Innovative Risk Mitigation Solutions for Cotton Industry

Nalin Rawal

Chief-Business Head

Skymet Weather Services Pvt. Ltd.

India's leading weather forecasting & Agriculture Risk Solutions Company

RISK / CHALLENGES IN COTTON BUSINESS

Production Side

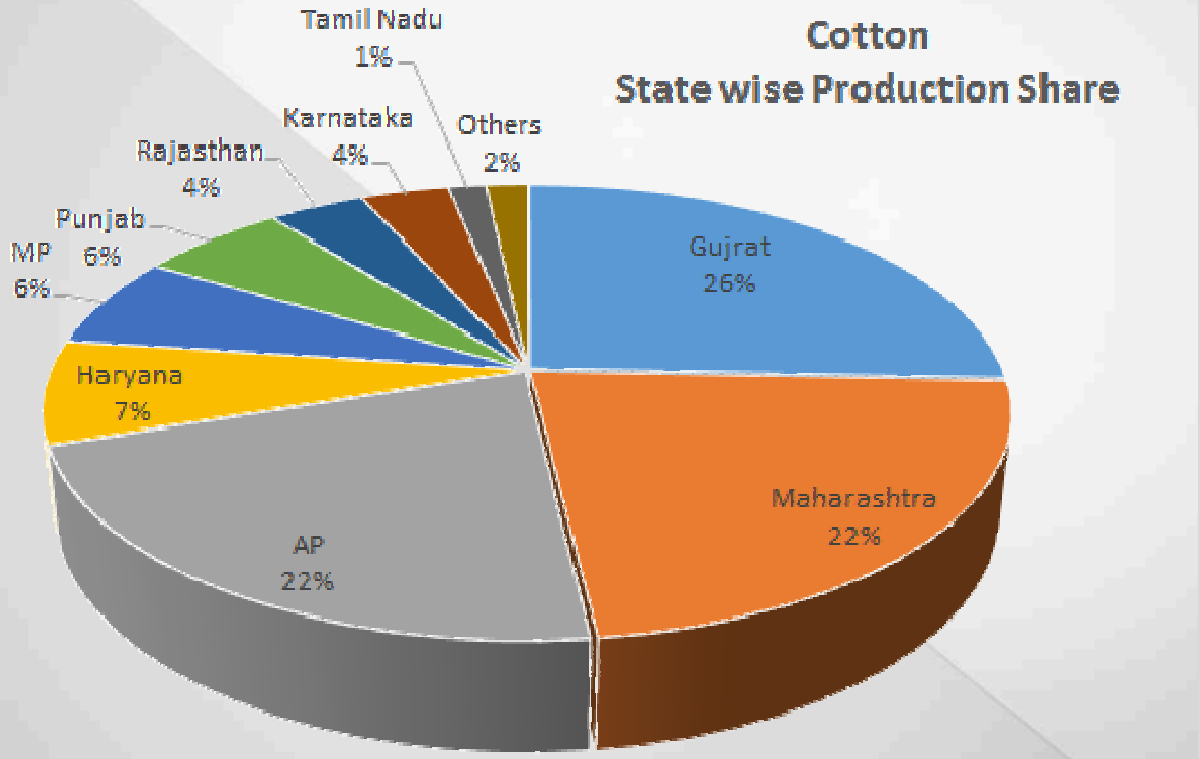
- ✓ Weather Risk –Abiotic stress
- ✓ Biotic (Pest & Diseases) stress during crop cycle
- ✓ Real time weather based crop advisories
- ✓ Crop failure risk in event of adverse weather

Market Side

- ✓ Estimating cotton Acreage
- ✓ Real time crop monitoring and yield forecasting
- ✓ Estimating right yield / production

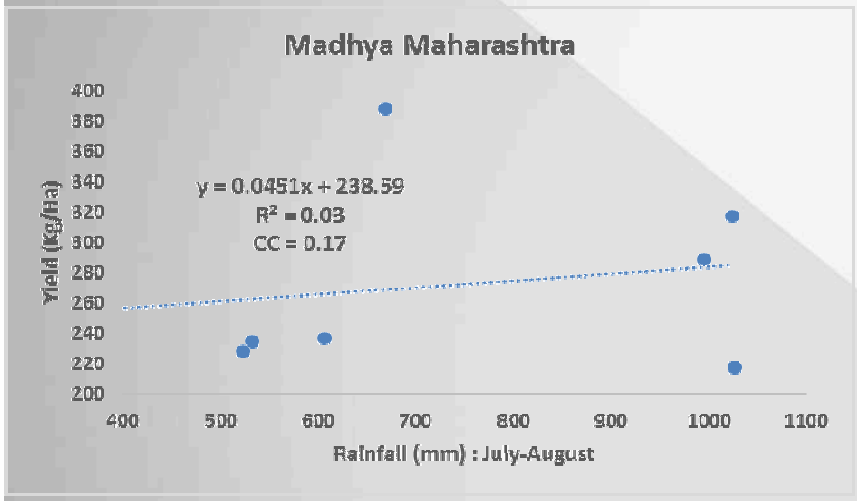
Weather & Cotton crop correlation

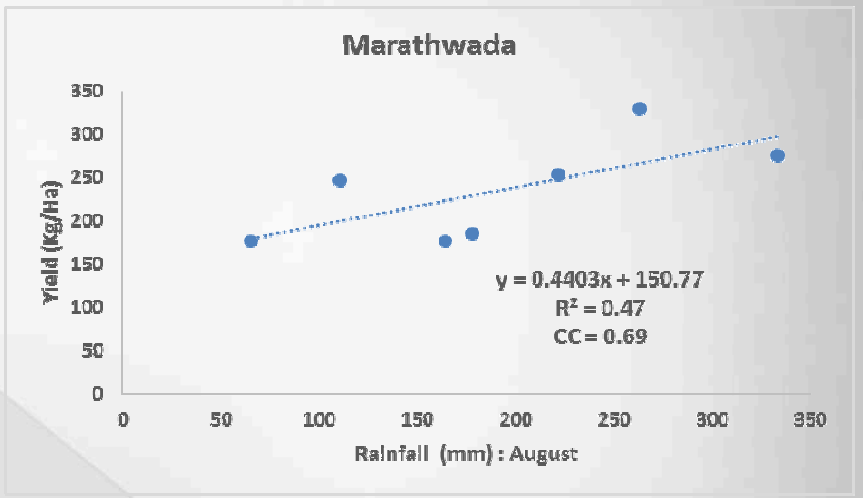
Total 9 states contribute 98 % + production of cotton

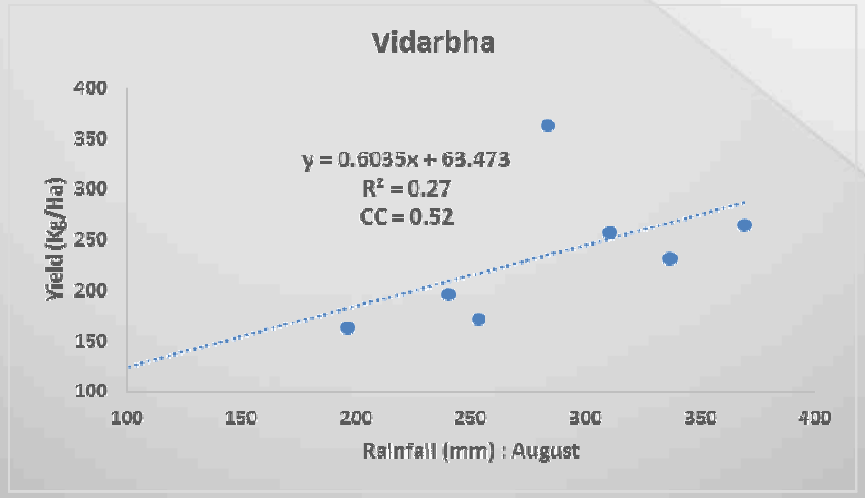


Rainfall and Yield Correlation

- ✓ **Last 10 years yield and actual rainfall of 9 states categorized into 11 sub-divisions.**
- ✓ **All districts considered have cotton area greater than 70,000 Hectare.**





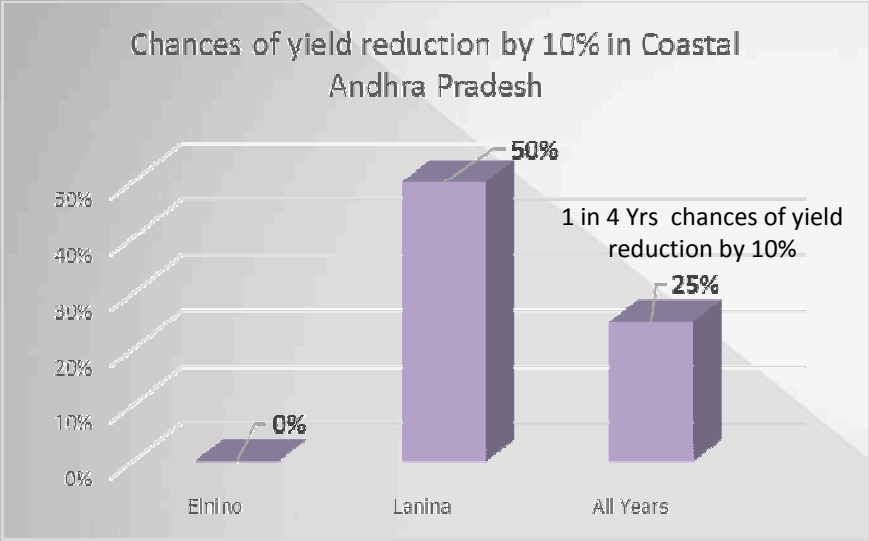


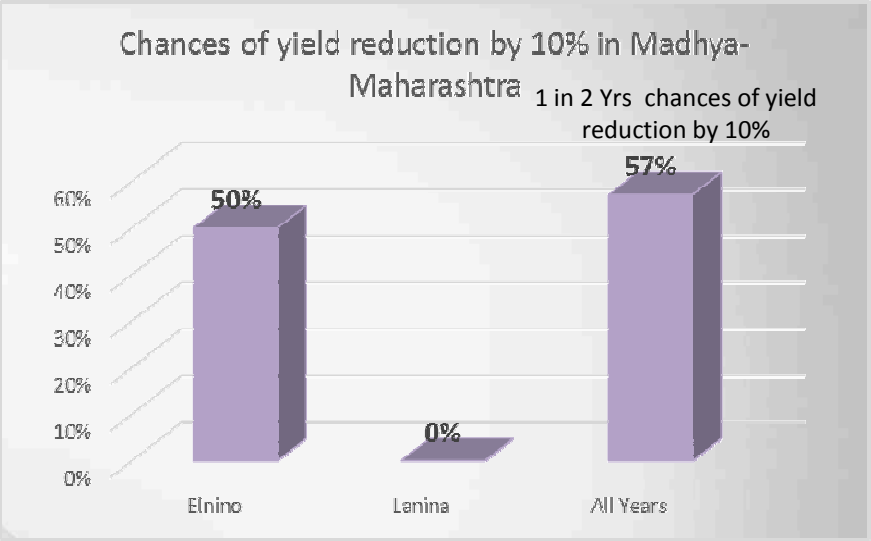
Rainfall & Productivity Correlations

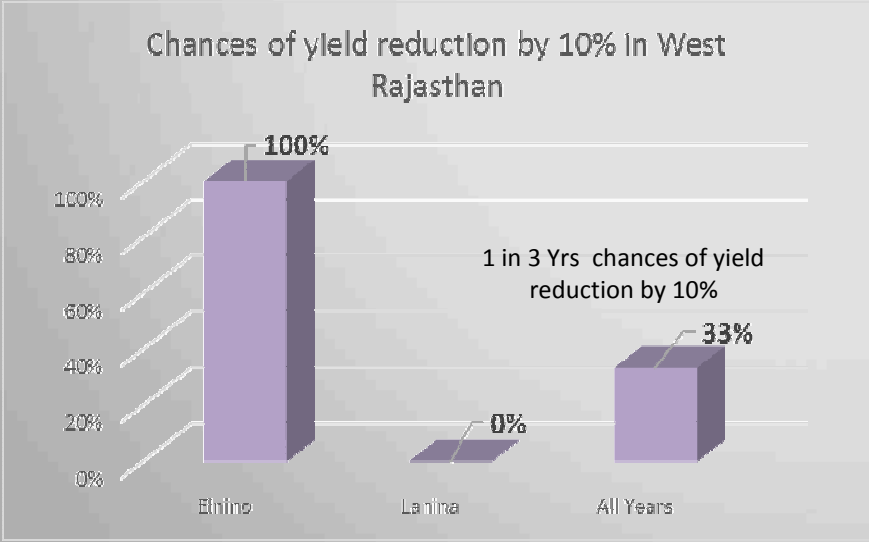
Strong Correlation between Rainfall & Productivity in Areas with low irrigation percent

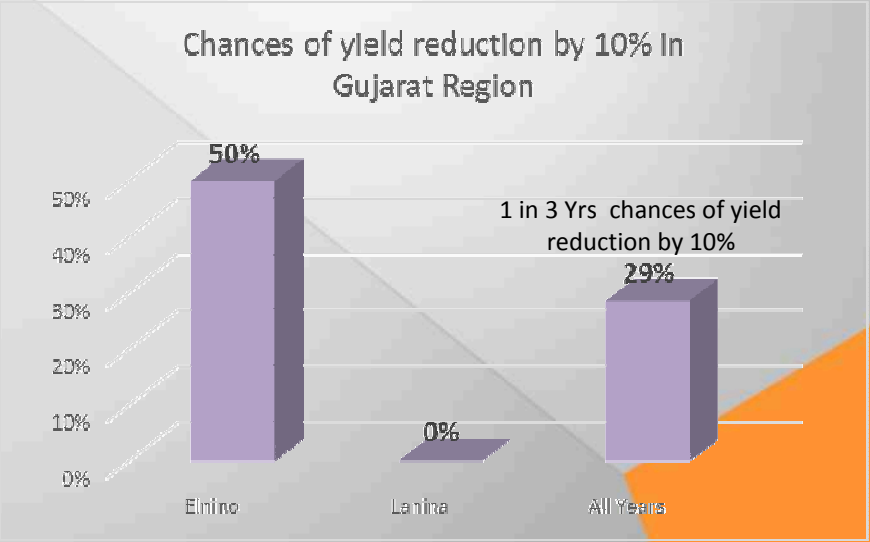
S.no	Zone	Correlations (Production & rainfall)	% Gross irrigated area
1	Coastal AP	0.6	50
2	Telengana	0.4	
3	NI Karnataka	0.9	66
4	West Rajasthan	0.2	64
5	Gujarat	0.3	38
6	Saurashtra & Kutch	0.8	
7	Haryana & Punjab	0.2	89 & 98
8	Marathwada	0.7	16
9	Vidharba	0.5	

Effect of El Nino & La Nina on Cotton Productivity









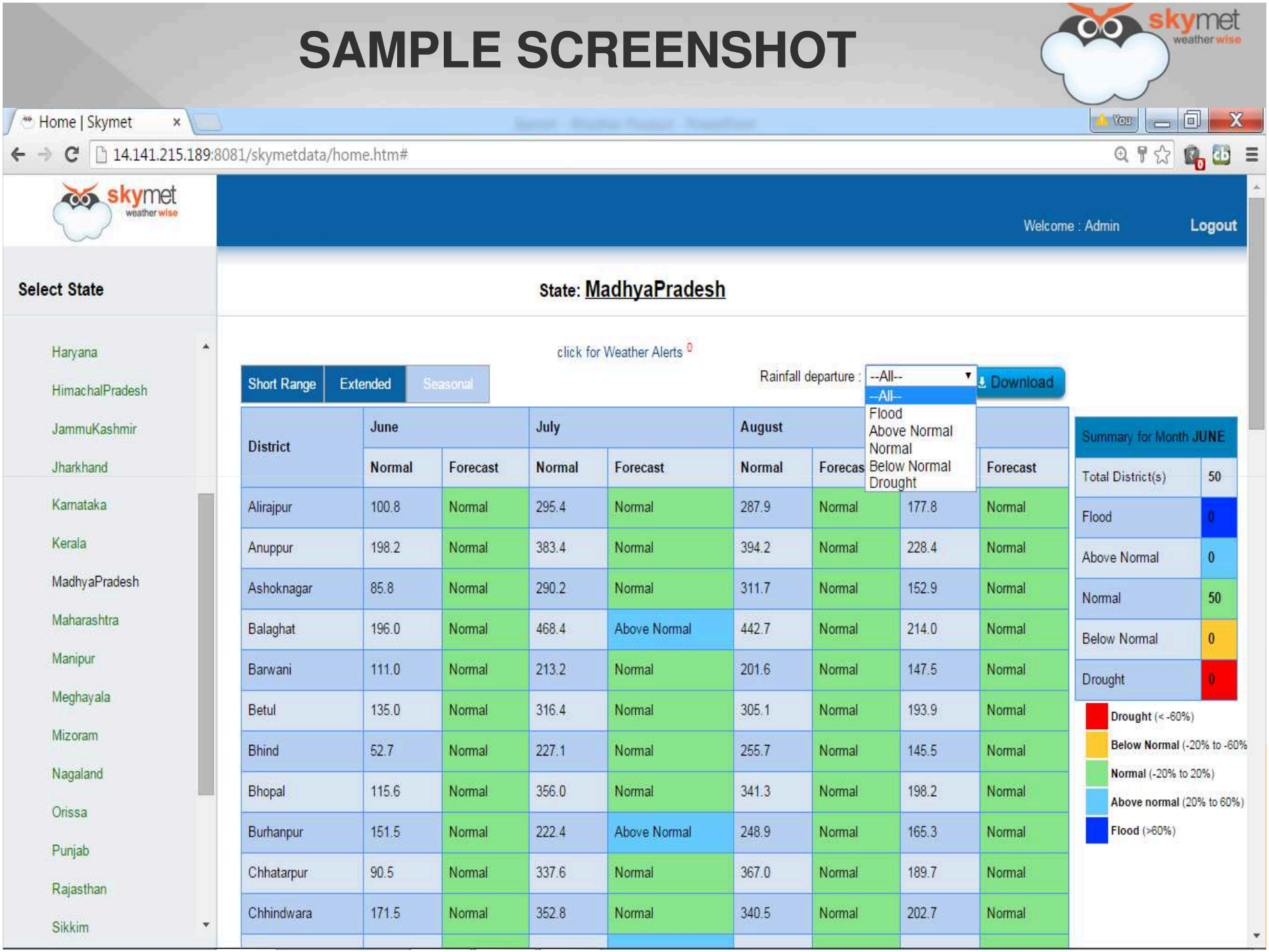
Mitigating Weather Risk

Weather Forecast

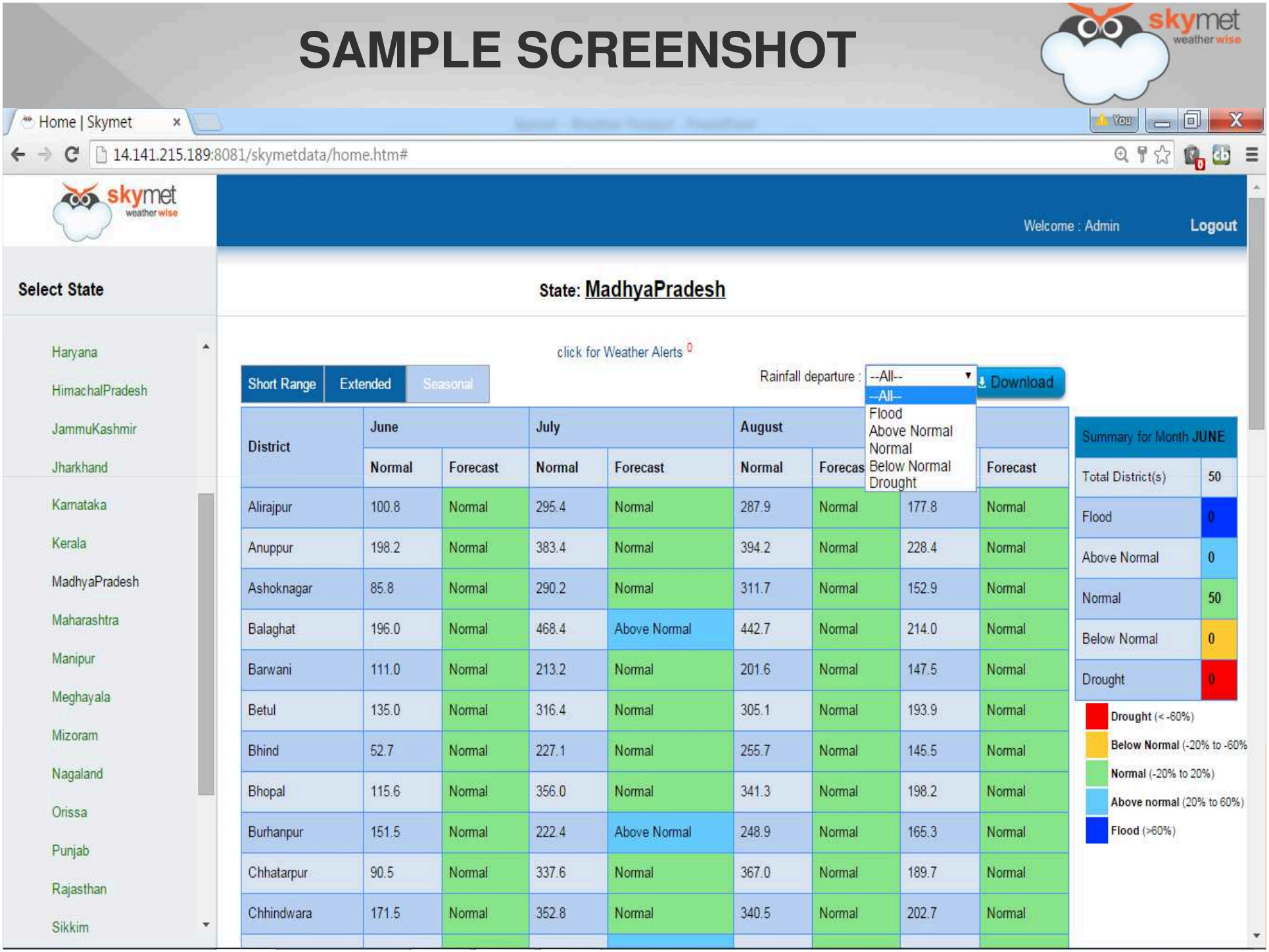
Weather forecast & Monitoring

- **Long Term Weather Forecast** – 3/4 months ahead
- **Medium Term Forecast** – 30 days ahead
- **Short Term Forecast** – 7 days ahead
- **Weather Alerts** – 24/72 Hrs ahead
- **Live Weather Data** – Hourly Live

