Impact of Tropical Cyclones and Storm Surges on Agriculture in India

Akhilesh Gupta
National Centre for Medium Range Weather Forecasting
Noida, India
Email: akgupta@ncmrwf.gov.in

Topics

- India- some salient features
- Tropical Cyclones in Indian Region
- Storm Surges and their Prediction
- Case studies of impact of TCs in the coastal regions of India
- Agromet Advisory Service and Economic Impact Assessment

INDIA: ECONOMIC GEOGRAPHY

Agriculture: Primary Sector

- Indian agriculture is inefficient and labor intensive.
- Animals are frequently used for power.
- The village is the focus of life for 74 percent of the Indian population with an estimated 580,000 villages.
- Approximately 2/3 of India's huge working population (63 percent) depends directly on the land for its livelihood.
- Substantial progress toward modernization has been made in the Punjab's wheat zone.
- Half of all rural families either owned as little as a half hectare (1.25 acres) or less, or no land at all.
- Land consolidation efforts have had only limited success, except in the states of Punjab, Haryana, and Uttar Pradesh.

INDIA: ECONOMIC GEOGRAPHY

Major crop zones:

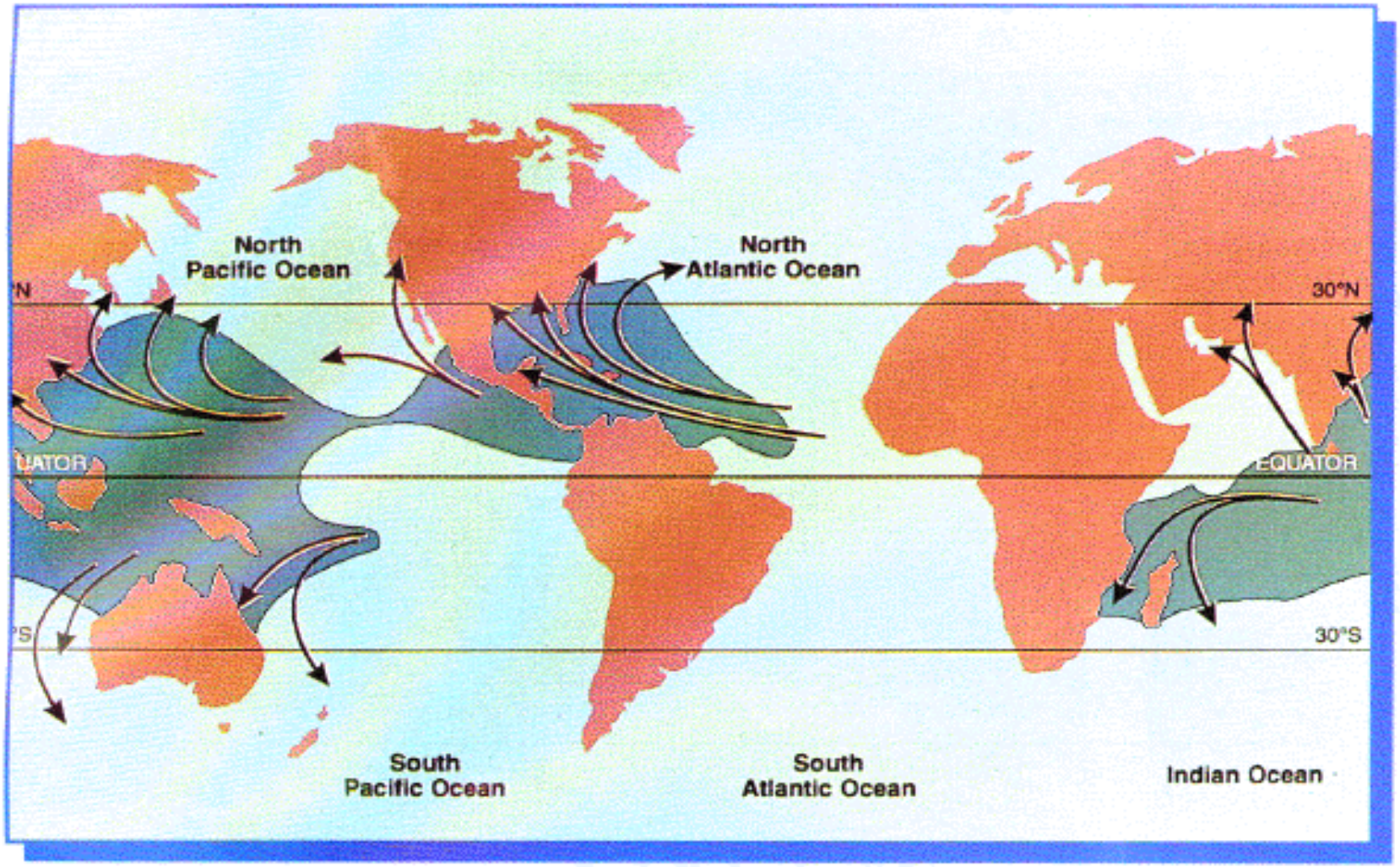
1. **Wheat**. Dry northwest notably in the Punjab and neighboring areas of the Upper Ganges. Many gains from the Green Revolution through the introduction of high-yielding varieties developed in Mexico.
2. **Rice.** Moist east and a summer monsoon drenched south. More than 1/4 of all of India's farmland lies under rice cultivation, most of it in the states of Assam, West Bengal, Bihar, Orissa, and eastern Uttar Pradesh. This area has more than 100 cm (40 inches) of rainfall. India has the largest acreage of rice among the world's countries. Yields per hectare are still low at below 1,000 kg (900 lbs./acre), however.
3. **Coconut.** Malabar Coast. (Kerala)
4. **Millet.** Southwestern India. A cereal grass, Setaria italica, extensively cultivated in the East and in southern Europe for its small seed or grain, used as food for man and fowls, but in the U.S. grown chiefly for fodder.
5. **Groundnut.** Kathiawar Peninsula.
6. **Cotton.** West-Central India (Deccan Plateau).
7. **Chick Peas.** Northwest.
8. **Plantation.** Northeast.

INDIA: ECONOMIC GEOGRAPHY

Livestock:

- India has more livestock than any other country in the world.
  - Cows - 200,000,000
  - water buffalo - 60,000,000
  - Goats and sheep - 60,000,000
  - Horses, donkeys, and elephants - 5,000,000
- Sheep are of major importance in the drier west where the Islamic population is clustered.
- Buffalo is dominant in the Ganges Delta and coastal regions.
- Cattle (particularly the Brahman or Zebu breeds) are found throughout India.

Average TC Movement in Different Basins



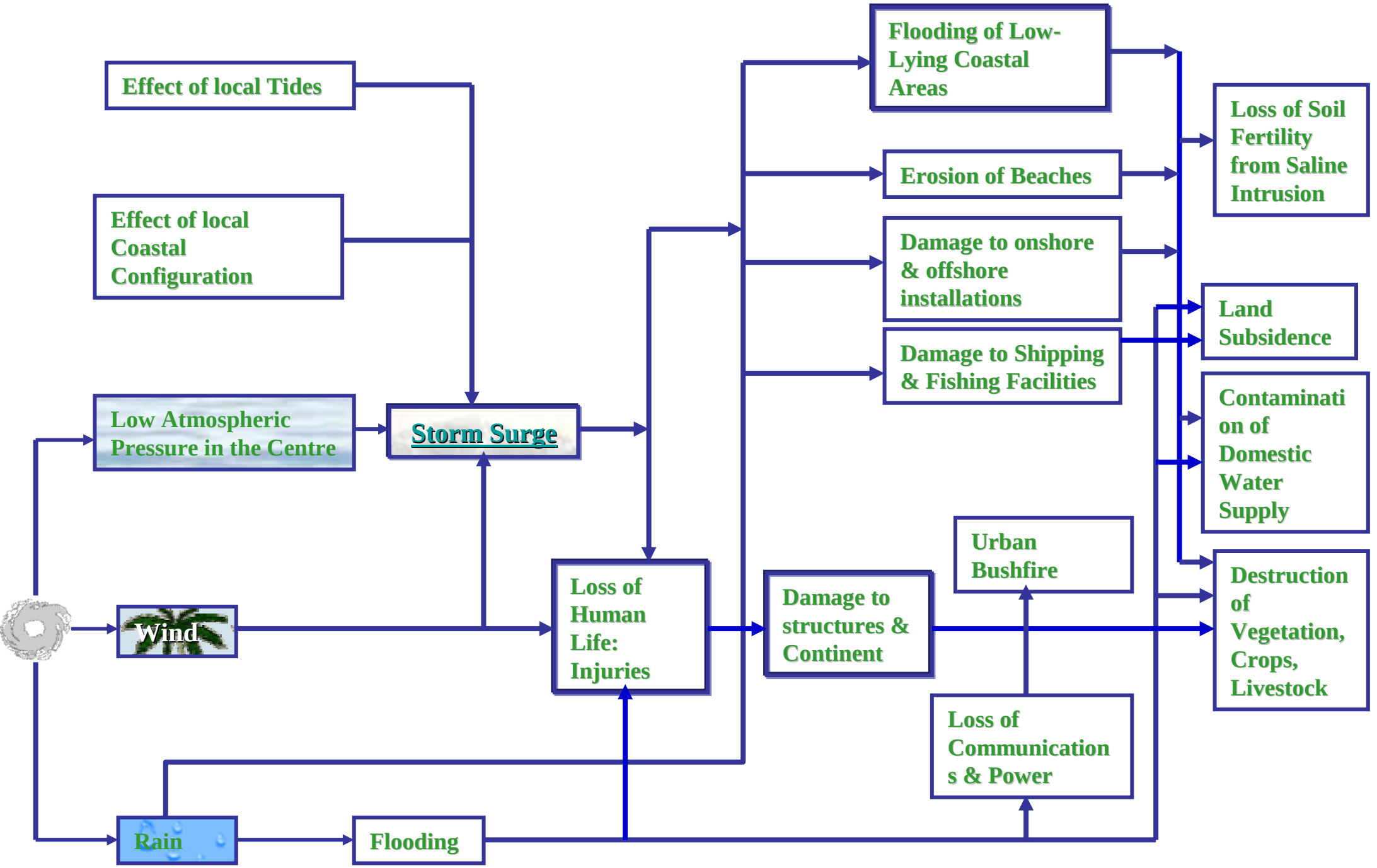
Planet Earth: Storm/Bill Hezlep © 1982 Time-Life Books, Inc.

Tropical Cyclones in Indian Region

- Only 7% of the world's total TC production, takes place in Indian Region.
- There are two major TC seasons: Pre-monsoon (April-May) and Post-monsoon (Oct-Dec).
- Bay of Bengal is 3 times more prone to TC as compared to Arabian Sea.
- On an average only **ONE TC** per year attains Hurricane Intensity in the region.
- **The region has highest population density and shallowest coastal bathemetry in the world- highest vulnerability to Storm surge**

TROPICAL CYCLONE VULNERABILITY STATES OF INDIA

- West Bengal
- Orissa
- Andhra Pradesh
- Tamilnadu
- Pondicherry
- Kerala
- Lakshadweep
- Karnataka
- Goa
- Maharashtra
- Gujarat
- Andaman & Nicobar Islands
- Diu & Daman

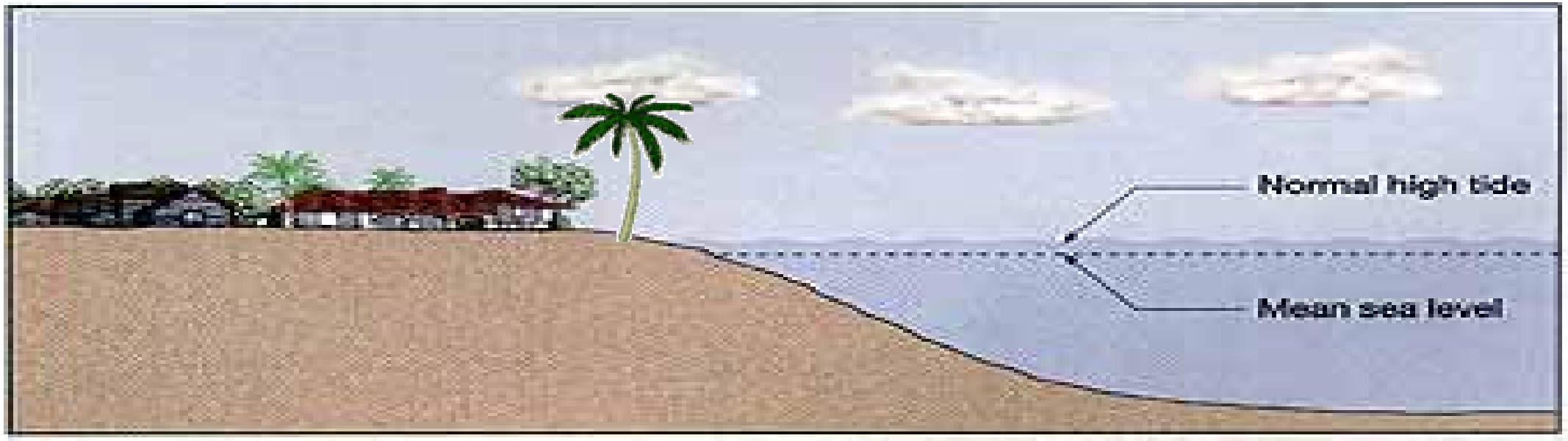


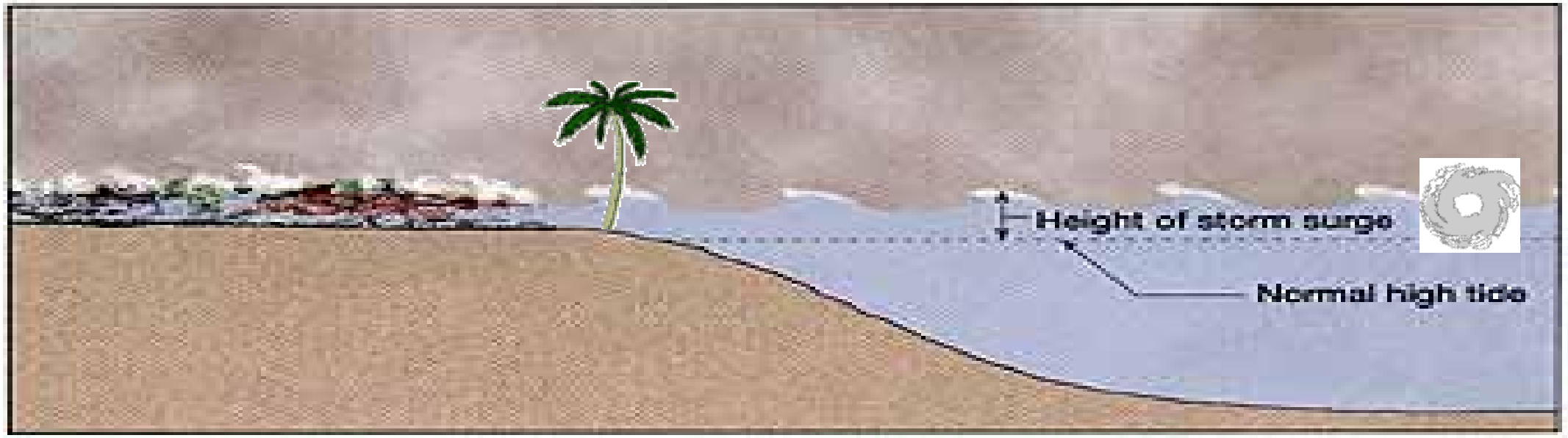
Potential Impact upon Landfall of a Tropical Cyclone

Storm Surge

A Storm Surge is an abnormal rise of sea level caused by a cyclone moving over a continental shelf

Storm Surge


Normal high tide
Mean sea level


Height of storm surge
Normal high tide

DEATHS IN TROPICAL CYCLONES

YEAR	COUNTRIES	DEATHS
1970	Bangladesh	300,000
1737	India	300,000
1886	China	300,000
1923	Japan	250,000
1876	Bangladesh	200,000
1897	Bangladesh	175,000
1991	Bangladesh	140,000
1833	India	50,000
1864	India	50,000
1822	Bangladesh	40,000
1780	Antilles(West Indies)	22,000
1965	Bangladesh	19,279
1999	India	15,000
1963	Bangladesh	11,520
1961	Bangladesh	11,466
1985	Bangladesh	11,069
1971	India	10,000
1977	India	10,000
1966	Cuba	7,196
1900	USA	6,000
1960	Bangladesh	5,149
1960	Japan	5,000
1972	India	5,000

- 74% events in the Bay of Bengal
- 59% of Bay events in Bangladesh
- 70% Deaths in Bangladesh

List of Cyclone Disasters with more than 999 Fatalities (1900-2001)

Year	Country	Fatalities
1900	USA	6,000
1906	Hong Kong	10,000
1928	USA	2,000
1946	Japan	1,400
1959	Japan	4,600
1963	Haiti	5,100
1970	Bangladesh	300,000
1974	Honduras	8,000
1977	India	20,000
1979	Caribbean / USA	1,400
1984	Philippines	1,000
1985	Bangladesh	11,000
1988	Bangladesh	5,708
1989	Thailand	1,000
1991	Bangladesh	140,000
1991	Philippines	5,000
1994	China	1,100
1994	Haiti	1,000
1996	India	2,000
1998	India	10,000
1998	Nicaragua / Honduras	9,200
1998	Caribbean	4,000
1999	India	15,000
2000	Muzambique	1,000

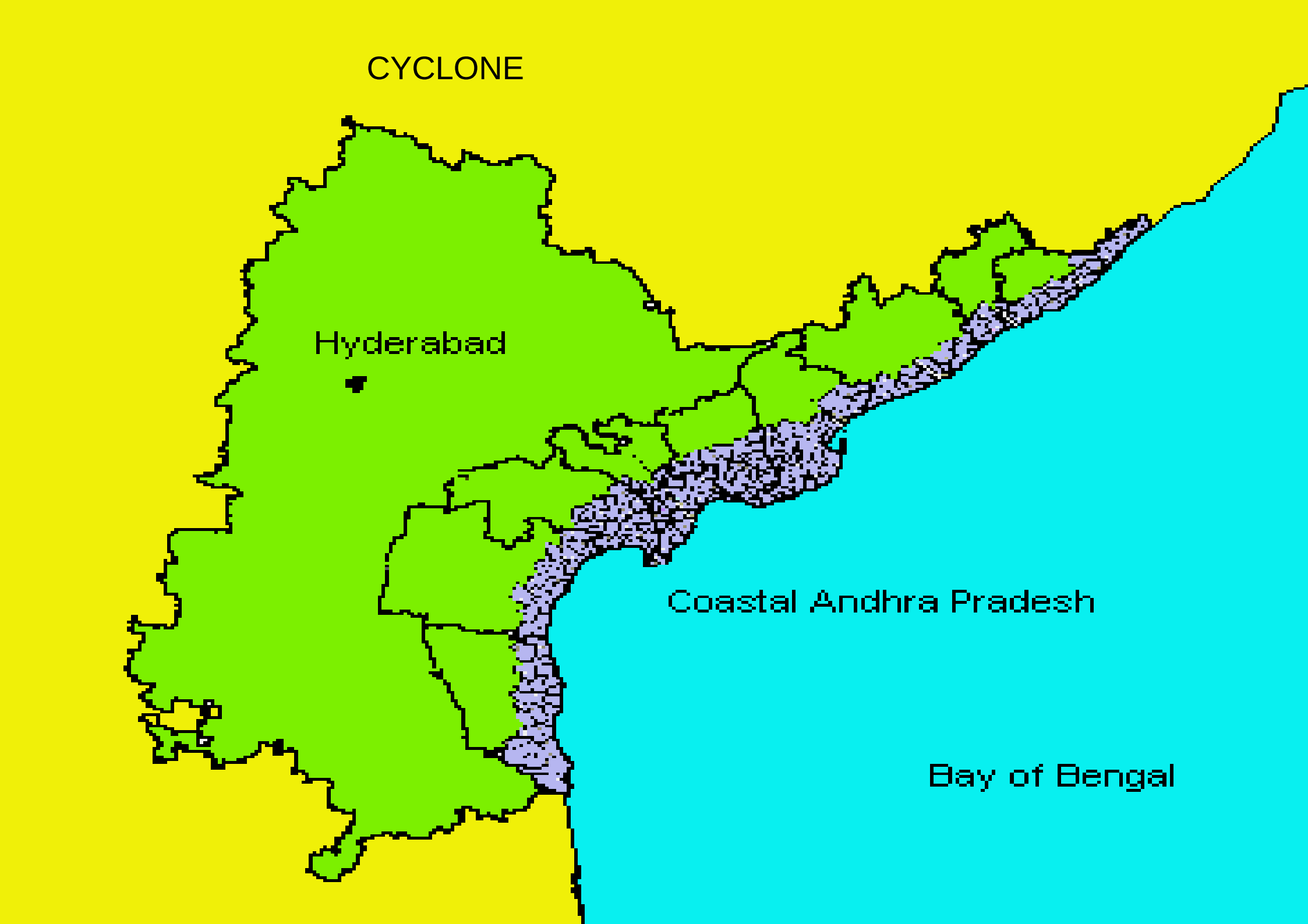
- 34% events in the Bay of Bengal
- 50% of Bay events in Bangladesh
- 91% Deaths in Bangladesh

