

# RS & GIS FOR AGRICULTURAL DROUGHT ASSESSMENT & MANAGEMENT

Prof. D. Nagesh Kumar

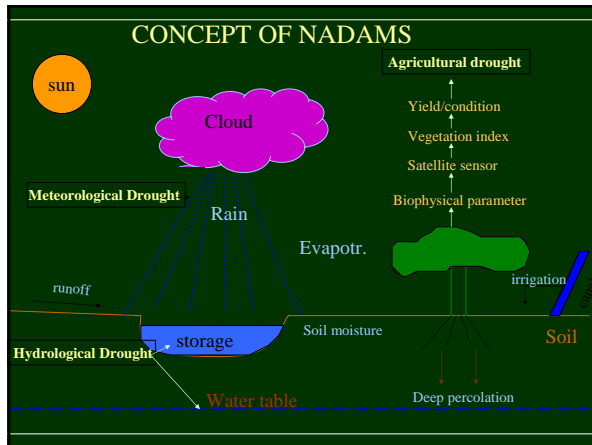
Dept. of Civil Engg.  
Indian Institute of Science  
Bangalore – 560 012

URL: <http://www.civil.iisc.ernet.in/~nagesh>

Acknowledgements  
Dr A.T. Jayaseelan, Scientist-F, NRSC, Hyderabad

## National Agricultural Drought Assessment and Monitoring System (NADAMS), NRSA

- NRSA has initiated NADAMS in 1989 and is providing near real-time information on prevalence, severity level and persistence of agricultural drought at national/ state/ district level during kharif season.
- Country Level Monitoring: Course resolution NOAA AVHRR data
- State & District Level Monitoring: Medium resolution WiFS/ AWiFS data
- Information is sent to the concerned Central/ State authorities for taking necessary action on the ground
- Project covers 14 states of the country, which are agriculturally important and vulnerable to drought.



## OBJECTIVE

- |                                  |                                                                                                                                                                                                                            |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initial objective (1986-1992):   | To provide periodic drought monitoring during kharif at district level                                                                                                                                                     |
| Objective (1992-1996 )           | To provide monthly reports with subdistrict information                                                                                                                                                                    |
| Objective (1996-2002)            | To provide monthly reports at district and state level for Nationwide Monitoring<br>To provide monthly reports at Taluk/mandal level for 2 States                                                                          |
| Current Objective (2002 onwards) | To provide district level for entire country.<br>River basin, irrigation and rainfed wise crop monitoring for comprehensive drought Monit.<br>Detailed monitoring over drought prone states<br>Through the year monitoring |

## Achievements, Methodology, Results and Planned activities for 1. Nationwide Monitoring

Established	NADAMS
Operational from	1989
Season monitored	Kharif Season (June to October)
Issued	Biweekly Bulletin during 1989-91 Monthly Detailed Reports since 1992
Sponsored by	Department of Agricultural and Cooperation Ministry of Agriculture (1989-1996)
Executed by	National Remote Sensing Agency/DOS
Supported by	i) India Meteorological Department ii) Central Water Commission iii) State Agriculture departments and iv) Other drought related agencies

## National Agricultural Drought Assessment and Monitoring System (NADAMS)

### Nationwide Monitoring

#### Service Provided

State wise reports at district level for fourteen Agriculturally important states of the country using 1km NOAA satellite data (Andhra Pradesh, Bihar, Chattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu, Uttaranchal and Uttar Pradesh)

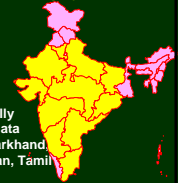
Summary reports at State level for Entire Country

#### Users

Central Agencies - Dept. of Agri and Cooperation, Planning commission

State Agencies - State Relief Dept., State Agrl. Dept.

