Crop Assessment using Space, Agro-Meteorology & Land based observations: Indian Experience

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Indian Agriculture

- **Net Area Sown**: 141.6 Mha (43%)
- **Food-grain production**: 252 Mt
  - (Kharif: 128 Mt, Rabi: 124 Mt)
- **Horticulture Production**: 281 Mt
- **Net Irrigated Area**: 65.3 Mha (46.4%)
- **Agrl. Share of GDP(%)**: 13.9
- **Employment Opportunity**: 54.6%
- **Average Field size**: 1.15 ha
Agriculture: the Major Driver for Indian Space Programme

Birth of Remote Sensing in India with Coconut Wilt Experiment of 1970

A Major Role in Defining Indian Remote Sensing Satellites

Significant Role in Growth of Digital Image Processing in India; Development of In-house Software

One of the Themes with Largest Number of Professionals (Inside & Outside ISRO) Involved

Crop Forecasting Activity is the Biggest Single User of Remote Sensing Data (especially, Resourcesat-2, Radarsat/RISAT) in India

Institutionalization: Establishment of MNCFC under MoA&FR

Acceptance in National and International Level
47 Years of Use of Remote Sensing in Crop Assessment

1969 - NASA-ISRO-MoA
1978 - JEP
1988 - CAPE
1997 - FASAL Pilot
2007 - FASAL
2012 - NCFC

Coconut Root Wilt study in Kerala
Experimental Studies on Crop Discrimination
Area & production Estimates of major crops at State level.
National Wheat, FASAL-Odisha
District-State-National forecasts using multiple approaches for multiple forecasts
Institutionalisation of Space Technologies developed by ISRO
Major National level Programmes

**FASAL** (Forecasting Agricultural output using Space, Agrometeorology & Land based observations)

**NADAMS** (National Agricultural Drought Assessment & Monitoring System)

**CHAMAN** (Coordinated Horticulture Assessment and Management using geoinformatics)

**KISAN** (Crop Insurance using Space technology And geoinformatics)
FASAL

Aims at providing multiple pre-harvest production forecasts of crops at National/State/District level

National/State/District forecasts:
- Rice (Kharif + Rabi)
- Cotton
- Sugarcane
- Wheat
- Rapeseed & Mustard
- Sorghum (Rabi)
- Pulses (Rabi)
- Jute

53.2% of total cropped area; 78.3% of Foodgrain production

Partners: MoA, ISRO, IMD, ICAR, IEG, 19 State Agriculture Depts., 17 State Remote Sensing Centres, 46 Agro-Met Field Units (SAUs)
Geospatial Technology for Field Data Collection

- Sampling plan based on RS data
- Smartphones/Tablets
- Android based App.
- Bhuvan Geoportal
- State Agri. Dept. Officials

>21000 GT points, >4000 CCEs

Groundtruth

Crop Cutting Expt
Yield forecasting: Methods

I. District/Met-Subdivision level Agro-meteorological models

II. Rice Biomass Modeling using SAR data

III. VCI based yield models for cotton and sugarcane

IV. Semi-Physical Model for Wheat and R&M

V. Crop Cutting Experiments using RS based Sampling Plan
# FASAL Forecasts

## Schedule of Forecasts (Rice)

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<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>31&lt;sup&gt;st&lt;/sup&gt; Aug</td>
<td>2 date data, State level</td>
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<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>30&lt;sup&gt;th&lt;/sup&gt; Sep</td>
<td>3 date data, District Level</td>
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<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>31&lt;sup&gt;st&lt;/sup&gt; Jan (Final)</td>
<td>Using Remote sensing based yield models</td>
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Comparison with DES

Correlation (Area)

RMSE { Area (M. Ha) }
Comparison with DES

Correlation (Production)

RMSE (Production) M. Tonn / Bales
Map of Rabi Emergence Area in 6 States

2015-16

(3rd Dekad of December) (1st Dekad of January) (2nd Dekad of January) (3rd Dekad of January) (1st Dekad of February)