SAMPLE SCREENSHOT



SAMPLE SCREENSHOT



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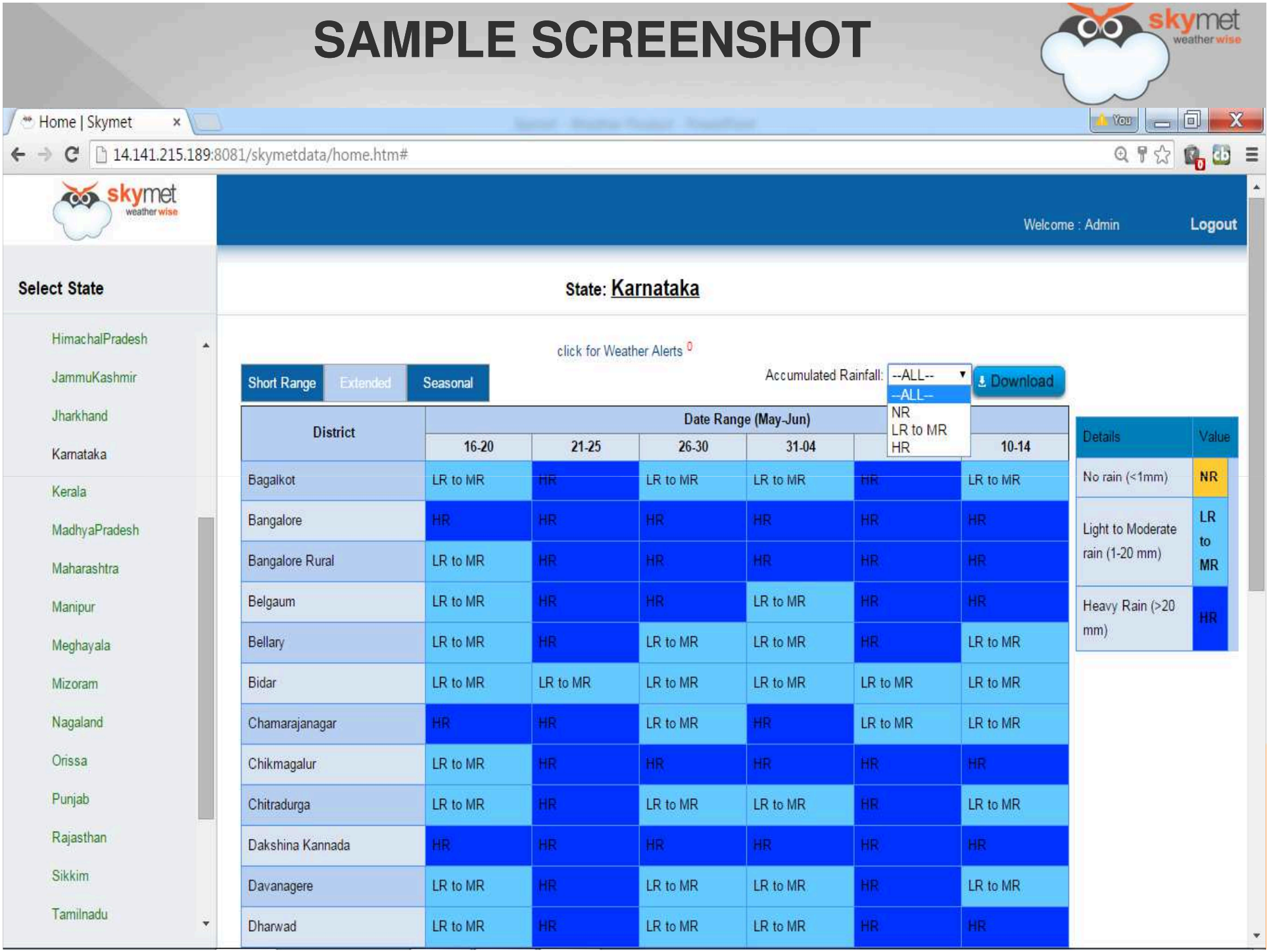
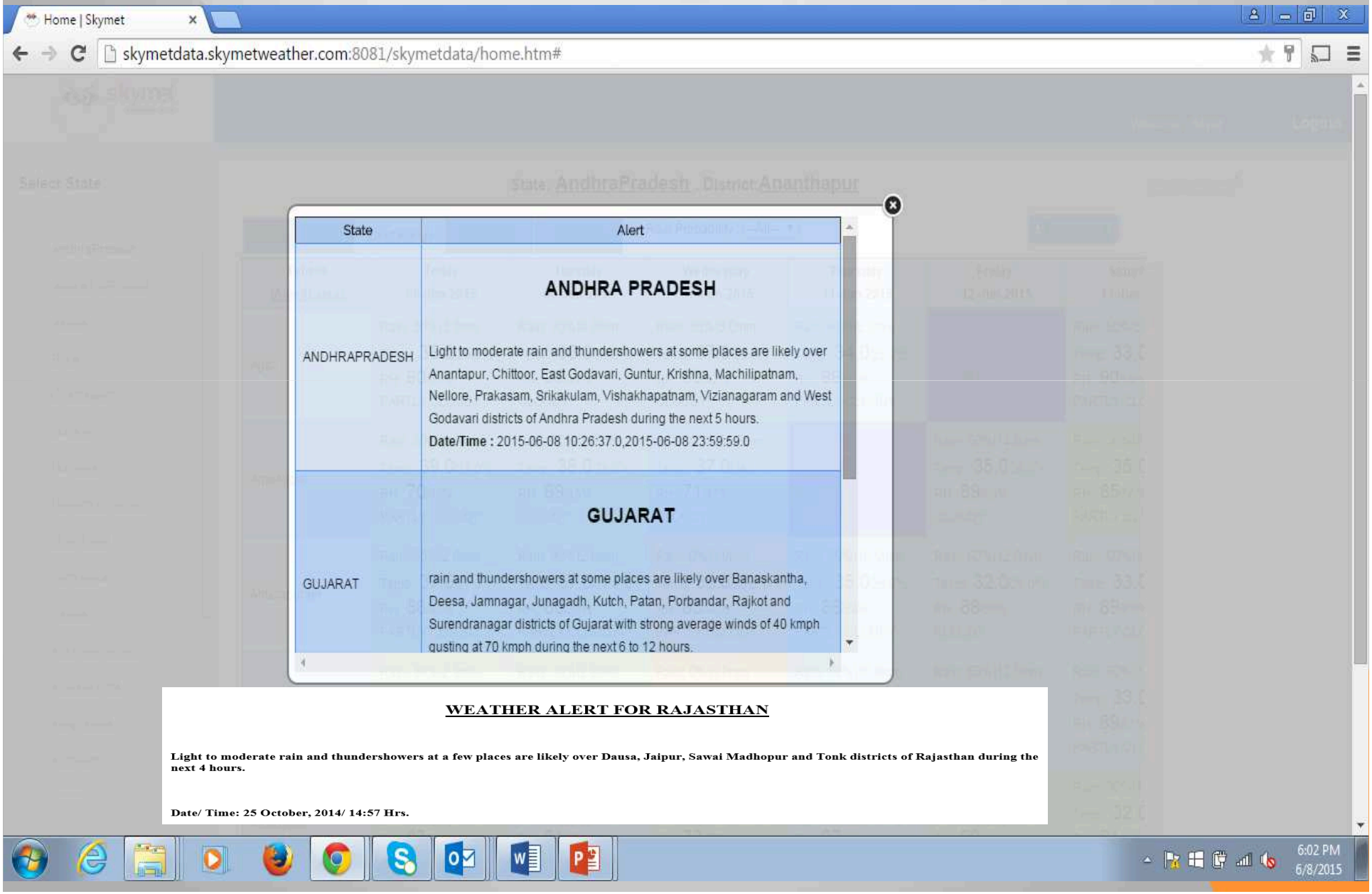
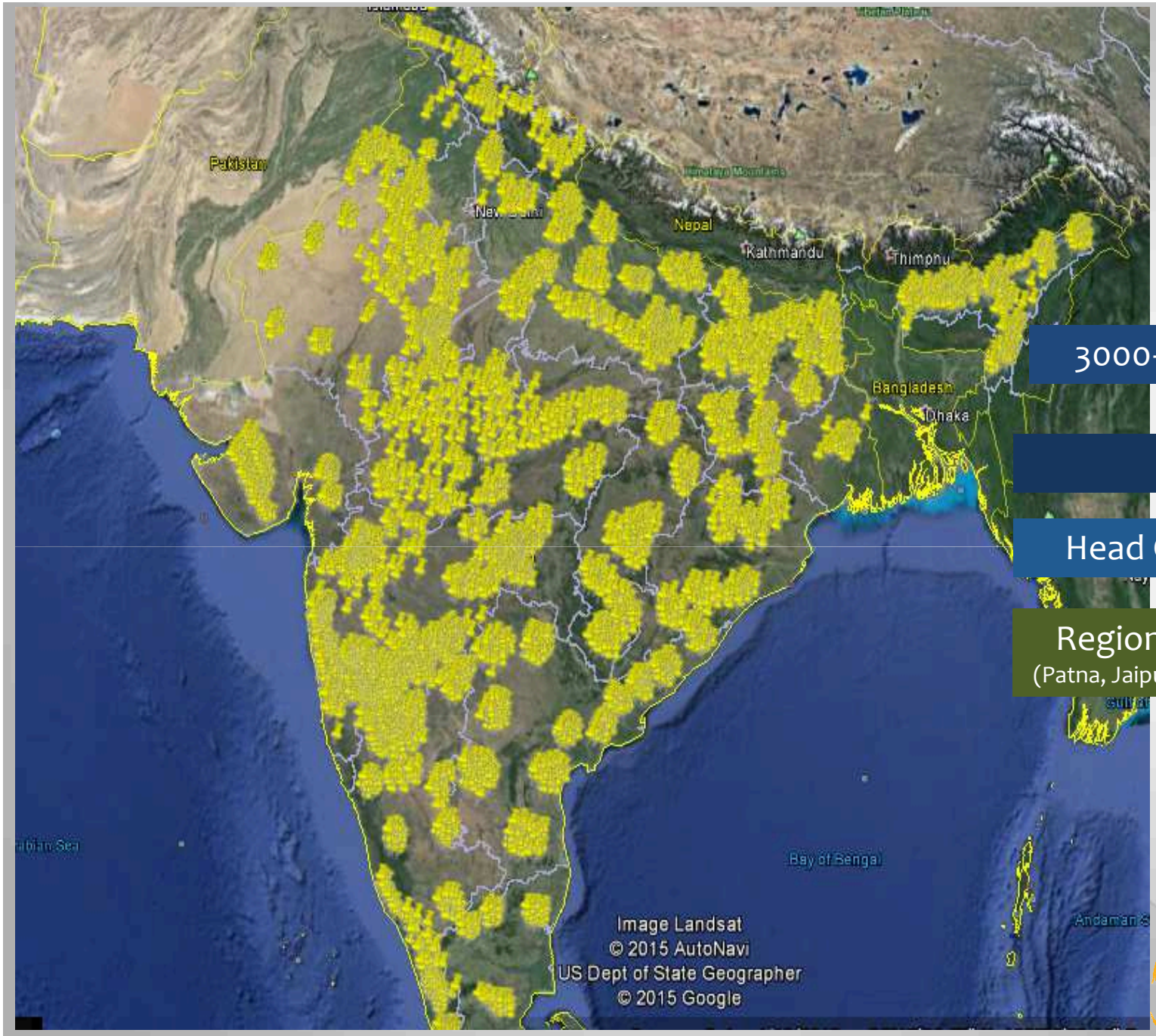


SHORT RANGE FORECAST - SAMPLE SCREENSHOT
District Level-Temp, RH, Rainfall

SHORT RANGE FORECAST - SAMPLE SCREENSHOT
Taluka Level-Temp, RH, Rainfall

Sample Report (Weather Alert)





skymet weather wise

3000+ AWS Locations

15 States

Head Office: Noida

Regional Office(S) : 4
(Patna, Jaipur, Mumbai & Hyderabad)

India maize summit'15

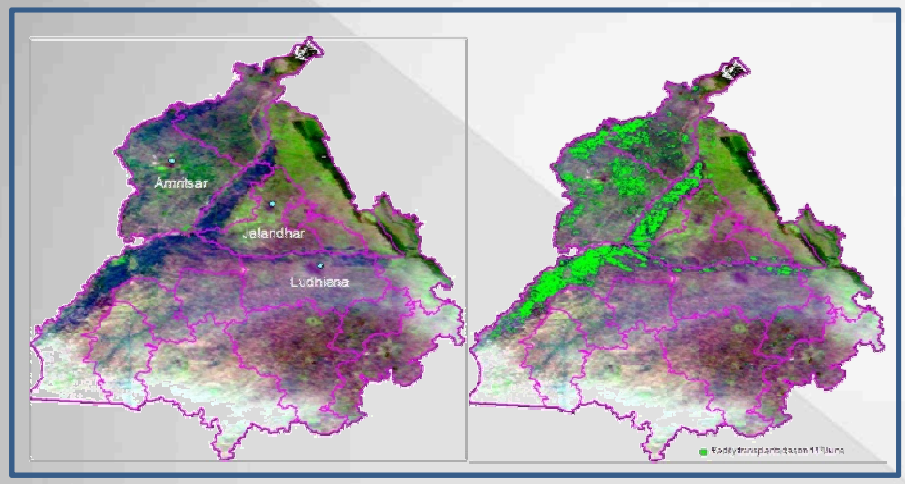
GIS & UAV (Drones) **Based**

Crop - Acreage / Health Monitoring

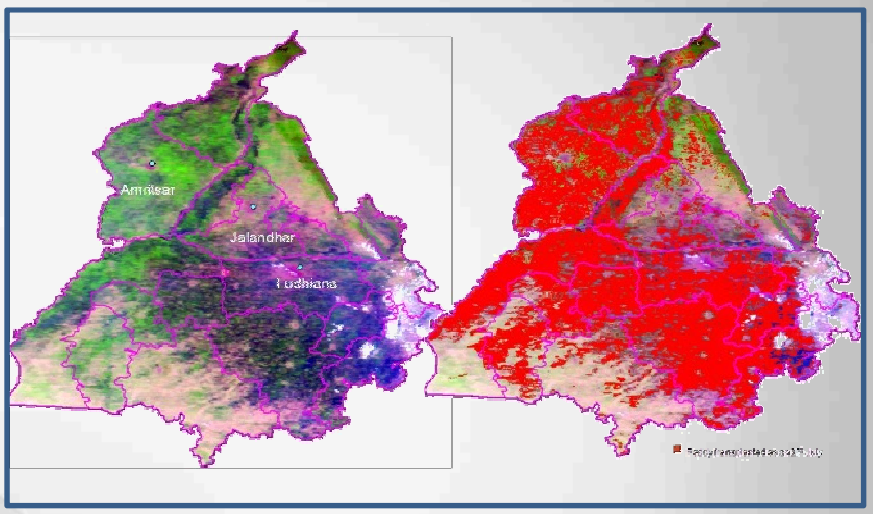
CROP ACREAGE STATUS – PUNJAB PADDY (Kharif'2013)

skymet weather wise

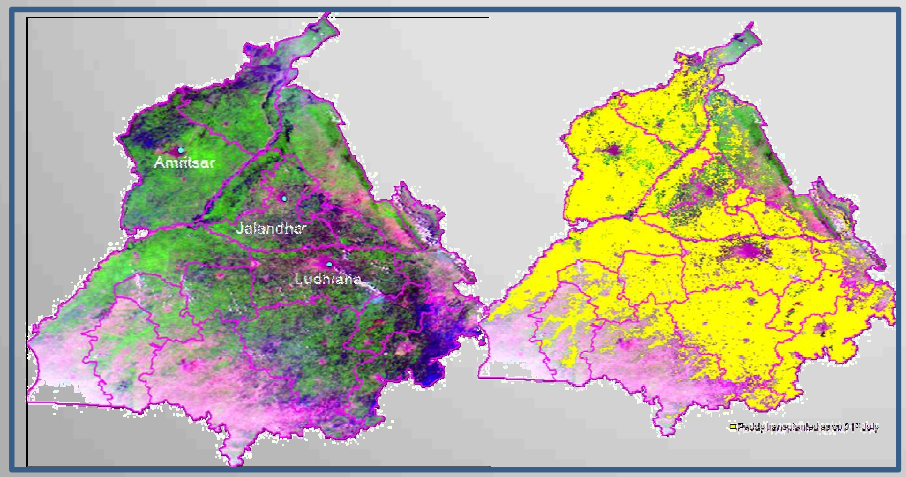
Paddy Crop Sowing Status till mid June

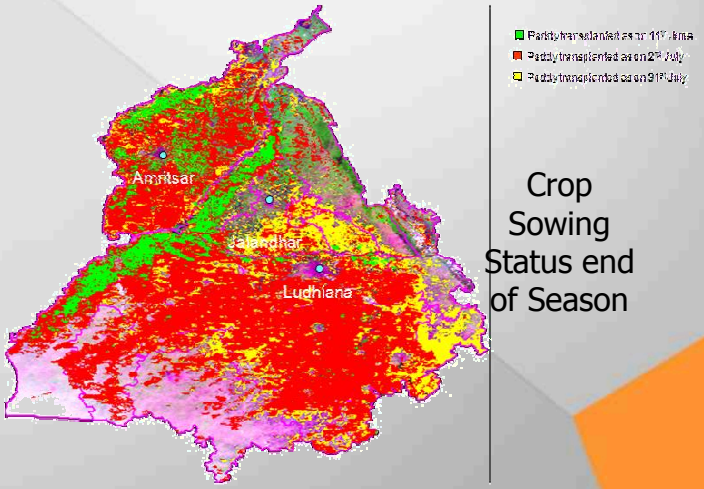


Paddy Crop Sowing Status till 1st week of July



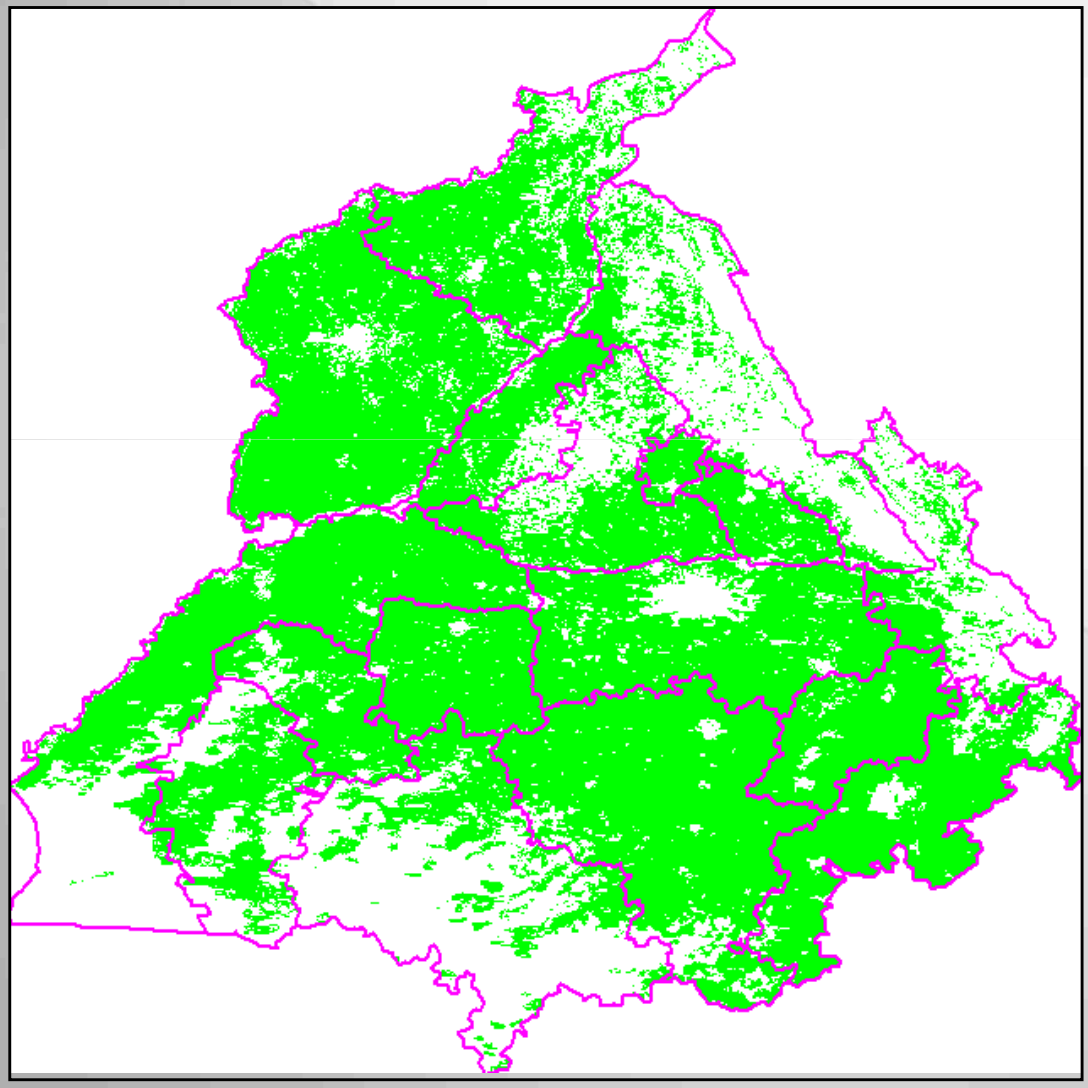
Paddy Crop Sowing Status till End of July





