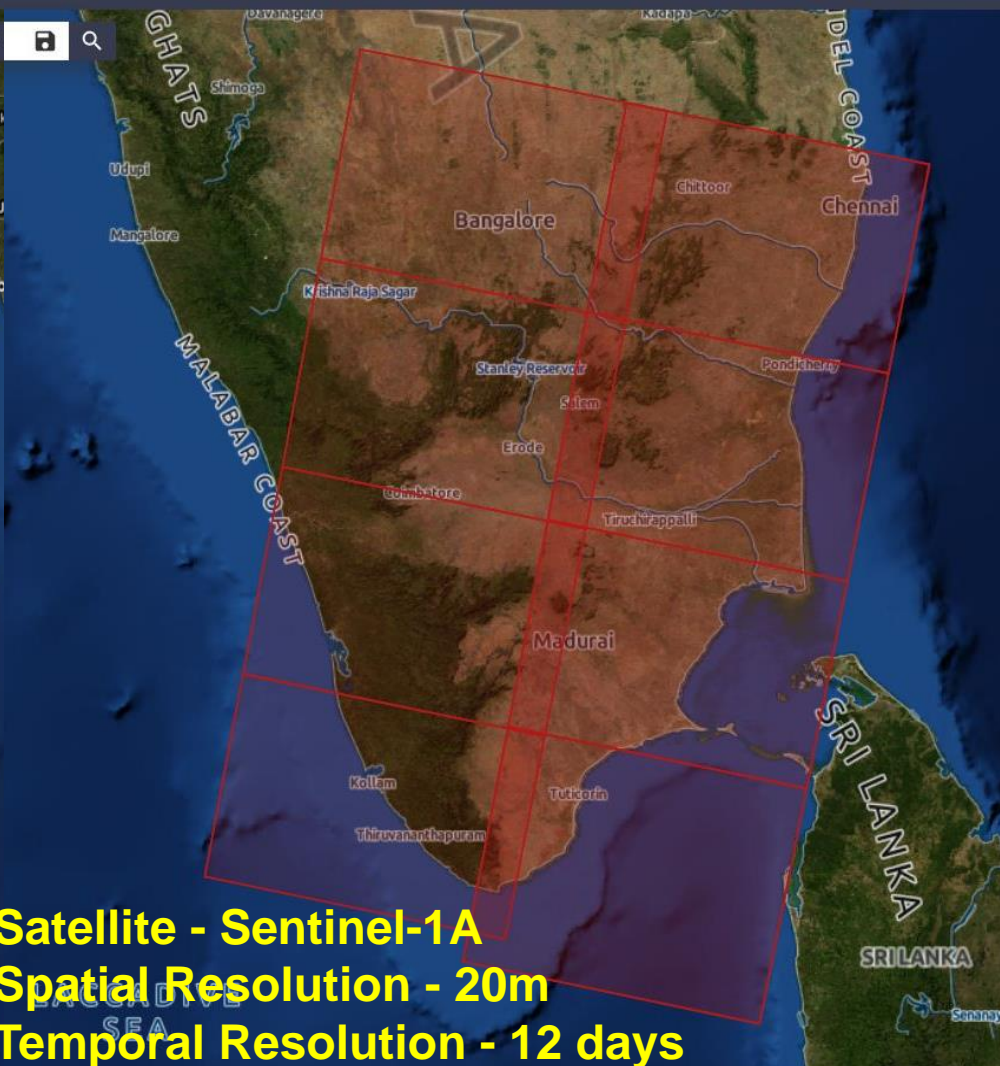
Insert search criteria...

Display 1 to 9 of 9 products. Select All

Request Done: (footprint:"Intersects(POLYGON((79.05159942548309 9.746249424628658,79.3996226080039 9.746249424628658,79.3996226080039 12.347231976012566,79.05159942548309 12.347231976012566,79.05159942548309 9.746249424628658,79.3996226080039 9.746249424628658))")

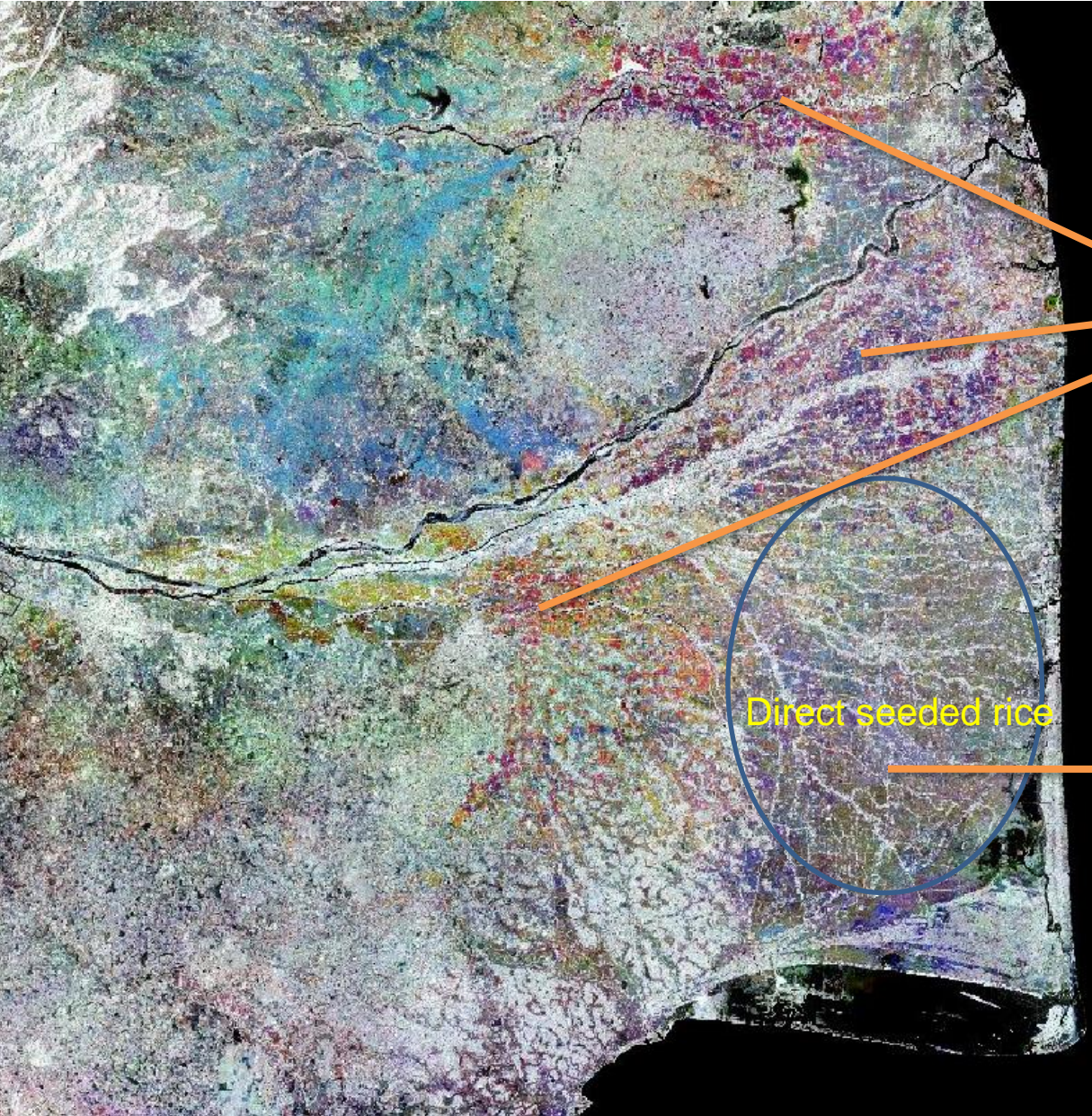
	S1A SAR-C S1A_IW_GRDH_1SDV_20150901T003159_20150901T003224_007514_00A615_FE5E Download URL: https://scihub.copernicus.eu/dhus/odata/v1/Products('1c8c210d-1208-468c-86bf-1d37ca4c449f') Mission: Sentinel-1; Instrument: SAR-C; Sensing Date: 2015-09-01T00:31:59.796Z; Size: 1 GB
	S1A SAR-C S1A_IW_GRDH_1SDV_20150901T003224_20150901T003249_007514_00A615_EBC4 Download URL: https://scihub.copernicus.eu/dhus/odata/v1/Products('0ae09962-6623-4dd4-84f9-8f940dcb650f') Mission: Sentinel-1; Instrument: SAR-C; Sensing Date: 2015-09-01T00:32:24.796Z; Size: 1 GB
	S1A SAR-C S1A_IW_GRDH_1SDV_20150901T003130_20150901T003159_007514_00A615_1A84 Download URL: https://scihub.copernicus.eu/dhus/odata/v1/Products('22401c80-4b0f-4e6d-8823-1254934a310') Mission: Sentinel-1; Instrument: SAR-C; Sensing Date: 2015-09-01T00:31:30.898Z; Size: 1 GB
	S1A SAR-C S1A_IW_GRDH_1SDV_20150820T003159_20150820T003224_007339_00A149_8CB7 Download URL: https://scihub.copernicus.eu/dhus/odata/v1/Products('dea6a9ab-3203-4ad0-b9a3-21c361738f7') Mission: Sentinel-1; Instrument: SAR-C; Sensing Date: 2015-08-20T00:31:59.330Z; Size: 1 GB
	S1A SAR-C S1A_IW_GRDH_1SDV_20150820T003224_20150820T003249_007339_00A149_E9EC Download URL: https://scihub.copernicus.eu/dhus/odata/v1/Products('77c1961b-8e8e-4cbd-b996-cf26897156e9') Mission: Sentinel-1; Instrument: SAR-C; Sensing Date: 2015-08-20T00:32:24.331Z; Size: 1 GB
	S1A SAR-C S1A_IW_GRDH_1SDV_20150820T003130_20150820T003159_007339_00A149_A6BE Download URL: https://scihub.copernicus.eu/dhus/odata/v1/Products('18fea672-6efa-409fa758-a6706a7b497c') Mission: Sentinel-1; Instrument: SAR-C; Sensing Date: 2015-08-20T00:31:30.420Z; Size: 1 GB
	S1A SAR-C S1A_IW_GRDH_1SDV_20150808T003223_20150808T003248_007164_009C87_7788