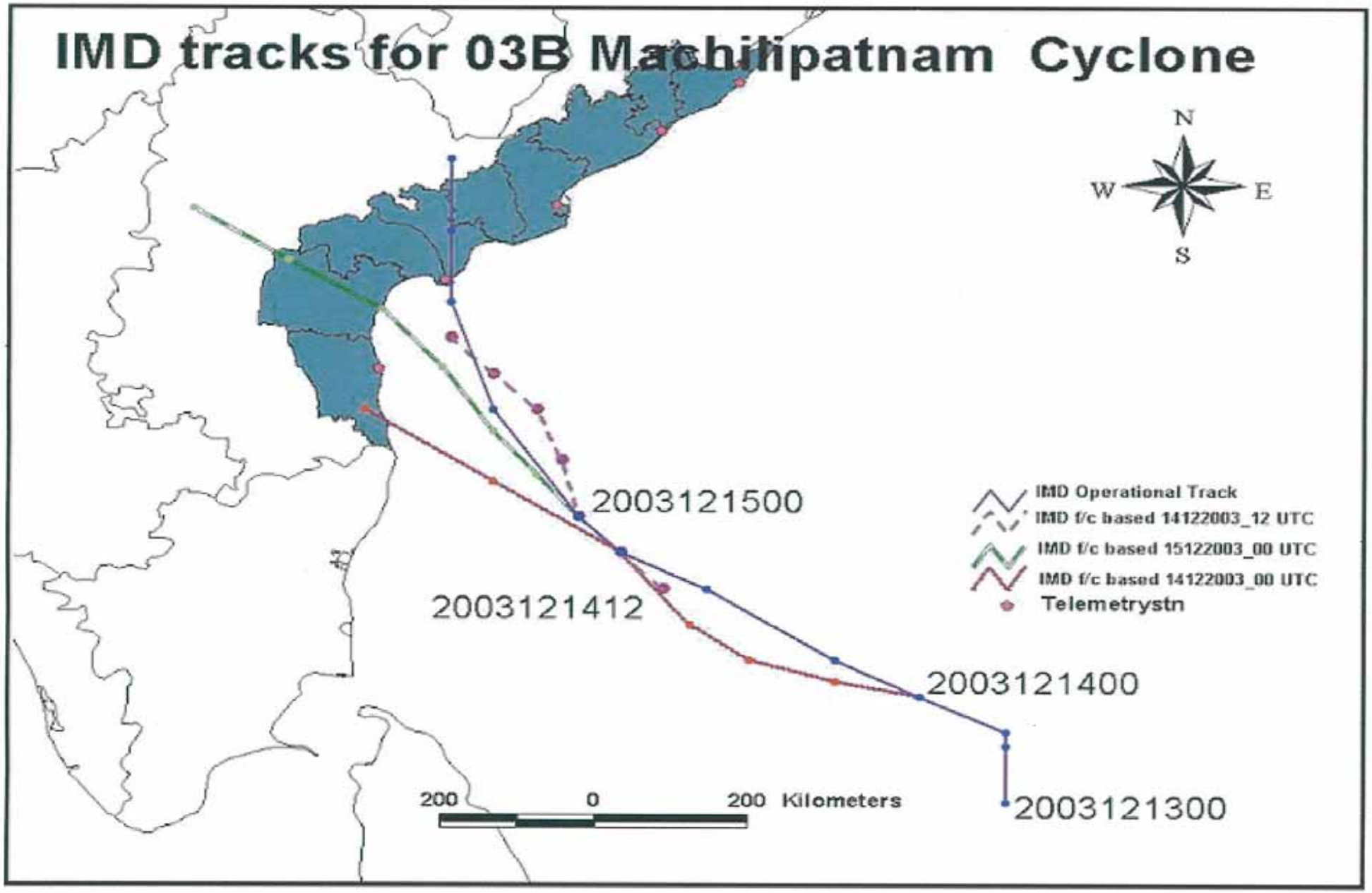
Damage due to Cyclones in excess of 1 billion US $ (1976-2001)

Year	Country	Total Damage Million US $	Insurance Damage Million US $
1977	India	1,000	No information
1979	Caribbean / USA	2,000	250
1979	USA	2,300	752
1980	Caribbean / USA	1,500	58
1983	USA	1,650	1,275
1988	Jamaica, Mexico	2,000	800
1989	Caribbean / USA	9,000	4,500
1991	Bangladesh	1,400	No information
1991	USA	1,000	620
1991	Japan	6,000	5,200
1992	USA	30,000	20,000
1992	Hawaii	3,000	1,600
1993	USA, Cuba	1,000	No information
1994	China	1,800	No information
1995	USA	3,000	2,100
1995	Caribbean	2,500	1,500
1996	USA	3,000	1,600
1996	India	5,400	No information
1996	China	1,500	No information
1998	USA	4,500	2,900
1998	Caribbean	10,000	3,400
1998	Nicaragua / Honduras	7,000	150
1998	Japan	1,500	700
1998	USA	1,500	350
1999	Japan	5,000	3,000
1999	India	2,500	115
2001	USA	6,000	3,500

Case Studies of TC Impact

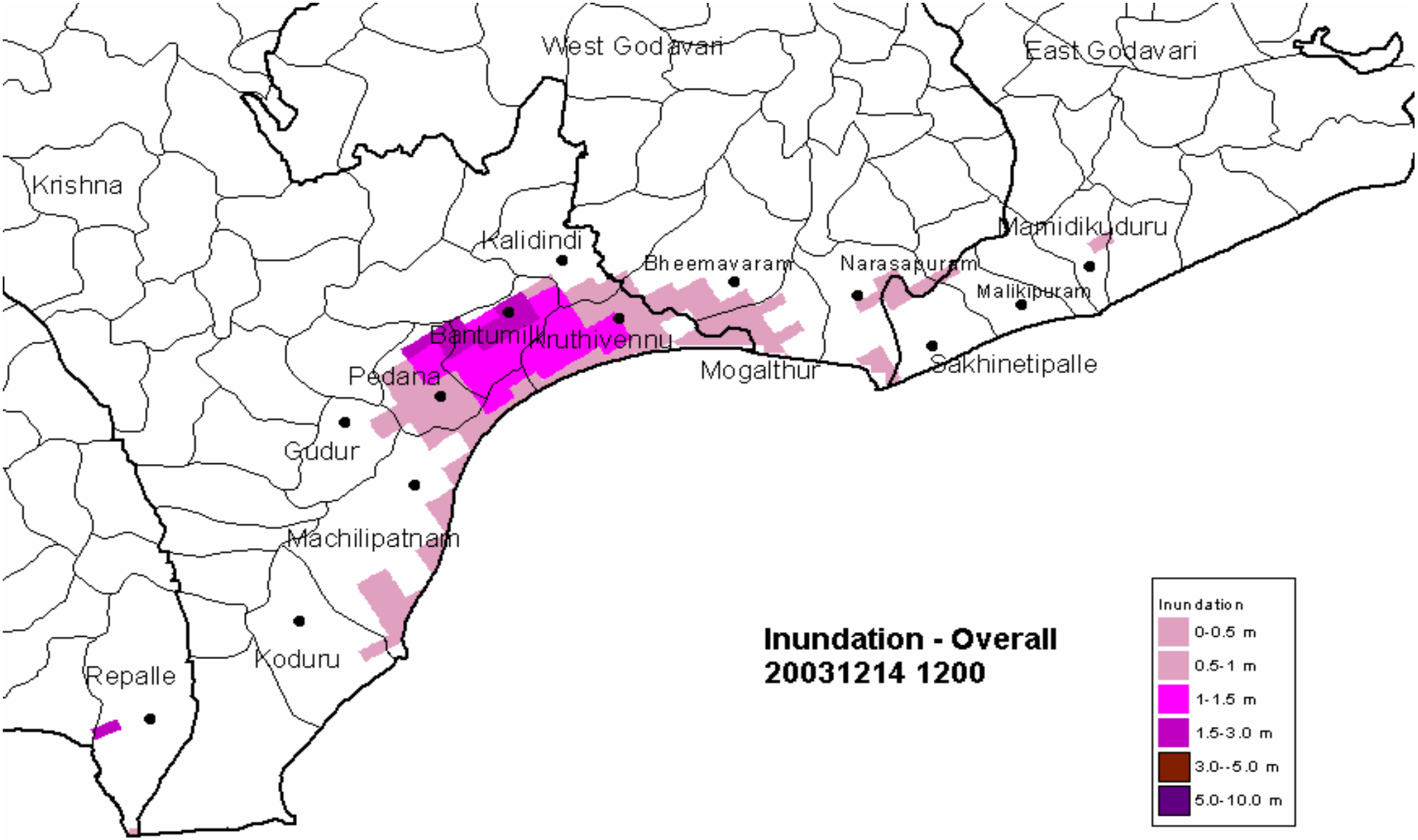
A case study of Andhra Pradesh Cyclone of December 2003

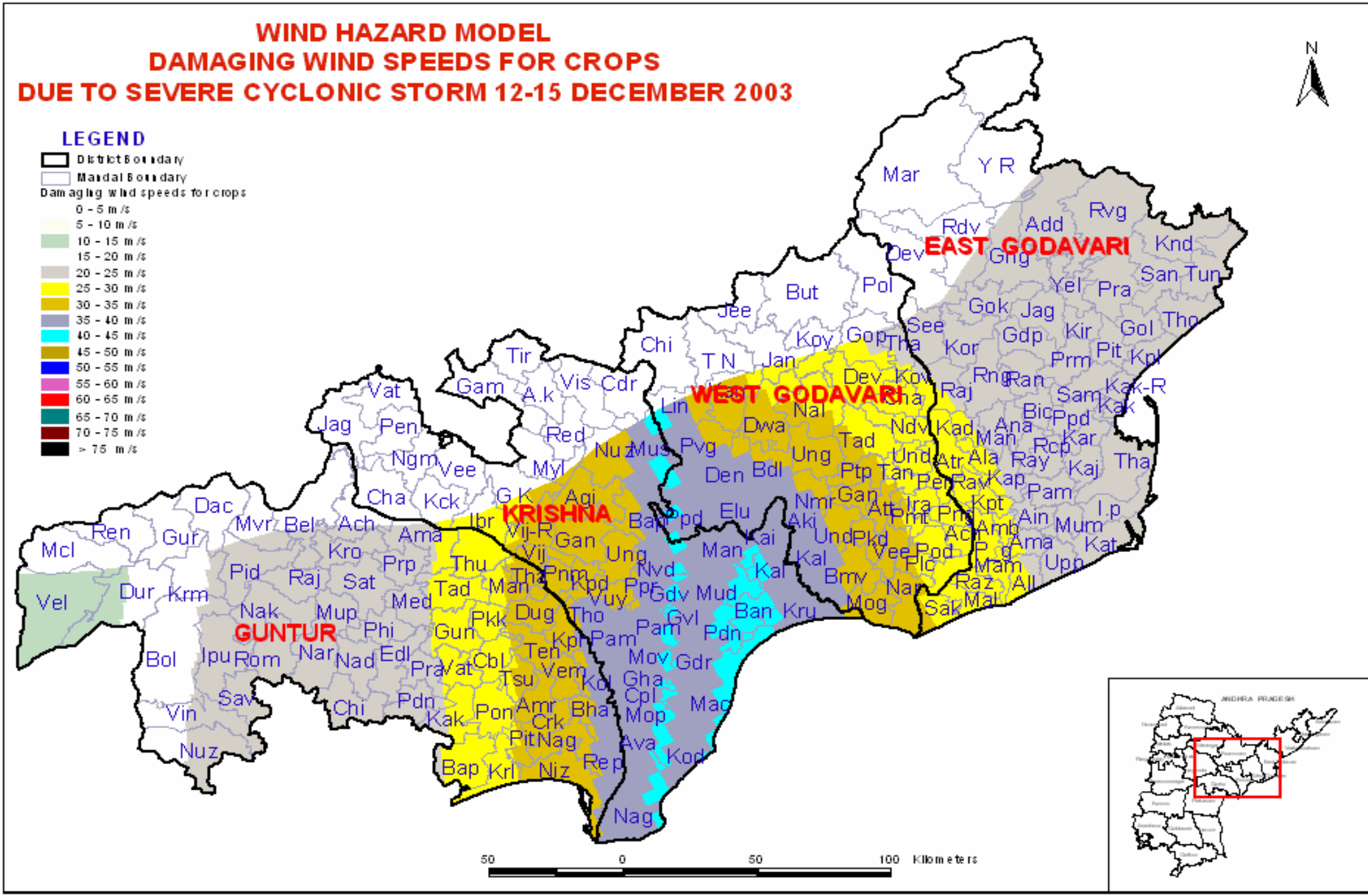

CYCLONE
Hyderabad
Coastal Andhra Pradesh
Bay of Bengal


IMD tracks for 03B Machilipatnam Cyclone
N
W
E
S
2003121500
2003121412
2003121400
2003121300
IMD Operational Track
IMD f/c based 14122003_12 UTC
IMD f/c based 15122003_00 UTC
IMD f/c based 14122003_00 UTC
Telemetrystn
200
0
200 Kilometers

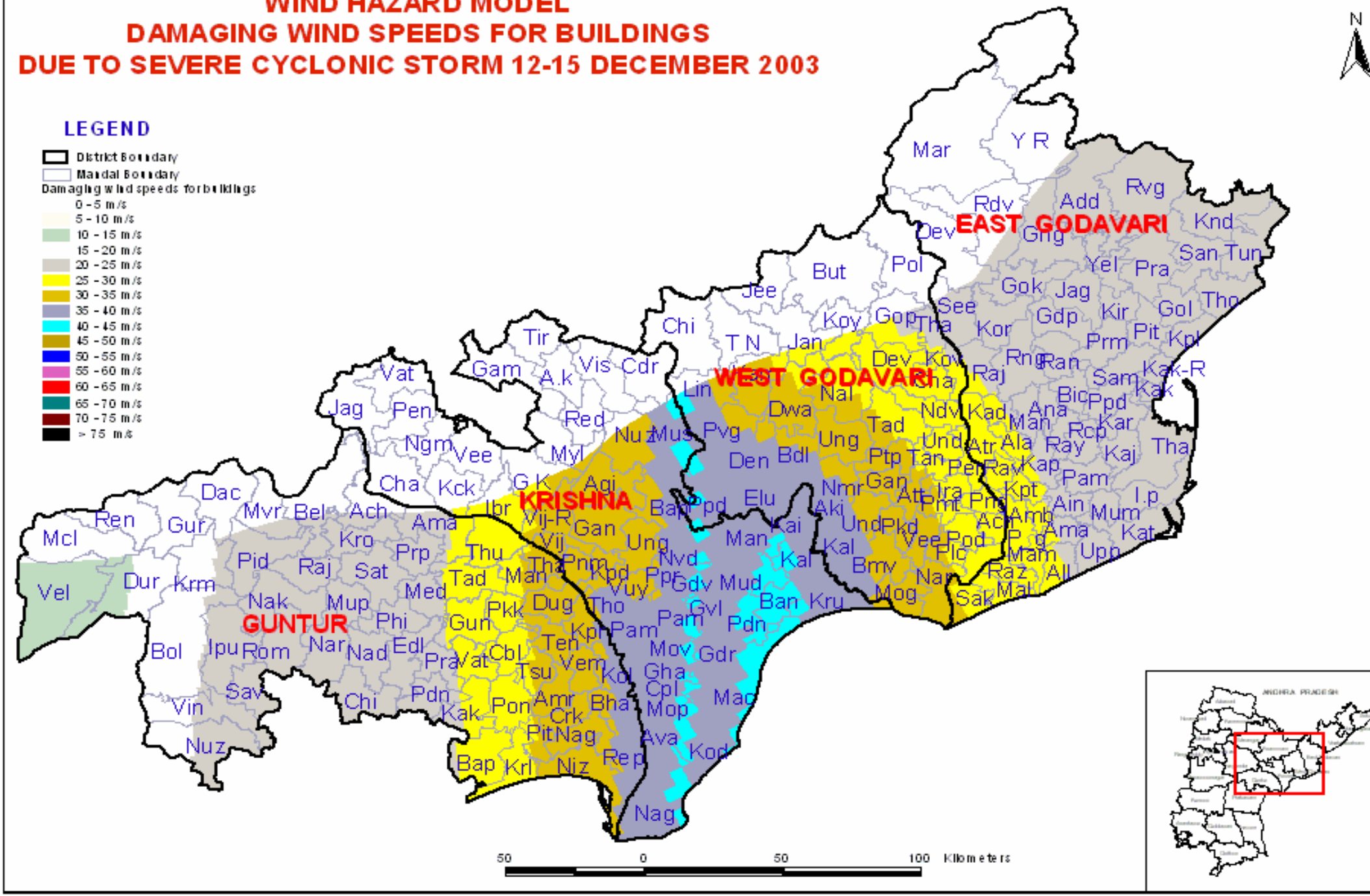
Information From DSS include …

- Population to be affected
- Densely populated villages
- Areas under threat
- Threat to Crops
- Damage to Structures
- Rail and Road network in the affected areas
- Vulnerable points
- Cyclone shelters