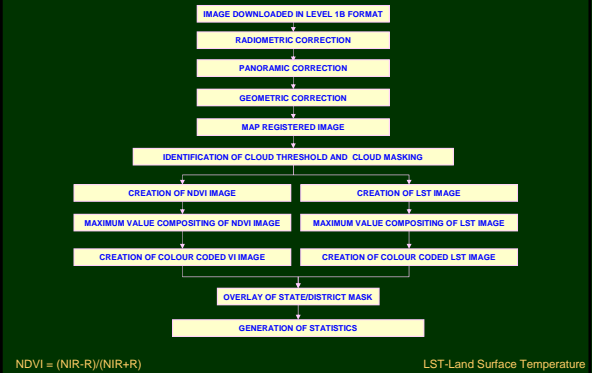
District report - District Collectors(District administration)



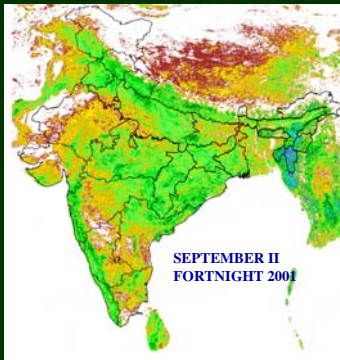
## Time Composite Images

- If an image contains cloud cover in a portion but that imagery can be acquired everyday like in the case of NOAA AVHRR a time composite imagery can be produced without cloud cover
- Co-register images acquired over number of days (say 15 days)
- Area with cloud cover is identified from the first imagery and is replaced by the next imagery of the same area.
- Cloud cover (if any) from this composite imagery is replaced with the third imagery.
- This procedure is repeated 15 times (say over 15 days imageries)
- Composite imagery is used for further analysis
- NRSA used such time composited imageries of NOAA AVHRR over 15 days for Agricultural drought assessment and analysis.

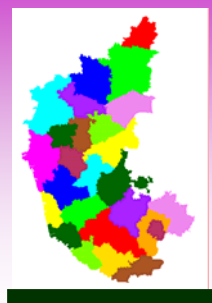
## SATELLITE DATA PROCESSING METHODOLOGY