Products per page: 25 << >> page: 1 of 1 >>> CLOSE



Satellite - Sentinel-1A
Spatial Resolution - 20m
Temporal Resolution - 12 days

Transplanted and Direct Seeded Rice as seen from Satellite



Transplanted Rice

Direct seeded rice

Direct Seeded Rice

Developed dB curves for different crops using SAR

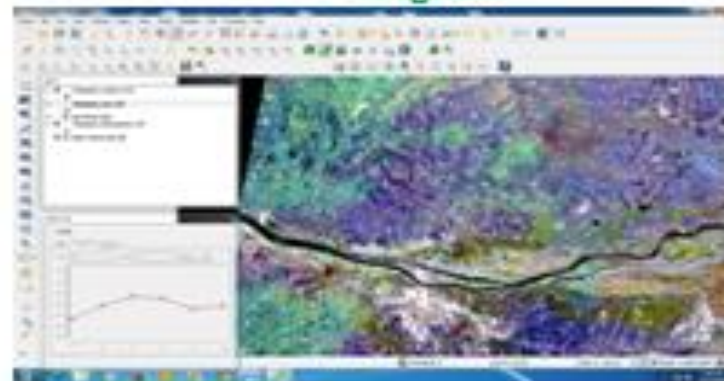
The results will be useful in devising methodology in parameters for mapping these and monitoring the growth in future

dB curves for different crops generated from SAR backscattering

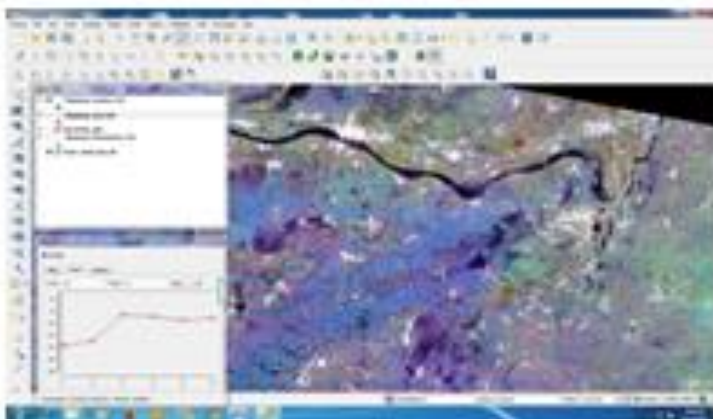
Rice



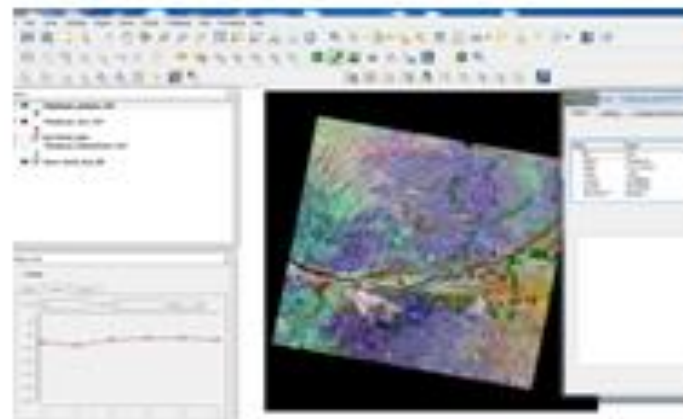
Sorghum



Cotton



Banana



Products

- Rice area maps
- Rice seasonality maps
 - Start of the season maps
 - peak of the season maps
- Rice phenology maps
- Rice yield maps

Rice area validation and accuracy assessment

Sensor - Sentinel-1A

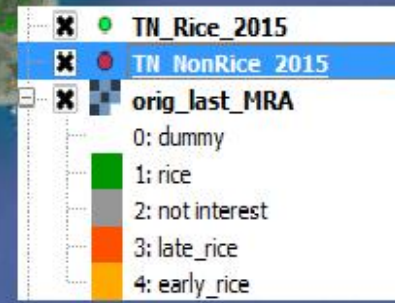
Spatial Resolution - 20m

Temporal Resolution - 12 days

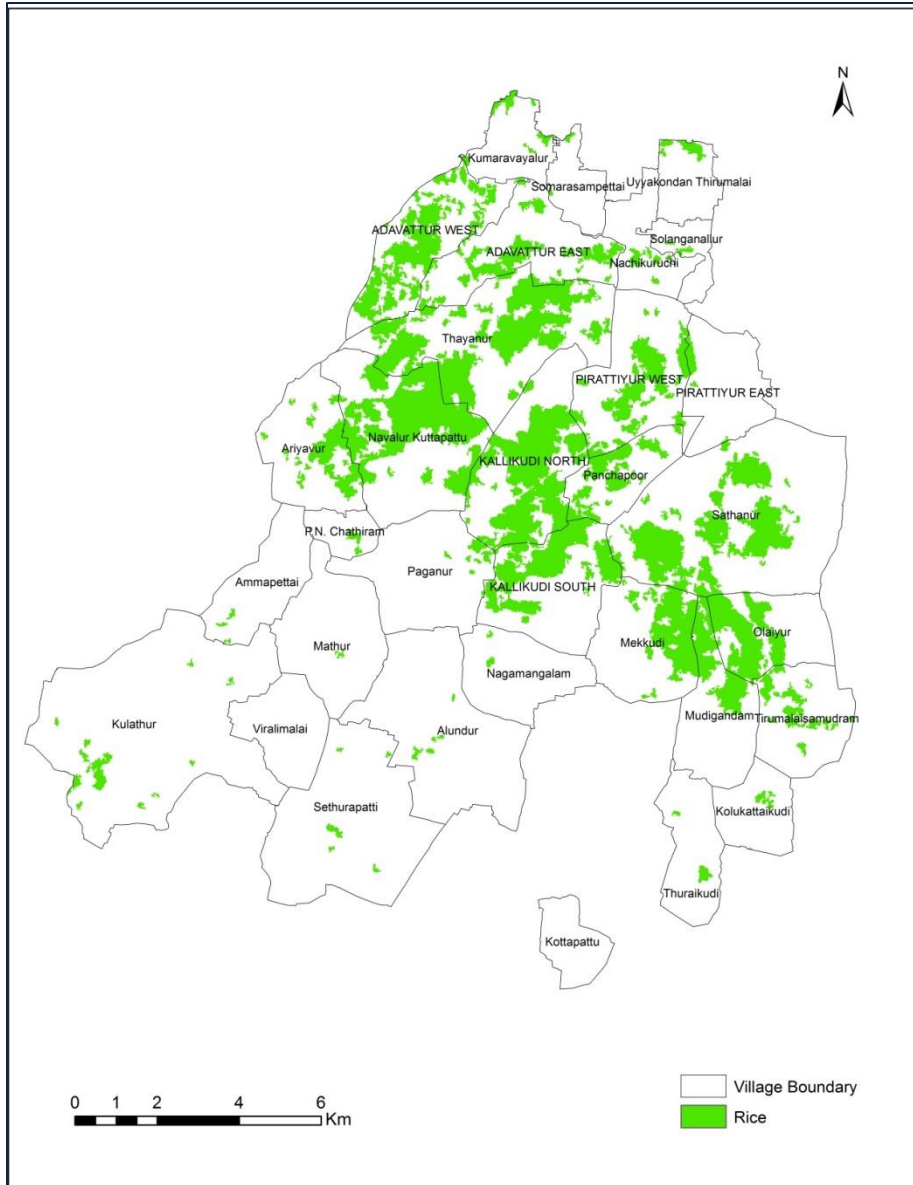
Districts covered:

Cuddalore, Ariyalur, Perambalur,
Tiruchirapalli, Thanjavur, Thiruvarur,
Nagapattinam and Pudukkottai

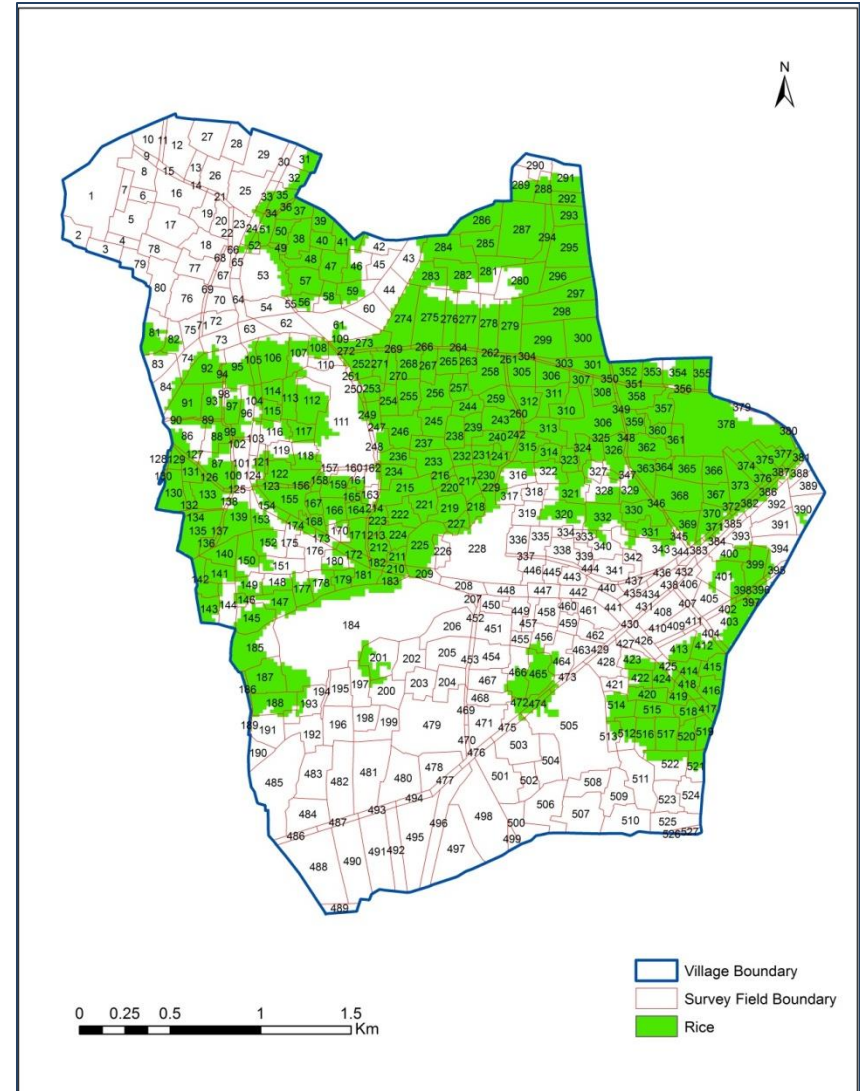
Confusion matrix computations from the "Accuracy Data" worksheet				
		Predicted class from the map		Accuracy
		Rice	Non-Rice	
Actual class from survey	Rice	162	14	92.0%
	Non-Rice	6	138	95.8%
Reliability		96.4%	90.8%	93.8%
Average accuracy		93.9%		
Average reliability		93.6%		
Overall accuracy		93.8%	Good Accuracy	
Kappa index		0.88		



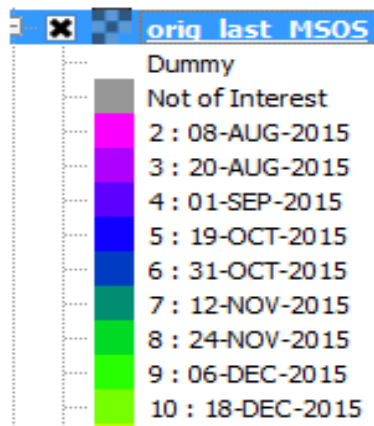
Rice Map of Manikandam Block



Rice Map of Navalur Kuttapattu Village of Manikandam Block



Start of the Season map



Rice Yield Estimation using RiceYES V 1.0

Homepage

REMOTE SENSING OPTION

Assimilate Remote Sensing Data

X Band SAR

Option for Test Run only

SubSample size (%) 1

REMOTE SENSING INPUT

Please Select DBStack File and SOS to Assimilate

Filter DBStack File [View](#)

Sep25Jan28_SoS_14-NOV-2014.csv
 Sep25Jan28_SoS_20-OCT-2014.csv
 Sep25Jan28_SoS_25-SEP-2014.csv

Select SOS Date

09-25-2014
 10-20-2014
 11-14-2014
 12-09-2014
 01-03-2015

DBStack File/s to Assimilate

Sep25Jan28_SoS_14-NOV-2014.csv,11-14-2014
 Sep25Jan28_SoS_20-OCT-2014.csv,10-20-2014
 Sep25Jan28_SoS_25-SEP-2014.csv,09-25-2014

YIELD LEVEL SETTING

Actual Yield Potential Yield

Nitrogen Sensitive Water Sensitive

MANAGEMENT SETTING

Establishment [View Management File](#)

Method of Establishment **TRANSPLANT**

Irrigation

0 1 **2** 3 4 5

75. 10.
 IRR12 WLOMIN

Automatic irrigation at min. standing soil water depth.

Fertilizer Rate

Days after emergence	FRate (kg N/ha)
20	40
38	45
55	40

Variety [View Variety File](#)

Filter Variety List

VAR 150.DAT

SOIL FILE

Soil

Filter Soil List

SOILORYZA.DAT
 WISEPD25910_Thanjavur.DAT

[View Soil File](#) [Generate Soil File](#)