Crop Sowing Status end of Season

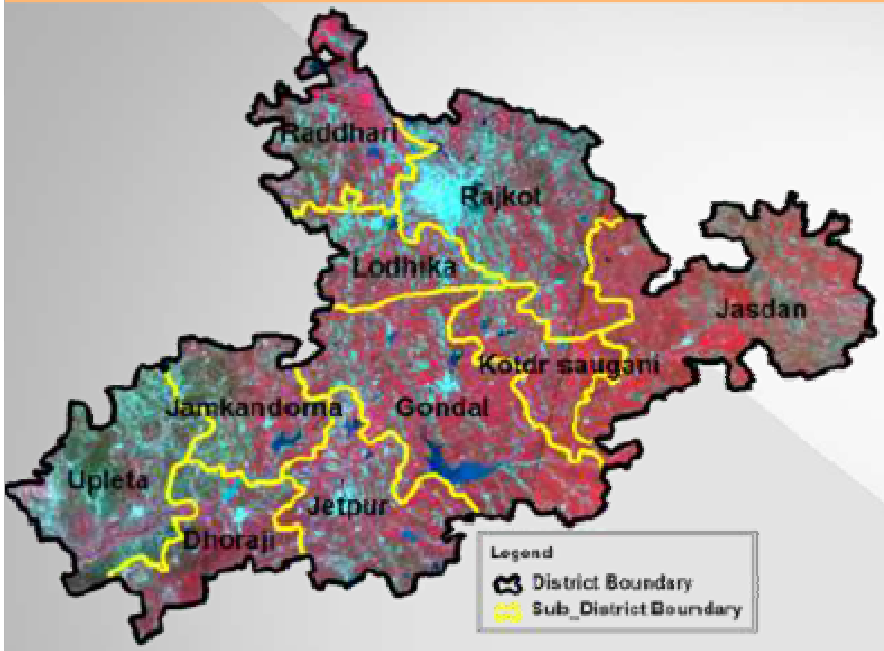
ACERAGE – PUNJAB DISTRICT WISE PADDY

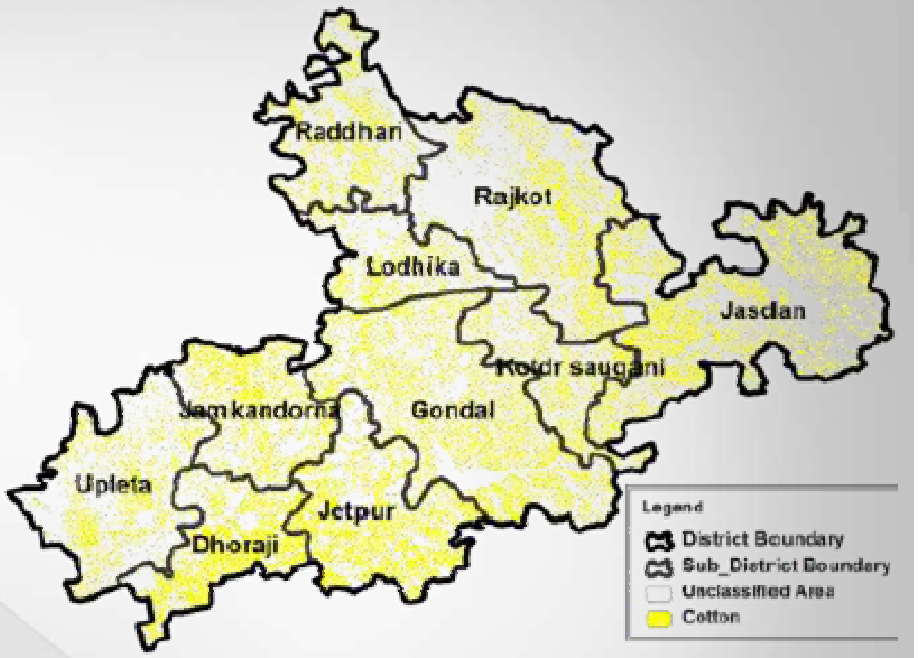


District wise Paddy acreage

S.No.	District	Acreage (Ha.)
1	Amritsar	323,163
2	Bhatinda	124,256
3	Faridkot	118,369
4	Fatehgarh Sahib	125,244
5	Firozpur	371,069
6	Gurdaspur	213,150
7	Hoshiarpur	78,019
8	Jalandhar	90,194
9	Kapurthala	99,725
10	Ludhiana	299,006
11	Moga	163,031
12	Muktheswar	73,688
13	Nawanshahr	11,069
14	Patiala	228,420
15	Ropar	52,641
16	Sangrur	425,206
Total		27,96,248

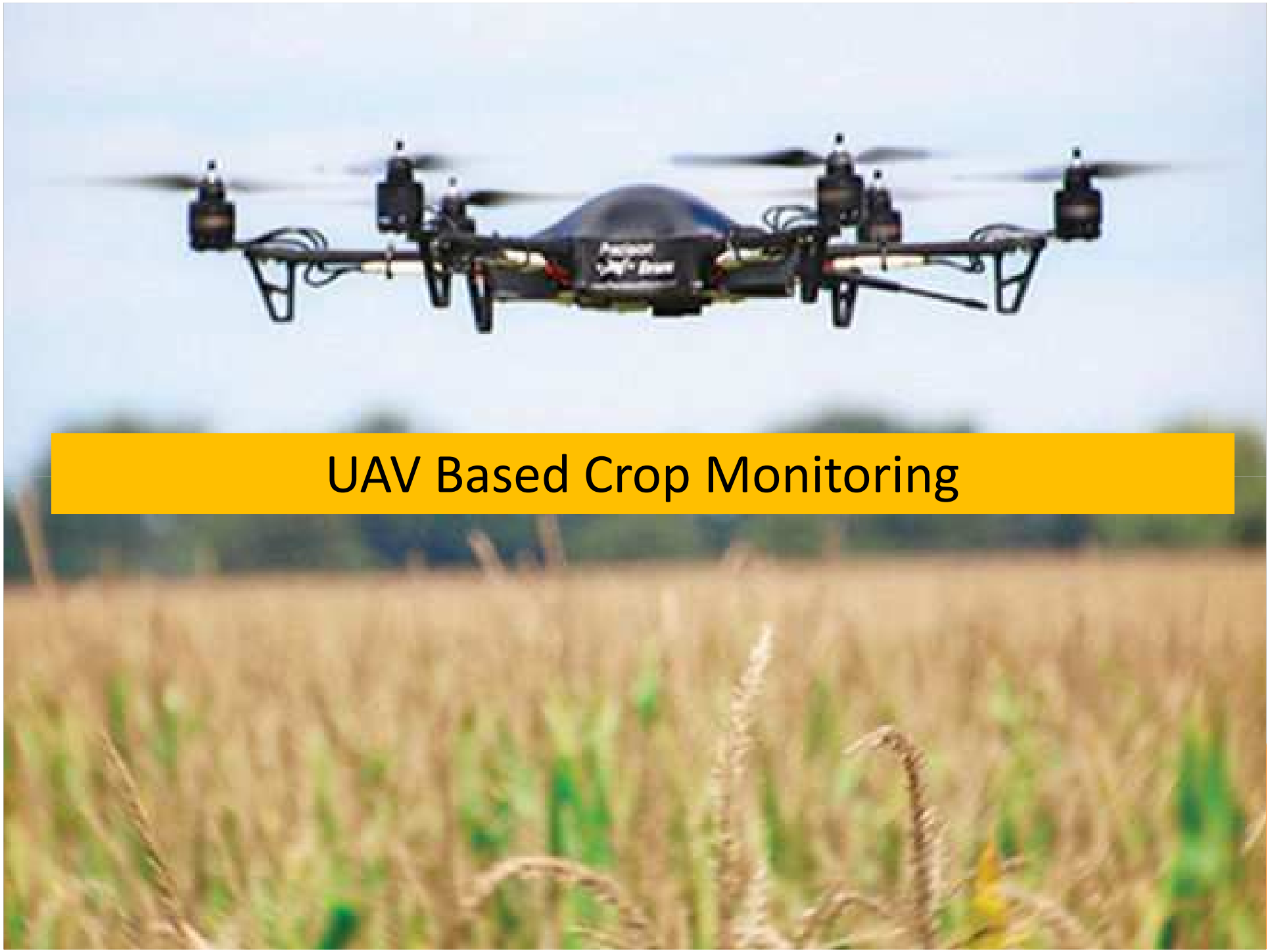
STUDY AREA, RAJKOT, GUJARAT





Sub District	Cotton
Jetpur	28,926
Raddhari	15,973
Lodhika	10,165
Rajkot	26,329
Jasdan	37,907
Kotdr saugani	12,892
Gondal	39,047
Upleta	17,489
Dhoraji	21,956
Jamkandorna	19,060
Total of All Sub Districts (Ha)	**230,743**

Satellite Image –LANDSAT
Acquisition Date – 29th Sep, 6th Oct 2015
District – Rajkot
Resolution – 30M
Acreage – Cotton – Ha 230,743


UAV Based Crop Monitoring

UNMANNED AERIAL VEHICLE (UAV)

- Completely automatic & remote controlled
- Ability to reach maximum of 400m from ground
- Area captured in one flight - 4 sq Km
- Ability to fly continuously for 1.5 Hrs
- Images captured in Visible region & IR (Infra Red) spectrum
- Provides Geo referenced images

UAV IMAGES – 150M

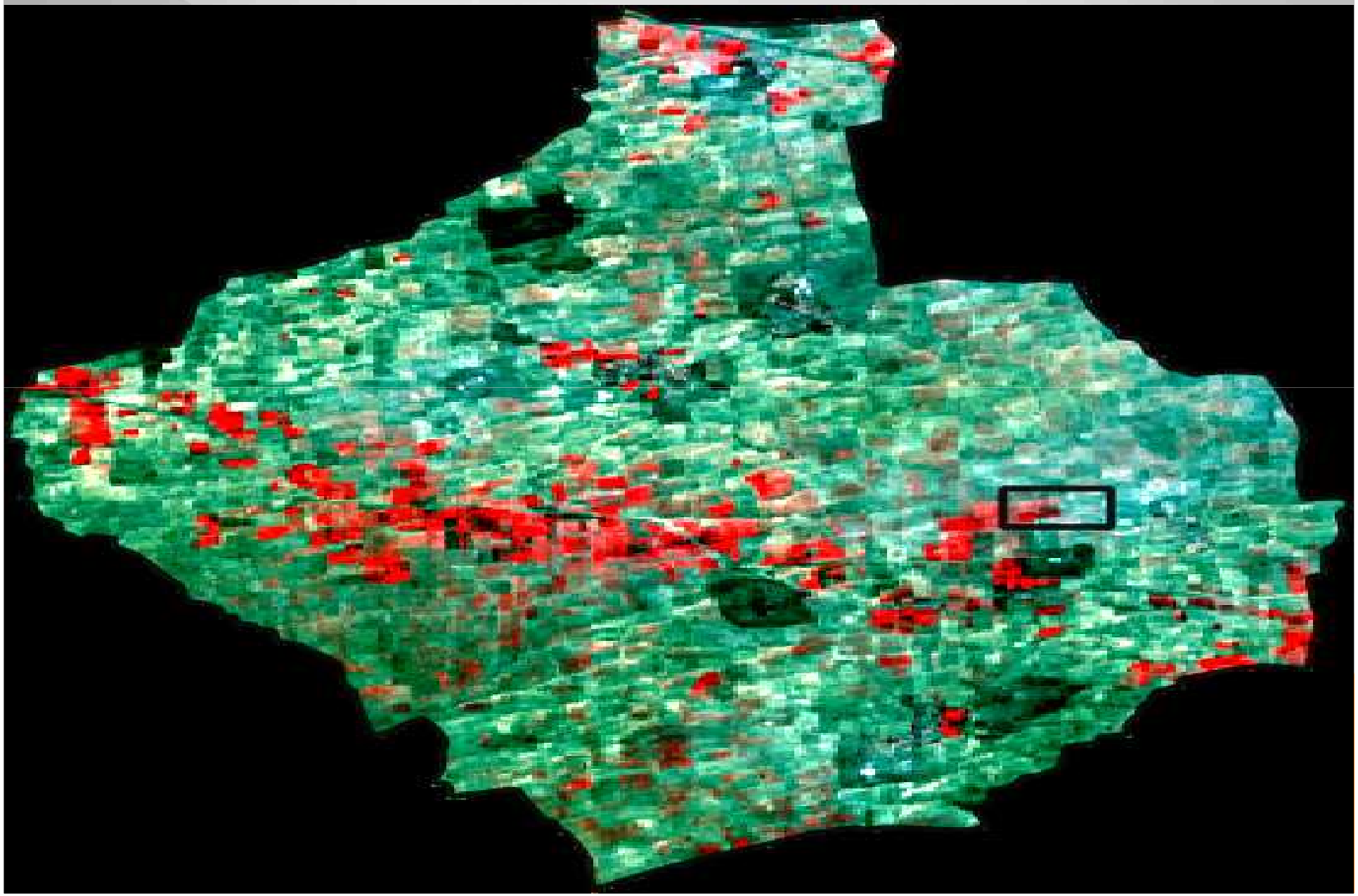
UAV IMAGES – 100M

UAV IMAGES – 75M

UAV IMAGES – 50M

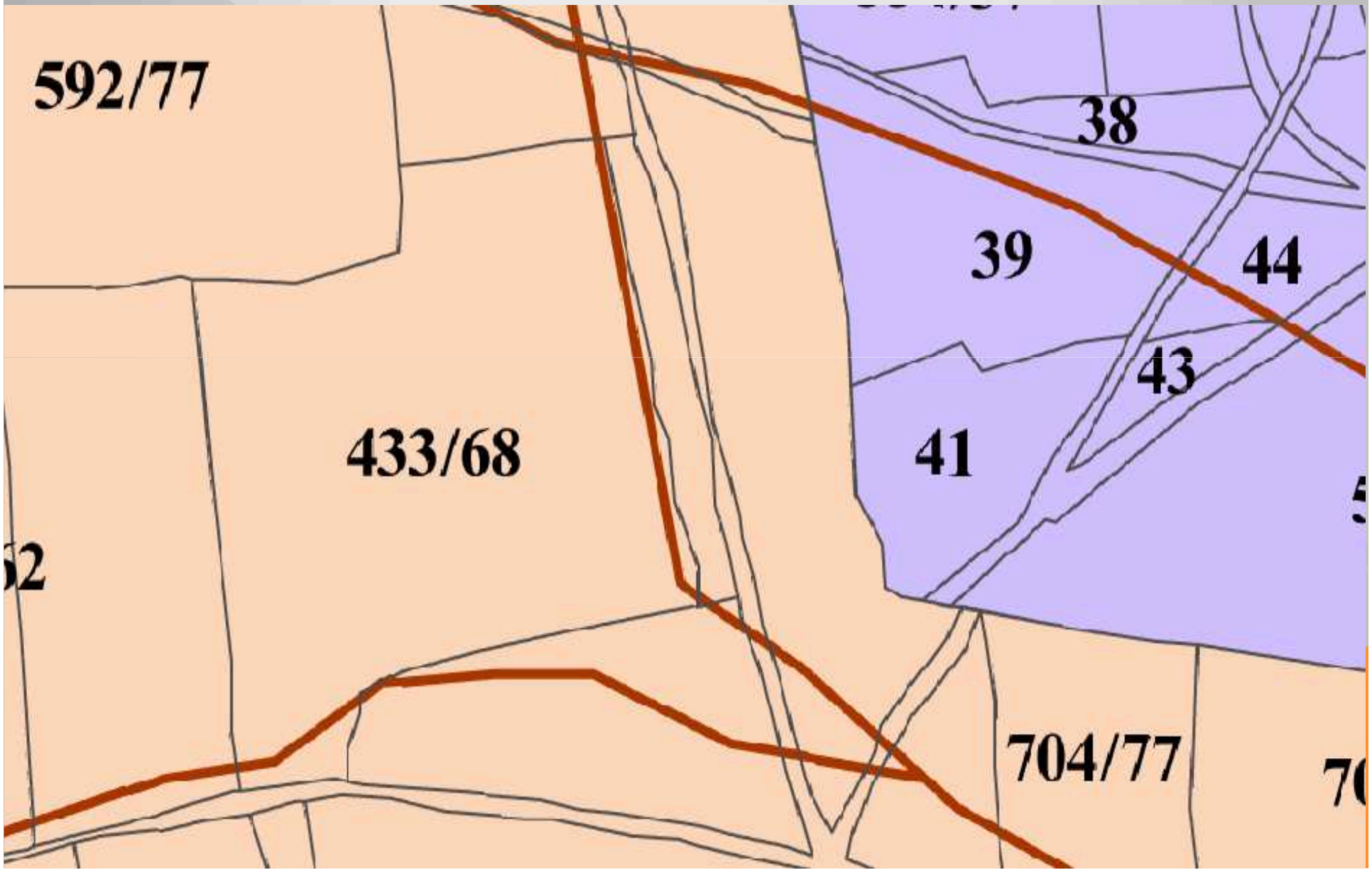
Monitoring Gram

Churu – Rajasthan (Rabi 2014-15)