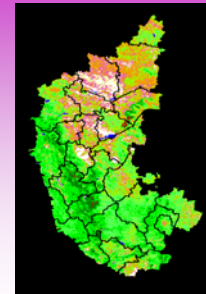
## FINAL MAXIMUM VALUE COMPOSITED COLOUR CODED FORTNIGHTLY IMAGE



## KARNATAKA STATE MASK

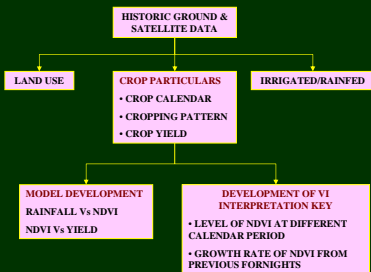


## KARNATAKA STATE IMAGE



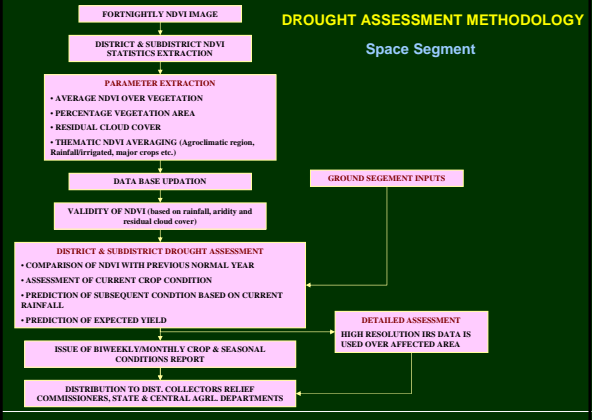
## DROUGHT ASSESSMENT METHODOLOGY

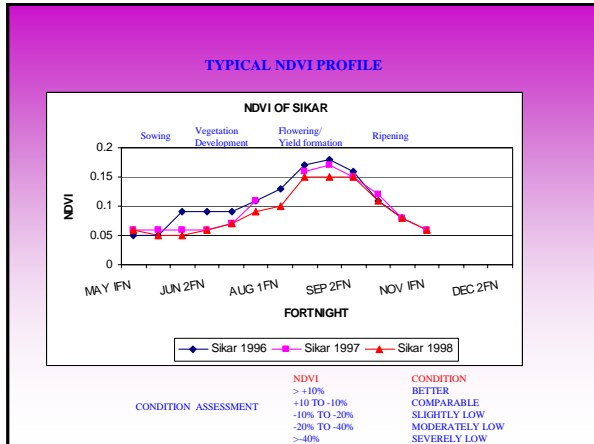
### Ground Segment



## DROUGHT ASSESSMENT METHODOLOGY

### Space Segment





### Regression Coefficients (R<sup>2</sup>) between NDVI and rainfall with crop yield

District	Major crop	R <sup>2</sup> for crop yield and NDVI (0.05)	R <sup>2</sup> with RF
Bangalore	Ragi	0.83	0.11
Bellary	Jowar	0.86	0.51
Belgaum	Jowar	0.85	0.05
Bidar	Jowar	0.75	0.05
Bijapur	Jowar	0.59	0.04
Chikmagalur	Ragi	0.72	0.68
Chitradurga	Ragi	0.74	0.73
Dharwad	Jowar	0.62	0.006
D.Kannada	Paddy	0.72	0.22
Gulbarga	Jowar	0.7	0.42
Hassan	Ragi	0.86	0.44
Kodagu	Paddy	0.49	0.24
Kolar	Ragi	0.93	0.4
Mandhya	Paddy	0.82	0.001
Mysore	Paddy	0.75	0.63
Raichur	Jowar	0.76	0.03
Shimoga	Paddy	0.89	0.81
Tumkur	Ragi	0.58	0.09
U.Kannada	Paddy	0.93	0.67

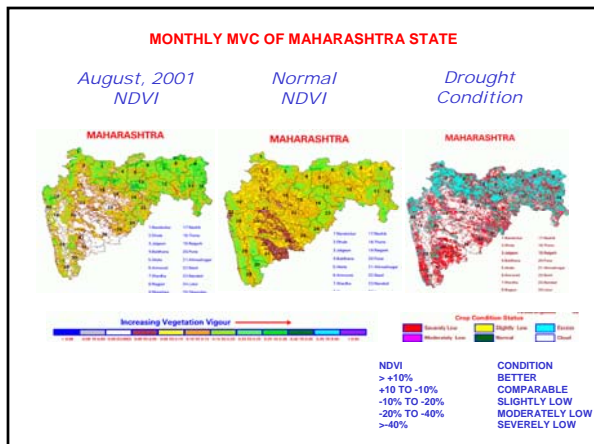
\* RF - Normal Rainfall  
NDVI - Normalized Vegetation Index with threshold above 0.85.  
R<sup>2</sup> - squared regression coefficient (R<sup>2</sup>) between NDVI and yield and rainfall and yield indicates better correlation of NDVI and yield rather with rainfall and yield in all districts of Karnataka. However, the regression between NDVI and yield is found to be low (R<sup>2</sup> < 0.4) in Bijapur, Tumkur and Kodagu districts.

### BIWEEKLY BULLETIN

- Issued at district level during June to December of 1989, 1990 and 1991 for 246 districts of 10 states
- Sent to Central and State Govt. Departments related with agriculture and revenue including district level officers totaling 700
- Provided timely reports with first cut alerts through telephone. In 3-4 days and printed bulletin in 10 days
- Bulletin contains vegetation index image, greenness comparison map and drought assessment report and progressive drought status at district level for every state.

### MONTHLY REPORTS

- Issued during Kharif season since 1992 for 11 states till 2000 and for 14 states since 2001.
- Each state report contains district wise Agri. background, consolidated reports on rain and Agri. operation, satellite based assessment on current vegetation development, early warning on subsequent period condition, expected reduction in yield from major crops.
- Sent to Central and State Govt. Departments related with agriculture and relief.



### DISTRICTWISE DROUGHT ASSESSMENT AND EARLY WARNING AS ON 30/09/2001

S.No	District	Cumulative Rainfall as on 26/09/2001	NDVI Condition	Early Warning
1	Panchkula	Excess	Better	Better
2	Amnabla	Excess	Normal	Normal
3	Yamunanagar	Deficient	Normal	Normal
4	Kurukshetra	Normal	Normal	Normal
5	Karnal	Normal	Normal	Normal
6	Kaithal	Excess	Normal	Normal
7	Jind	Normal	Slightly Low	Normal
8	Fatehabad	Normal	Moderately Low	Watch - Likely to improve
9	Sirsa	Normal	Moderately Low	Watch - Likely to improve
10	Hisar	Normal	Slightly Low	Normal
11	Panipat	Deficient	Normal	Normal
12	Sonapat	Deficient	Normal	Normal
13	Rohtak	Normal	Slightly Low	Normal
14	Bhiwani	Excess	Normal	Normal
15	Hajjar	Normal	Slightly Low	Normal
16	Mahendragarh	Deficient	Severely Low	Warning-Likely for concern
17	Rawani	Excess	Moderately Low	Watch-Likely to improve
18	Gurgaon	Normal	Slightly Low	Normal
19	Faridabad	Normal	Normal	Normal