WEATHER FILE

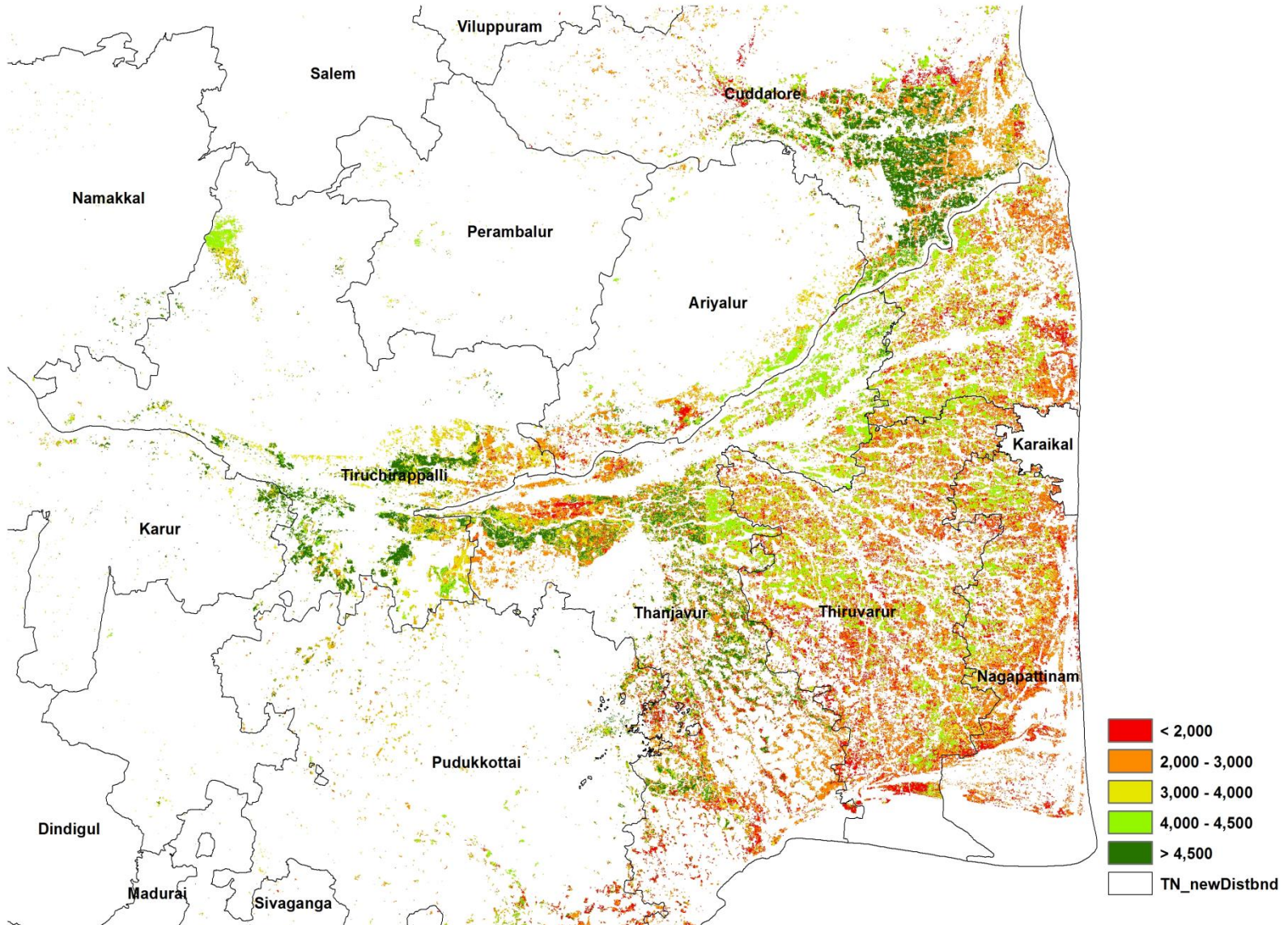
Weather

Filter Weather List

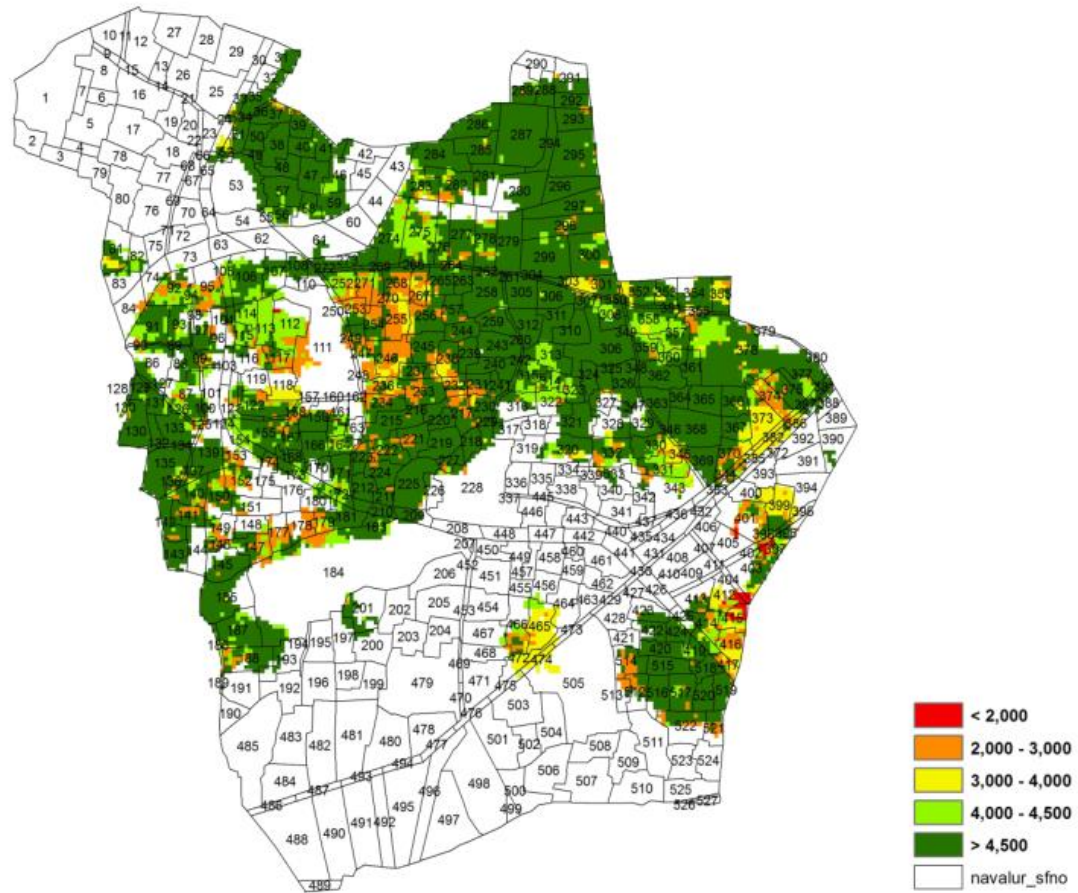
nstr456077.014
 nstr456077.015

nstr 456077 2014

Rice yield map 2015-16



Cadastral level yield map



Individual Farm Level Yield Results, Thanjavur District

Farm Level CCE Yield vs ORYZAYesv1 Model Derived Yield

No. of blocks covered	7
No. of villages covered	32
Sample size of CCE fields	55
Farm level yield accuracy (Samba season 2014-15)***	90.1%

Farm level yield estimates

Value Tool

Enable

Table Graph Options

Decimals 2

	Layer	Value
1	site09_2014_Yield	5927.5

Coordinate: (79.248440, 10.867200)

Identify Results

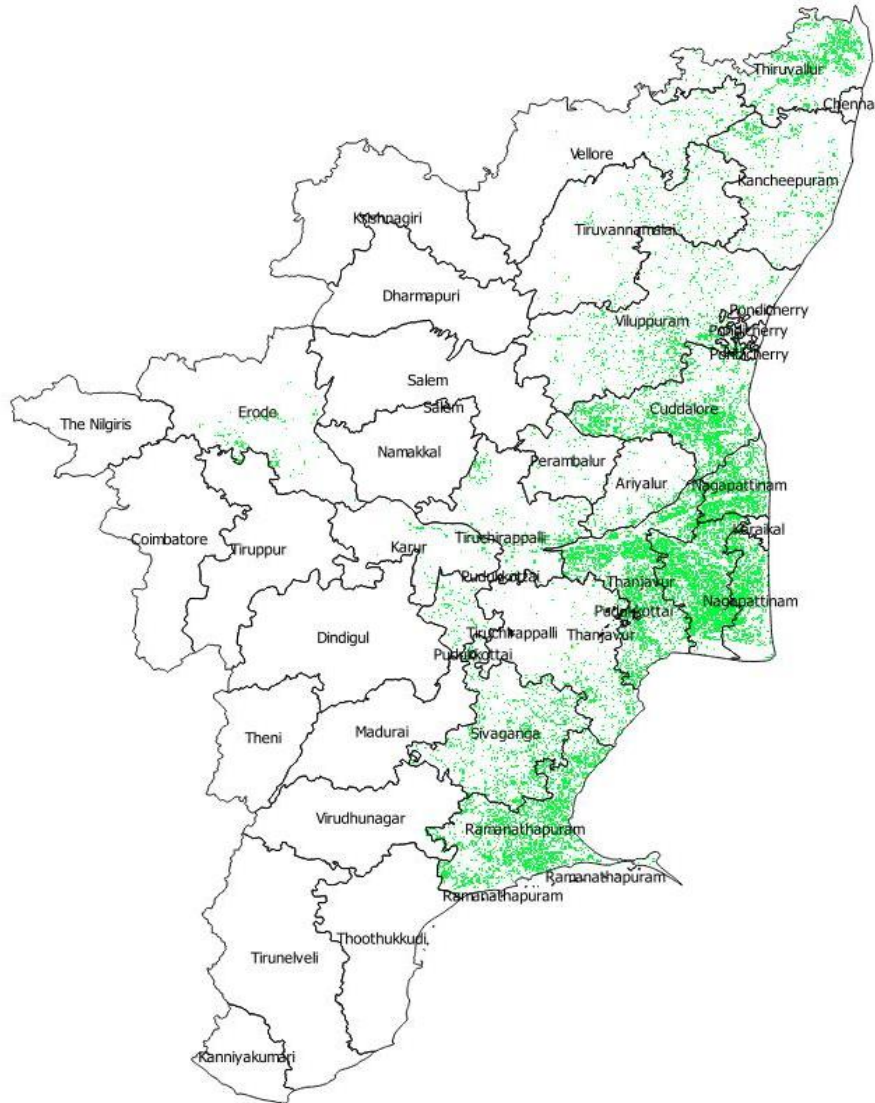
Value	Feature
NULL	Input_Rice_ExcelF_csv
	Block_Name
	(Derived)
	(Actions)
67	Field No.
NULL	Block_Name
NULL	Village
3	Corner ID
NULL	Variety
NULL	Farmer_name
NULL	Father_name
NULL	Random No.
NULL	Survey No.
NULL	Harvest dt.
10.867858	Latitude(Y)
79.248353	Longitude(X)