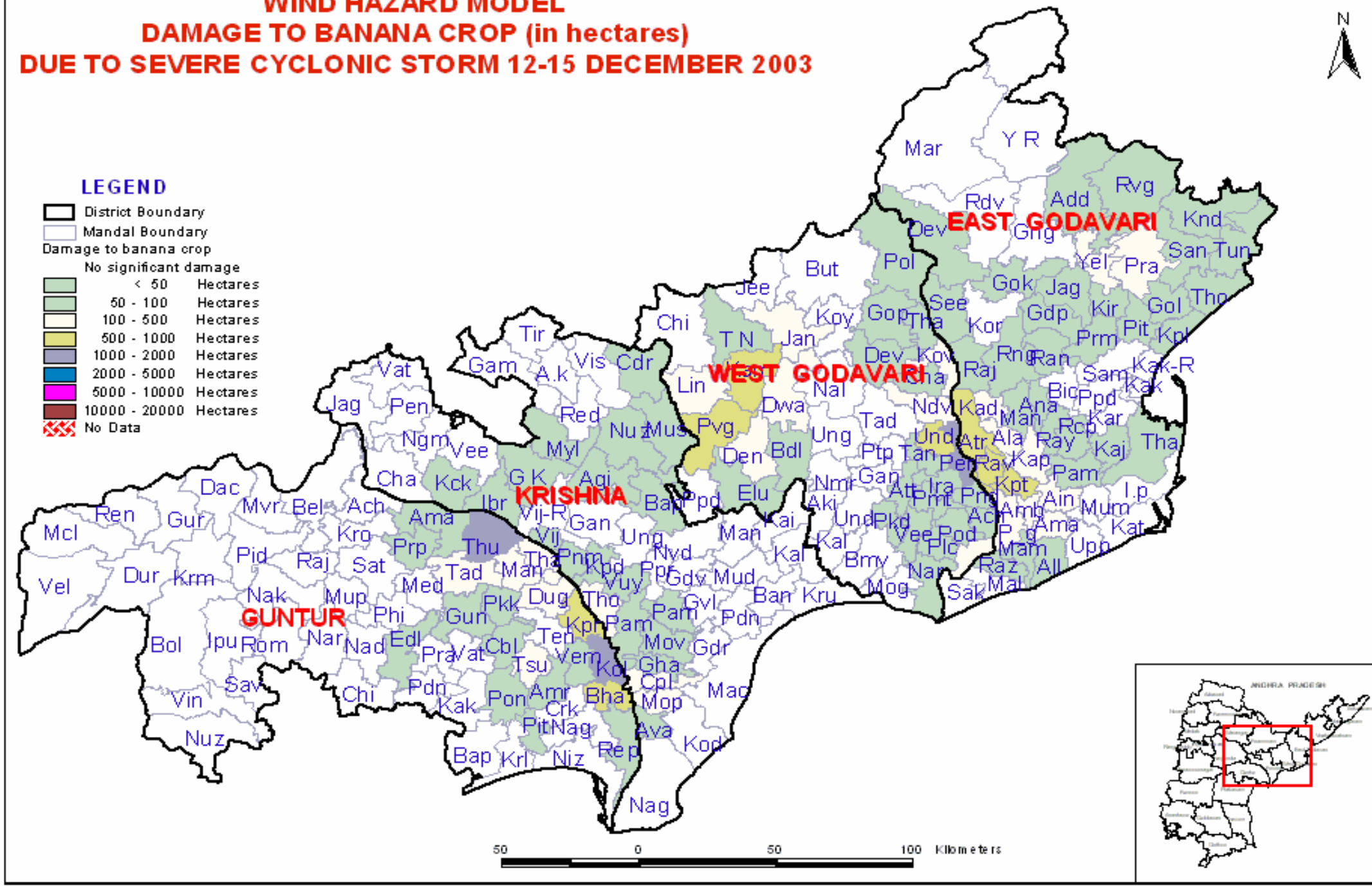

West Godavari
East Godavari
Krishna
Kalidindi
Bheemavaram
Narasapuram
Mamidikuduru
Malikipuram
Bantumilli
Kruthivennu
Pedana
Mogalthur
Sakhinetipalle
Gudur
Machilipatnam
Koduru
Repalle
Inundation - Overall
20031214 1200
Inundation
0-0.5 m
0.5-1 m
1-1.5 m
1.5-3.0 m
3.0--5.0 m
5.0-10.0 m


WIND HAZARD MODEL
DAMAGING WIND SPEEDS FOR CROPS
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003
LEGEND
District Boundary
Mandal Boundary
Damaging wind speeds for crops
0 - 5 m/s
5 - 10 m/s
10 - 15 m/s
15 - 20 m/s
20 - 25 m/s
25 - 30 m/s
30 - 35 m/s
35 - 40 m/s
40 - 45 m/s
45 - 50 m/s
50 - 55 m/s
55 - 60 m/s
60 - 65 m/s
65 - 70 m/s
70 - 75 m/s
> 75 m/s
EAST GODAVARI
WEST GODAVARI
KRISHNA
GUNTUR
N
50 0 50 100 Kilometers

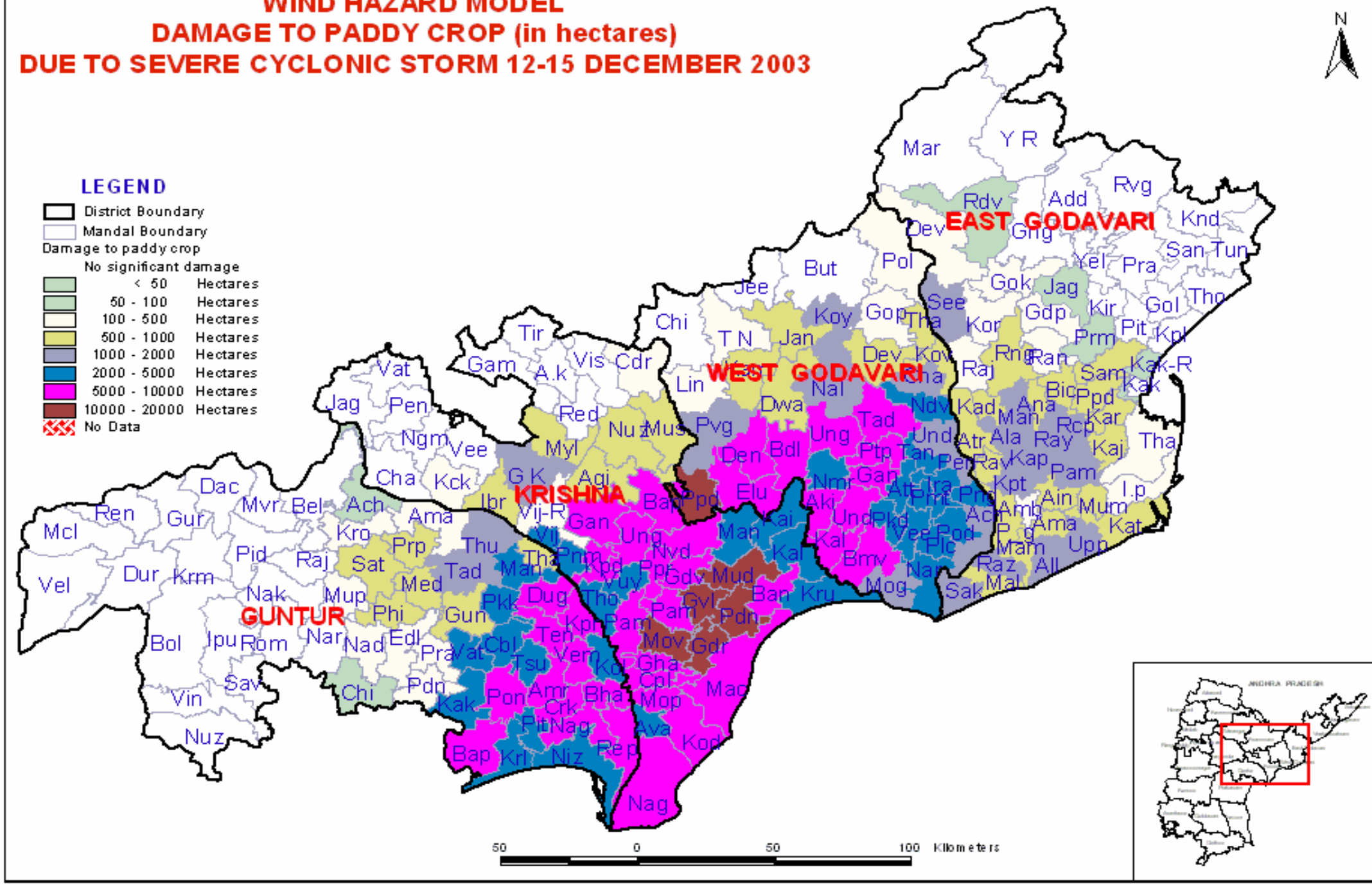
WIND HAZARD MODEL
DAMAGING WIND SPEEDS FOR BUILDINGS
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003



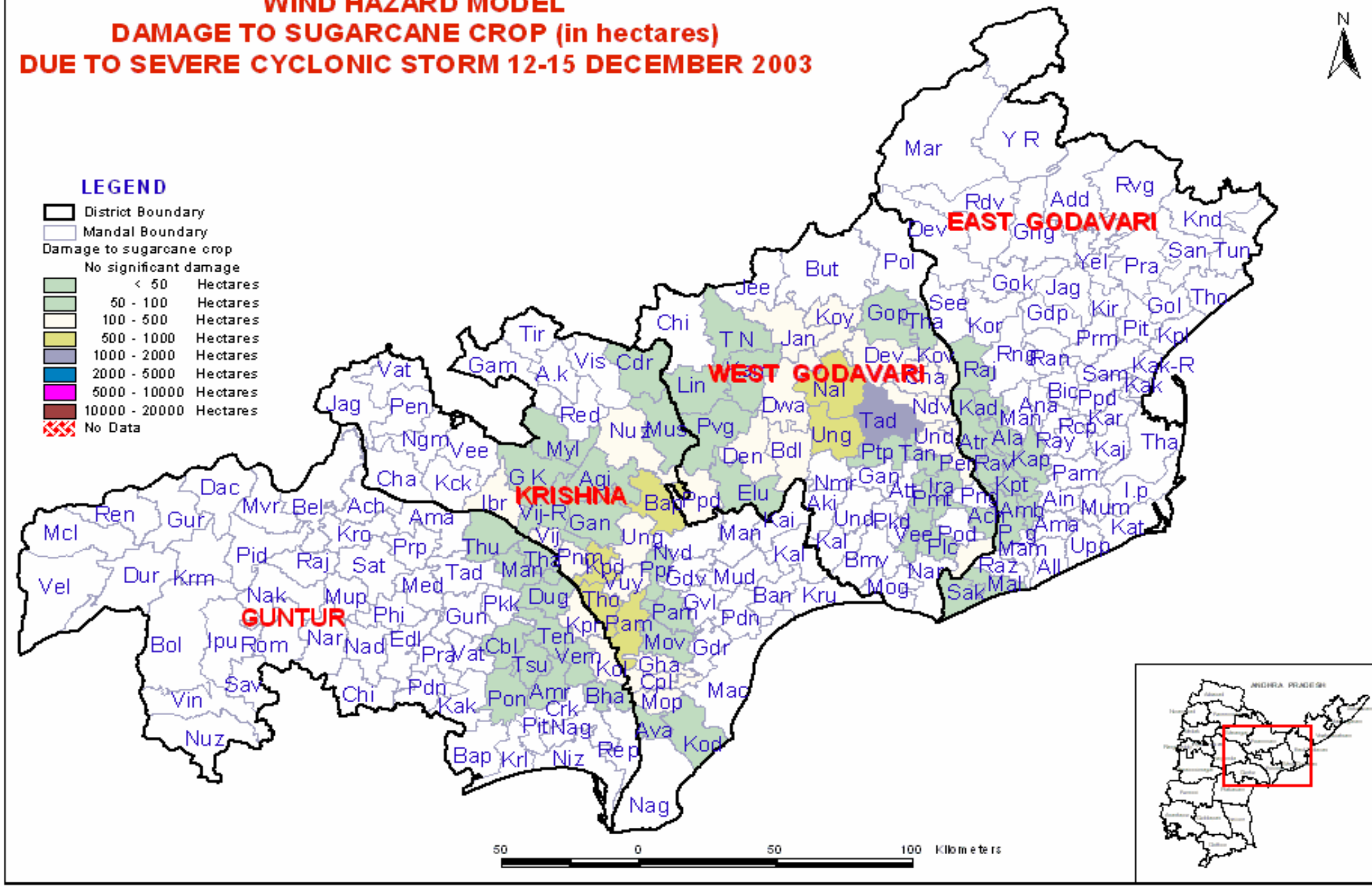
WIND HAZARD MODEL
DAMAGE TO BANANA CROP (in hectares)
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003



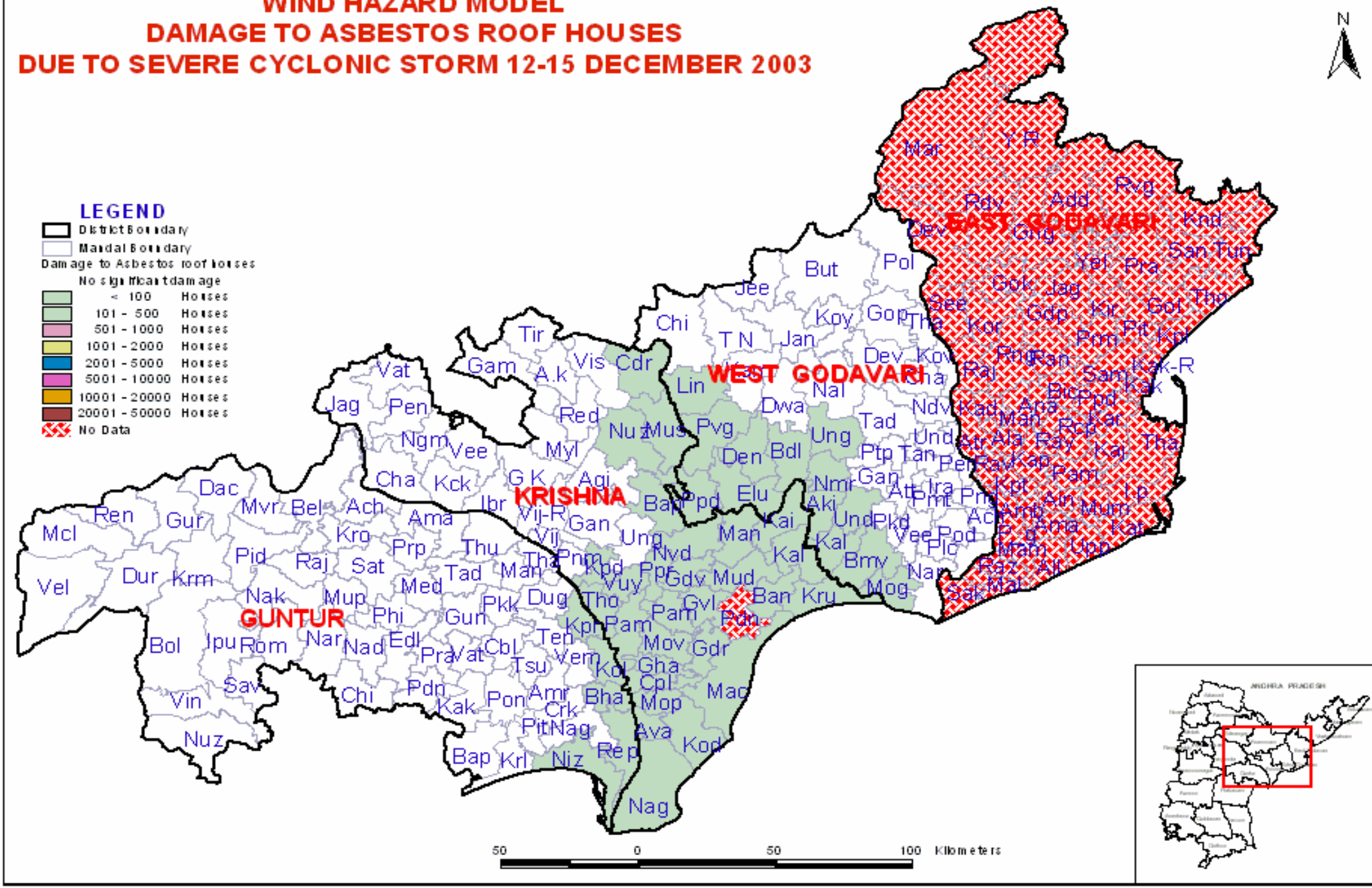
WIND HAZARD MODEL
DAMAGE TO PADDY CROP (in hectares)
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003



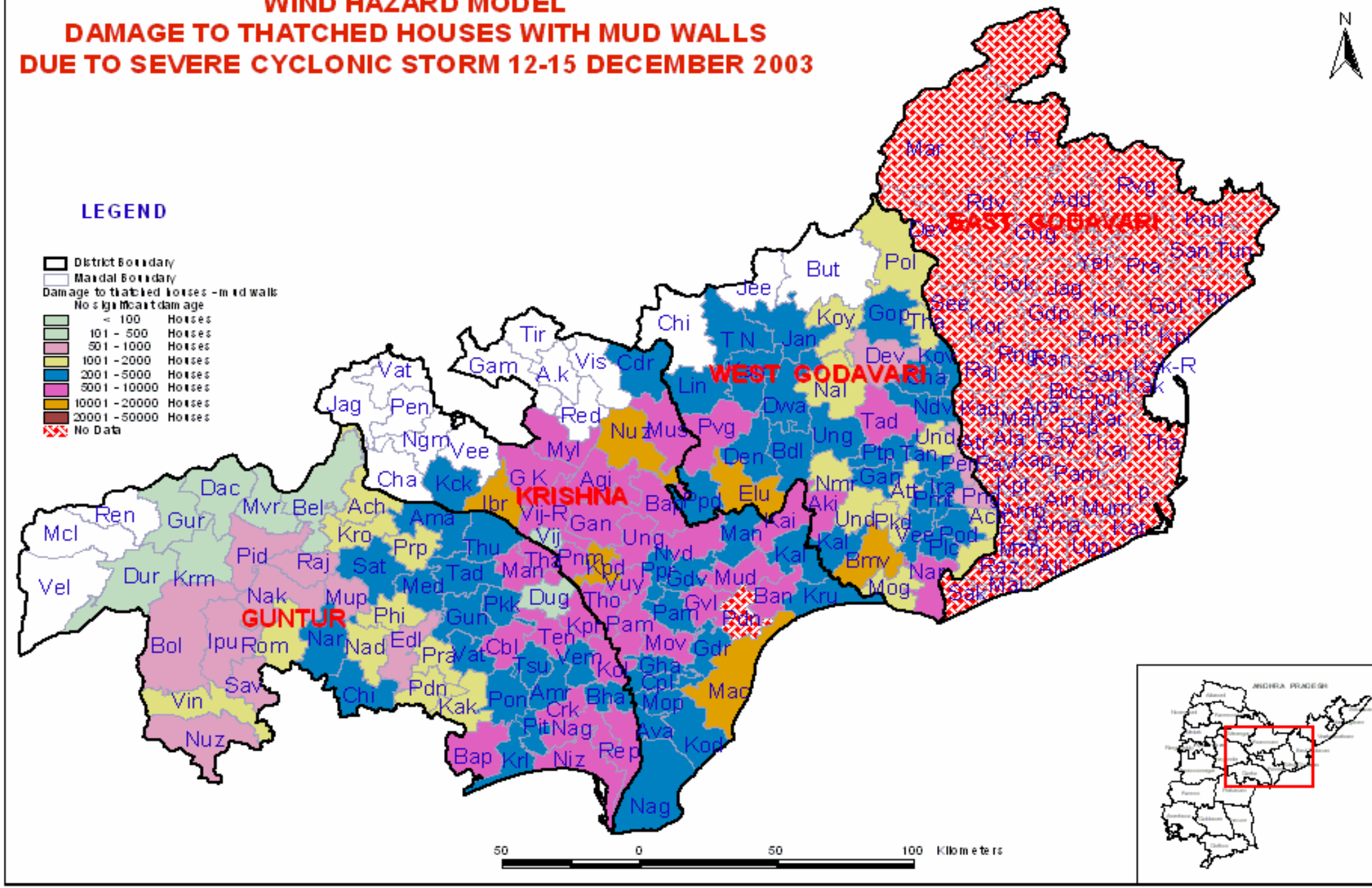
WIND HAZARD MODEL
DAMAGE TO SUGARCANE CROP (in hectares)
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003