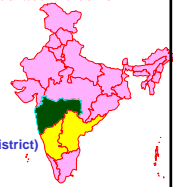
**PROGRESSIVE DROUGHT STATUS UPTO OCTOBER 31, 2001**

TABLE 3: PROGRESSIVE DROUGHT STATUS UPTO OCTOBER 31, 2001

S.NO	District	15-30 June	01-15 July	16-31 July	01-15 August	16-31 August	01-15 September	16-30 September	01-15 October	16-31 October
1	Prachinika	Comparable	Moderately Low	Comparable	Better	Better	Better	Better	Moderately Low	Moderately Low
2	Arbela	Better	Comparable	Comparable	Better	Better	Comparable	Comparable	Severely Low	Severely Low
3	Vamanunagar	Better	Comparable	Comparable	Better	Better	Comparable	Comparable	Severely Low	Severely Low
4	Kondatneta	Better	Comparable	Comparable	Better	Better	Comparable	Comparable	Severely Low	Severely Low
5	Kanul	Better	Comparable	Comparable	Better	Better	Comparable	Comparable	Moderately Low	Severely Low
6	Elathal	Better	Comparable	Comparable	Better	Better	Comparable	Comparable	Severely Low	Severely Low
7	Andhra Pradesh	Better	Comparable	Comparable	Better	Better	Comparable	Comparable	Moderately Low	Moderately Low
8	Palnabadi	Better	Better	Better	Comparable	Comparable	Comparable	Moderately Low	Severely Low	Moderately Low
9	Sissa	Comparable	Better	Better	Comparable	Comparable	Comparable	Moderately Low	Moderately Low	Moderately Low
10	Hisar	Better	Better	Better	Comparable	Comparable	Comparable	Slightly Low	Moderately Low	Moderately Low
11	Panipat	Better	Comparable	Comparable	Comparable	Comparable	Comparable	Comparable	Moderately Low	Moderately Low
12	Sonapat	Better	Comparable	Comparable	Comparable	Comparable	Comparable	Comparable	Moderately Low	Moderately Low
13	Mohak	Better	Better	Better	Comparable	Comparable	Comparable	Comparable	Slightly Low	Slightly Low
14	Bhawan	Better	Better	Better	Comparable	Comparable	Comparable	Comparable	Better	Better
15	Jhajjar	Better	Better	Better	Better	Better	Comparable	Slightly Low	Comparable	Comparable
16	Mahendraganj	Better	Better	Better	Better	Better	Comparable	Slightly Low	Severely Low	Severely Low
17	Rewari	Better	Better	Better	Better	Better	Comparable	Moderately Low	Moderately Low	Better
18	Gurgaon	Better	Better	Better	Better	Better	Comparable	Moderately Low	Slightly Low	Comparable
19	Faridkot	Better	Better	Better	Comparable	Comparable	Comparable	Comparable	Slightly Low	Slightly Low

The current NDVI is compared with the corresponding period of normal NDVI  
 \* - Cloud cover is more than 20% of the geographical area  
 Caution: The comparative condition need to be viewed with caution if there is significant residual cloud cover even after time composition of daily satellite data for the month.

**Achievements, Methodology, Results and Planned activities for Phase 2. Regional Monitoring**



Service Provided

Detailed NADAMS monthly report at Mandal/Taluk (sub-district) level using WIFS data for Andhra Pradesh and Karnataka

Users

Central Agencies - Dept. of Agri and Cooperation, Planning commission

State Agencies - State Relief Dept., State Agri. Dept.