Mode: Layer selection Auto open form

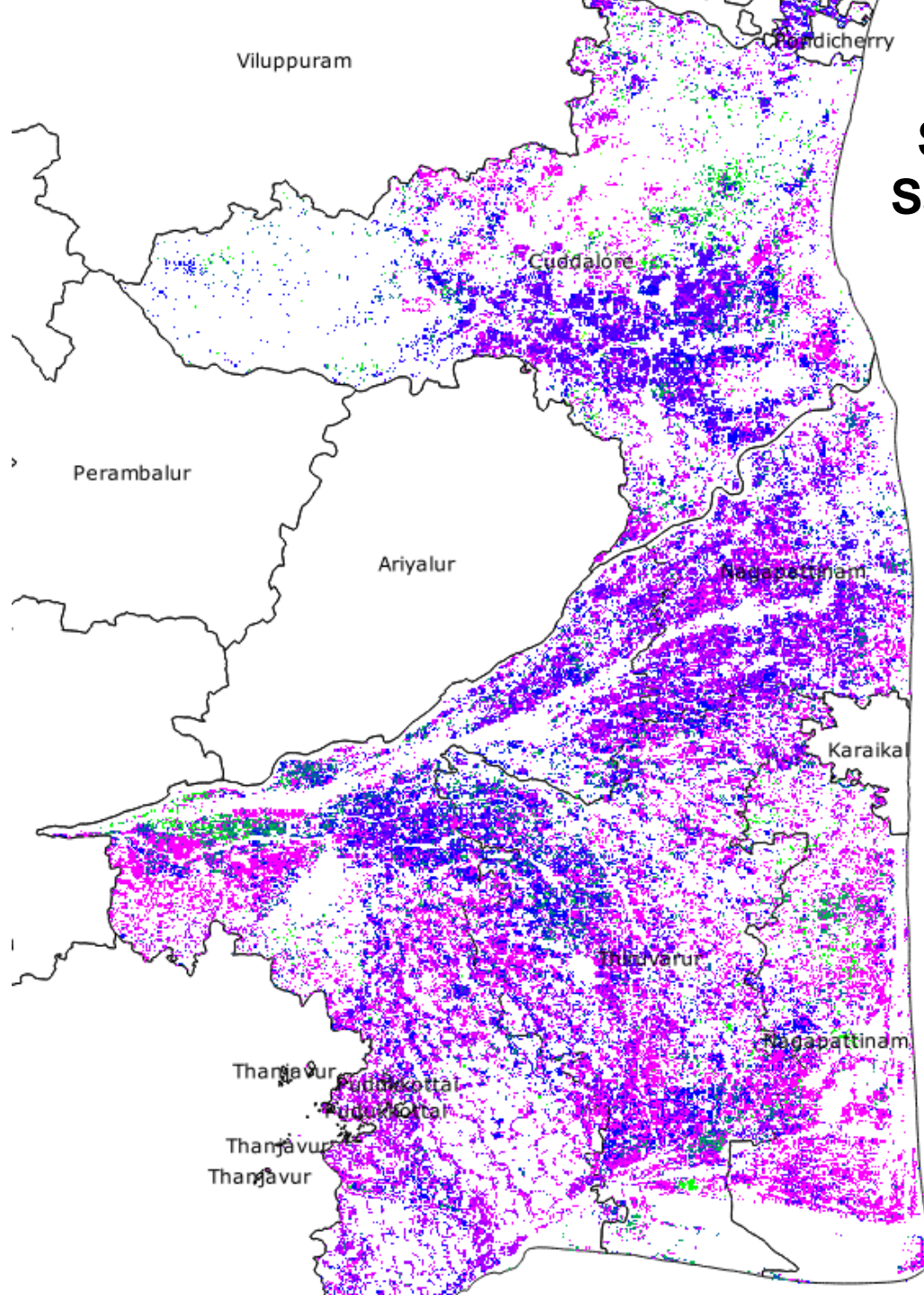
View: Tree Help

Rice area and Start of Season Map Samba 2016

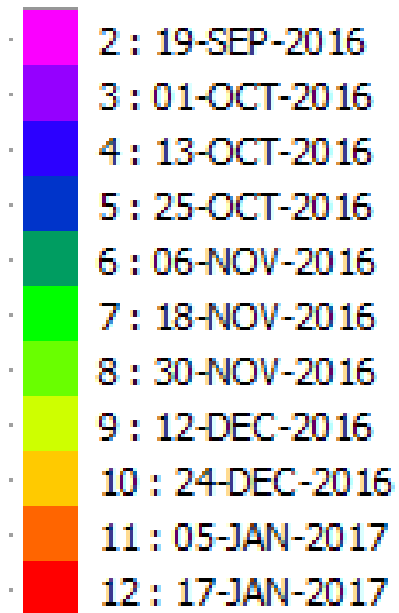
Rice area Map and Statistics - Samba 2016 – Major Districts of Tamilnadu



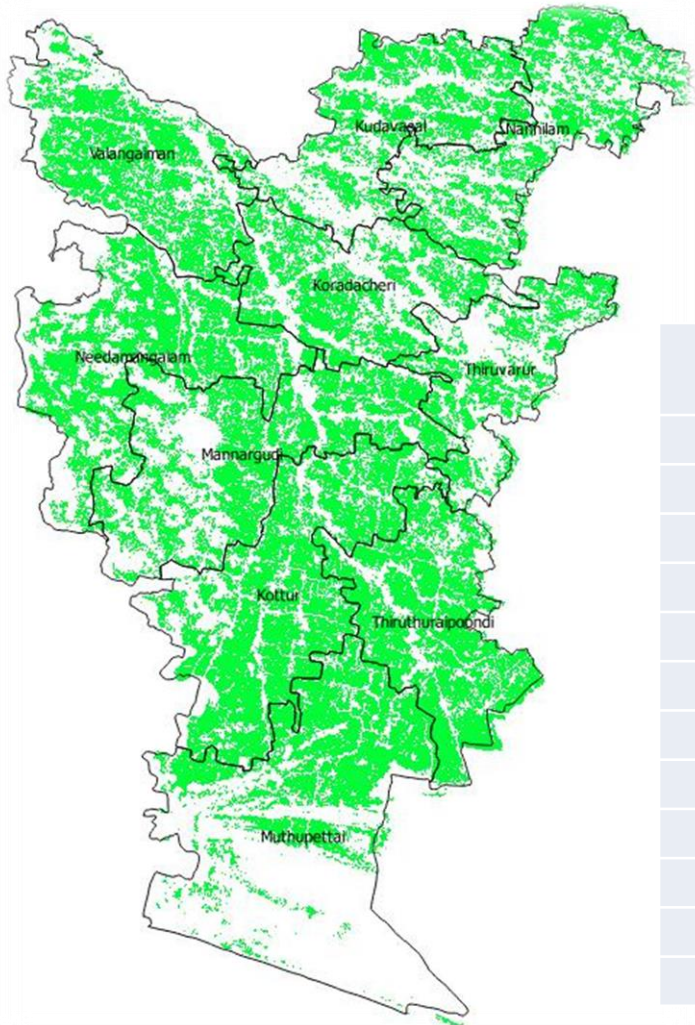
District	Area (ha)
Ariyalur	10768
Cuddalore	104856
Erode	3025
Karur	4719
Nagapattinam	103211
Namakkal	2349
Perambalur	4437
Pudukkottai	32088
Ramanathapuram	121569
Sivaganga	58826
Thanjavur	132258
Thiruvarur	119019
Tiruchirappalli	23564
Tiruvannamalai	16678
Kanchipuram	24960
Tiruvallur	48896
Vellore	10707
Total	821930



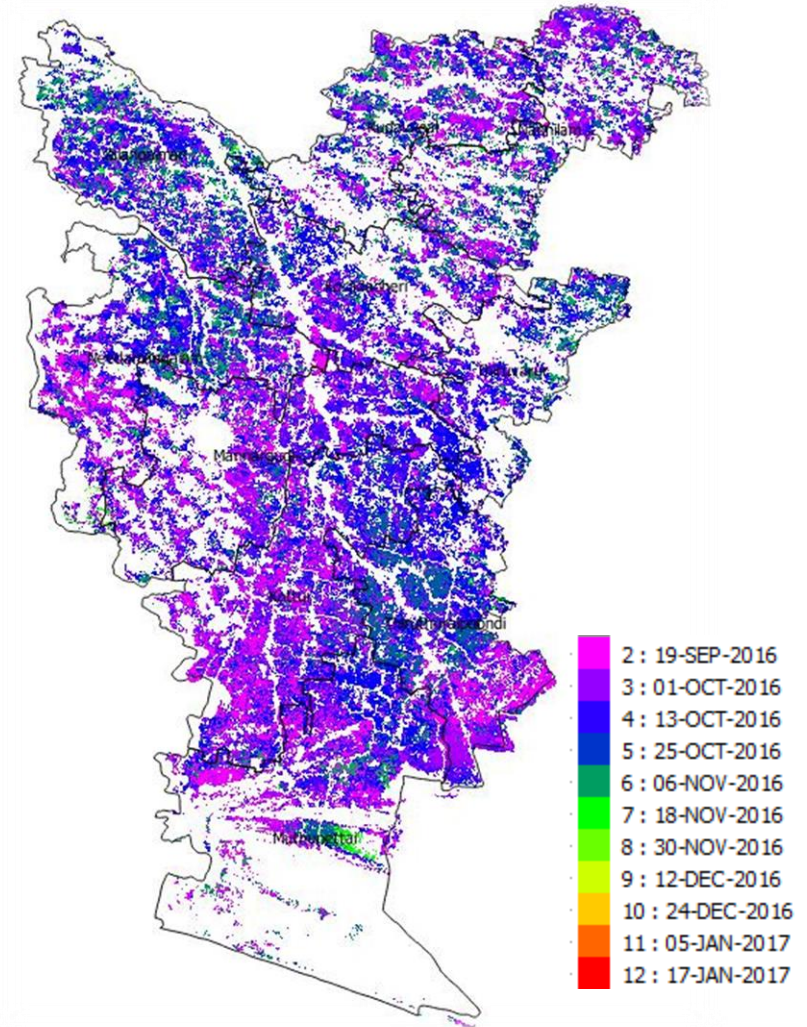
Start of the Season - Samba 2016 – Cauvery Delta Districts of Tamilnadu