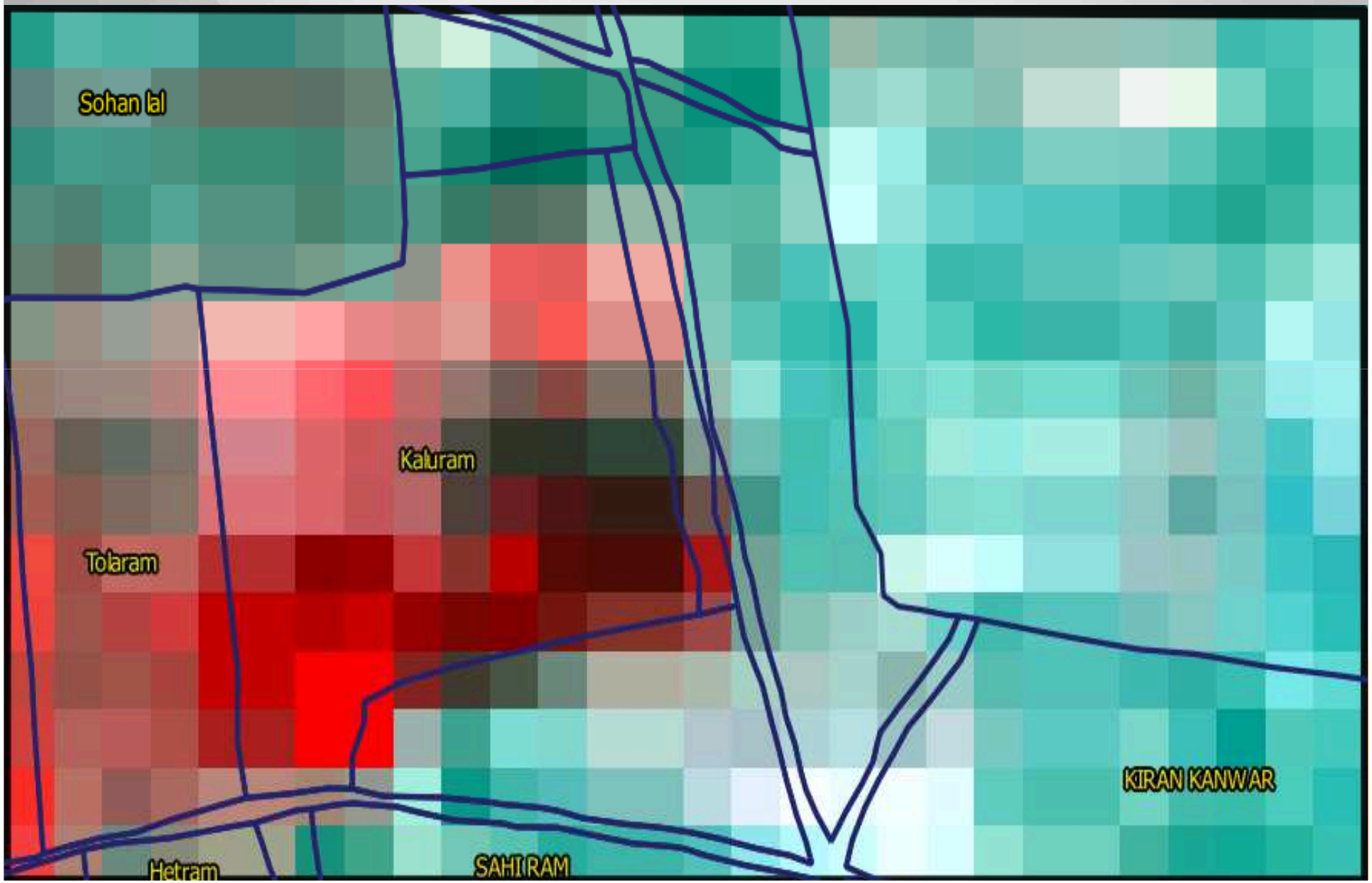
Cadstral Map

Churu – Rajasthan



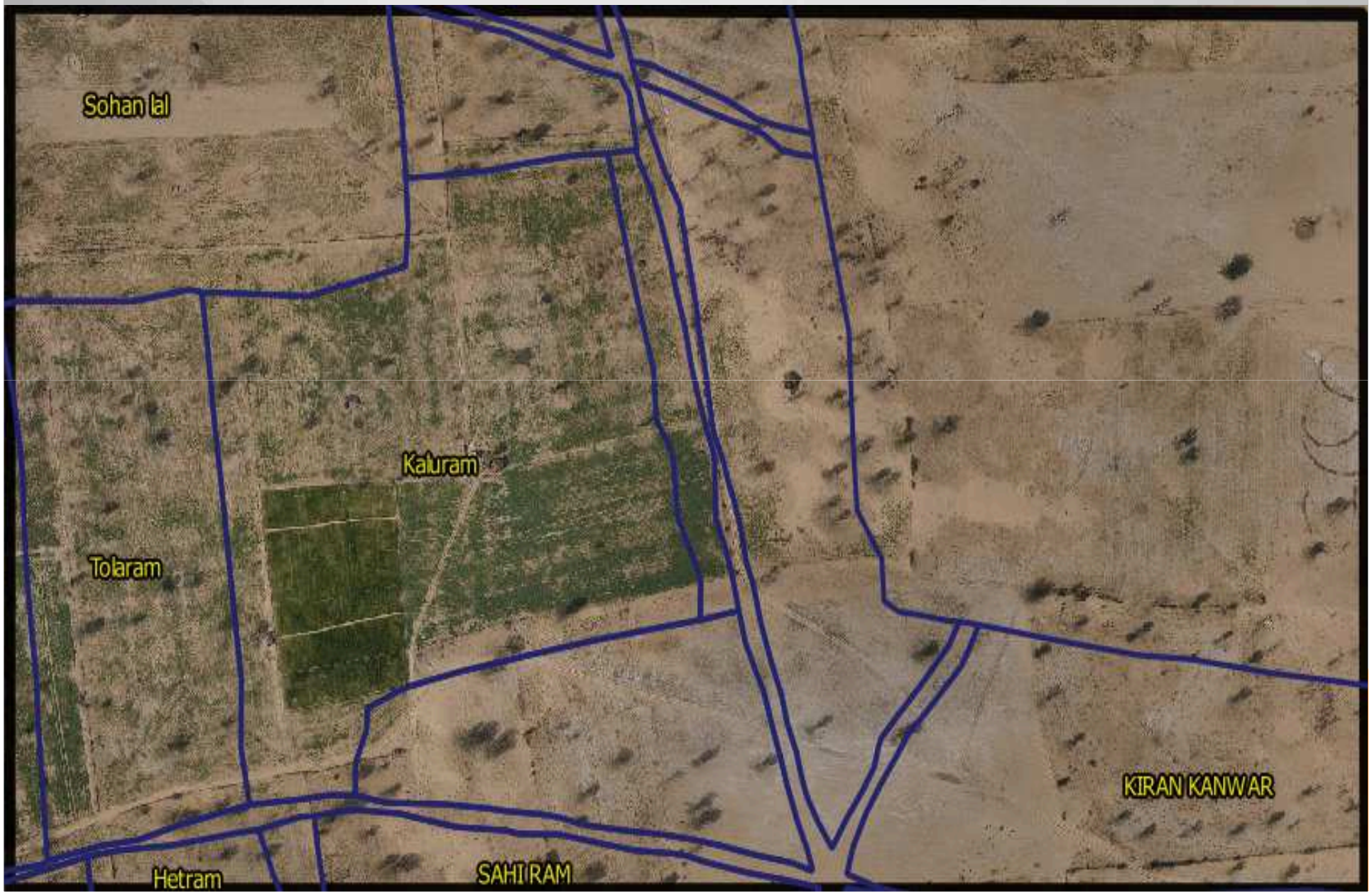
Monitoring Gram – Remote Sensing

Churu – Rajasthan (Rabi 2014-15)



Monitoring Gram - UAV

Churu – Rajasthan (Rabi 2014-15)

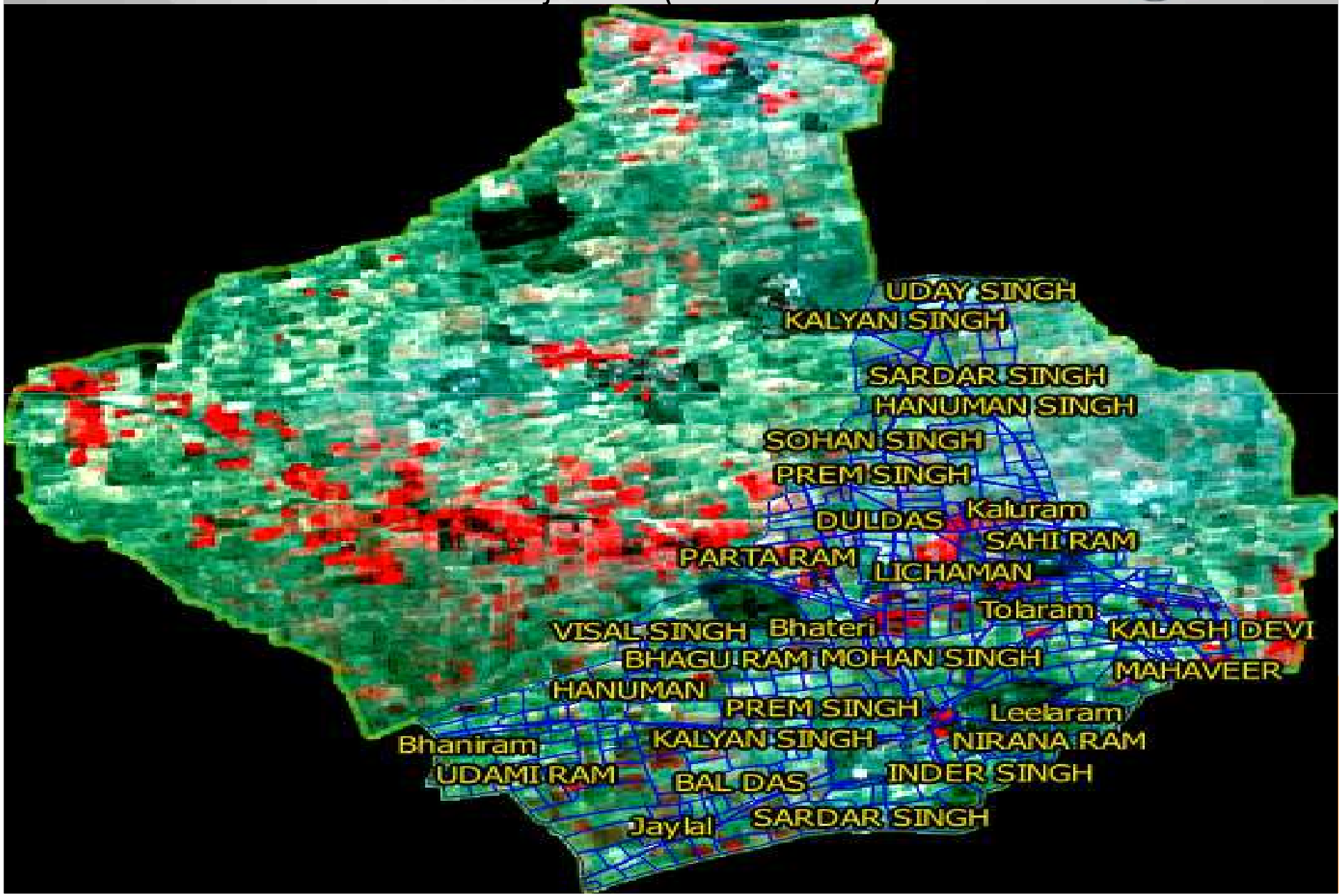


Monitoring Gram - UAV

Churu – Rajasthan (Rabi 2014-15)

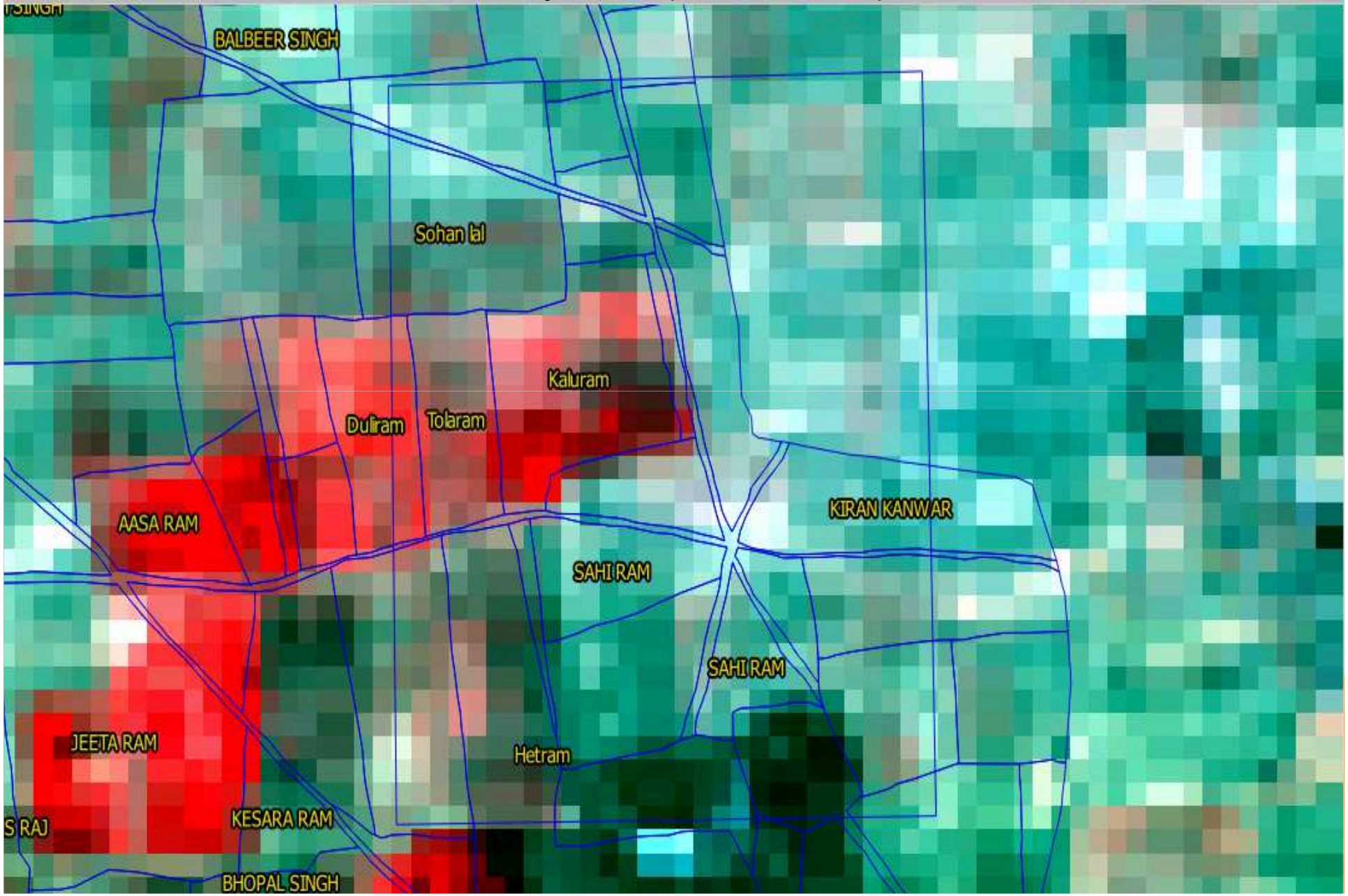
Monitoring Gram

Churu – Rajasthan (Rabi 2014-15)



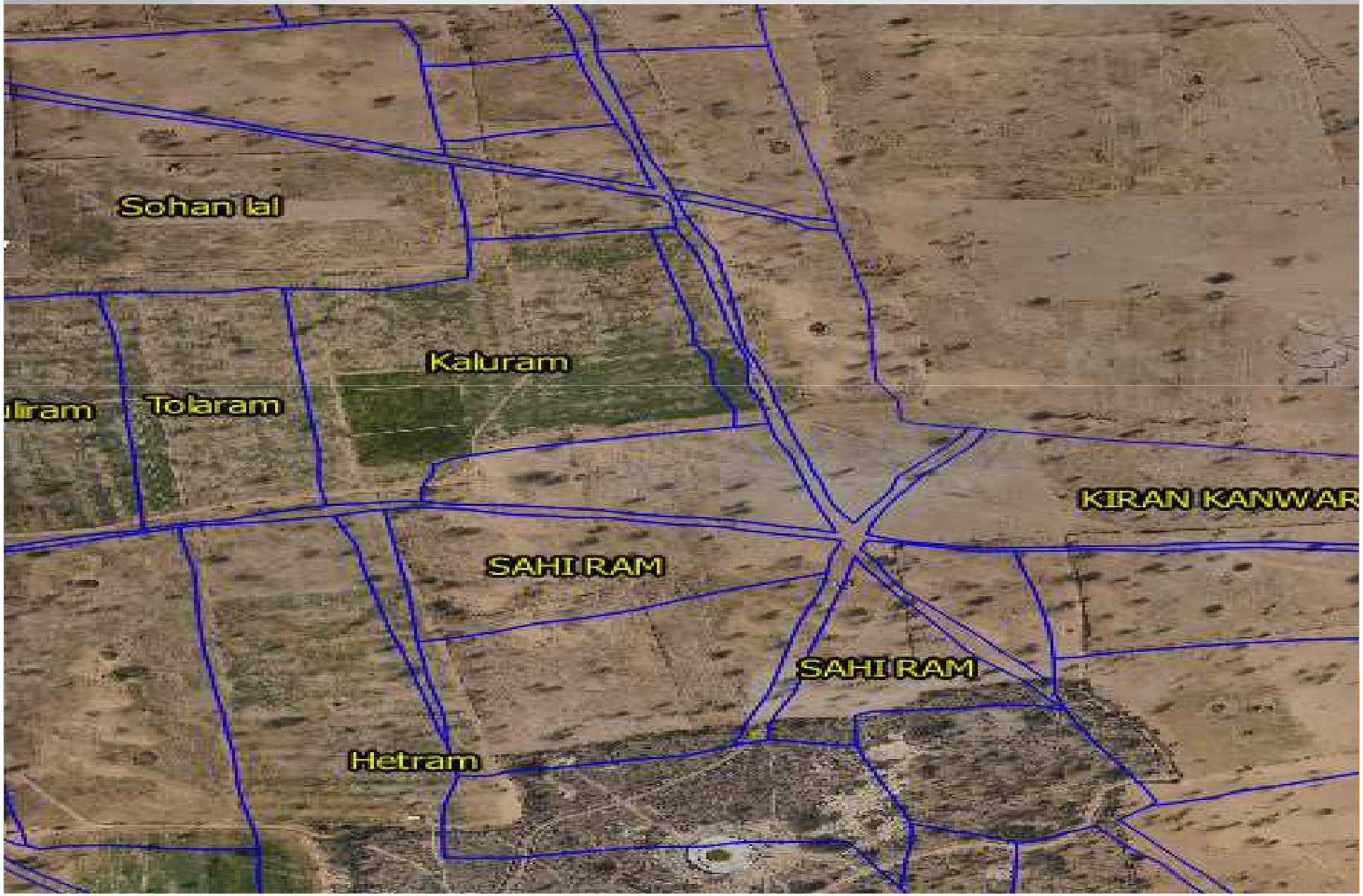
Monitoring Gram

Churu – Rajasthan (Rabi 2014-15)

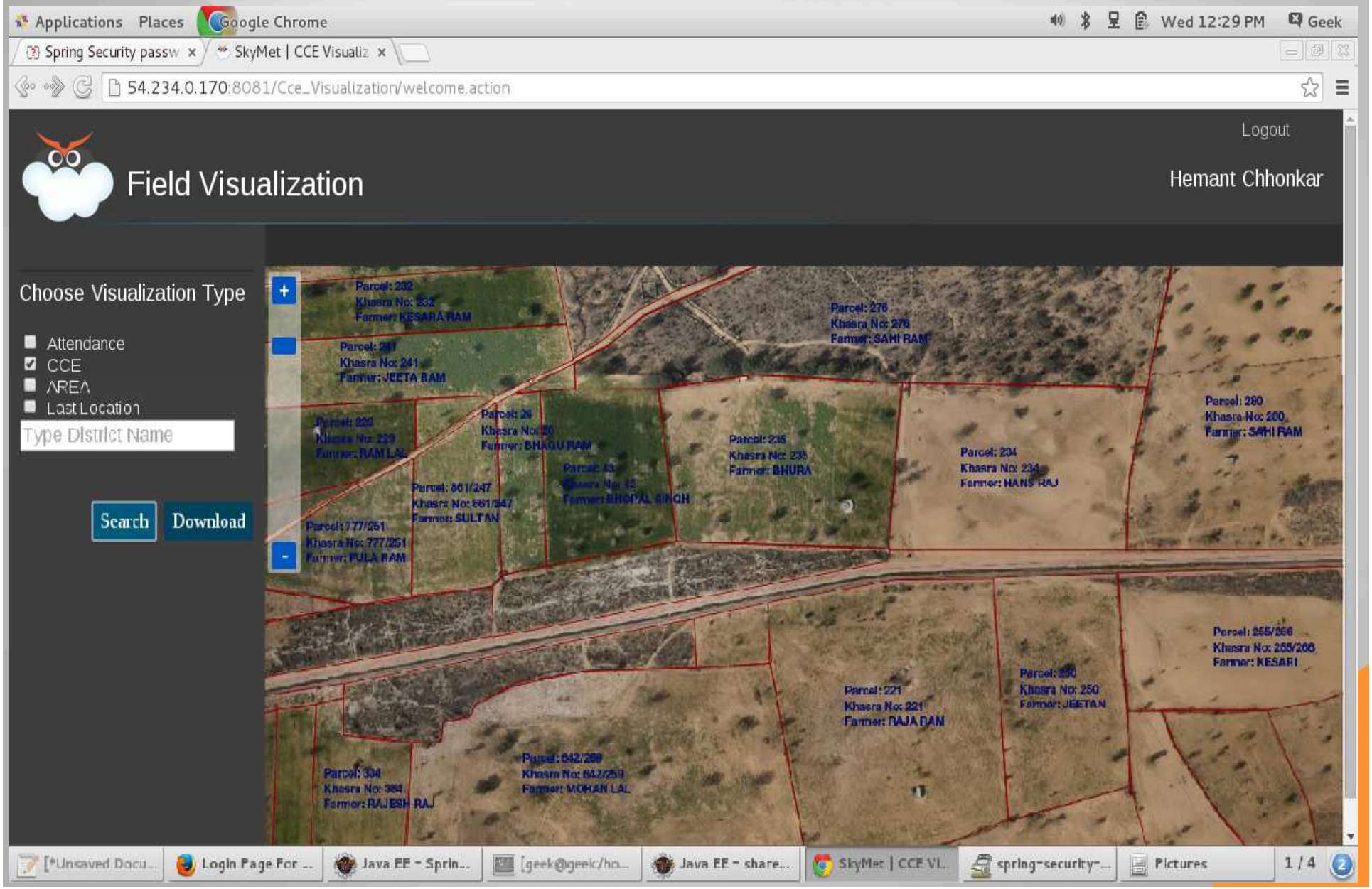


Monitoring Gram

Churu – Rajasthan (Rabi 2014-15)