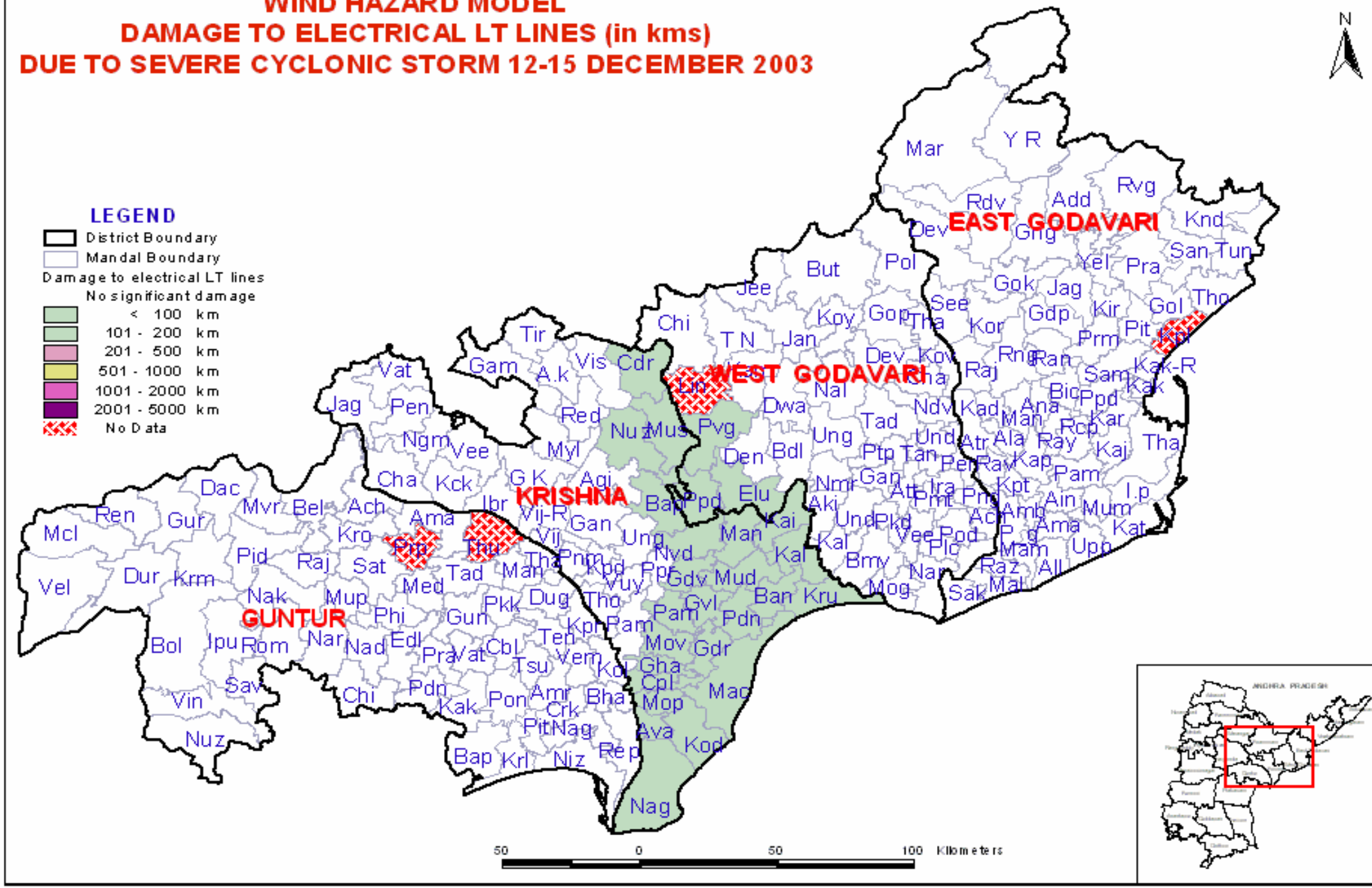
WIND HAZARD MODEL
DAMAGE TO ASBESTOS ROOF HOUSES
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003



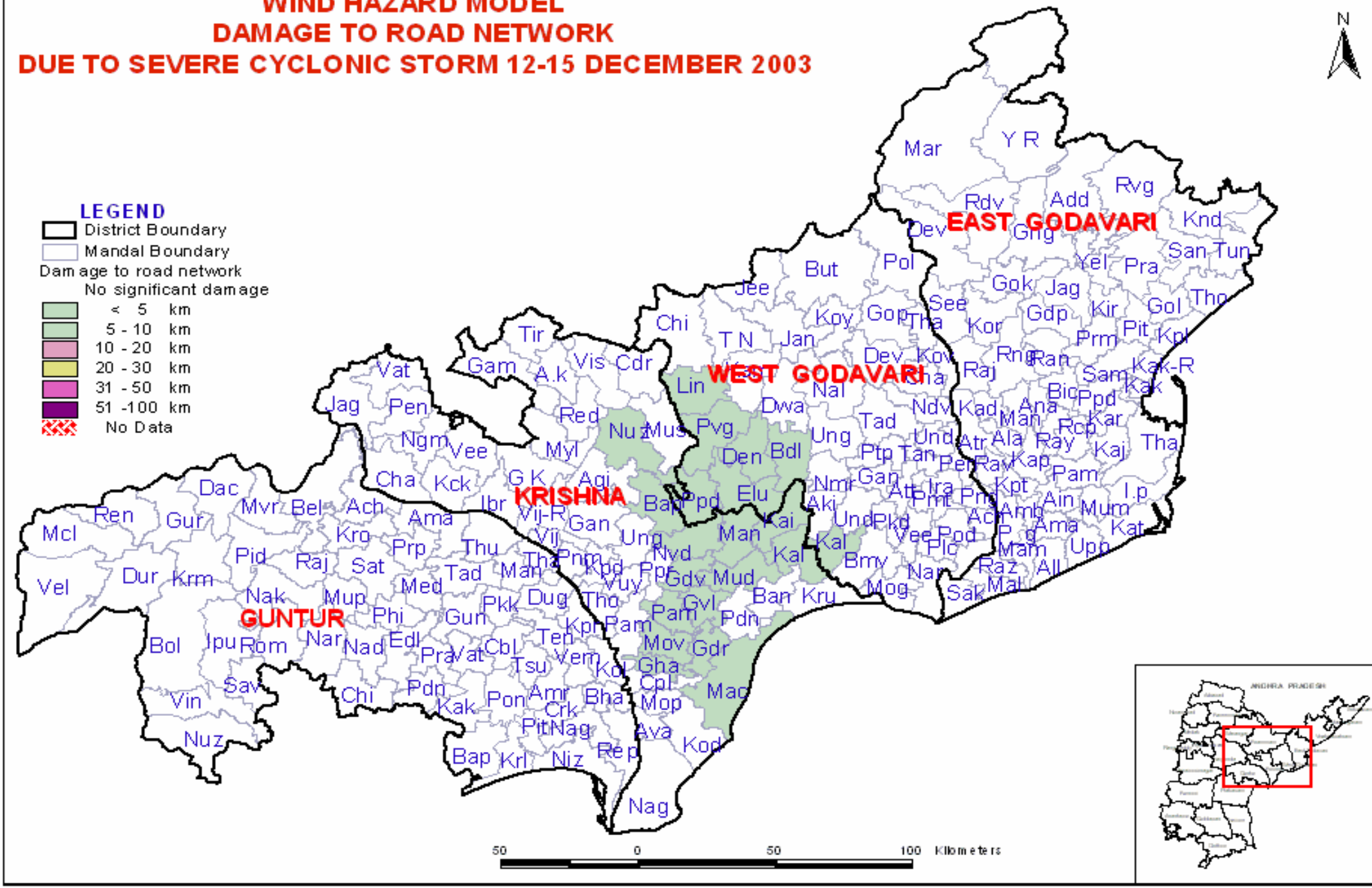
WIND HAZARD MODEL
DAMAGE TO THATCHED HOUSES WITH MUD WALLS
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003

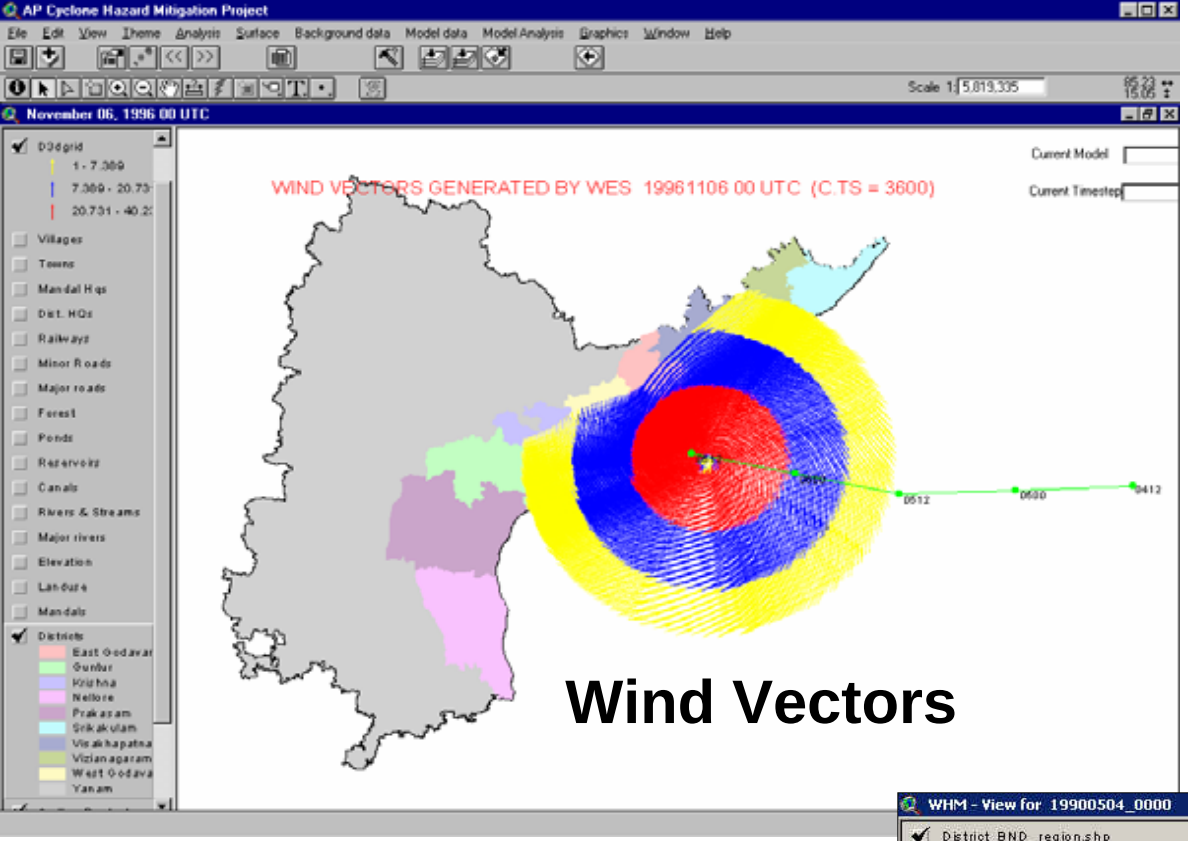


WIND HAZARD MODEL
DAMAGE TO ELECTRICAL LT LINES (in kms)
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003

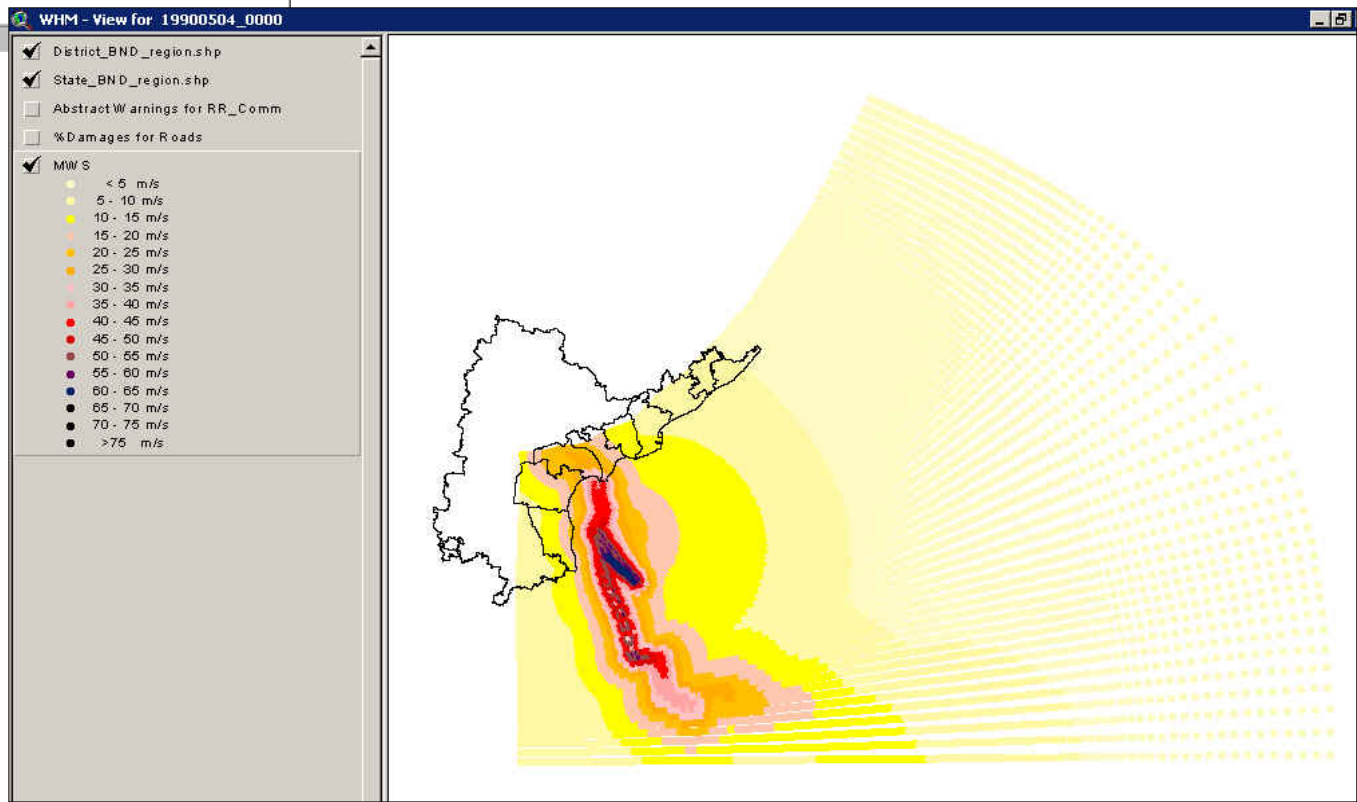


WIND HAZARD MODEL
DAMAGE TO ROAD NETWORK
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003