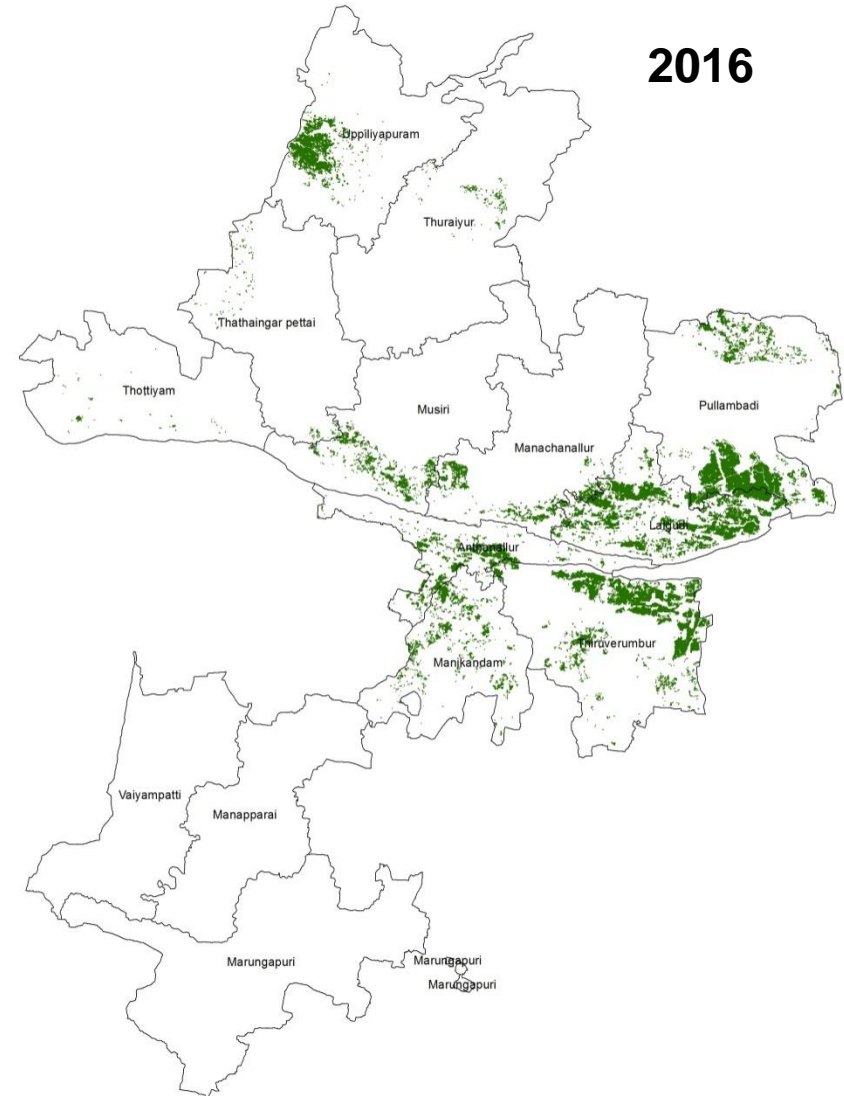
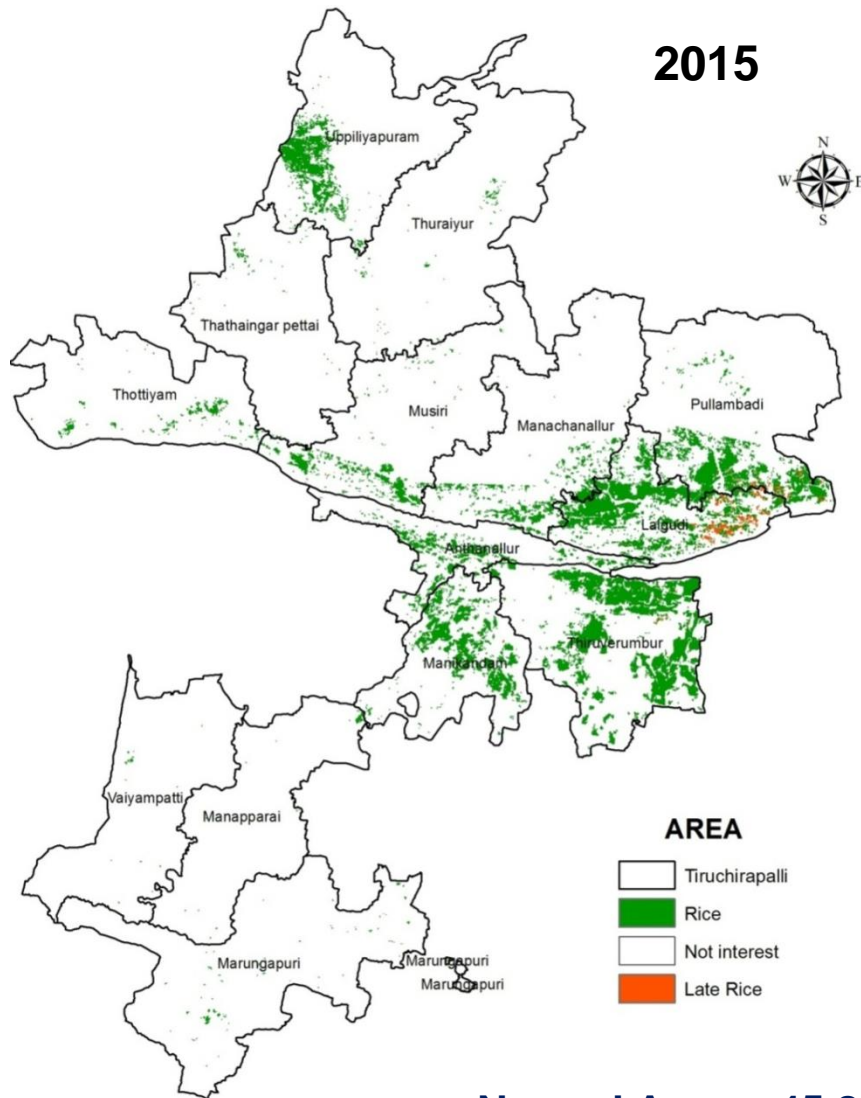
Tiruvarur District - Rice area and Corresponding Date of Planting - Samba 2016



Date	Rice Area (ha)
19-Sep	30114
01-Oct	11115
13-Oct	20790
25-Oct	31972
06-Nov	16871
18-Nov	6811
30-Nov	1067
12-Dec	260
24-Dec	19
05-Jan	0
17-Jan	0
Total	119020