WEB PORTAL | UAV BASED FARM MONITORING



FINAL CROP ESTIMATE – CROP CUTTING EXPERIMENTS

Acreage & Final yield estimation

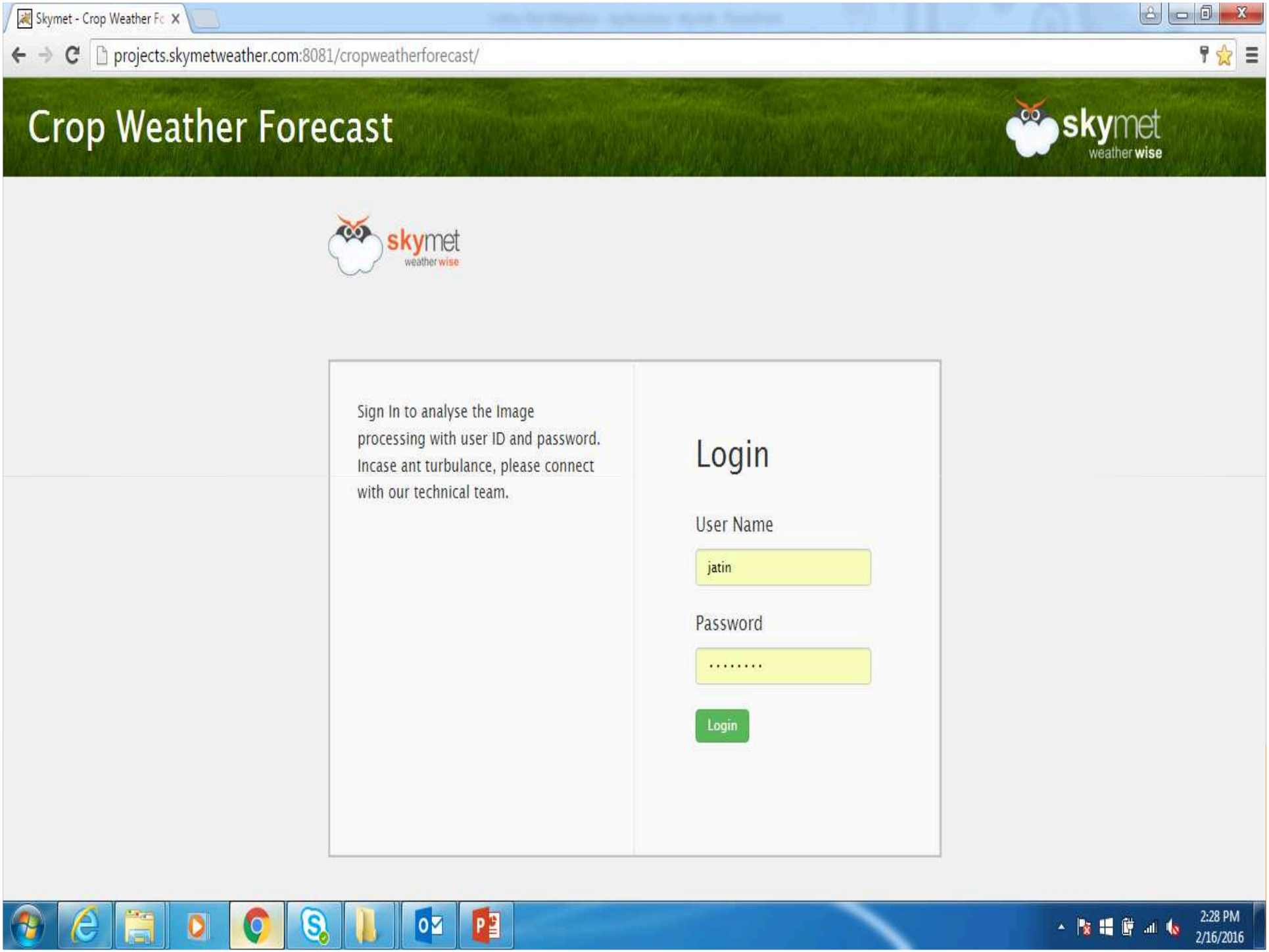
(95% accuracy)

Crop Monitoring

CROP MONITORING

Monitoring Cotton Crop from Sowing till Harvesting

- **Weather forecasting**
  - ✓ Long Term – Strategic level
  - ✓ Medium Range – Tactical level
  - ✓ Short Range – Operational level
- **Crop acreage estimation – Remote Sensing & UAV (Unmanned Aerial Vehicle)**
- **Weather monitoring – effect of weather on target crops**
- **Crop stage – from sowing till harvesting (biotic & abiotic stress)**
- **Crop yield forecasting – Survey & CCE based (Crop Cutting Experiments)**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Crop Weather Forecast
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weather wise
skymet
weather wise
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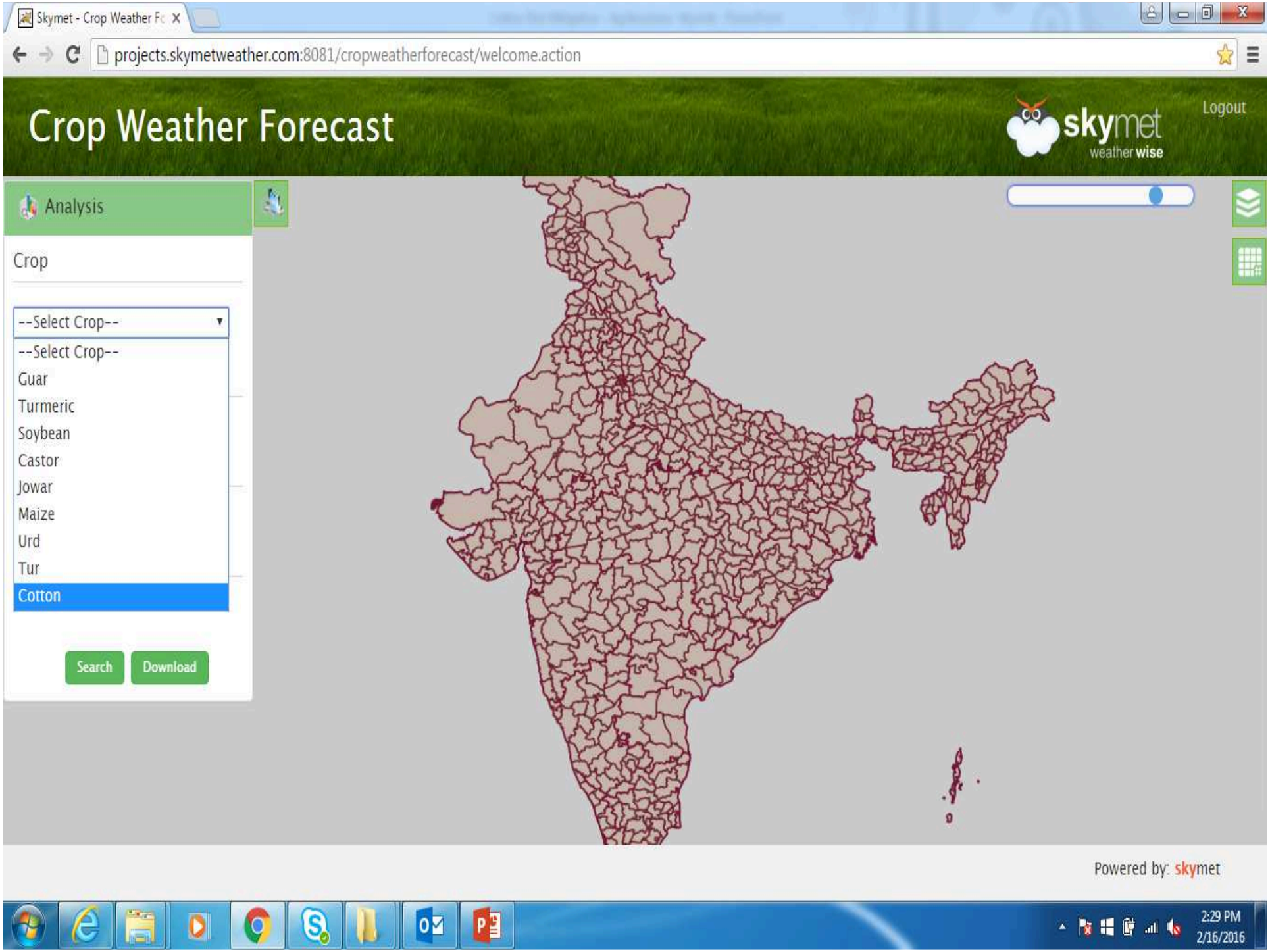
2/16/2016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--Select Crop--
Guar
Turmeric
Soybean
Castor
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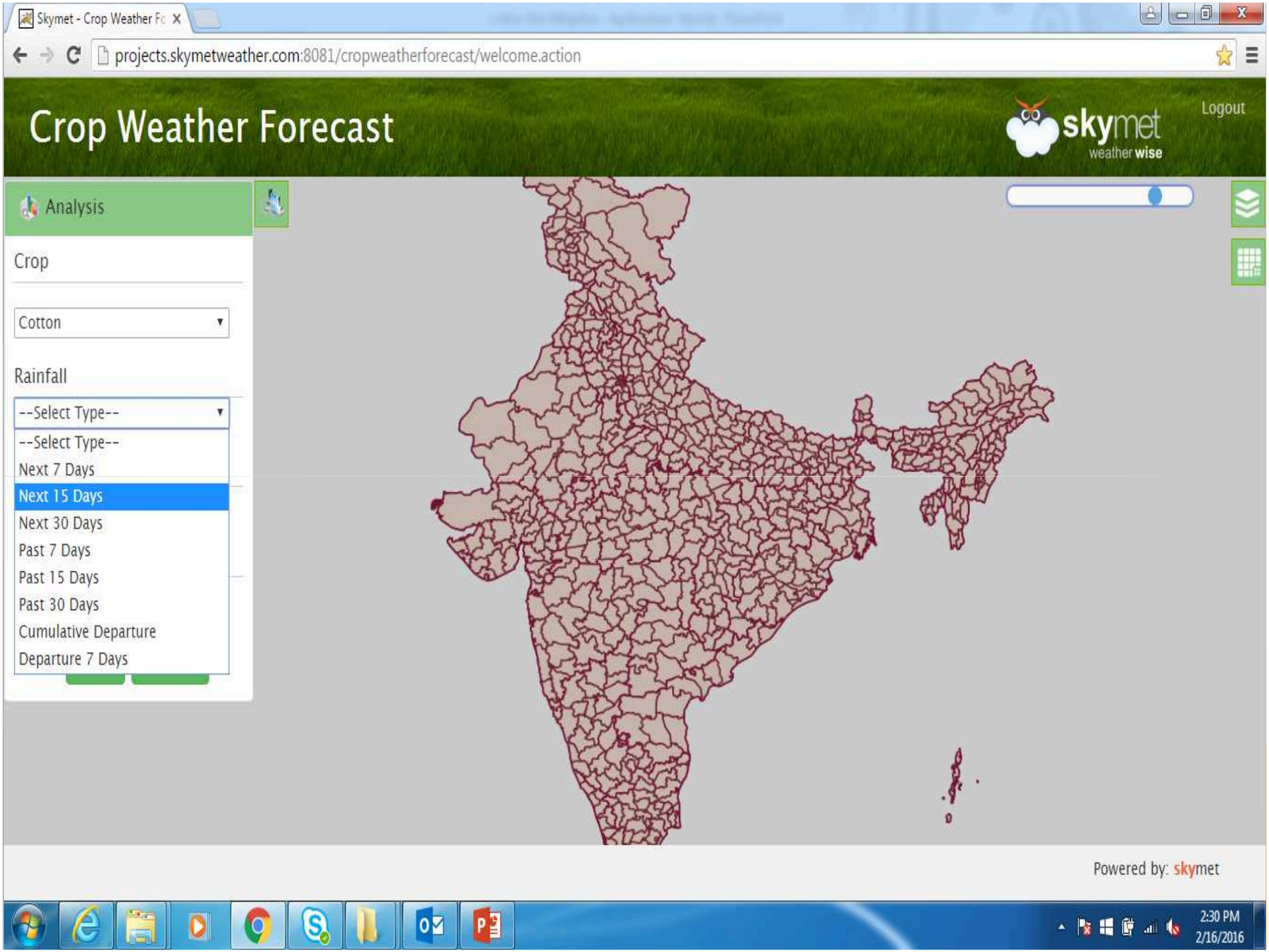
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Rainfall
--Select Type--
--Select Type--
Next 7 Days
Next 15 Days
Next 30 Days
Past 7 Days
Past 15 Days
Past 30 Days
Cumulative Departure
Departure 7 Days
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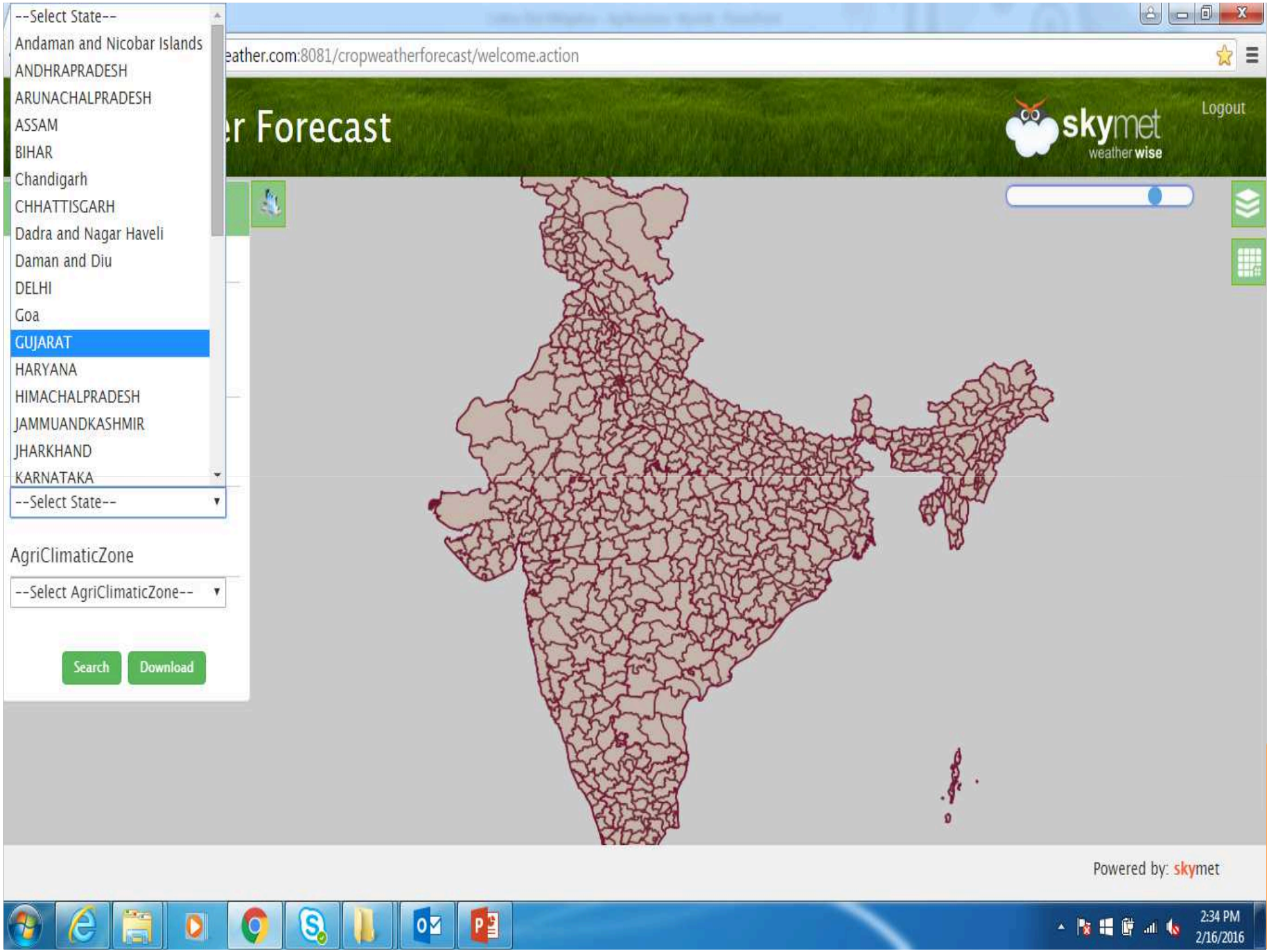
--Select State--
Andaman and Nicobar Islands
ANDHRAPRADESH
ARUNACHALPRADESH
ASSAM
BIHAR
Chandigarh
CHHATTISGARH
Dadra and Nagar Haveli
Daman and Diu
DELHI
Goa
GUJARAT
HARYANA
HIMACHALPRADESH
JAMMUANDKASHMIR
JHARKHAND
KARNATAKA
--Select State--
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--Select AgriClimaticZone--
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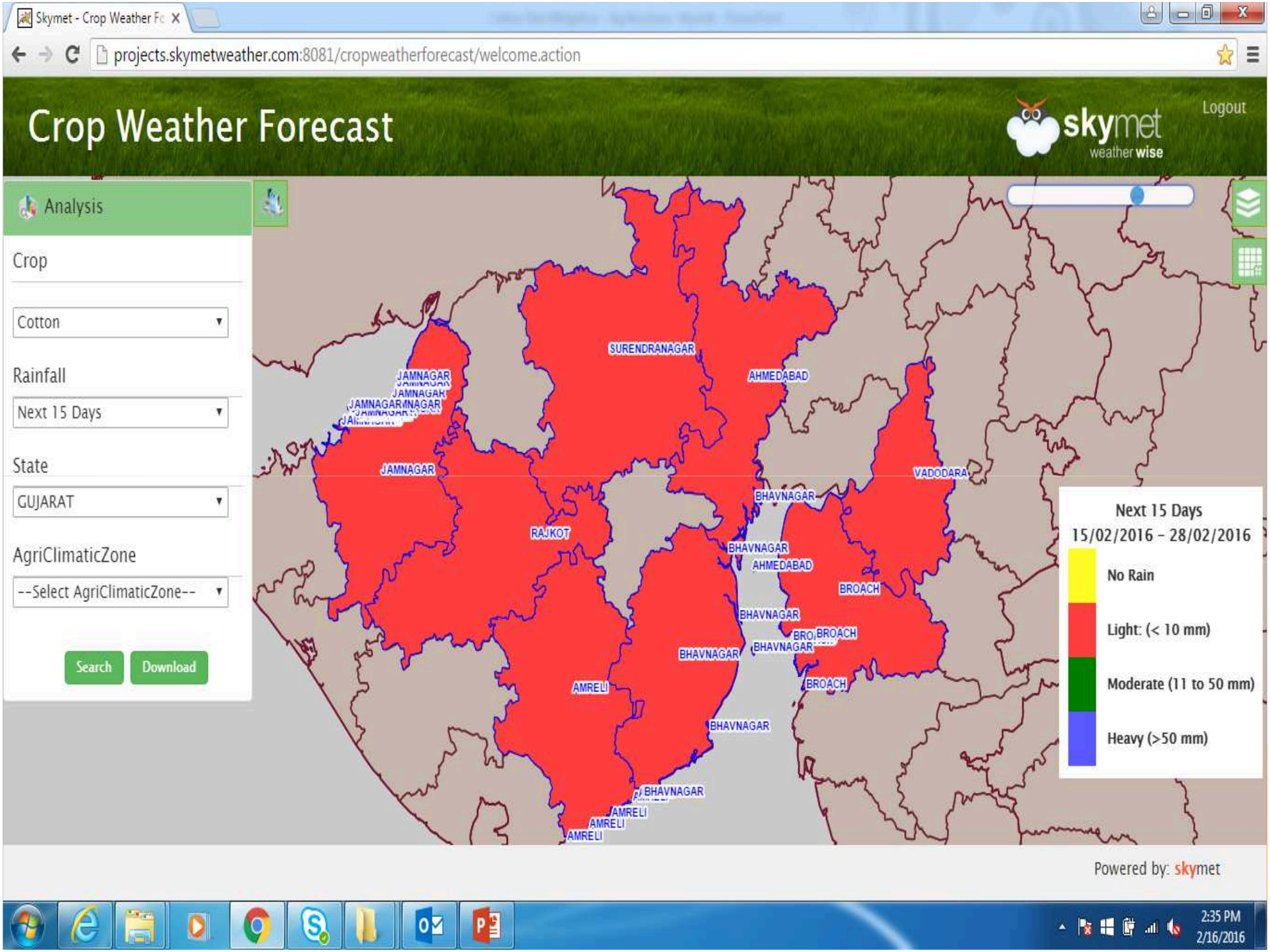
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Download
SURENDRANAGAR
AHMEDABAD
JAMNAGAR
VADODARA
BHAVNAGAR
RAJKOT
BROACH
AMRELI
Next 15 Days
15/02/2016 - 28/02/2016
No Rain
Light: (< 10 mm)
Moderate (11 to 50 mm)
Heavy (>50 mm)
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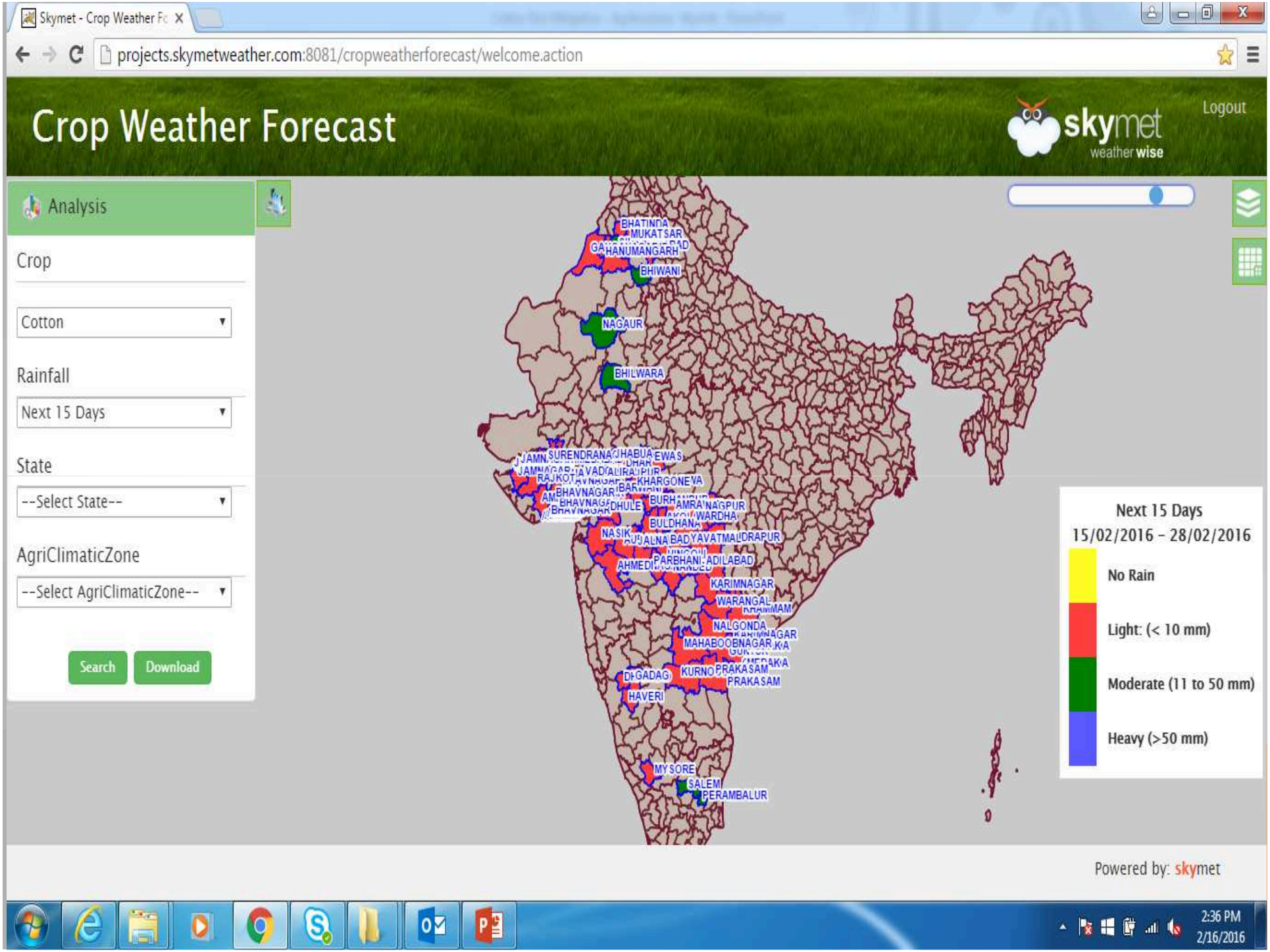
2/16/2016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Crop Weather Forecast
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weather wise
Logout
Analysis
Crop
Cotton
Rainfall
Next 15 Days
State
--Select State--
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Search
Download
BHATINDA
MUKATSAR
HANUMANGARH
BHIWANI
NAGAUR
BHILWARA
KHARGONE
BHAVNAGAR
DHULE
BURHANPUR
AMRAVATI
NAGPUR
WARDHA
BULDHANA
NASIK
JALNA
YAVATMAL
PARBHANI
ADILABAD
KARIMNAGAR
WARANGAL
NALGONDA
MAHABOOBNAGAR
KURNOOL
PRAKASAM
HAVERI
MYSORE
SALEM
PERAMBALUR
Next 15 Days
15/02/2016 - 28/02/2016
No Rain
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Moderate (11 to 50 mm)
Heavy (>50 mm)
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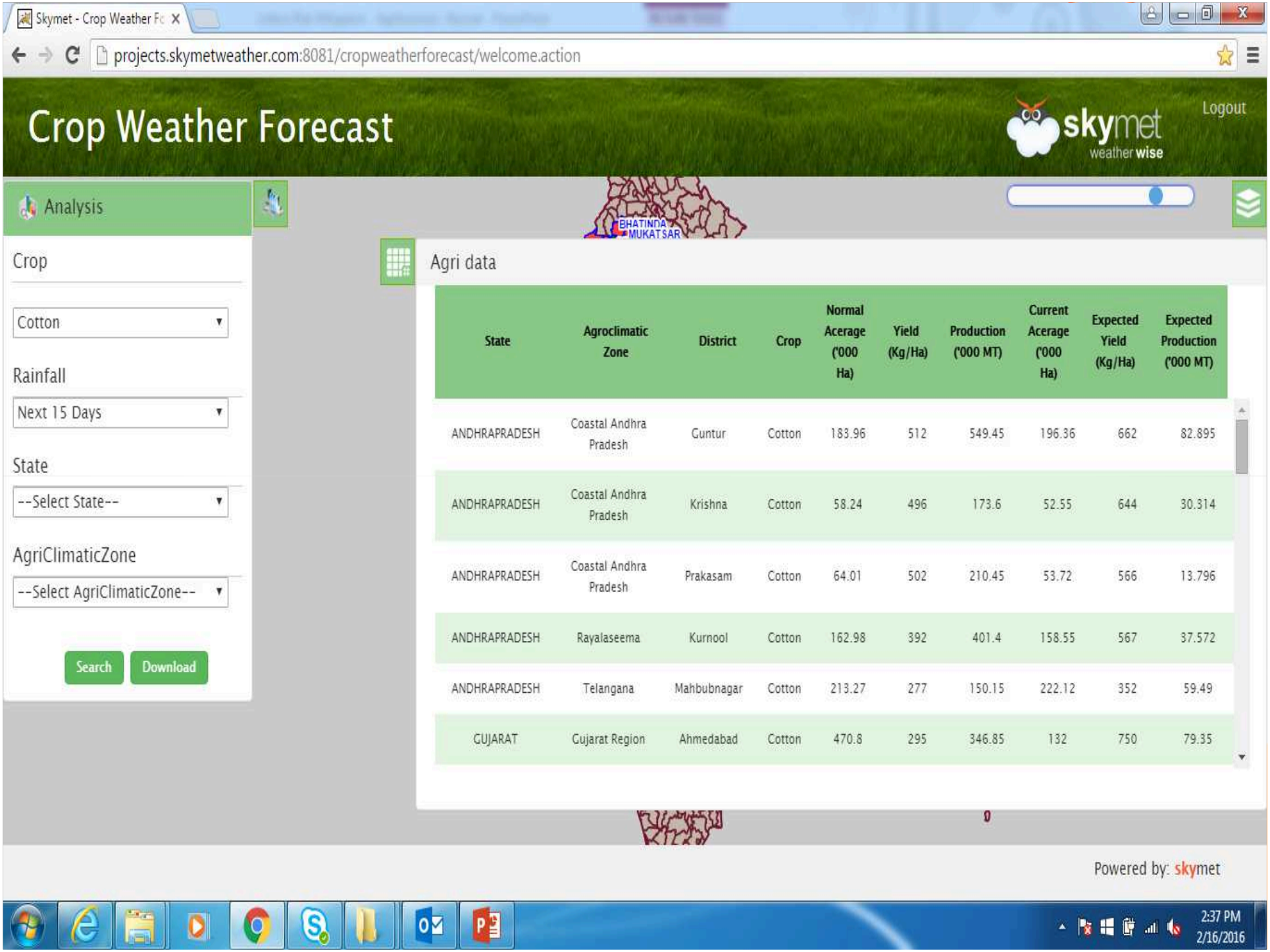
2/16/2016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Crop Weather Forecast
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Logout
Analysis
Crop
Cotton
Rainfall
Next 15 Days
State
--Select State--
AgriClimaticZone
--Select AgriClimaticZone--
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Download
BHATINDA
MUKATSAR
Agri data
State
Agroclimatic Zone
District
Crop
Normal Acerage ('000 Ha)
Yield (Kg/Ha)
Production ('000 MT)
Current Acerage ('000 Ha)
Expected Yield (Kg/Ha)
Expected Production ('000 MT)
ANDHRAPRADESH Coastal Andhra Pradesh Guntur Cotton 183.96 512 549.45 196.36 662 82.895
ANDHRAPRADESH Coastal Andhra Pradesh Krishna Cotton 58.24 496 173.6 52.55 644 30.314
ANDHRAPRADESH Coastal Andhra Pradesh Prakasam Cotton 64.01 502 210.45 53.72 566 13.796
ANDHRAPRADESH Rayalaseema Kurnool Cotton 162.98 392 401.4 158.55 567 37.572
ANDHRAPRADESH Telangana Mahbubnagar Cotton 213.27 277 150.15 222.12 352 59.49
GUJARAT Gujarat Region Ahmedabad Cotton 470.8 295 346.85 132 750 79.35
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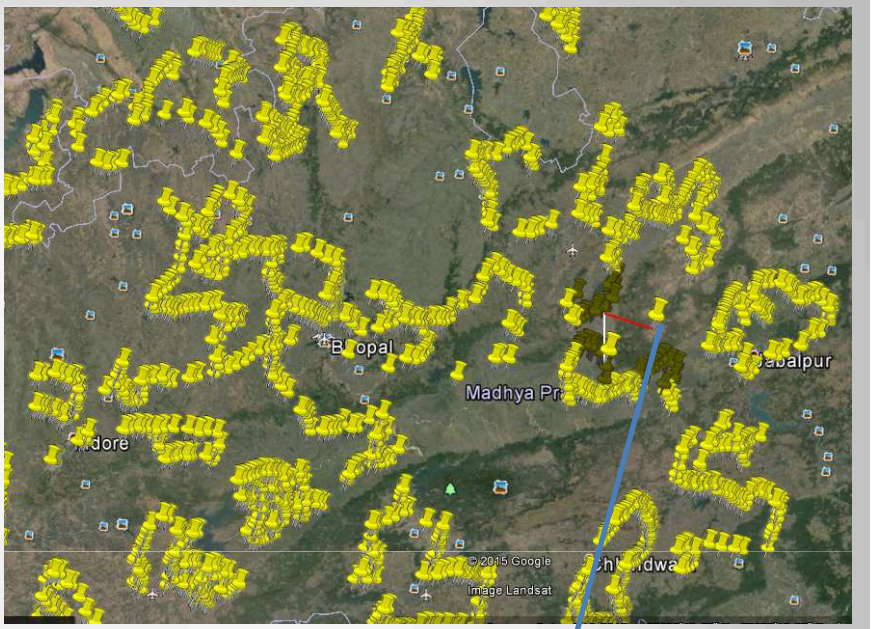
2:37 PM
2/16/2016