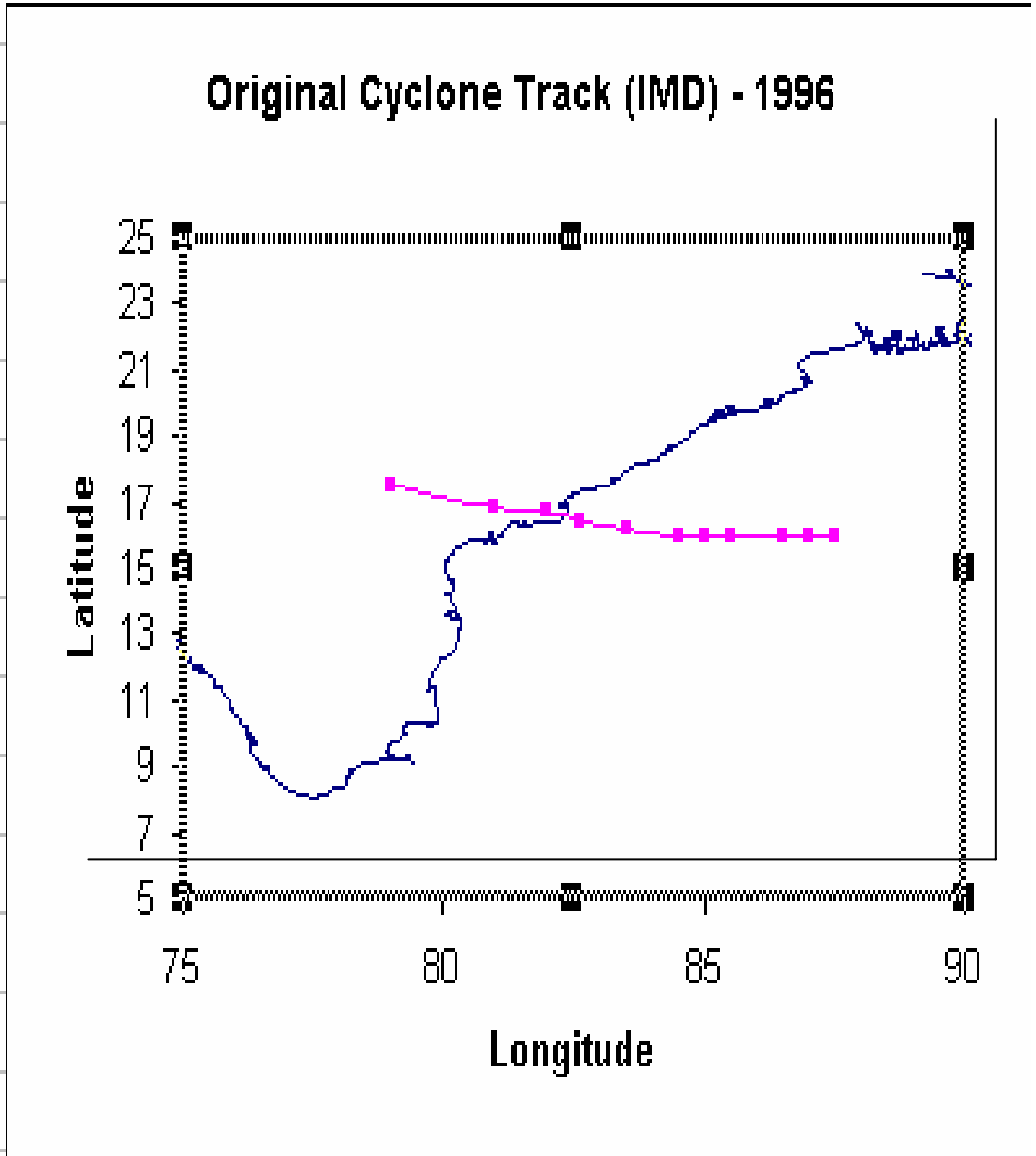


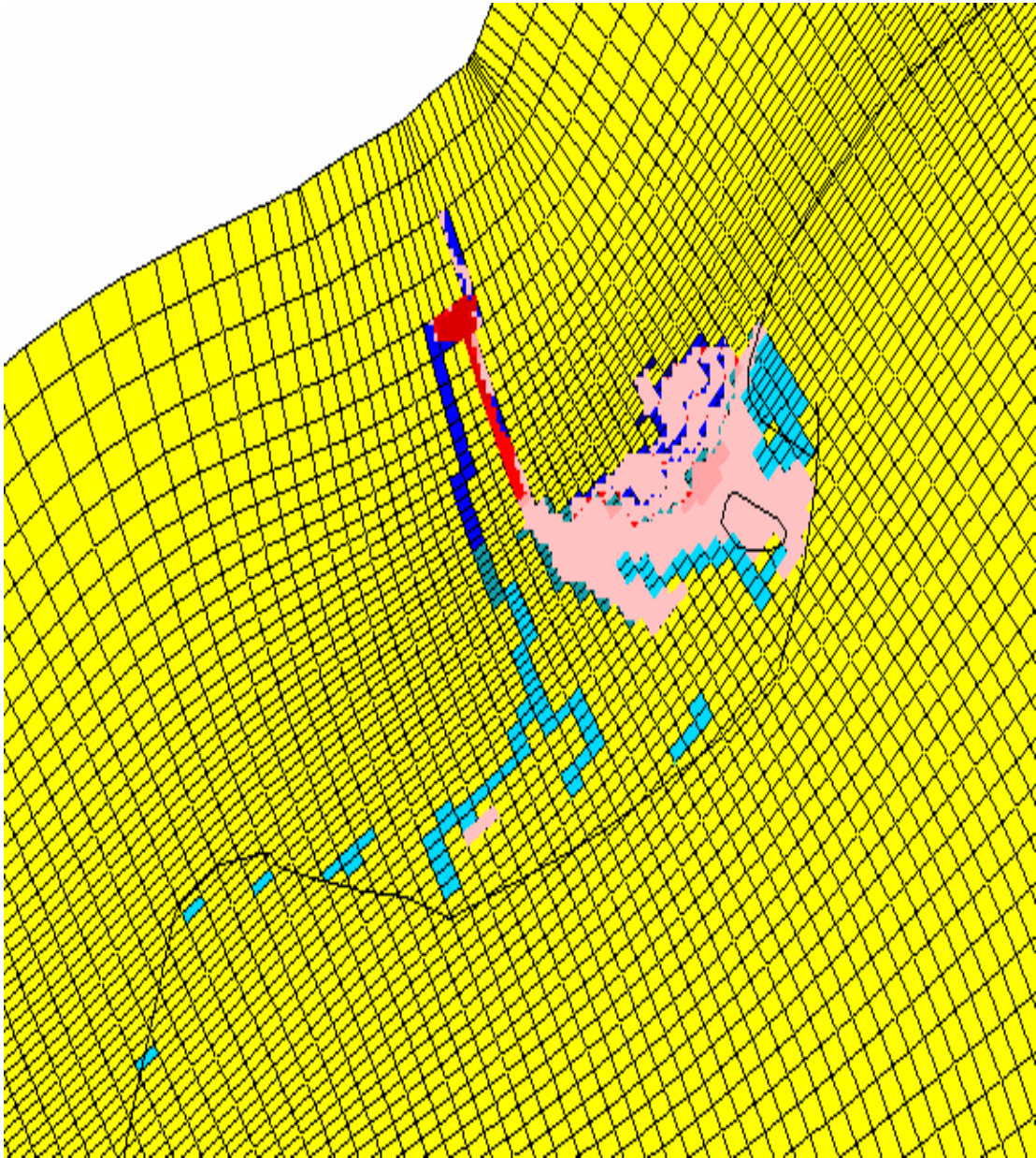
Wind Vectors



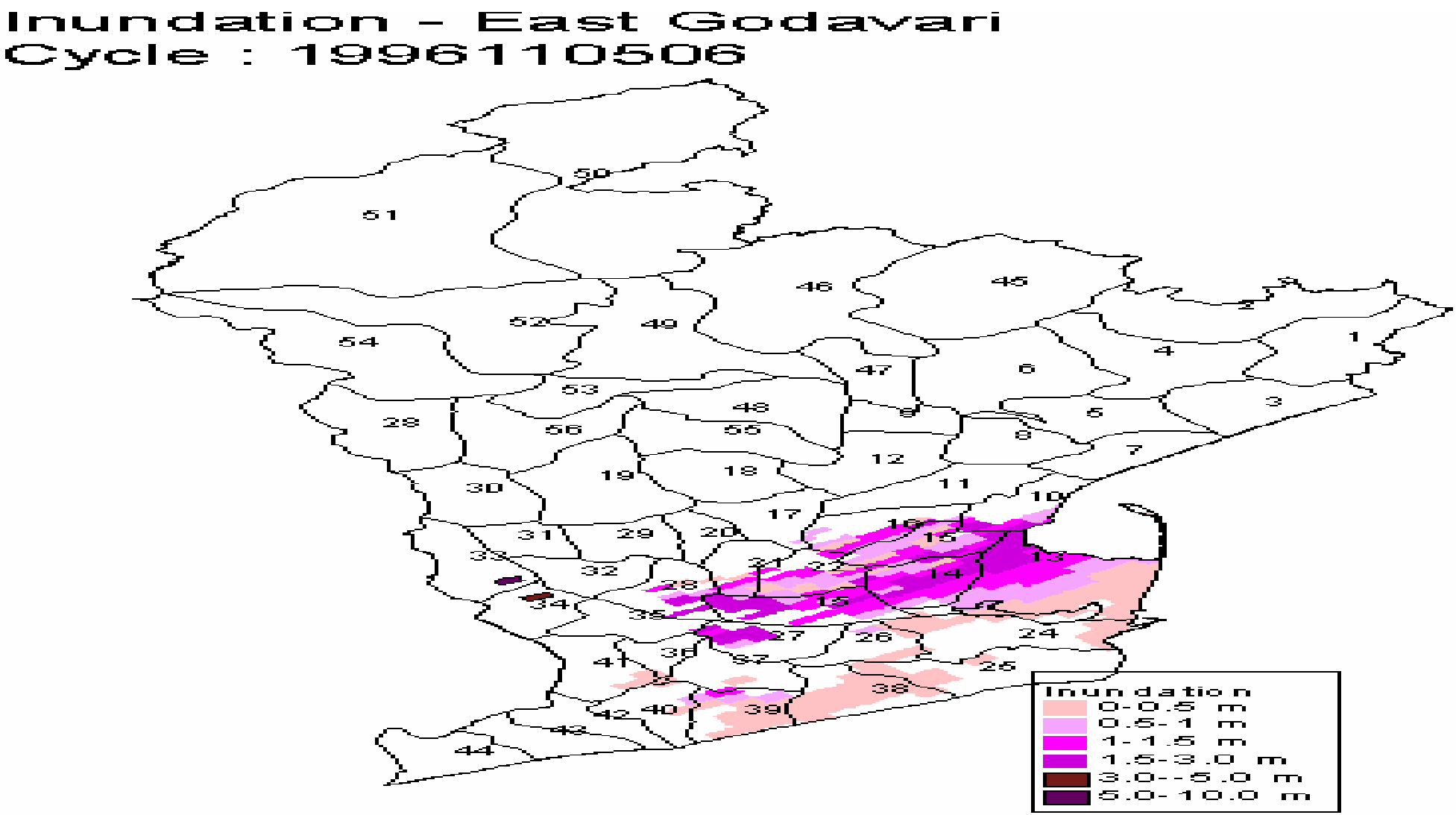
Maximum Instantaneous Wind Speeds1990 Cyclone

Inundation Maps For 1996 Kakinada Cyclone





DSS Generating Sample Maps



Hazard Mitigation Modeling System for Floods

Rainfall Data
from Cyclone Model
Telemetry Data
IMD Network
Satellite Derived (region)

UP Model

Inflow into River Mouths

Developed and Calibrated 1:1Mil To develop for 1:250000 and 1:50000

Additional Inputs from:
Measured Telemetry and Discharges
Gauge Network from CWC, Hydrology Network from I&CAD

River Channel Survey
Bank Levels

From cyclone models

MIKE 11

3D-DEM
Completed 1: 50K
Process: 1:25 K
(Coastal 20Km stretch only)

Simulated Flow Levels and possible Bank Overflows

Decision Support System

GIS Offline Interface (Overlaying, Zooming and Other Data Input

Flood Watch

Quantification of Flooding
Flood areas
Depth/Duration/ Extent

Advisories/ Bulletins

VALUE ADDITION
- Damage Quantification,
- Advisories for facilitating relief routing,
- Increase in Lead time
- Delta Water Management and Water Quality Management
- Flood Control Strategies (long-term and short term mitigation plans)

Andhra Pradesh flood modelling

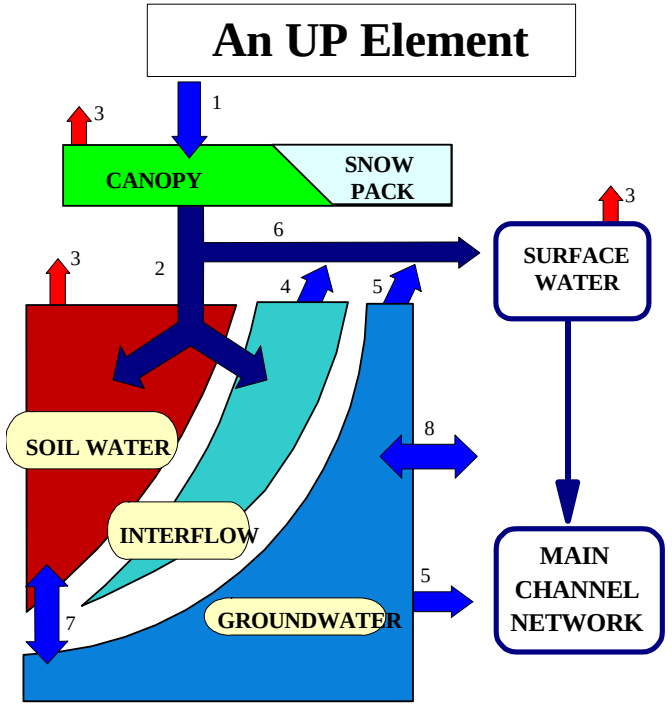
- 24 Rivers Modelled, including Godavari, Krishna, and Pennar
- Flood forecasting covering 14 districts
- Network of real-time river and rainfall gauges
- Rain gauges – 55 Nos
- River gauges/Tide Flow – 49 Nos
- Meteorological Stations – 5 Nos
- Real-Time Monitoring of River Flows

UP Model

- Upscaled Physically-based model designed:
  - to simulate water exchanges between the land surface and the atmosphere
  - to simulate lateral transfer of water, solutes and sediment
  - to be applicable from catchment-scale to continental-scale

UP Element

- Precipitation
- Evapotranspiration
- Soil water storage
- Surface runoff



1 PRECIPITATION
2 THROUGHFALL & SNOWMELT
3 EVAPORATION & TRANSPIRATION
4 INTERFLOW DISCHARGE
5 GROUNDWATER DISCHARGE
6 SURFACE RUNOFF
7 PERCOLATION & CAPILLARY RISE
8 INTER-ELEMENT EXCHANGES

MIKE 11 GIS

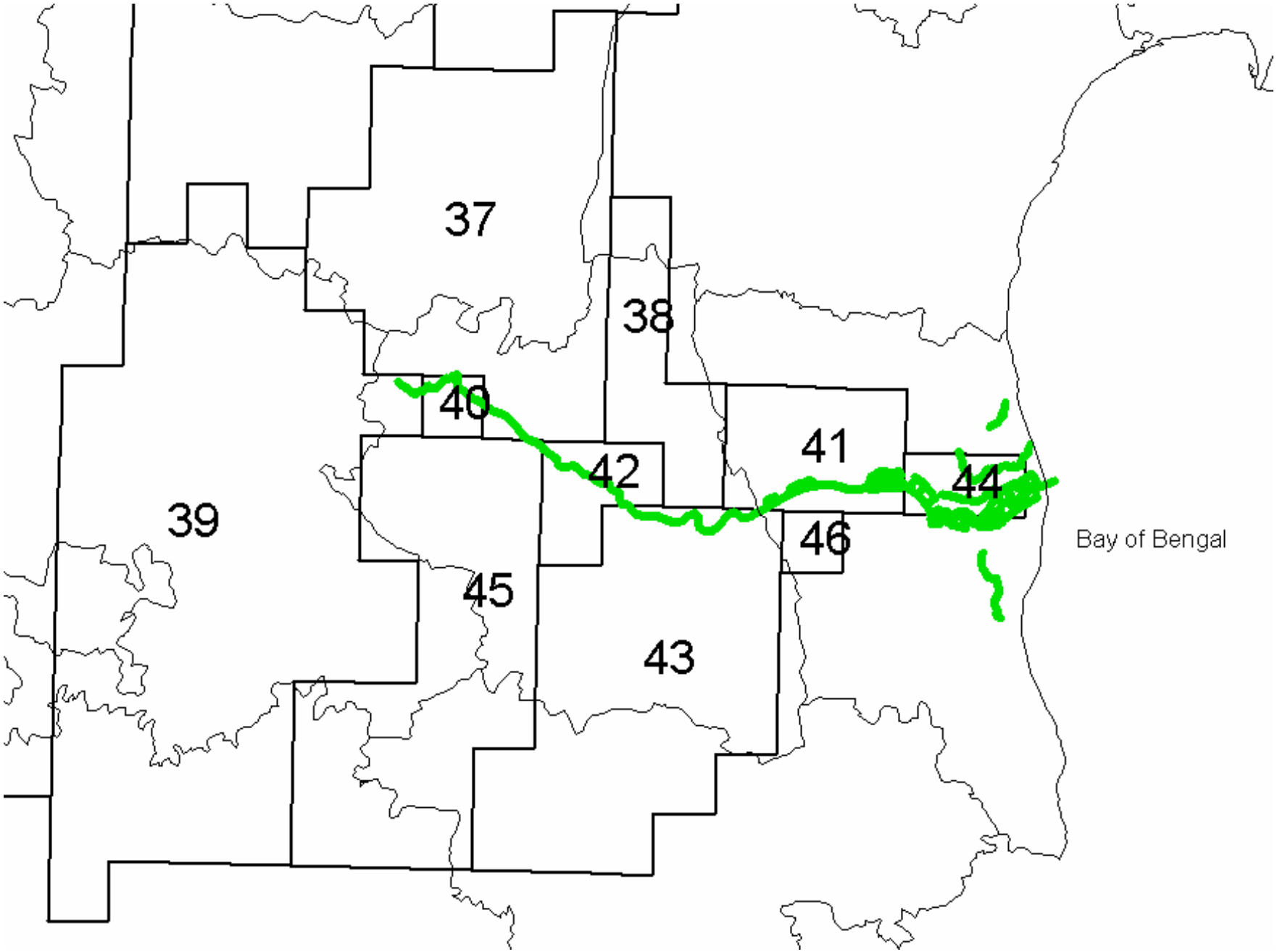
- Flood Mapping: MIKE 11-GIS
- Fully integrated GIS based flood modelling
- Centred on ArcView GIS
- Leverages full power of GIS for modelling
- Pre-processing: Floodplain schematization
- Post-processing: Inundation maps
  - Comparison maps
  - Duration maps
- Analysis with other GIS data

Basic data requirements for modelling

- River cross-sections
- Maps of floodplains
- Historical river flow data
- Tidal variations
- Data on structures along river that affect flow

River Pennar Model

- Model extends from Somasila to Bay of Bengal
- The total modelled length of the River Penneru is around 117 km
- Major structure is Somasila dam
- One existing CWC station at Nellore is present within model reach