Rice Prevented sowing assessment in Trichy District



Normal Area – 45,800 ha

Area Sown (Samba) – 11,674 ha

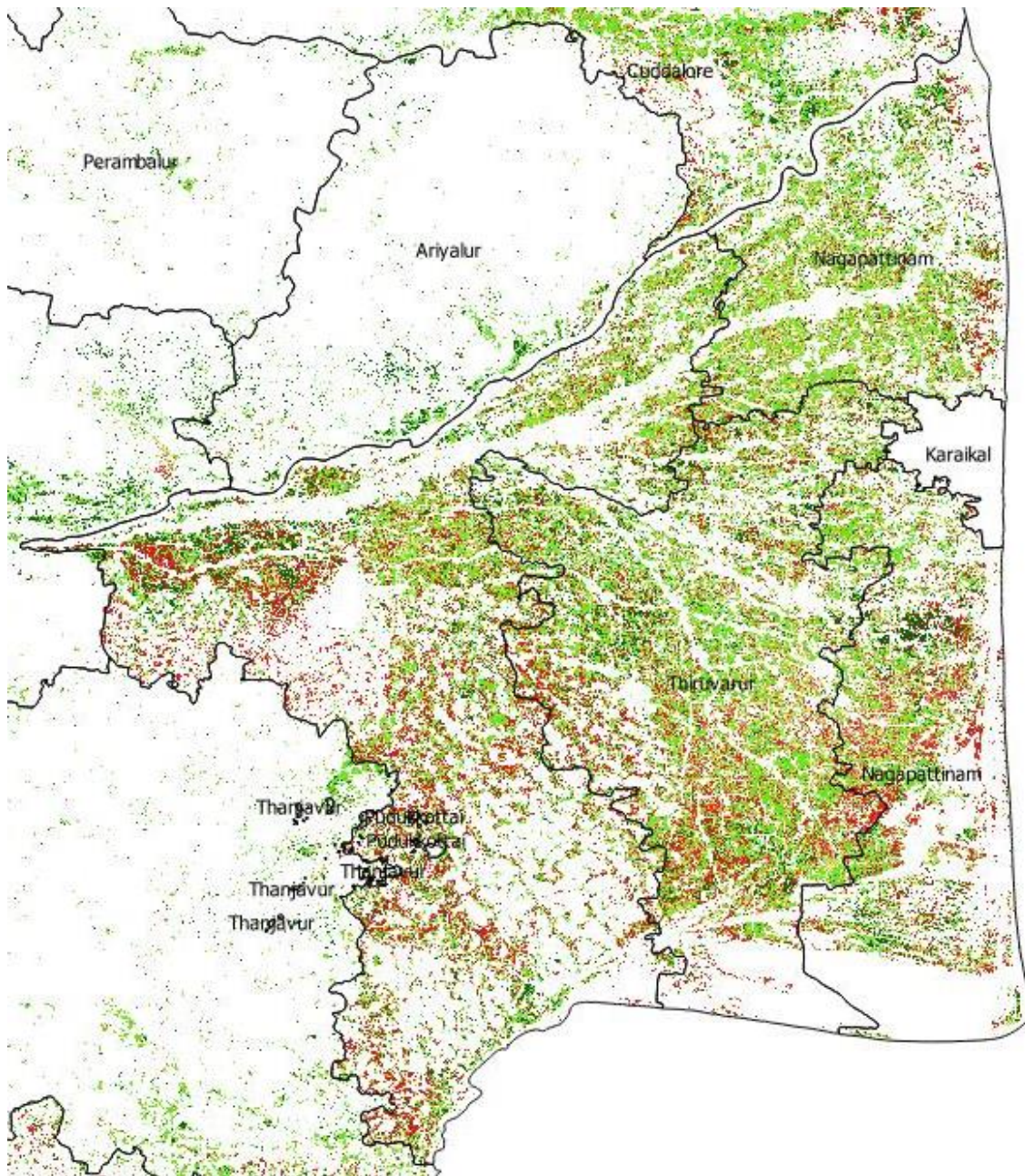
Villages Monitored - 466

Villages Identified for Prevented Sowing - 210

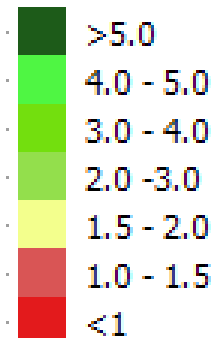
Village wise rice area in Erode district within sowing window

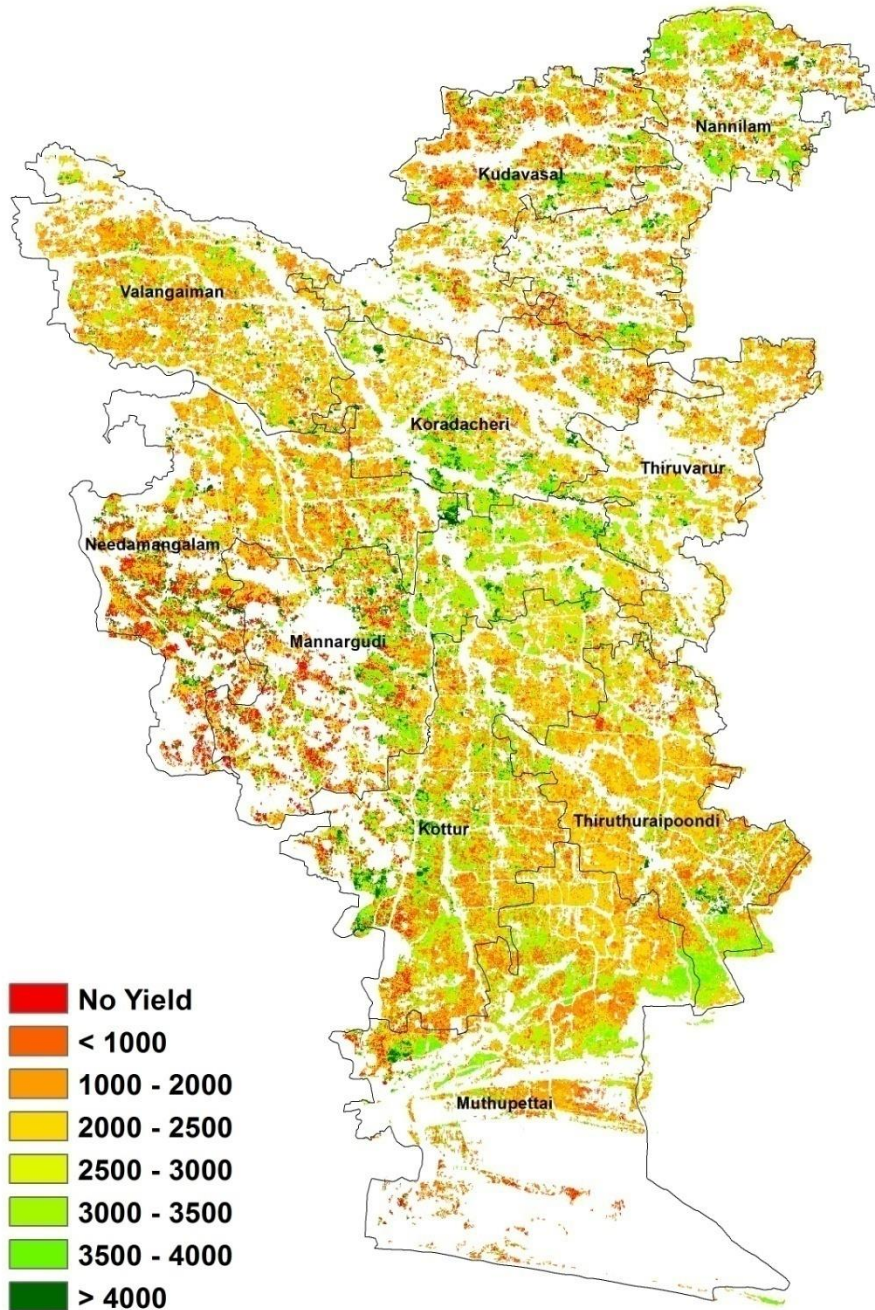
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Erode District Village List	26-Jul	07-Aug	19-Aug	31-Aug	12-Sep	24-Sep	06-Oct	18-Oct	30-Oct	11-Nov	23-Nov	05-Dec	17-Dec	29-Dec	
349	Velampalayam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
350	Velampalayam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
351	Velamundi(R.F.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
352	Vellalapalayam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
353	Vellankovil	0	0	0	0	0	0	0	0	1.64	0	0	0	0	0	
354	Vellithiruppur	0	0.12	1.04	0	0	0.04	0.04	0	0	0	0	0	0	0	
355	Vellottamparappu(TP)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
356	Vemandampalayam	0	0.16	0	0	0	0.4	20.12	37.8	0.44	0	0	0	0	0	
357	Vembathi	0	0	0	0	0	0	0	0.08	4.36	1.44	0	0	0	0	
358	Vengampudur(TP)	0.12	3.16	13	0	0	8.2	4.04	1.88	0.68	0	0	0	0	0	
359	Veppampalayam	0	0	0.12	0	0	0	0	0	0	0	0	0	0	0	
360	Vettaiankinar	0	0	0.04	0	0	0	0	0	0.6	0	0	0	0	0	
361	Vijayapuri (CT)	0	0	0.08	0	0	0.04	0	0.08	0.28	0	0	0	0	0	
362	Vilakethi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
363	Villarasampatti	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
364	Vinnappalli	0	0.04	1.2	0	0	0	0	0	0	0	0	0	0	0	
365	Voipadi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
366	Vyramangalam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
367	total	10.96	510.6	185.88	1.96	54.6	94.52	288.16	1407.64	463.24	8.16	0	0	0	0	
368								625.12								3025.72
369														2015-16		31650
370																

Normal Area – 31,650 ha
Area Sown (Samba) – 625 ha
Villages Monitored - 365
Villages Identified for Prevented Sowing
- 127