Cotton Crop Survey – Online monitoring

GPS survey



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Glencore_Crop_GCP:y	22.63328333330
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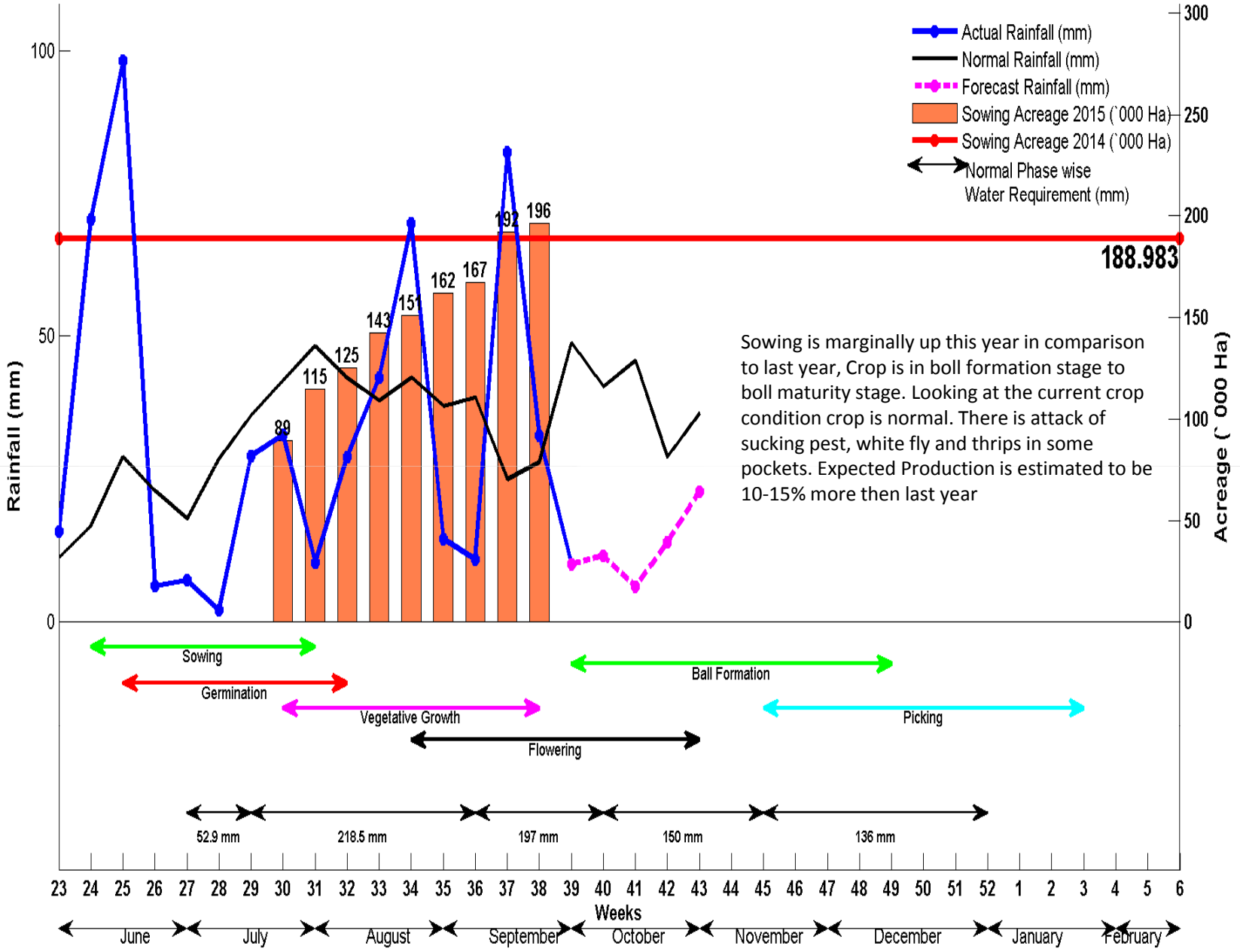
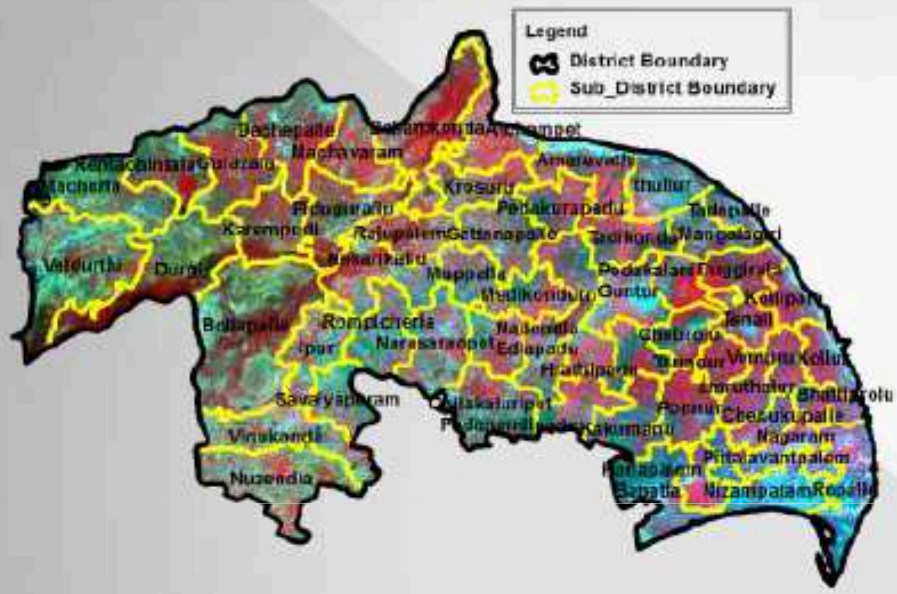
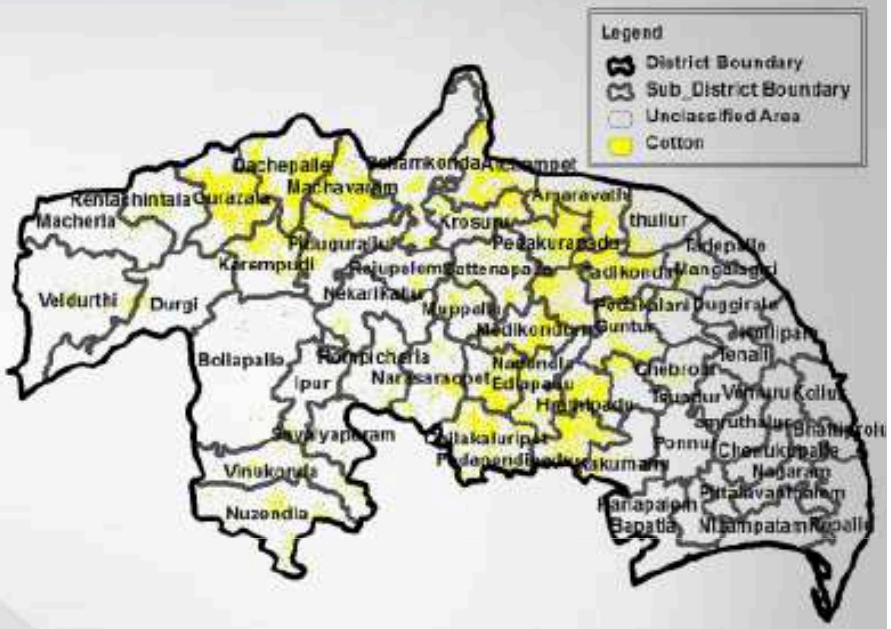
Glencore_Crop_GCP:district_n	Marvi
Glencore_Crop_GCP:sub_distri	Wankaner

COTTON CROP PROGRESS CALENDAR - GUNTUR (ANDHRA PRADESH)



STUDY AREA, GUNTUR, ANDHRA PRADESH

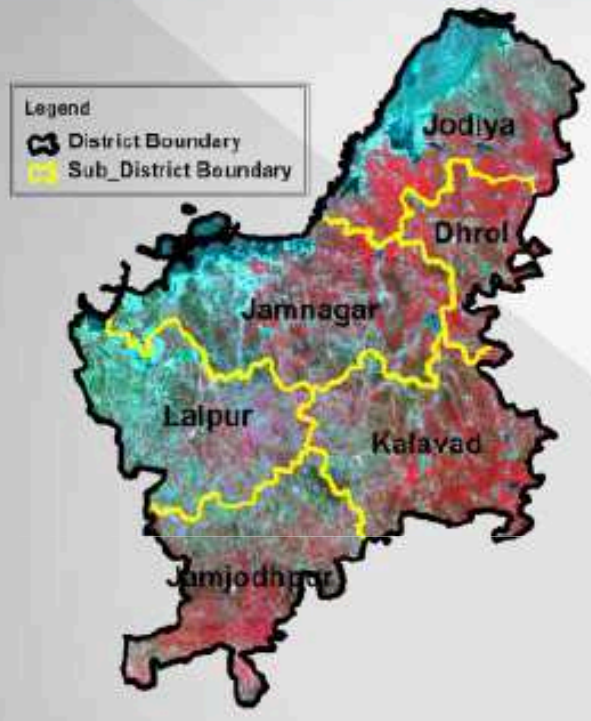




Sub District	Cotton
Dachepalle	12,685
Gurazala	12,130
Rentachintala	2,305
Macherla	863
Veldurthi	1,826
Durgi	994
Chebrolu	761
thullur	2,485
Edlapadu	5,627
Repalle	0
Narasaraopet	3,415
Bollapalle	400
Atchampet	8,603
Pidugurallu	5,976
Kakumanu	1,486
Hrathipadu	6,355
Pedakalani	1,004
Mangalagiri	1,160

Satellite Image –AWiFS
Acquisition Date – 14th Oct 2015
District – Guntur
Resolution – 56M
Acreage – Cotton – Ha 177,835

STUDY AREA, JAMNAGAR, GUJARAT



Sub District	Cotton
Jodiya	27,031
Kalavad	51,680
Jamjodhpur	37,256
Lalpur	19,115
Dhrol	24,398
Jamnagar	40,018
Total of All Sub Districts (Ha)	**199,498**