37
38
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41
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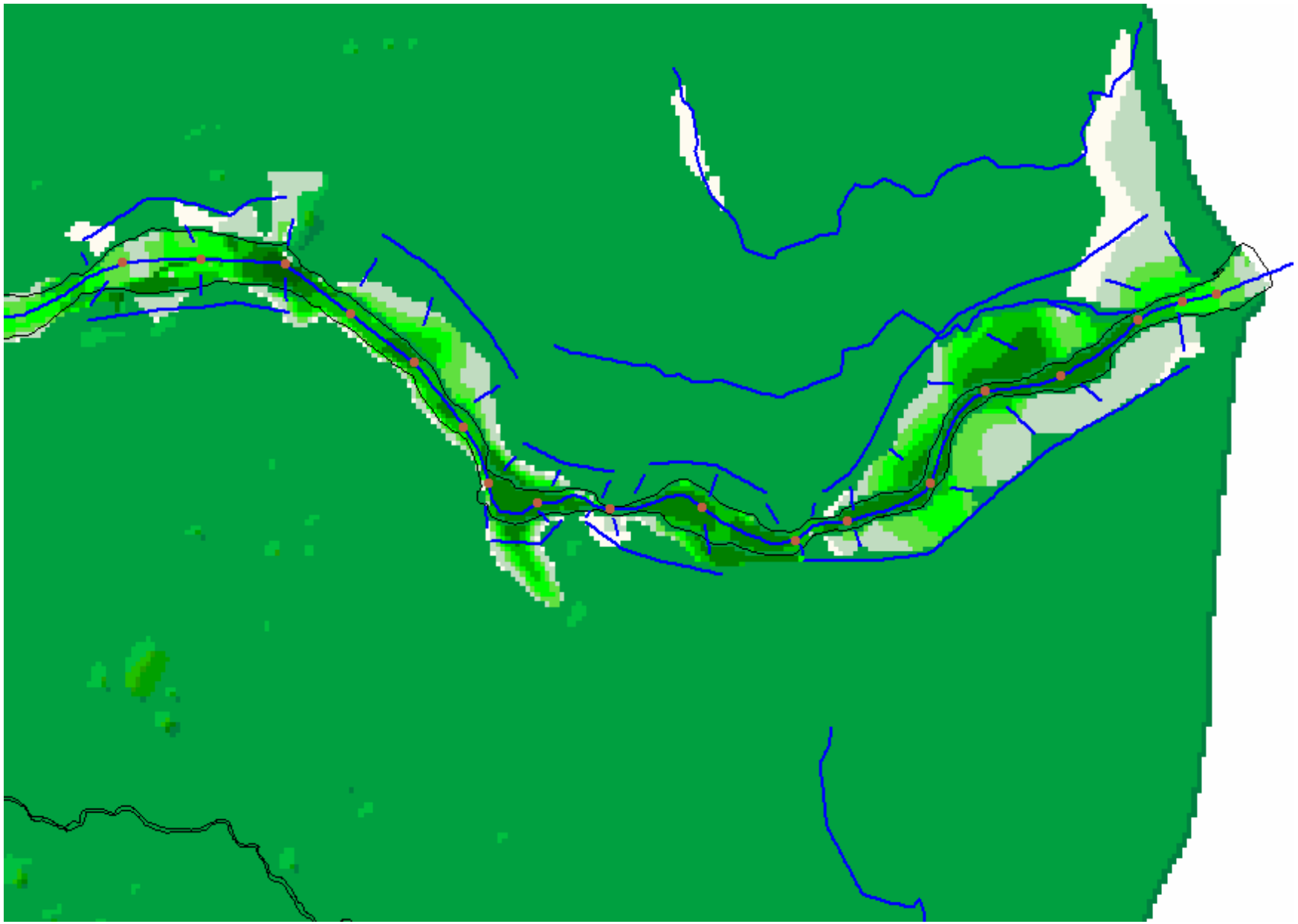
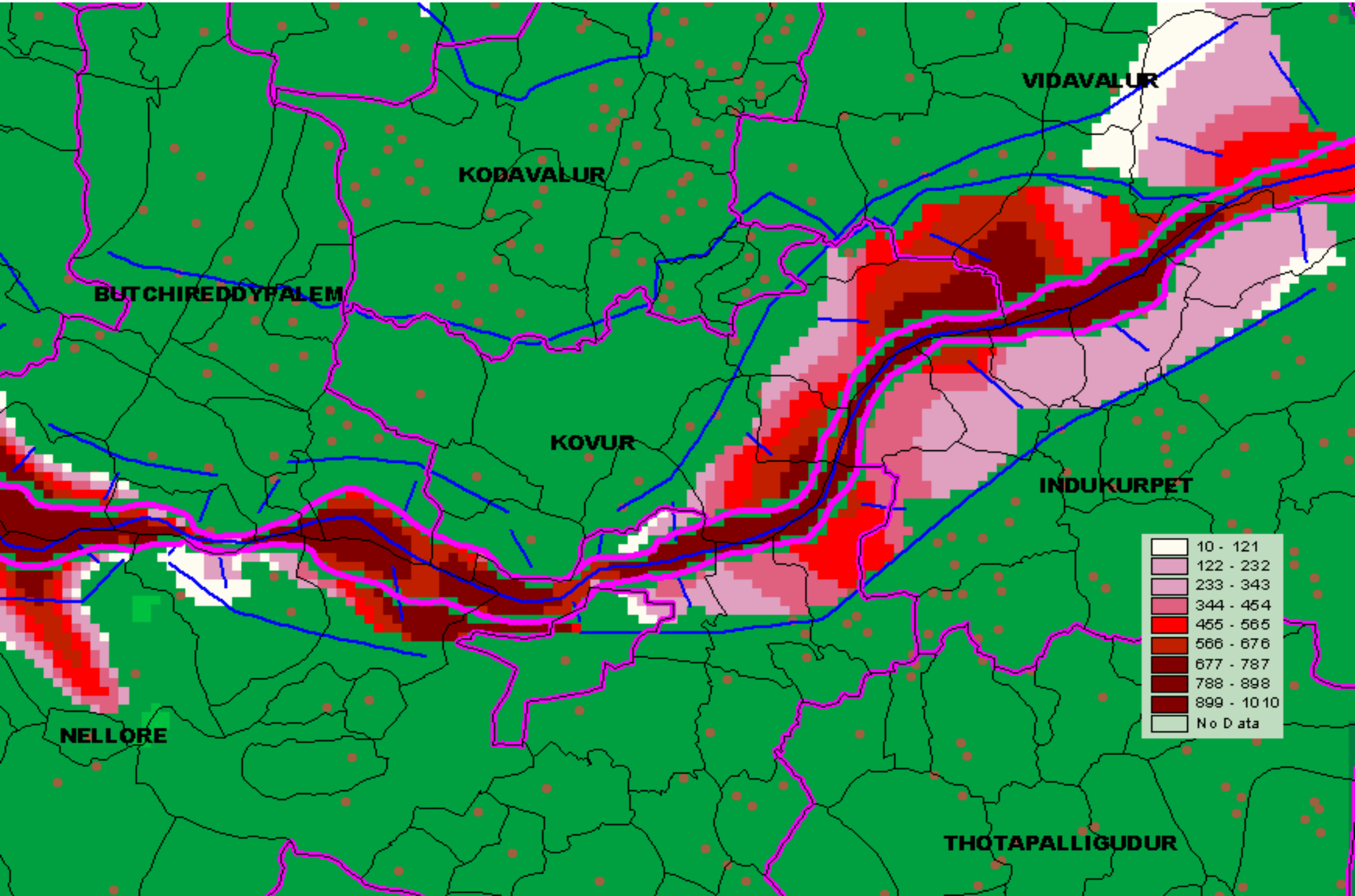
44
39
46
45
43
Bay of Bengal




VIDAVALUR
KODAVALUR
BUTCHIREDDYPALEM
KOVUR
INDUKURPET
NELLORE
THOTAPALLIGUDUR
10 - 121
122 - 232
233 - 343
344 - 454
455 - 565
566 - 676
677 - 787
788 - 898
899 - 1010
No Data

FLOOD WATCH

A Management System for Real-Time Flood Forecasting and Warning

MIKE Flood Watch is a decision support system for real-time flood forecasting combining an advanced time series data base with the MIKE 11 hydro- dynamic modeling and real-time forecasting system, MIKE11 FF together with the Geographical Information System (GIS), Arc View GIS

The Strengths of MIKE Flood Watch

A fast and reliable system for real-time operation
Direct-access time series database
Integration with external databases, e.g. Oracle
Automatic import of telemetric data
Data quality control and data processing facilities
GIS presentation facilities
Automatic forecasting and storage of results
Dissemination of flood maps, flood warnings, bulletins and graphics on the World

Hydrometric Data - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites History Mail Print Edit Discuss

Address http://projects.dhi.dk/ap/Catchment.htm Go

DHI Software

GOVERNMENT OF ANDHRA PRADESH - DISASTER MANAGEMENT UNIT
FLOOD & CYCLONE MONITORING CENTRE

Catchments

28 May 1988 at 10:00

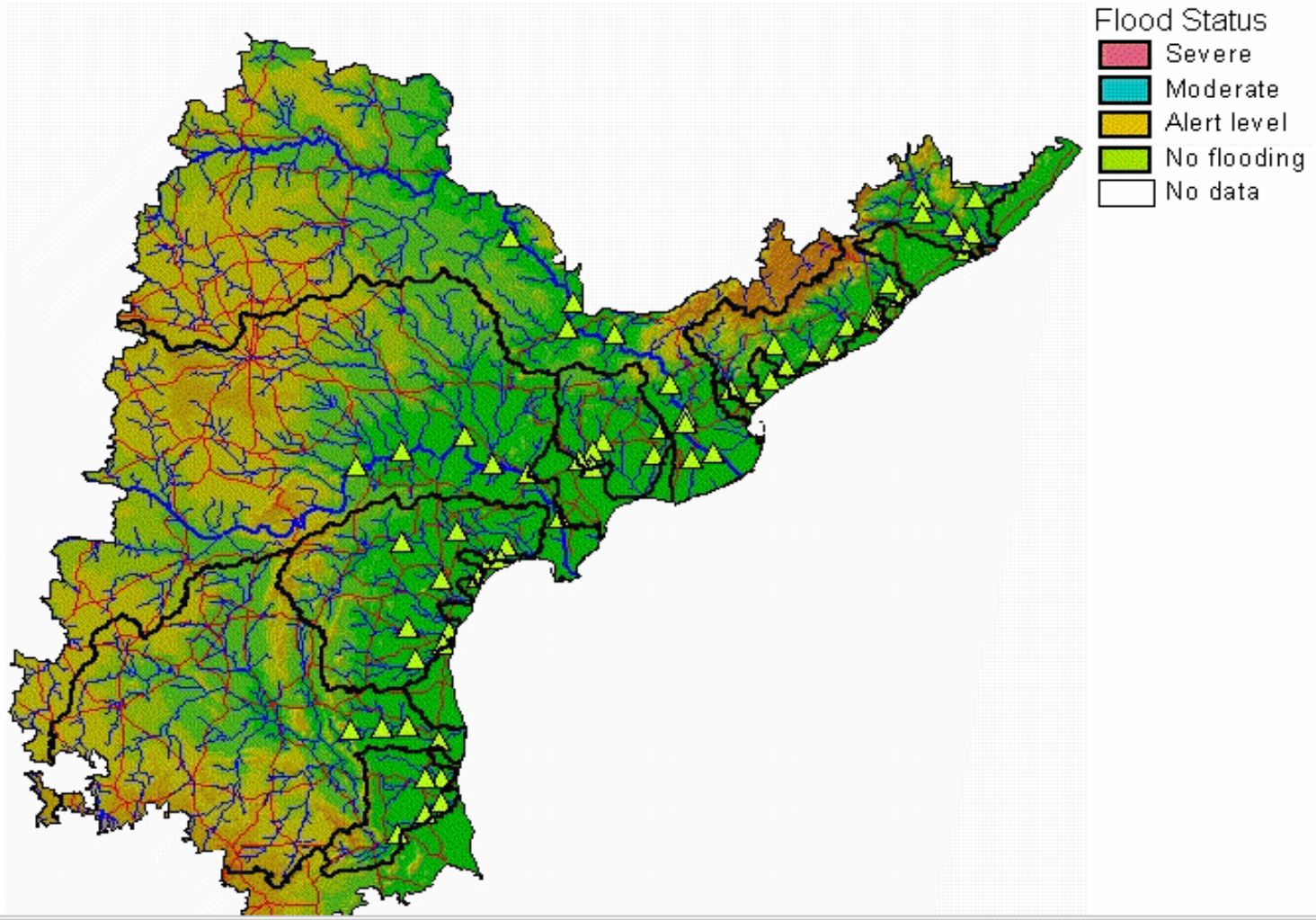
Current | 0-24 HRS | 24-48 HRS | 48-72 HRS | Bulletin | Home

CONTENTS

- District Data
- Hydrometric Data

- Cyclone Bulletins (Study B)

- Start Page



Done Internet

Start | Exploring - 11-11-2002 | Inbox - Outlook Express | Hydrometric Data ... | New Microsoft Word D... | 3:48 PM

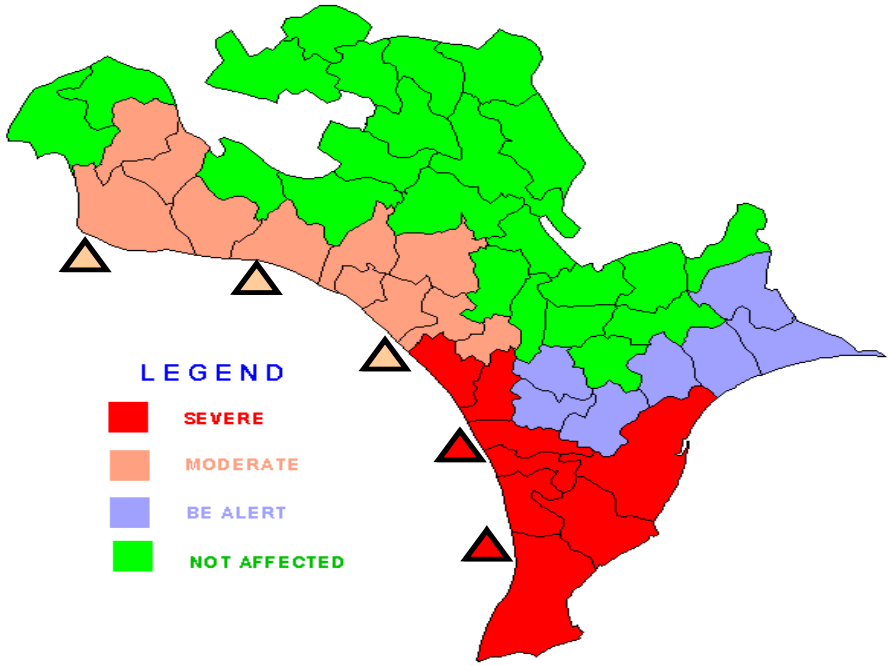
Fax / email output

Front page of District Level flood inundation report

e.g. District Collectors, district government offices

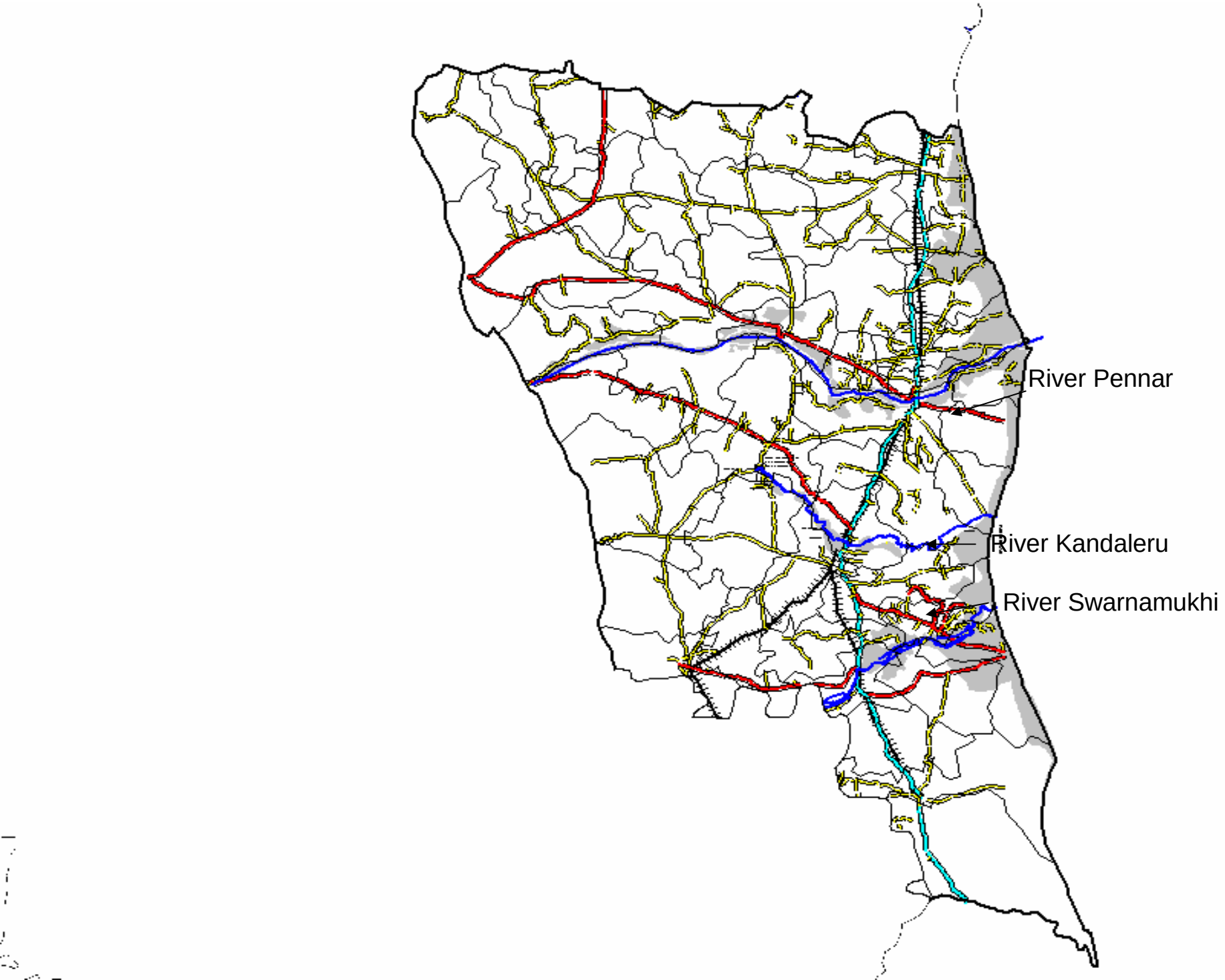
DISTRICT INUNDATION WARNING REPORT
KRISHNA DISTRICT

Date & Time of Information	:	23 April 2001 8:00 PM
Date & Time of Transmission	:	23 April 2001 8.15 PM

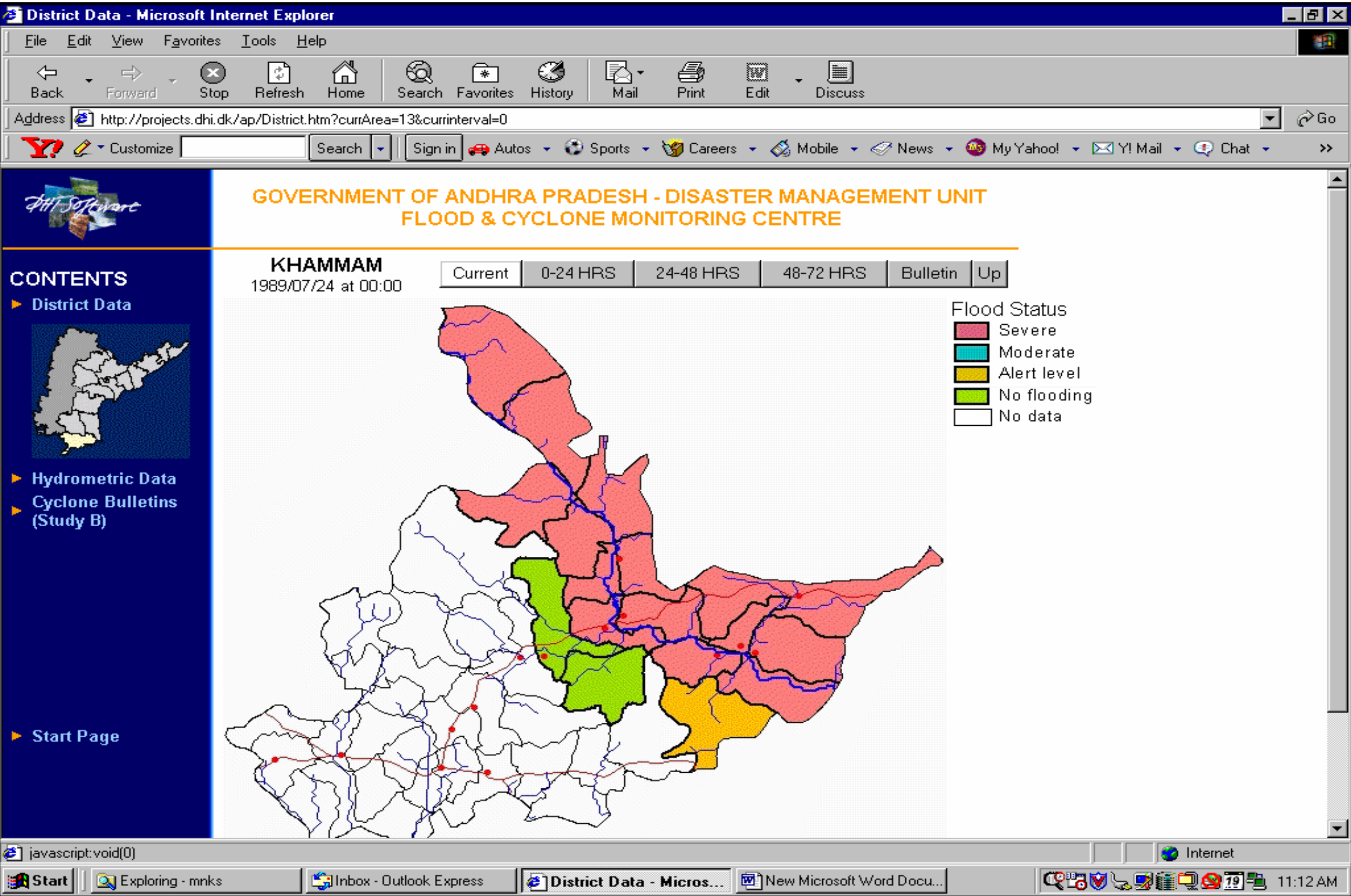


Severely affected Mandals	Max Flood Depth			
	+ 24 hours	+48 hours	+72 hours	Max Flood Depth and Tim
Thotlavalluru	0 m	0.25 m	1.5 m	1.5 m 25/04/01 12.00pm
Pamidimukkala	0 m	0.6 m	1.5 m	1.6 m 25/04/01 6.00pm
Ghantasala	0 m	0.25 m	1 m	1.2 m 25/04/01 10.00am
Machilipatnam	0 m	0.2 m	1,2 m	1.3 m 25/04/01 12.00pm
Challapalle	0 m	0.6 m	1.6 m	1.9 m 25/04/01 9.00pm
Avanigadda	0.25 m	1 m	1.6 m	1.7 m 25/04/01 8.00pm
Koduru	0.25 m	1 m	1.5 m	1.5 m 25/04/01 7.00pm
Nagayalanka	0 m	1 m	1.4 m	1.5 m 25/04/01 8.00pm