LAI for Rice Area - Samba 2016 – Cauvery Delta Districts of Tamilnadu



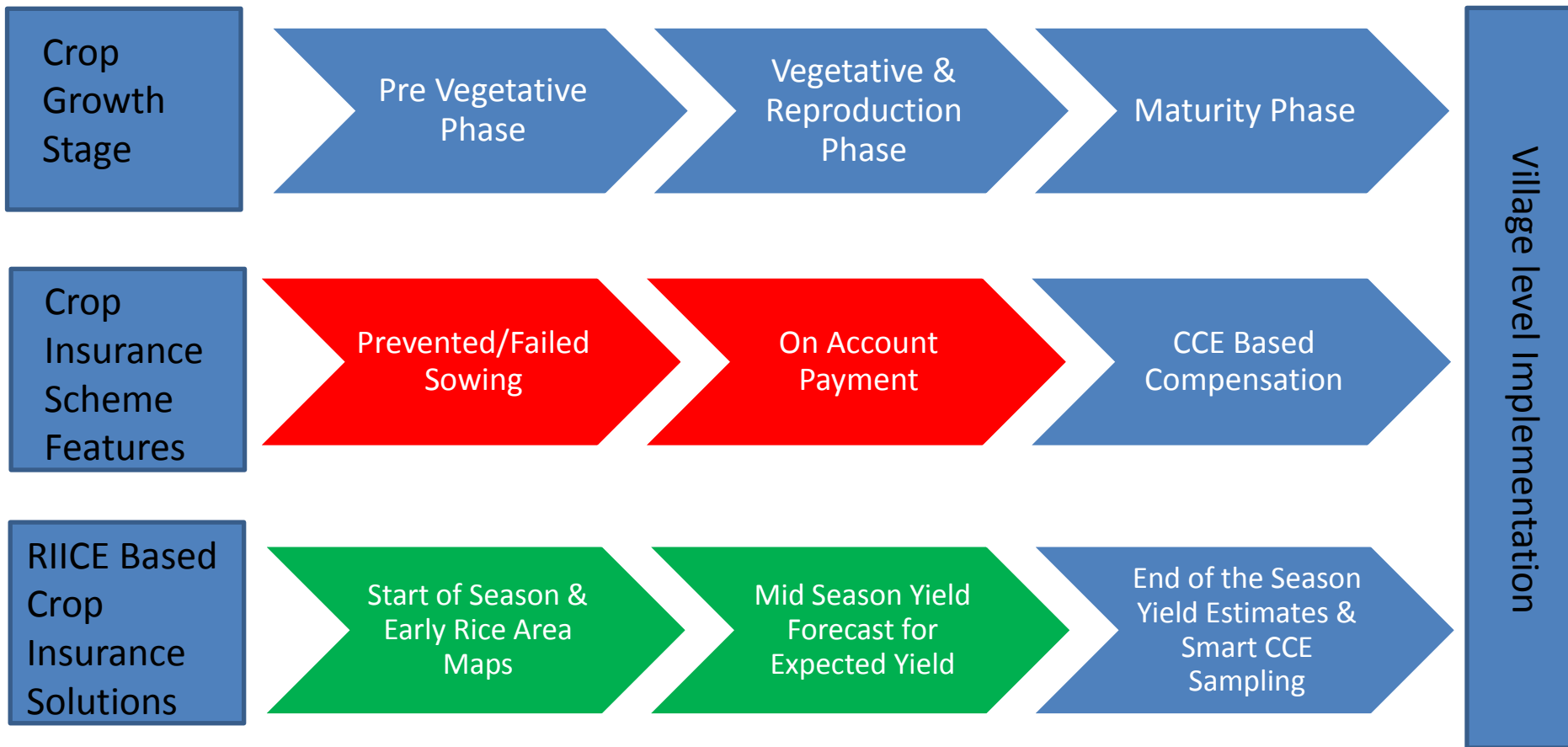


Paddy Yield in Tiruvarur district (Samba 2016) as estimated by Satellite based RIICE technology

Paddy Yield (Kg/ha)	Area (ha)
No Yield	9148
< 1000	9839
1000 – 2000	20618
2000 – 2500	41495
2500 – 3000	6356
3000 – 3500	19092
3500 – 4000	7803
> 4500	4354
Total	118705



Application of RIICE technology in Crop Insurance in India



Case Study: Disaster Risk Assessment

2015 Tamil Nadu flood resulted in loss of rice area being lost

Block	Flooded area (ha)
Parangipettai	5817
Kurinjipadi	4719
Melbhuvangiri	2398
Kumaratchi	1987
Keerapalayam	1729
Kattumannargudi	627
Vridhachalam	601
Cuddalore	596
Panruti	480
Kammapuram	463
Annagramam	226
Nallur	209
Mangalore	159



Information delivered by RIICE and its national partner Tamil Nadu University, helped relief efforts by distributing seeds in Tamil Nadu flood affected areas, after satellite data had been delivered to the state level emergency authorities.

Role of RIICE Technology in Crop Insurance in India

Area of improvement	RIICE
In-season crop area monitoring & yield estimation	<input checked="" type="checkbox"/>
Determination of progress of area sown/emerged	<input checked="" type="checkbox"/>
Continuous monitoring of crop health	<input checked="" type="checkbox"/>
Efficient identification of homogenous/stress areas	<input checked="" type="checkbox"/>
Disaster mapping and loss assessment (Flood & Drought)	<input checked="" type="checkbox"/>
Prevented sowing cover and on-account payment	<input checked="" type="checkbox"/>
Improved targeting/ Smart Sampling of Crop Cutting Experiments	<input checked="" type="checkbox"/>

RIICE Milestones in Tamil Nadu, India

Mar-Apr
2016

- RIICE project presented to the, Dept. of Agriculture, Govt. of Tami Nadu
- Dept. of Agriculture recommends RIICE project to be piloted in the 2016 season

July 2016

- RIICE project mentioned as one of the pre-conditions for selection of insurance companies in the Tender Process

Nov 2016

- RIICE project approved by Committee on Crop Insurance for a state wide pilot
- RIICE-team observes late start of season using satellite technology, shares information

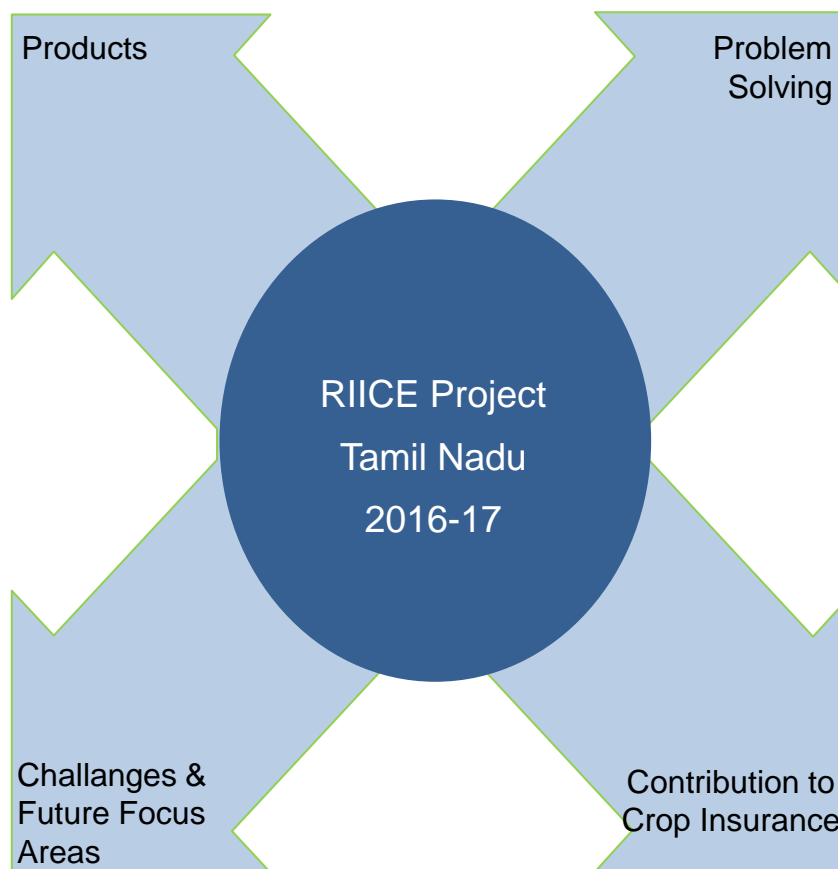
Jan-Mar
2017

- Department of Agriculture analyses satellite information on delayed start of Samba season
- Stakeholders consider RIICE based information for insurance pay-outs
- RIICE Pilot extended in 2017 cropping season

Summary of experiences and challenges ahead

- Start of season area maps
- Village wise rice area
- Mid season expected yield
- End of Season yield maps
- Village level yield estimate
- Disaster Risk Assessment

- Detailing PMFBY features like prevented sowing, on a/c payment etc
- Developing a Smart CCE sampling methodology in cooperation with DEA
- Availability of quality village level boundary maps



- Area discrepancy
- Rapid loss assessment
- In season monitoring
- Village level crop statistics
- Mid season & End of season yield assessment
- Timely compensation to farmers

- Field validated products
- World class technology & expertise
- Timely, scientific transparent & efficient processes
- Insurance ready solutions
- RIICE Insurance pilot by State Govt.

Thank You

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