District report - District Collectors(District administration)

From 2006 - AWIFS based drought monitoring over Maharashtra

**IRS WiFS (IRS P3) & AWiFS (IRS P6/ Resourcesat)**

**WIFS Sensor Characteristics**

Resolution	188 x 188 (B3 & B4)
Swath	188 x 246 (B5)
Range/scan	770 Km
Spectral Bands	0.62 - 0.68 microns (B1)
	0.77 - 0.86 microns (B4)
	1.55 - 1.69 microns (B5)

**AWiFS Image**



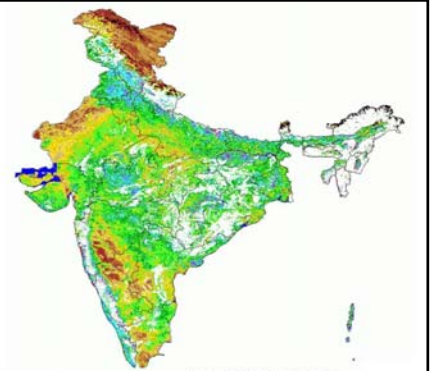
**AWiFS Sensor Characteristics**

Spectral Bands	B2, B3, B4 and B5
Swath	740 km (combined)
	370 km each head
Saturation radiance (mw/cm <sup>2</sup> /sr/micron)	B2 - 53 B3 - 47 B4 - 31.5 B5 - 4.04
Integration time	9.56 msec
Quantization	10 bits
No. of gains	16

The AWiFS camera provides enhanced capabilities compared to the WIFS camera on-board IRS-1C/1D, in terms of spatial resolution (56 m Vs 188m), radiometric resolution (10 bits Vs 7 bits) and Spectral bands (4 Vs 2) with the additional feature of on-board detector calibration using LEDs. The spectral bands of AWiFS are same as LISS-III.

**NADAMS**

IRS WiFS monthly composite NDVI image of agricultural area, India, Sep. 2003



Source: <http://www.nrca.gov.in/engnrsa/spacesolutions/disaster/drought2.htm>

**HIGHLIGHTS OF WIFS and AWiFS BASED ASSESSMENT**

NADAMS

**National Agricultural Drought Assessment and Monitoring System**

September 2001

ANDHRA PRADESH

Water Resources Group  
National Remote Sensing Agency  
Dept. of Space, Gov. of India, Hyderabad

**Information By End of August**

- Table showing sub-district cropped area till the end of July and August and crop condition assessment
- Maps of cropped area and condition assessment for each districts.

**Information By End of September**

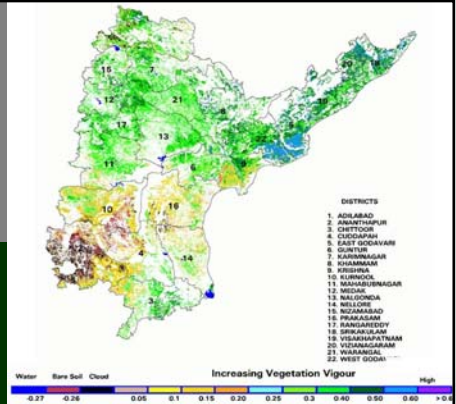
- Table showing sub-district cropped area till the end of September, crop condition assessment and early warning

**Information By End of October**

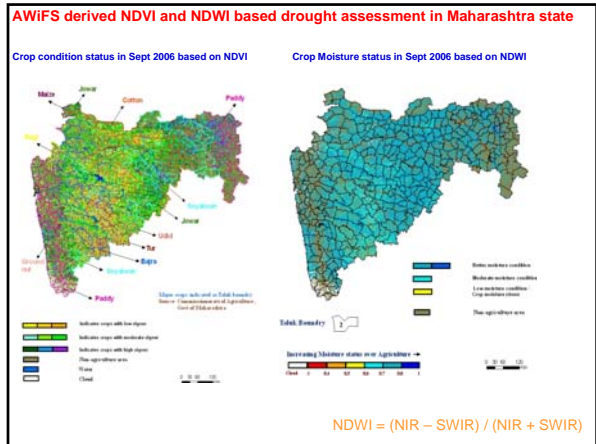
- Table showing mandal wise cropped area, crop condition assessment and early warning on expected yield.
- Sent to Central and State Govt. Departments related with agriculture, relief and district collectors

**NADAMS**

IRS WiFS monthly composite NDVI image of agricultural area, Andhra Pradesh Sep. 2003



Source: <http://www.nrca.gov.in/engnrsa/spacesolutions/disaster/drought2.htm>



## Conclusions

- Satellite Remote Sensing and GIS can play a very important role in Agricultural Drought Assessment and its mitigation



Thank you