Nellore District Flood Inundation Map



DSS Outputs – District Level



DSS Outputs - Bulletin

KHAMMAM Bulletins - Microsoft Internet Explorer

Select a bulletin: Bulletin 2L | Print | |<< first | << prev | next >> | last >>|

GOVERNMENT OF ANDHRA PRADESH - DISASTER MANAGEMENT UNIT
FLOOD & CYCLONE MONITORING CENTRE

FLOOD ADVISORY BULLETIN

DISTRICT REPORT **TYPE 2**

KHAMMAM DISTRICT (PAGE 1 OF 3)

Forecast at: 1989/07/24 at 00:00 Issued at: 2002/11/15 at 17:14

Mandal		Current	0-24 HRS	24-48 HRS	48-72 HRS	APPROXIMATE TIME AND DATE OF PEAK
Ref. No.	Name	-	see note (1)			-
AP136	WAZEED	S	S	S	S	1989/07/24 at 18:00
AP185	VENKATAPURAM	S	S	S	S	1989/07/24 at 18:00
AP229	CHERLA	S	S	S	S	1989/07/25 at 10:00
AP250	PINAPAKA	S	S	S	S	1989/07/24 at 18:00
AP268	GUNDALA	X	X	X	X	
AP281	MANUGUR	S	S	S	S	1989/07/25 at 10:00
AP301	DUMMAGUDEM	S	S	S	S	1989/07/25 at 10:00
AP313	ASWAPURAM	S	S	S	S	1989/07/25 at 10:00
AP315	CHINTUR	S	S	S	S	1989/07/25 at 15:00
AP323	PALWANCHA	-	S	S	S	1989/07/25 at 04:00
AP337	KOTHAGUDEM	X	X	X	X	
AP343	YELLANDU	X	X	X	X	
AP344	BHADRACHALAM	S	S	S	S	1989/07/25 at 04:00
AP348	BAYYARAM	X	X	X	X	
AP353	TEKULAPALLE	X	X	X	X	
AP355	BURGAMAPADU	S	S	S	S	1989/07/25 at 04:00

NOTES:

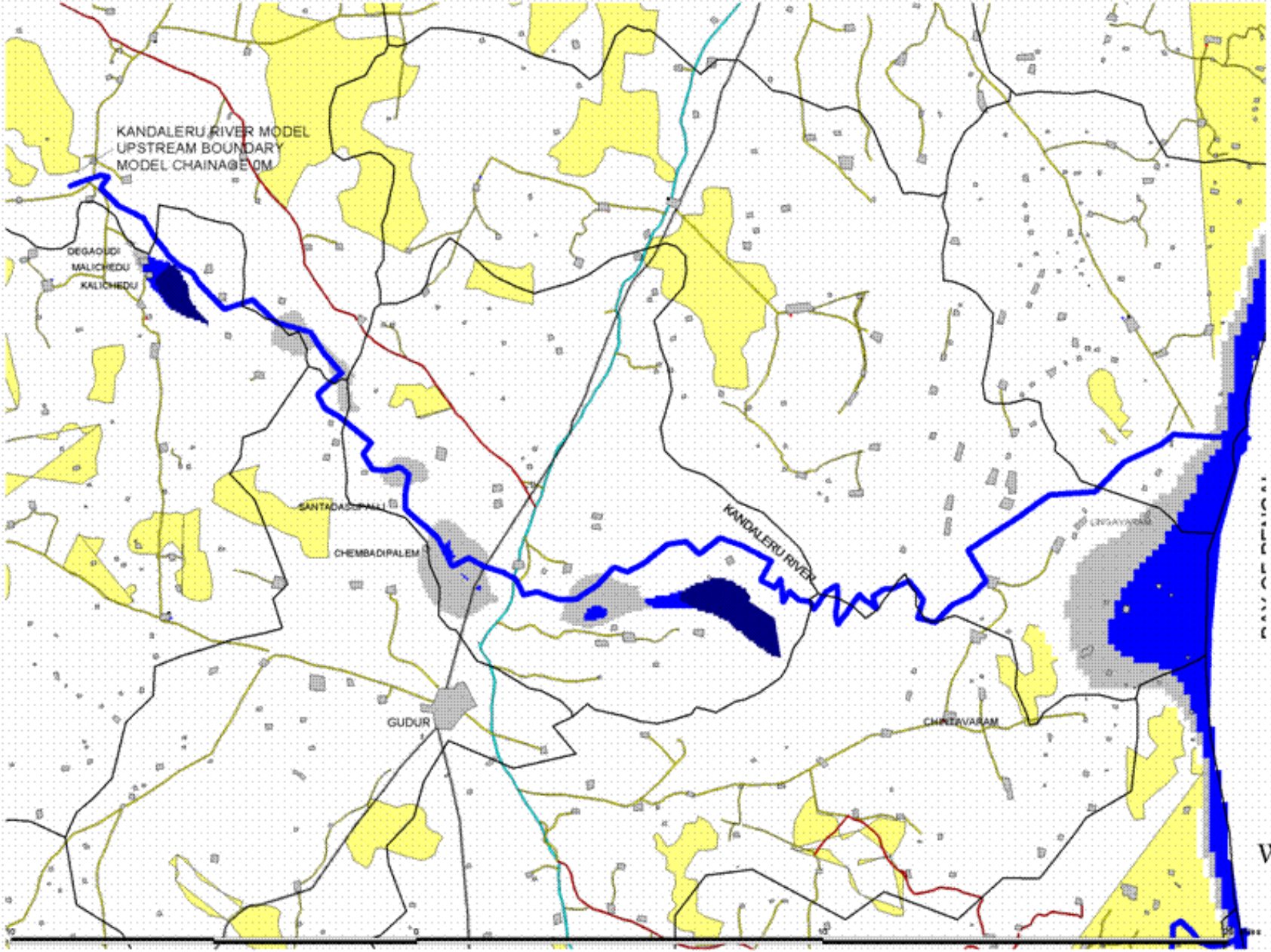
1. Showing worst situation in time period shown
2. Blank box indicates no flooding imminent
4. 'A' indicates alert level reached
5. 'M' indicates moderate flooding expected

Start | Exploring - mnks | Inbox - Outlook Express | District Data - Microso... | New Microsoft Word ... | KHAMMAM Bulleti... | 11:13 AM

Bulletin Types

BULLETIN No.	CONTENT
1	Routine Daily State-wide Report based on both Districts and Catchments/Areas
2	Specific District Report with Mandal forecast information
3	District Report with indicative Mandal inundation data
4	District Report with indicative Mandal 'assets at risk' assessment
5	Catchment/Area based Flood Forecasting Station Report

Kandaleru Extreme Flood Event - Nellore District



HMIS

Hazard Mitigation Information System is a network connecting all the district and Mandal Head quarters with Secretariat and other Heads of Departments through APSWAN for faster and efficient dissemination of information throughout the Andhra Pradesh

Dissemination of Model Outputs

The outputs of all the models analysed through DSS with the help of GIS database are linked to HMIS for faster dissemination to the concerned authorities

Asia: Issues for TC impact on Agriculture

- Data collection and storage from the region
- Early Warning System for Agriculture?
- Multi-sectoral, multi-country, multi-institutions participation
- Vulnerability and disaster mapping
- Insurance

Regional Groupings / Fora

- SAARC
- AASIAN
- BIMSTEC
- WMO/ESCAP Panel

BIMSTEC

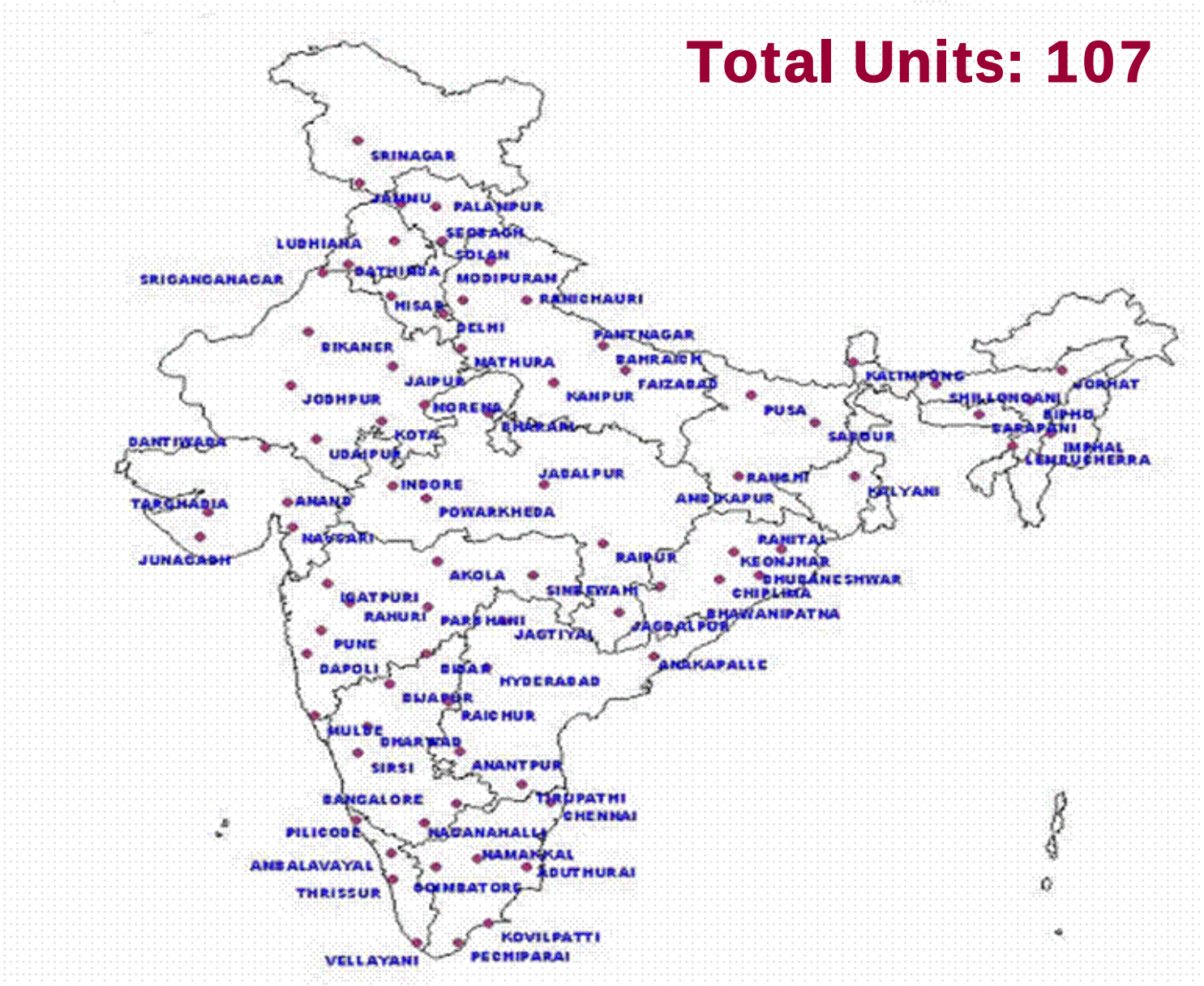
Bay of Bengal
Initiatives for
Multi-
Sectoral
Technical and
Economic
Cooperation

Medium Range Prediction and Drought Monitoring in India

Agromet Advisory Service (AAS) in India

Agromet Advisory Service (AAS) Network

Total Units: 107



Salient Features of Agromet Advisory Service (AAS)

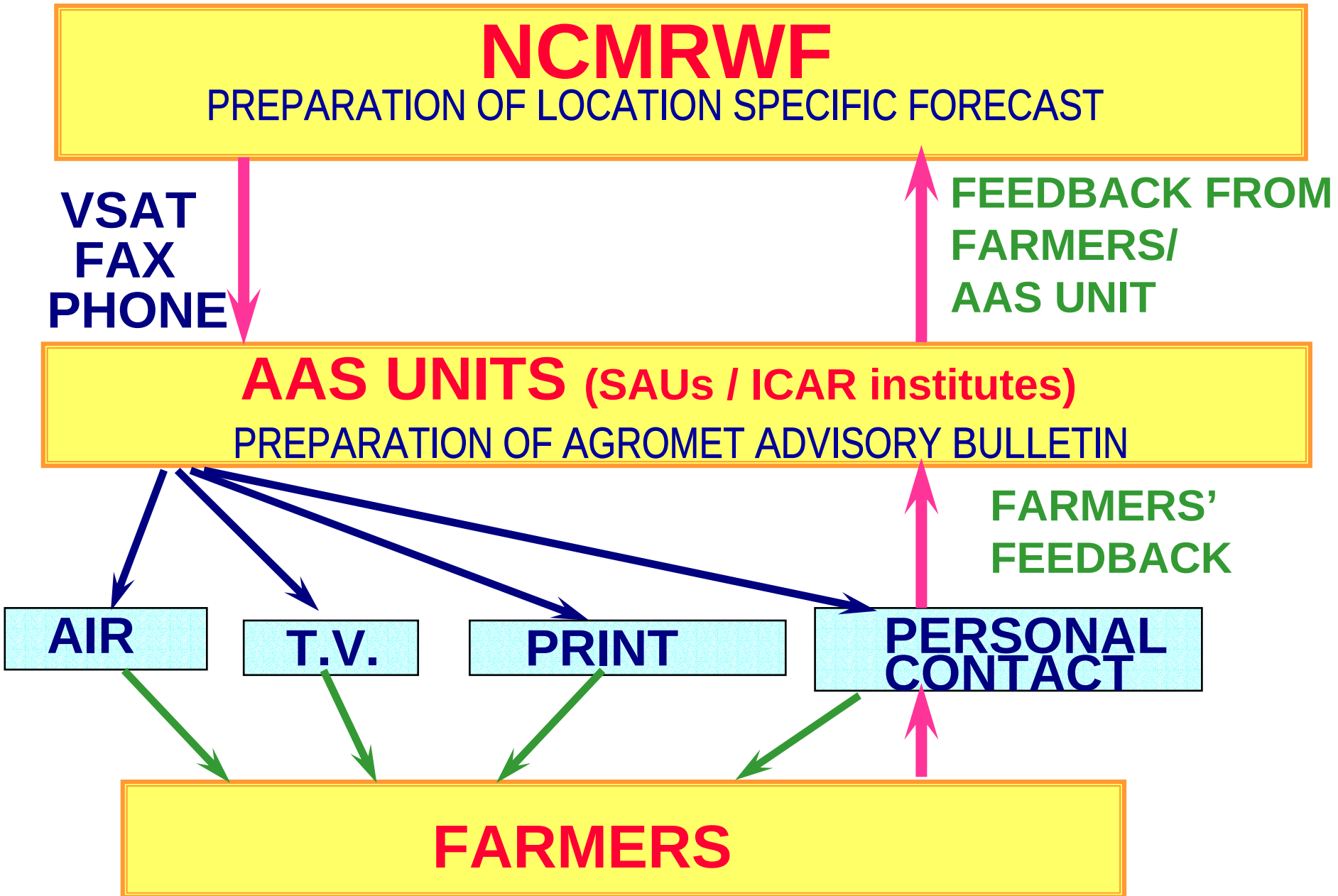
- **At present in 107, but plans to cover all 127 agro-climatic zones.**
- **Units are opened in State Agricultural Universities and ICAR Institutes.**
- **NCMRWF issues location specific quantitative weather forecasts upto one week in advance twice a week.**
- **AAS Units translate these forecasts into Agro-advisories and disseminate them to Media and also directly to farmers.**
- **Units run Crop Weather Models and include output in the Day today advisories.**

NCMRWF FORECAST PRODUCTS DISSEMINATED TO AAS UNITS

- 24 HR PRECIPITATION (MM)
- AVERAGE CLOUDINESS (OKTA)
- AVERAGE WIND SPEED (KMPH) AT 10 FT HEIGHT
- PREDOMINANT WIND DIRECTION (DEG.) AT 10 FT HEIGHT
- MAXIMUM TEMPERATURE TREND (DEG. C) AT 4.5 FT HEIGHT
- MINIMUM TEMPERATURE TREND (DEG. C) AT 4.5 FT HEIGHT

Frequency of Forecast : Twice-a-week
Dissemination : On Tuesday and Friday
Period covered : 4 days

AGROMETEOROLOGICAL ADVISORY SERVICE OF NCMRWF



FORMAT FOR AGROMET ADVISORY BULLETIN

❑ WEATHER INFORMATION

- Weather summary of preceding week,
- Climatic normal for the week,
- Weather forecast and
- Crop moisture index, Drought severity index etc.

❑ CROP INFORMATION

- Type, state and phenological stages of the crops
- Information on pest and disease and
- Information on crop stresses

❑ ADVISORY BULLETIN

- Crop-wise farm management information tailored to weather sensitive agricultural practices like sowing, irrigation scheduling, p & d control operation, fertilizer use etc.
- Spraying condition for insect, weed and their products
- Wildfire rating forecasts in wildfire prone areas
- Livestock managemnet information for housing, health and nutrition etc.