Satellite Image –LANDSAT
Acquisition Date – 6th Oct 2015
District – Jamnagar
Resolution – 30M
Acreage – Cotton – Ha 199,498

viewcce.skymetweather.com:8081/Cce_Visualization/logout.action
Apps
Bookmarks
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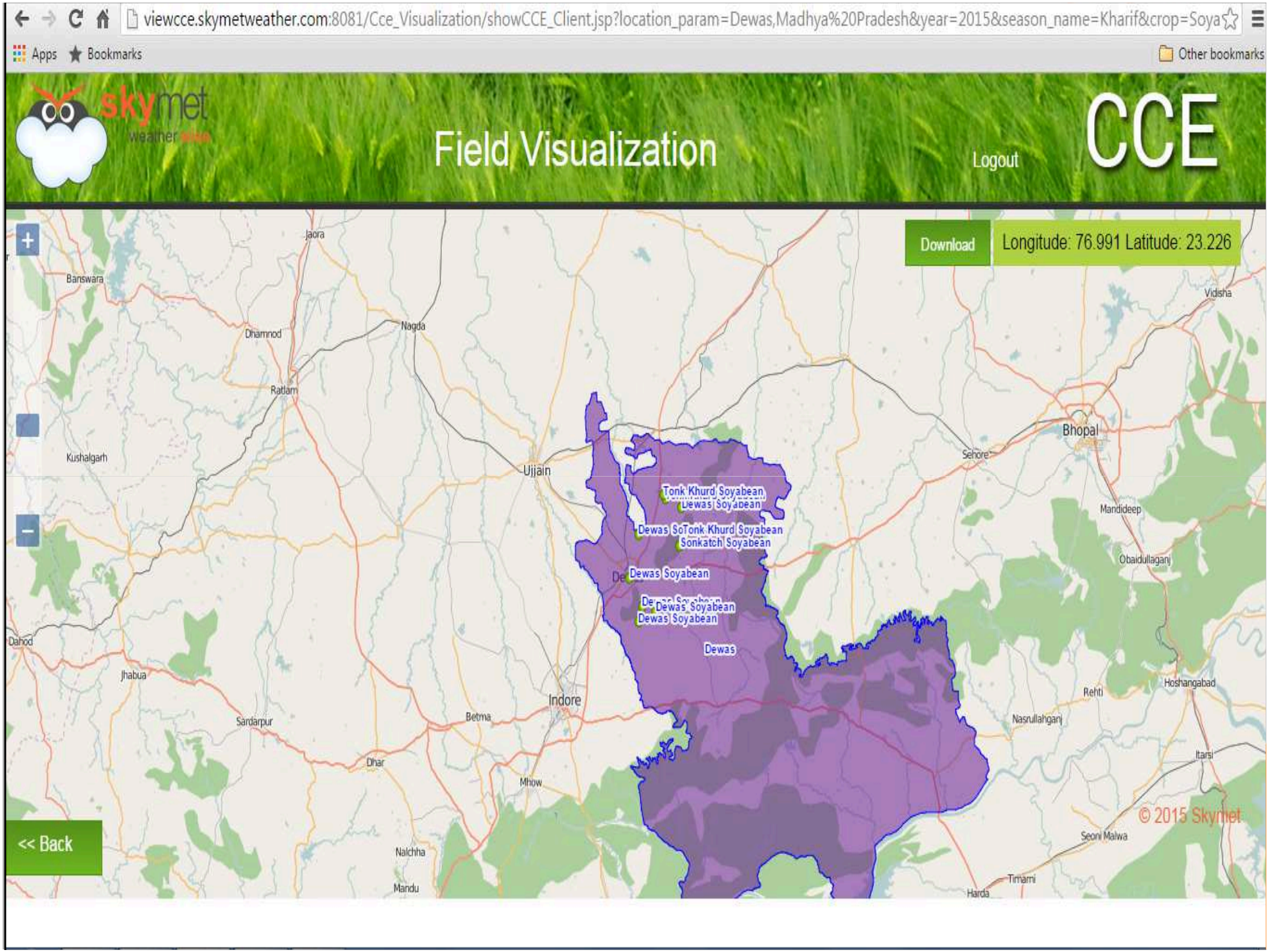
0~10kg: d=5g
10~50kg: d=10g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Apps
Bookmarks
Other bookmarks
skymet
weather
Field Visualization
Logout
CCE
Download
Longitude: 76.991 Latitude: 23.226
Jaora
Banswara
Dhamnod
Nagda
Ratlam
Kushalgarh
Ujjain
Vidisha
Bhopal
Sehore
Mandideep
Obaidullaganj
Tonk Khurd Soyabean
Dewas Soyabean
Dewas SoTonk Khurd Soyabean
Sonkatch Soyabean
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Jhabua
Sardarpur
Indore
Betma
Dhar
Mhow
Rehti
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Itarsi
Seoni Malwa
Timarni
Harda
Nalchha
Mandu
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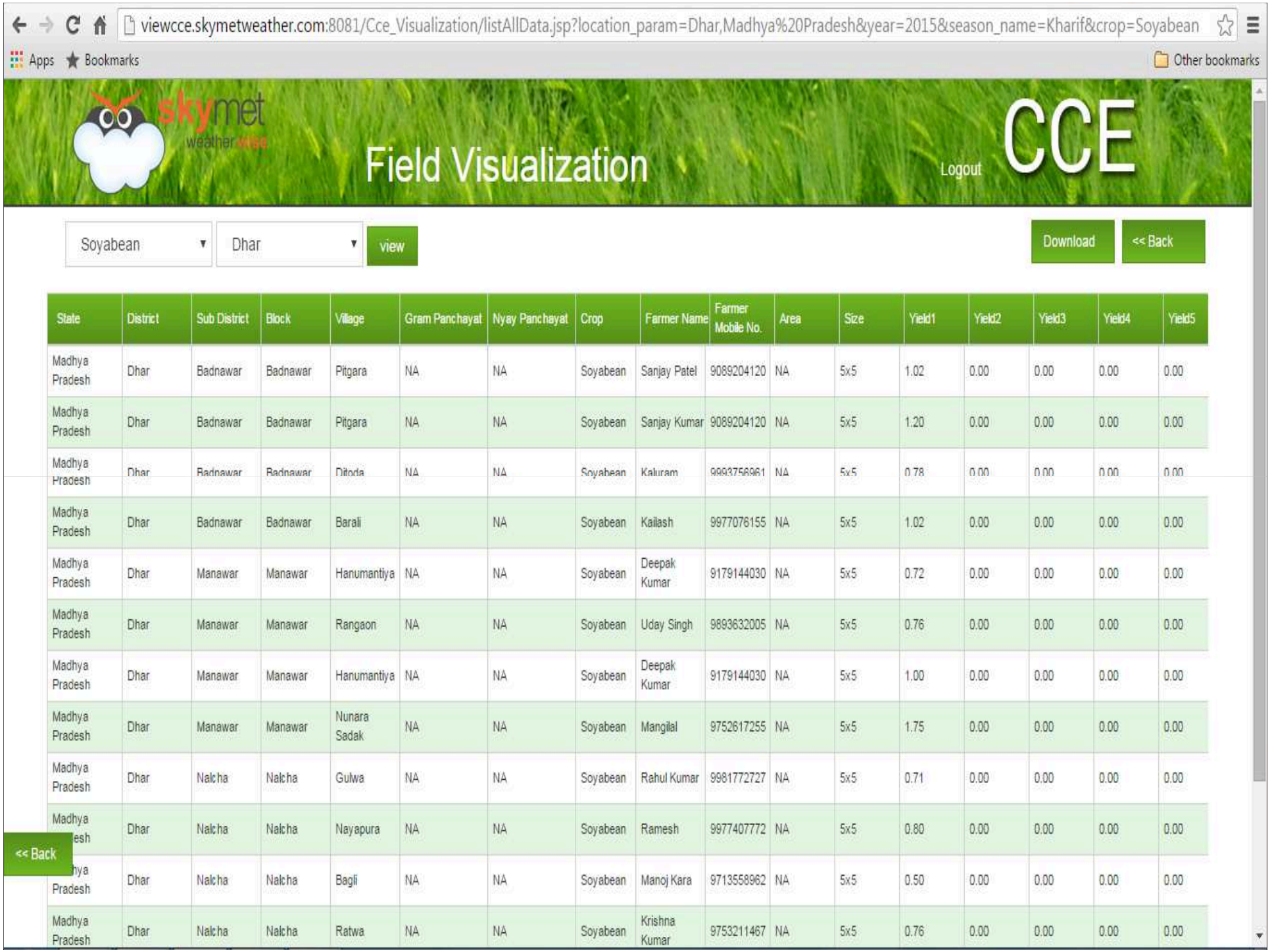
© 2015 Skymet



State	District	Sub District	Block	Village	Gram Panchayat	Nyay Panchayat	Crop	Farmer Name	Farmer Mobile No.	Area	Size	Yield1	Yield2	Yield3	Yield4	Yield5
Madhya Pradesh	Dhar	Badnawar	Badnawar	Pitgara	NA	NA	Soyabean	Sanjay Patel	9089204120	NA	5x5	1.02	0.00	0.00	0.00	0.00
Madhya Pradesh	Dhar	Badnawar	Badnawar	Pitgara	NA	NA	Soyabean	Sanjay Kumar	9089204120	NA	5x5	1.20	0.00	0.00	0.00	0.00
Madhya Pradesh	Dhar	Badnawar	Badnawar	Ditoda	NA	NA	Soyabean	Kaluram	9993756961	NA	5x5	0.78	0.00	0.00	0.00	0.00
Madhya Pradesh	Dhar	Badnawar	Badnawar	Barali	NA	NA	Soyabean	Kailash	9977076155	NA	5x5	1.02	0.00	0.00	0.00	0.00
Madhya Pradesh	Dhar	Manawar	Manawar	Hanumantiya	NA	NA	Soyabean	Deepak Kumar	9179144030	NA	5x5	0.72	0.00	0.00	0.00	0.00
Madhya Pradesh	Dhar	Manawar	Manawar	Rangaon	NA	NA	Soyabean	Uday Singh	9893632005	NA	5x5	0.76	0.00	0.00	0.00	0.00
Madhya Pradesh	Dhar	Manawar	Manawar	Hanumantiya	NA	NA	Soyabean	Deepak Kumar	9179144030	NA	5x5	1.00	0.00	0.00	0.00	0.00
Madhya Pradesh	Dhar	Manawar	Manawar	Nunara Sadak	NA	NA	Soyabean	Mangilal	9752617255	NA	5x5	1.75	0.00	0.00	0.00	0.00
Madhya Pradesh	Dhar	Nalcha	Nalcha	Gulwa	NA	NA	Soyabean	Rahul Kumar	9981772727	NA	5x5	0.71	0.00	0.00	0.00	0.00
Madhya Pradesh	Dhar	Nalcha	Nalcha	Nayapura	NA	NA	Soyabean	Ramesh	9977407772	NA	5x5	0.80	0.00	0.00	0.00	0.00
Madhya Pradesh	Dhar	Nalcha	Nalcha	Bagli	NA	NA	Soyabean	Manoj Kara	9713558962	NA	5x5	0.50	0.00	0.00	0.00	0.00
Madhya Pradesh	Dhar	Nalcha	Nalcha	Ratwa	NA	NA	Soyabean	Krishna Kumar	9753211467	NA	5x5	0.76	0.00	0.00	0.00	0.00

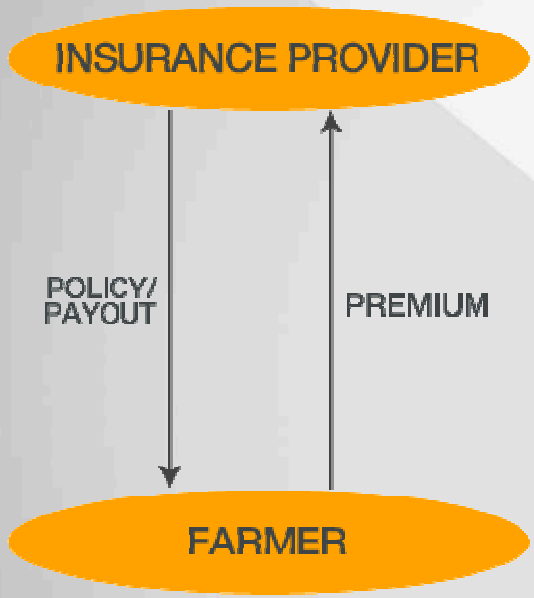
Cotton CCE in Progress…..

Crop Risk Management

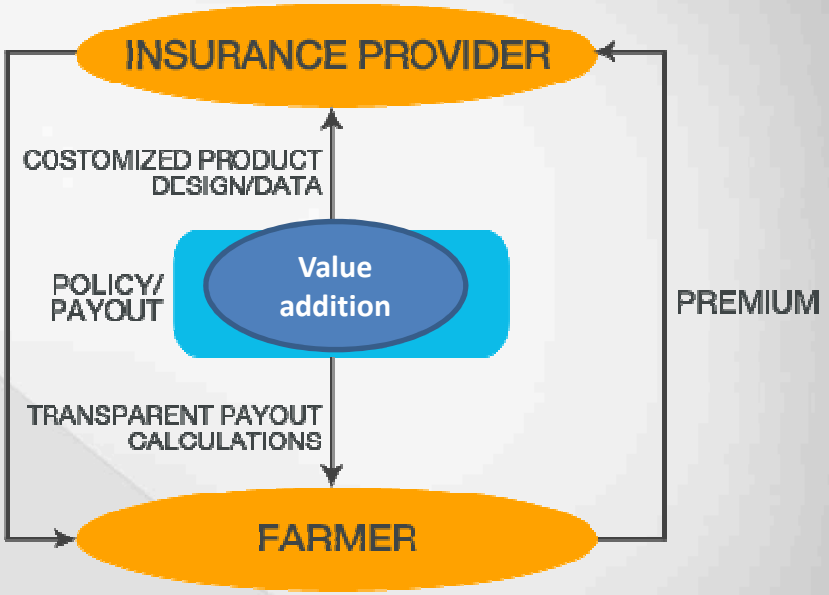
CUSTOMISED CROP RISK MANAGEMENT

Weather Based Crop Insurance

EXISTING



PROPOSED



Drawbacks:

- Inadequate product
- Cryptic payout calculations
- Opaque payouts
- Mistrust on insurance

Benefits:

- Customized product
- Transparent payout calculations
- Equitable payouts
- Trust build-up on insurance

Crop Risk Management

Particular	Features
Customized Crop Insurance	✓ Weather based customized crop insurance products ✓ Transparent Payout calculations ✓ Access to live weather data ✓ Equitable payout
Weather Derivative based Crop Insurance	✓ Companies having direct interest in agriculture ✓ Companies pay out premium and payouts are paid directly to company ✓ Seed companies involved in contract farming / seed production programs

PRODUCT CUSTOMIZATION (PEPSICO) – POTATO (PATIALA)

Earlier Product

Crop	Potato
Location	Patiala
Data Provider	INGEN Technologies P Ltd
Excess Rainfall Index	
Date From	1-Jan
Date to	20-Feb
Excess Rainfall Strike	Maximum of Cumulative 10 days
Strike_1 > (mm)	17
Strike_2 > (mm)	87
Exit (mm)	187
Notional (Rs. / mm)_1	72
Notional (Rs. / mm)_2	249.6
Maximum Payout (Rs.)	30000
Total Maximum Payout (Rs.)	30000
Frost Loss Index	
Date From	15-Dec
Date to	10-Jan
Frost Index Definition : (Multiple events)	Single day minimum temperature below the strike value
Strike	Notional (Rs./°C)
3.5 > X >= 1.5	225
1.5 > X >= 0	600
0 > X >= -2	1200
Maximum Payout (Rs.)	30000
Total Sum Insured (Rs/Acre)	60000
Premium Rs./Acre	4150

Modified Product

Crop	Potato	
Location	Patiala	
Data Provider	Skymet	
Excess Rainfall Index		
Date From	1-Jan	
Date to	20-Feb	
Excess Rainfall Strike	Maximum of Cumulative 10 days Rainfall > 17	
Strike (mm)	Fixed Payout	Variable Payout (Rs. / mm)
17	0	72
87	5040	249.6
Exit (mm)	187	
Maximum Payout (Rs.)	30000	
Total Maximum Payout (Rs.)	30000	
Frost Loss Index		
Date From	15-Dec	
Date to	10-Jan	
Frost Index Definition : (Multiple events)	Single day minimum temperature below the strike value.	
Strike (=<)	Payout (Rs.)	
3.5	100	
2.5	225	
1.5	450	
0.5	1050	
-0.5	1950	
-1.5	3150	
Maximum Payout (Rs.)	30000	
Total Sum Insured (Rs/Acre)	60000	
Premium Rs./Acre	3652	

TRANSPARENCY – INFORMATION & PAYOUTS

NAME : RAJESH KUMAR
F NAME : TAPESHWAR SHARMA
ADDRESS : VILL- BALSA, POST- BALSA
DIST- BALSA, ASSAM
PLAN : XYZ
STATION : ASSAM ADD STATION

TOTAL PAYOUT TILL DATE
₹ 5000

TEHSIL SUMMARY

STATION NAME	LEAST MIN(°C)	LEAST MAX(°C)	TOTAL RAINFALL
BALSA	26.25	35.32	28.69
BARAMA	26.25	35.32	28.69
DHARAMDHAMA	26.25	35.32	28.69
JALAH	26.25	35.32	28.69
NAGRIJULI	26.25	35.32	28.69
TAMULPUR	26.25	35.32	28.69

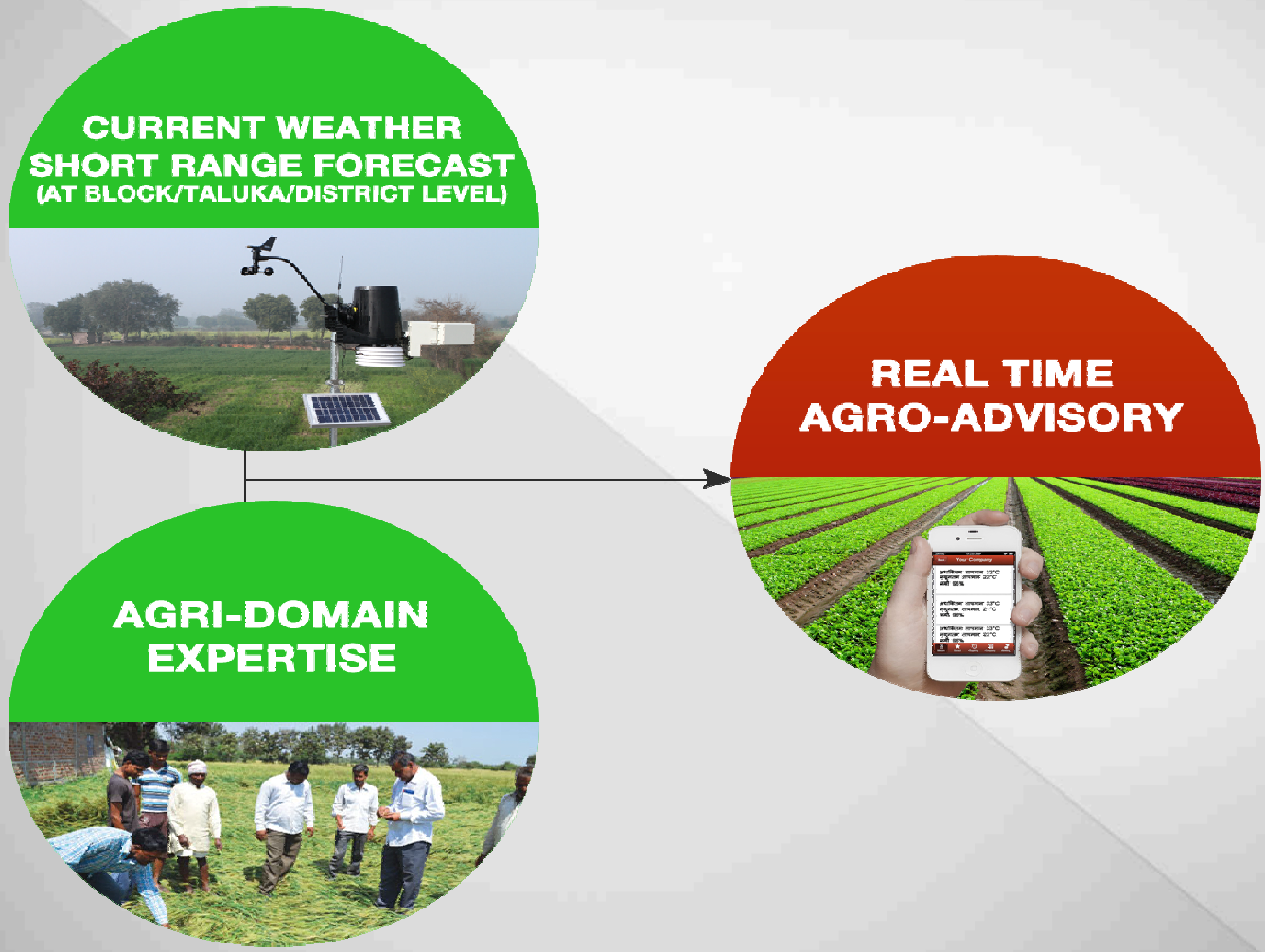
CHANGE STATION ASSAM

DATE/TIME	TAvg(°C)	TMax(°C)	TMin(°C)	Rh(%)	WS Avg (kmph)	WS Max (kmph)	WS Min (kmph)	WDir	Rainfall (mm)	Battery (V)	Charging	Network	Reason
09 JUL 2014 00:00	26.96	27.03	26.84	95	0.04	3.63	0.00	NW	0.00	3.94	0	0	
09 JUL 2014 01:00	26.67	26.04	26.84	96	0.00	0.00	0.00	NW	0.00	4.00	0	0	
09 JUL 2014 02:00	26.67	26.78	26.84	96	0.00	3.63	0.00	NW	0.00	3.95	0	0	
09 JUL 2014 03:00	26.76	26.81	27.25	96	0.02	0.00	0.00	NW	0.00	3.94	0	0	
09 JUL 2014 04:00	26.34	26.60	27.89	97	0.02	3.78	0.00	NNE	0.00	3.92	0	0	
09 JUL 2014 05:00	26.32	26.38	26.84	94	0.05	3.72	0.00	NNE	0.00	3.85	0	0	
09 JUL 2014 06:00	26.67	27.03	27.04	93	0.06	3.63	0.00	NNE	0.00	3.82	0	0	
09 JUL 2014 07:00	27.77	28.25	26.84	92	0.07	3.00	0.00	NW	0.00	3.80	0	0	
09 JUL 2014 08:00	28.96	29.75	26.85	90	0.03	3.63	0.00	NW	0.00	3.70	0	0	
09 JUL 2014 09:00	28.84	29.39	26.84	85	0.03	2.98	0.00	NW	0.00	3.50	0	0	
09 JUL 2014 10:00	27.94	32.39	28.84	80	0.04	3.63	0.00	NW	0.00	3.40	0	0	
09 JUL 2014 11:00	29.99	32.37	27.00	75	0.05	3.63	0.00	NNE	0.00	3.34	0	0	
09 JUL 2014 12:00	31.22	32.38	26.84	72	0.05	3.63	0.00	NNE	0.00	3.30	0	0	
09 JUL 2014 13:00	32.33	35.36	26.95	70	0.02	3.92	0.00	NNE	0.00	3.15	0	0	
09 JUL 2014 14:00	33.01	35.03	27.10	85	0.04	2.92	0.00	NW	0.00	3.00	0	0	
09 JUL 2014 15:00	30.22	33.03	28.80	87	0.04	3.63	0.00	NW	0.00	2.98	0	0	