2013-14

(3rd Dekad of December) (1st Dekad of January) (2nd Dekad of January) (3rd Dekad of January) (1st Dekad of February)
Operational Drought assessment during Kharif using Remote Sensing (Methodology developed by ISRO)

Periodic District/Sub-District level drought assessment for 14 Agriculturally Dominant states of India (5 at Sub District level)

Satellite based indices, Rainfall data, Ground information on Sowing progression and Irrigation Statistics are used for drought assessment

Drought Warning (Normal, Watch & Alert) is given in June July & August, while Drought Declaration (Mild, Moderate & Severe) in September & October
Drought Assessment: Inputs

1. Remote Sensing based indices:
   - Normalized Difference Vegetation Index (NDVI)
   - Normalized Difference Water Index (NDWI)
   - Vegetation Condition Index (VCI)

2. Area Favourable for Crop Sowing (using Satellite based Index and Soil Moisture Index)

3. District level Rainfall Deviation

4. Irrigation percentage

District level Irrigation percentage

Rainfall Data from IMD

NDVI from NOAA Data (1 km)

NDWI from MODIS Data (500 m)

NDVI from AWiFS Data (56 m)

Soil Moisture Index
28 August 2015
Vegetation & Temperature Condition Index

- Vegetation Condition Index (NDVI) = \(100 \times \frac{(NDVI - NDVI_{\text{min}})}{(NDVI_{\text{max}} - NDVI_{\text{min}})}\)
- Vegetation Condition Index (NDWI) = \(100 \times \frac{(NDVI - NDVI_{\text{min}})}{(NDVI_{\text{max}} - NDVI_{\text{min}})}\)
- Temperature Condition Index = \(100 \times \frac{(LST_{\text{max}} - LST)}{(LST_{\text{max}} - LST_{\text{min}})}\)
CHAMAN: Horticulture Assessment

- Area assessment and production estimation of major horticultural crops
- Geospatial Applications for Horticultural Development
- R&D Studies: Precision Farming, Signature Study, Yield Modeling.

**Area and Production (7 Crops, 12 states, 180 Districts)**
- Fruits: Banana, Mango and Citrus
- Vegetables: Potato, Onion and Tomato
- Spices: Chili

**Horticultural Development Studies**
1) Site Suitability
2) Post-Harvest Infrastructure
3) Crop Intensification
4) GIS database creation
5) Orchard Rejuvenation
6) Aqua-horticulture.
Satellite Merged Products for Orchard Classification

LISS IV 26-Nov-2013

Cartosat-1 25-Nov-2014

Fused Image LISS IV and Cartosat-1

Mango Orchard
- Old Orchard
- Mature Orchard
- Young Orchard
Post-Harvest Infrastructure Planning for Bihar State

Existing

Proposed

Cold Storage Location Map for Bihar State

Proposed Cold Storages Map for Bihar State

Legend:
- Proposed Cold Storages
- Existing Cold Storages
- Major Roads
- District Boundary

Village Clusters Significance in Potato Production:
- 3 Low
- 2
- 1
- 0
- Very Low

Source: DFC, Ministry of Agriculture
Prepared by: NCFC
KISAN: Remote Sensing for Crop Insurance

Objectives

- High Resolution Remote sensing for Crop Cutting Experiment planning
- To develop better models for crop yield assessment
- To provide yield estimates at block level
- To develop/evaluate an approach/index for index-based insurance
Impact of Disaster on Agriculture

- **Rice-Flooded Area Assessment, post-Phailin Cyclone in Odisha State, October, 2013**

- **Impact Assessment of Heavy Rainfall and Hailstorm in Northern India during Feb-Mar, 2015**
Whitefly Attack

18 Aug, 2014

19 Sept, 2014

5 Oct, 2014

21 Aug, 2015

6 Sept, 2015

8 Oct, 2015
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