Mitigating Crop Risk

Real Time Crop Advisory

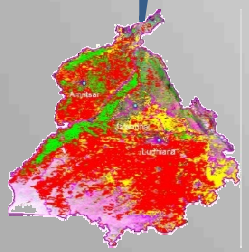
Real Time Crop Advisory



Paddy (Pusa Basmati 1121)
Real Time Crop Advisory

Current Weather & Forecast

GIS image



May wk-3 till June 2nd wk	**1: Sowing**	**Ideal conditions** Temperature-38-40 ⁰ C, Relative Humidity- 40-50, Moisture - sufficient
June wk -3 to 10th July	**2: Transplanting** (21-30 Days After Sowing)	**Ideal conditions** Temperature-35-38 ⁰ C, Relative Humidity- 60 – 70 %, Moisture – sufficient, Special emphasis of weed control
Aug-4th WK to Sept 10th	**3: Vegetative Stage** (7-60 Days After Transplanting)	**Ideal conditions** Temperature-32-38 ⁰ C, Relative Humidity- 70 %, Moisture – sufficient, Special emphasis on fertilisers & micro nutrients required
Sept Wk-4 to Oct Wk-1	**4: Panicle Initiation** (85-90 Days After Transplanting)	**Ideal conditions** Temperature-34-36 ⁰ C, Relative Humidity- 75 %, Moisture – sufficient, micro nutrients required
Oct Fortnight-1	**5: Flowering Stage** (96-100 Days After Transplanting)	**Ideal conditions** Temperature-33-35 ⁰ C, Relative Humidity- 70 %, Moisture – sufficient, (
Oct Fortnight-2	**6: Grain filling** (101-110 Days After Transplanting)	**Ideal conditions** Temperature-31-34 ⁰ C, Relative Humidity- 60 %, Moisture – sufficient, (most critical), irrigate field based on wind speed else crop will fall
Nov week-1	**7: Milky Stage** (111-120 Days After Transplanting)	**Ideal conditions** Temperature-30-34 ⁰ C, Relative Humidity- 60 %, Moisture – sufficient, (most critical), nutrients required
Nov week-2	**8: Maturity** (140-145 Days After Transplanting)	**Ideal conditions** Temperature-29-32 ⁰ C, Relative Humidity- 60 %, Moisture – Not required, harvest crop based on moisture

Actual Condition
Temp-43 ⁰ C ; RH-20%
No Rain / Moisture stress

Crop Advisory

1) Drain water from nursery and fill fresh water on daily basis
2) Delay Transplanting by -7 days

- ✓ Sales Employee
- ✓ Marketing person
- ✓ Distribution person
- ✓ Seed Production

- ✓ Farmers
- ✓ Retailers
- ✓ Dealers

BENEFITS

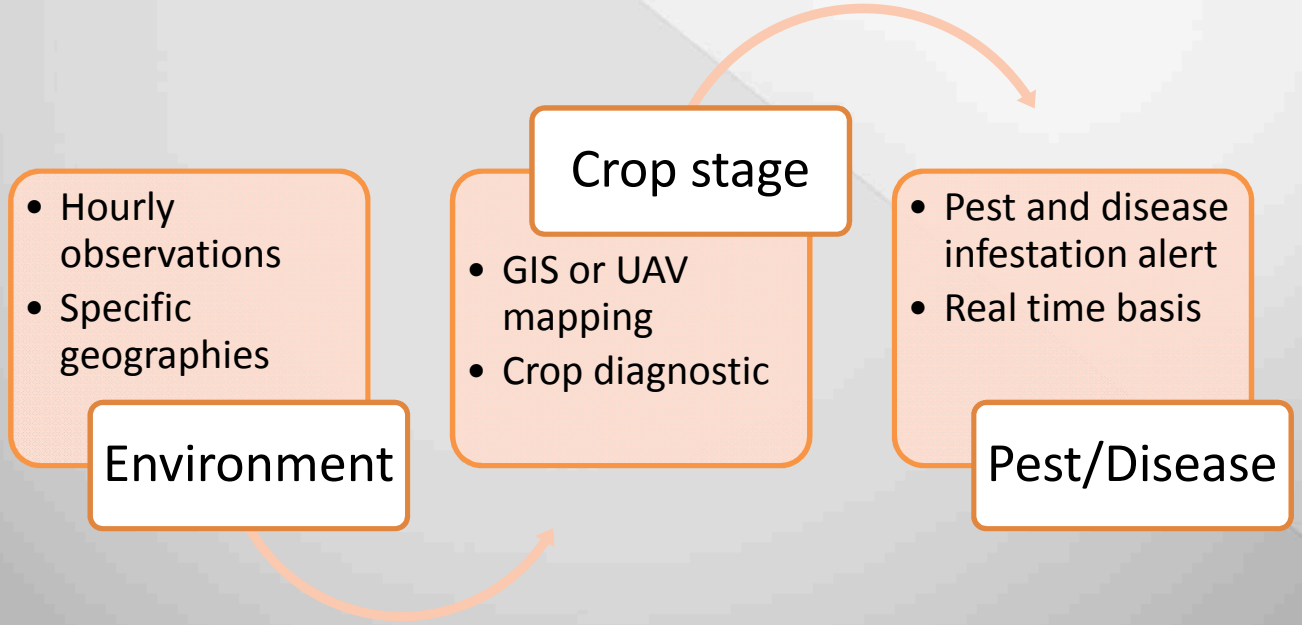
Farmers

- ✓ **Scheduling crop specific agronomic practices** based on weather / forecast
- ✓ **Scheduling Fertilizer and herbicide application**
- ✓ **Harvesting & Post harvest management advisories**
- ✓ **Strengthening brand equity thru realistic advisories**

Pest Forecasting Model

PEST FORECAST MODEL

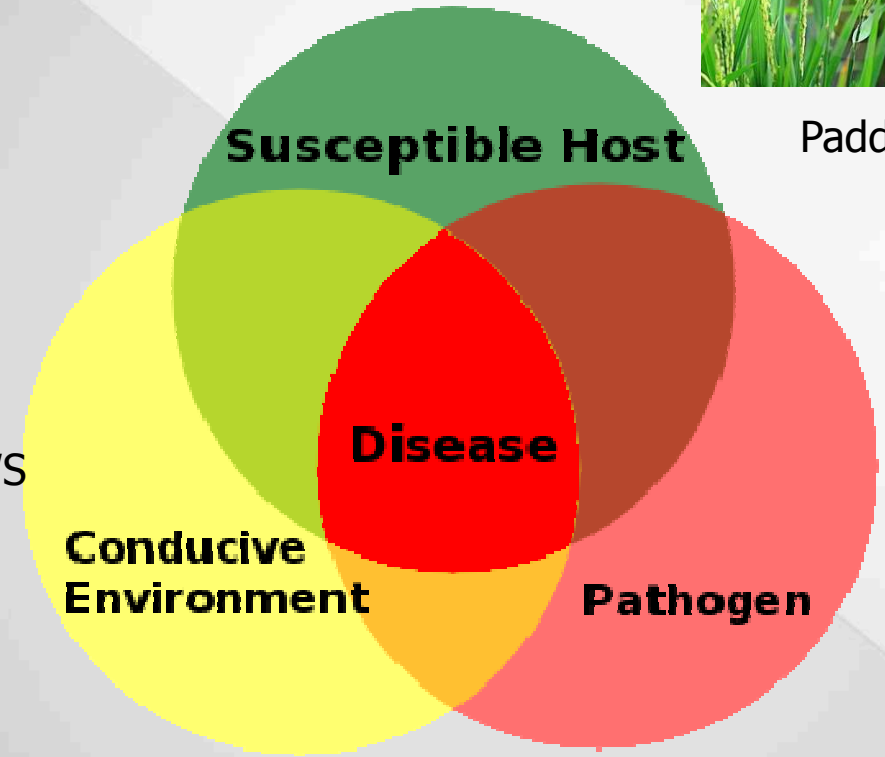
- The model combines three parameters of the disease triangle:
  - Crop (host)
  - Pathogen (present at field)
  - Environment (monitored by Automated Weather Station)



BROWN PLANT HOPPER – PADDY

Crop stage information

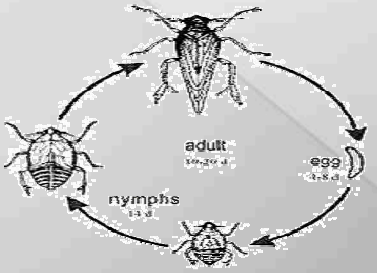
Paddy



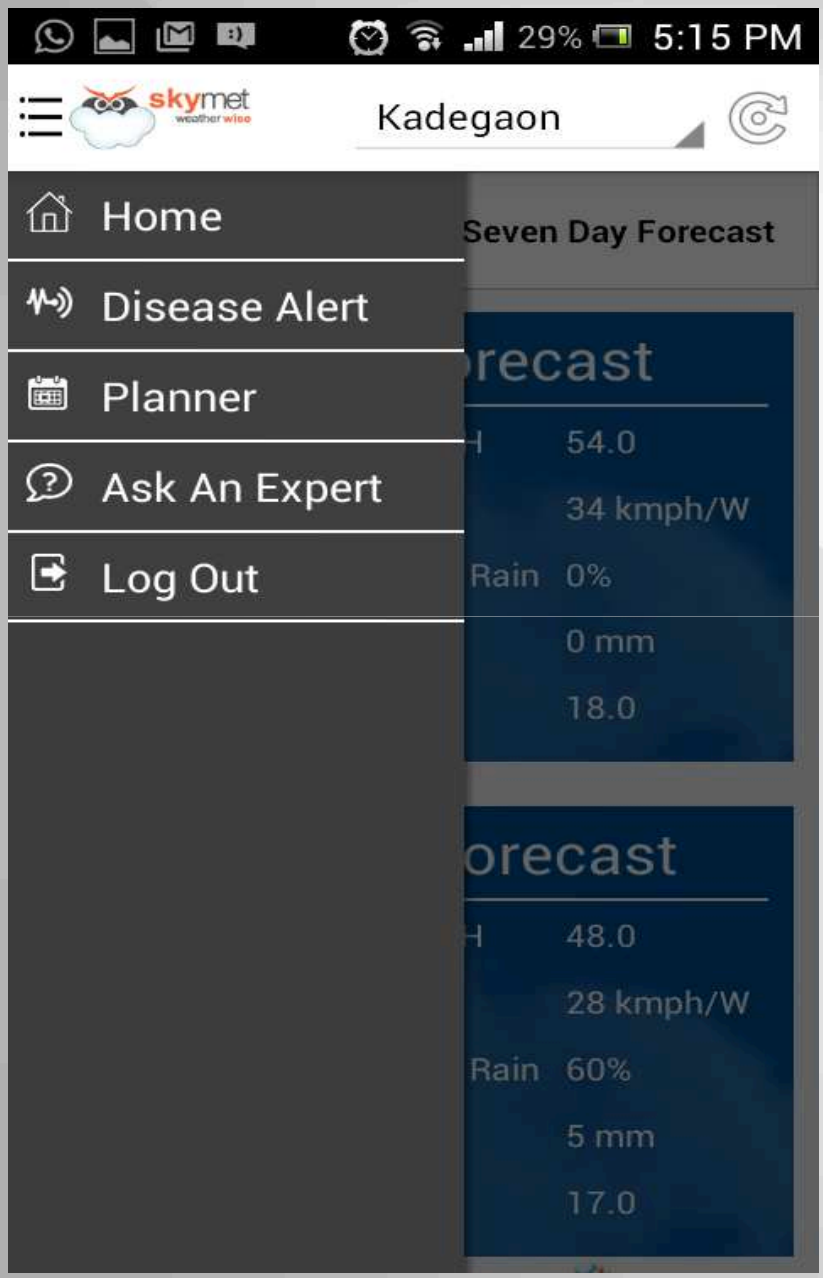
Monitor using AWS

Brown Plant Hopper (BPH)

BPH Life Cycle



Eggs Hatchability highest at 25°C
BPH Population Max 28-30°C
RH >70
High Nitrogen levels



Real Time Crop Advisory through Mobile phone

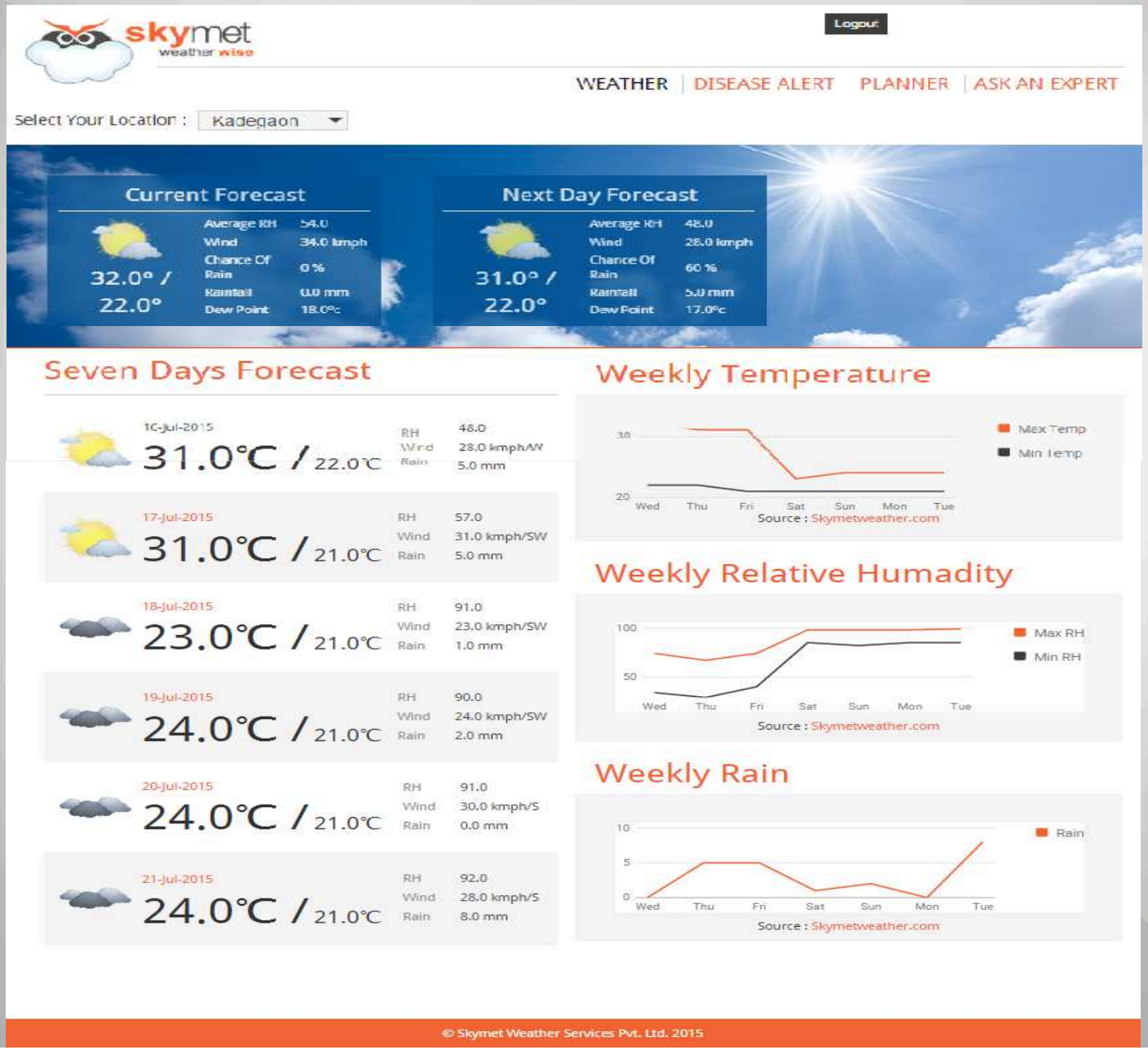
- **Weather forecast** (7 days locational weather data)
- **Disease alert** (7 days alert)
- **To do list** (Plan calendar for management)
- **Ask an expert** (Take field photo & share with expert)

- **Weather forecasting**

Data includes:

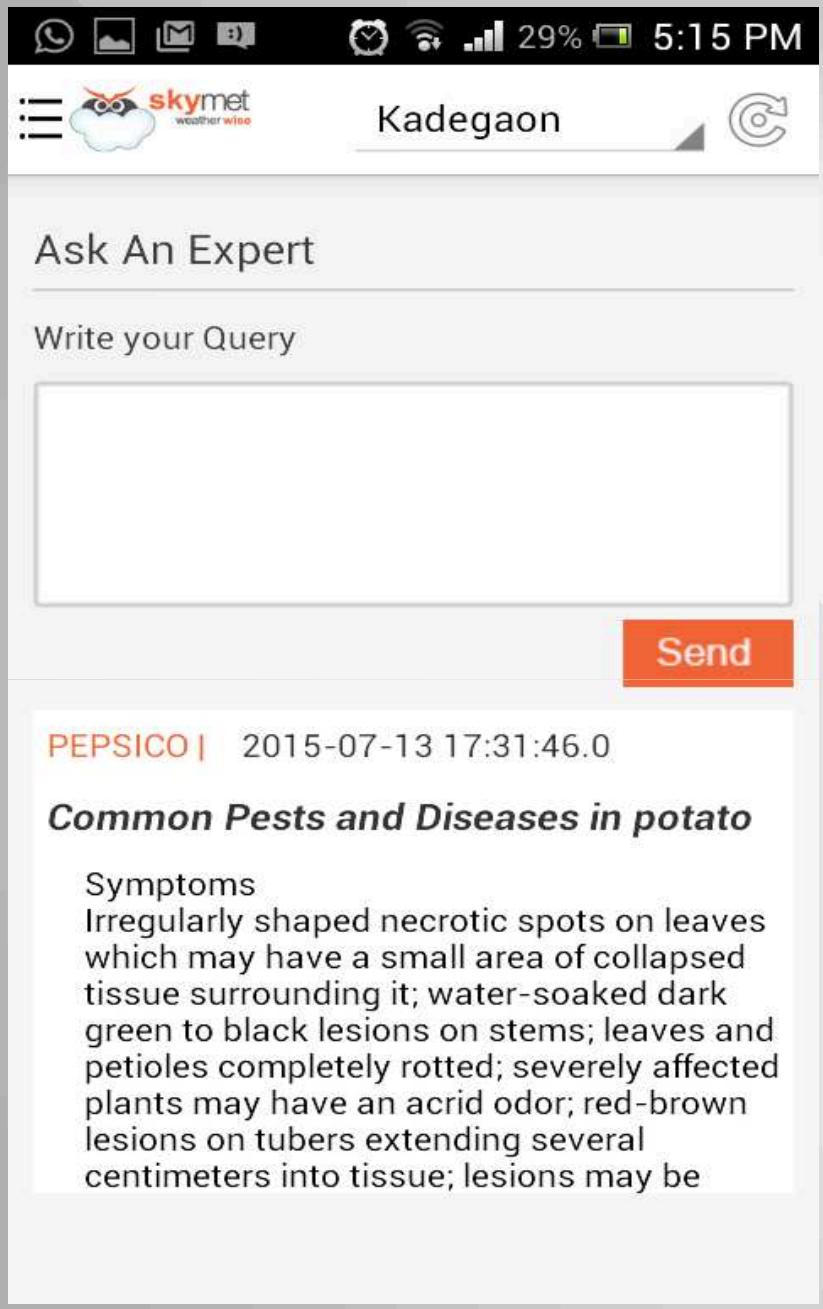
1. **Hourly data of temperature**
2. **Hourly %RH**
3. **Wind speed**
4. **Rain chance %**

Weather Forecast



Disease alert (7 days alert based on forecast and updated on real time basis based on AWS data)

Location wise weekly disease alert and its intensity



Ask an expert (Take field photo & share with expert)

- **Photos can be uploaded & internally sent to expert for remedies.**
- **Immediate data sharing & acting on the remedies are key initiative for LB management**

RISK MITIGATION POINTERS

1. **Weather Risk –** long, medium & short range weather forecast
2. **Accurate information on Increase / decrease of crop acreage in geography**
3. **Farmer Crop Risk Management** – area specific crop Insurance products
4. **Realistic crop advisories & Pest Forecasting tools**
5. **Monitoring Crop from sowing till Harvesting**

Realistic & Better Production forecast

THANK YOU FOR YOUR TIME AND CONSIDERATION