Weather Events covered in AAS

- Frost / Cold Wave
- Heat Wave
- Heavy Rain / Snowfall
- Dry Spell
- Strong Winds
- Hail
- Cyclone

Crops/ Livestock covered under AAS

Field crops

Rice
Wheat
Sorghum
Millet
Maize
Barley
Gram
Soybean
Groundnut
Sesam
Cowpea
Mustard

Vegetables

Tomato
Cauliflower
Potato
Toria
Onion
Beans
Ginger
Peas

Horticultural

Apple
Mango
Grapes
Orange
Coconut
Guaua
Papaya

Livestock

Avian Birds
Sheep/ Goat (wool, meat)
Cow / Buffalow (milk)

Major Agricultural Operations covered under AAS

- **Sowing / Transplanting**
  - **Rainfed**
  - **Irrigated**
- **Pest & Disease**
  - **Spraying**
- **Water Management**
  - **Irrigation**
- **Fertiliser Application**
- **Harvesting**
- **Post Harvesting / Storage**

ECONOMIC IMPACT ASSESSMENT OF AAS

Based on Farmer's feedback, Field visits by scientists, Objective techniques (Crop cutting and Saving due to reduction in farm inputs) *and* Notional savings

FIELD UNIT	Crops/ Livestock	Weather Events/ Management Practices
Kovilpatti	Sorghum, Cotton	Early sowing
Ludhiana	Potato, Tomato	Frost
Coimbatore	Sorghum, Maize, Banana, Onion	Early sowing, Wind speed, Cloudiness
Madras	Poultry	Thermal stress, Pest & Disease management
Namakkal	Poultry	Heat stroke, Disease management
Pune	Sorghum	Dry sowing
Raipur	Chilli, Potato	Irrigation, Wind speed, Cloudiness
Anand	Pigeonpea, Cotton, Potato	Pesticide application

SAVINGS ACHIEVED: 2-20%

Medium Range Forecast and Drought Monitoring during MONSOON-2005

Onset and Advance of Monsoon

MONSOON-2005

- Late onset over Kerala by about 4 days (5th June)
- Delayed advance over northeast India by about two weeks (16th June)
- Monsoon arrived over Mumbai late by 9 days (19th June)

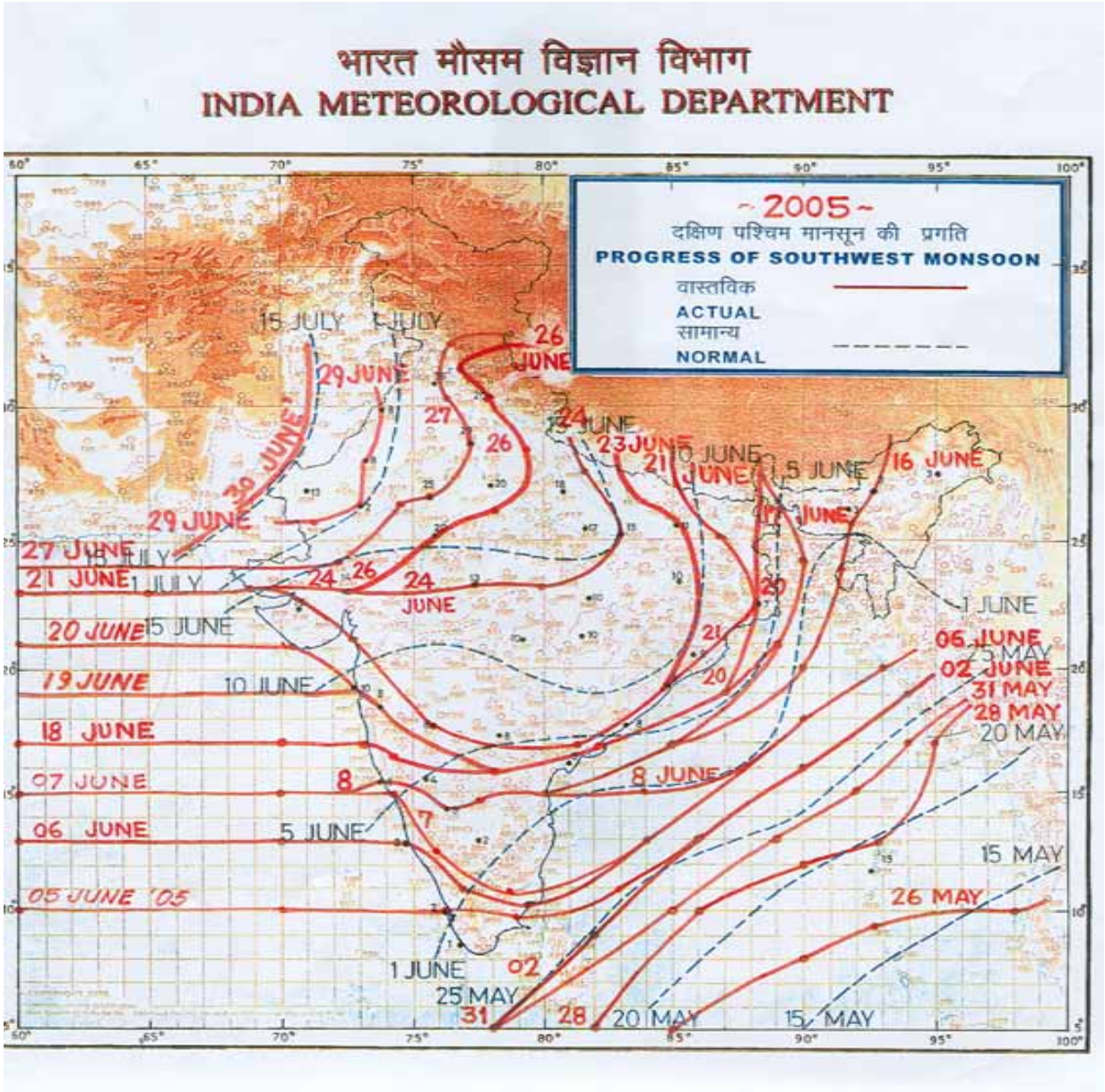
Onset and Advance of Monsoon

MONSOON-2005

- Onset over central India Delayed by about 10-15 days (20th -24th June)
- Delayed onset over northern plains by about 7 to 10 days
- Normal Onset over parts of Northwest India including Delhi
- Monsoon covered entire country by 30th June, 15 days ahead of normal date.

Progress of Monsoon over different parts of the Country

MONSOON-2005



Monsoon-2005: A Glimpse

Country as a whole rainfall Distribution:

Normal for 1 June-28 September	= 884.4 mm
Actual rainfall	= 872.8 mm
% Dep. From Normal	= -1%

Zone-wise rainfall distribution

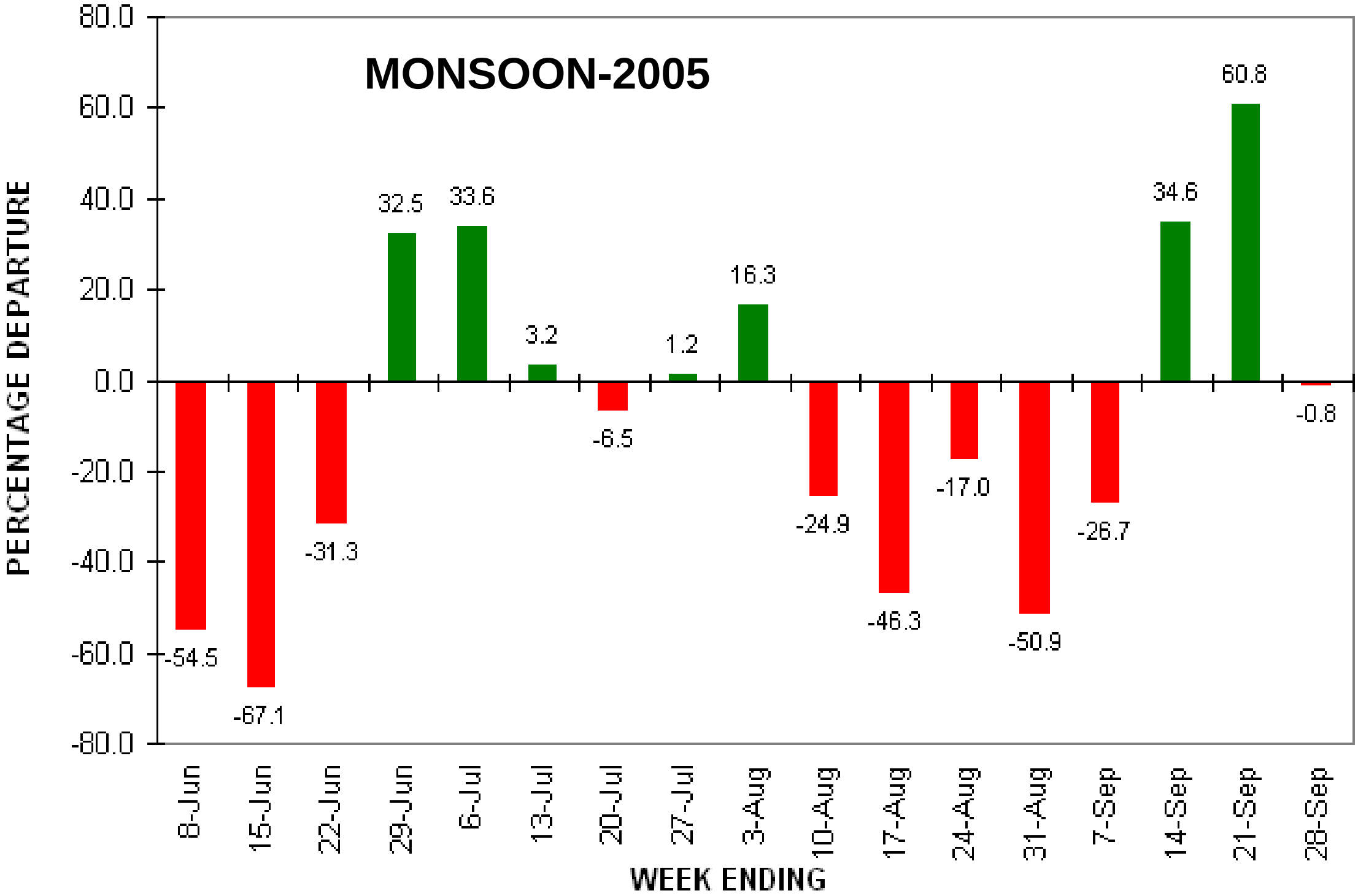
	Normal	Actual	% Dep
North-west	608.7	550.0	- 10%
Central	985.6	1092.2	+11%
South Peninsula	711.2	798.5	+ 12%
North-east India	1415.7	1122.9	- 21%

Sub-Division wise rainfall distribution

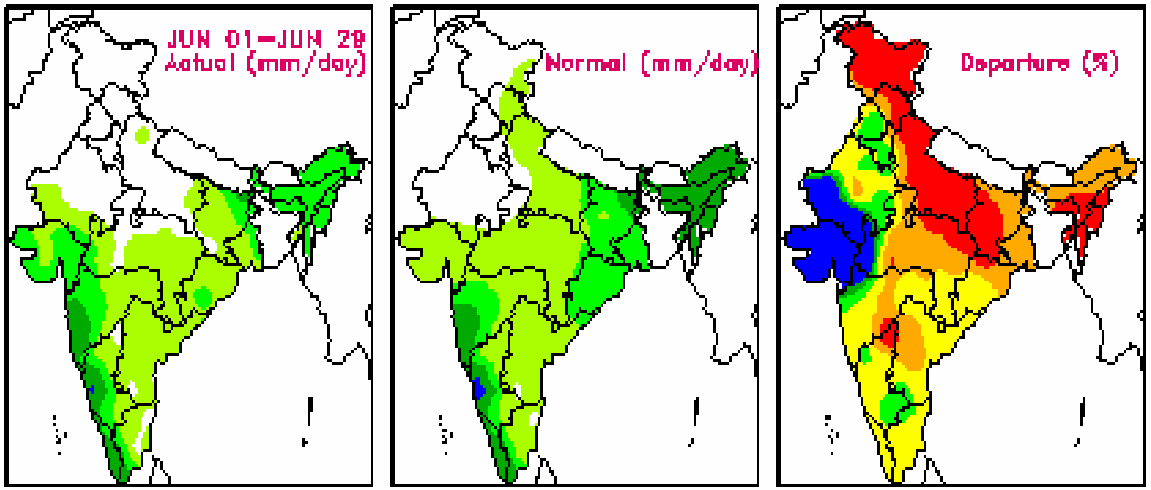
Excess	=	9 (25%)
Normal	=	23 (64%)
Deficient	=	4 (11%)
Scanty	=	0

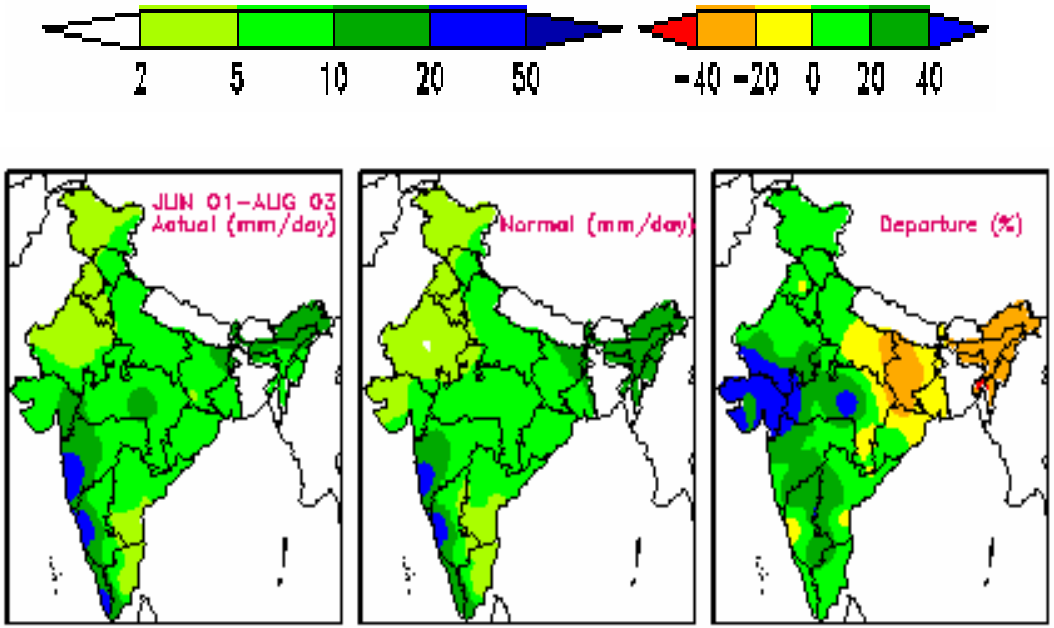
District wise rainfall distribution

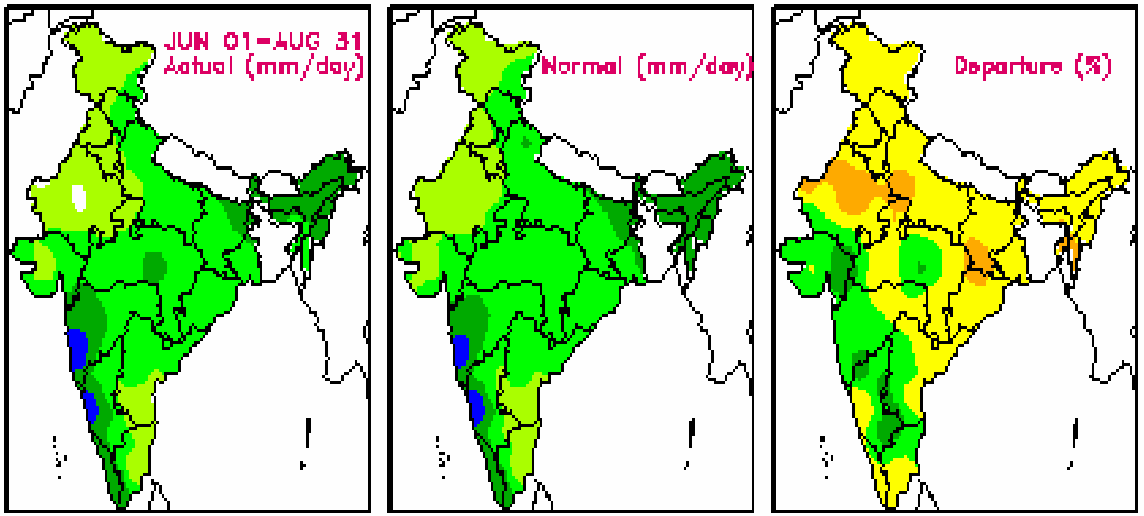
Excess	=	110 (22%)
Normal	=	249 (50%)
Deficient	=	133 (26%)
Scanty	=	11 (2%)
No Rain	=	0 (0%)

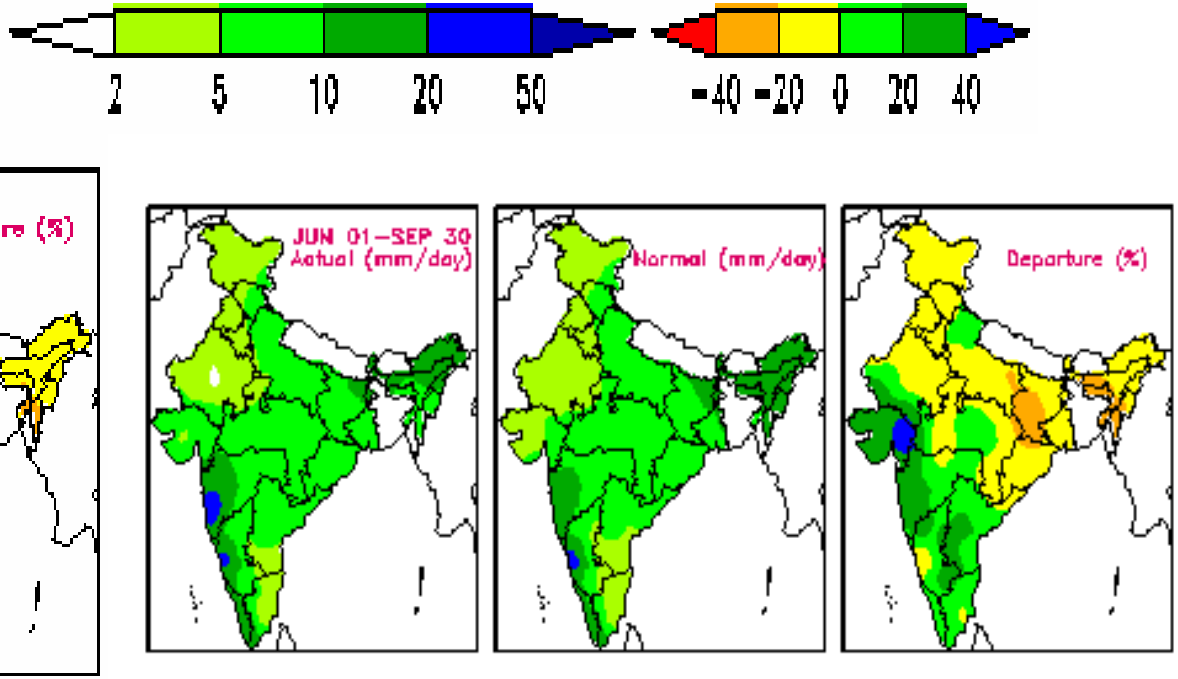

MONSOON-2005
PERCENTAGE DEPARTURE
80.0
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
-80.0
-54.5
-67.1
-31.3
32.5
33.6
3.2
-6.5
1.2
16.3
-24.9
-46.3
-17.0
-50.9
-26.7
34.6
60.8
-0.8
8-Jun
15-Jun
22-Jun
29-Jun
6-Jul
13-Jul
20-Jul
27-Jul
3-Aug
10-Aug
17-Aug
24-Aug
31-Aug
7-Sep
14-Sep
21-Sep
28-Sep
WEEK ENDING

Monsoon-2005: Month-wise rainfall performance

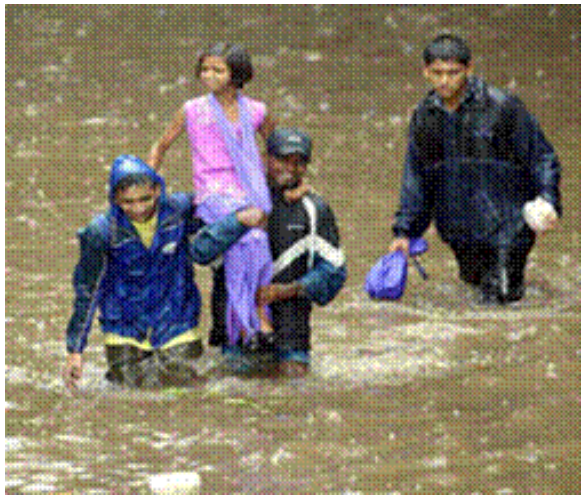








Exceptionally Heavy rains in Indian Metros-2005



Mumbai: 26 July

Delhi: 15 September

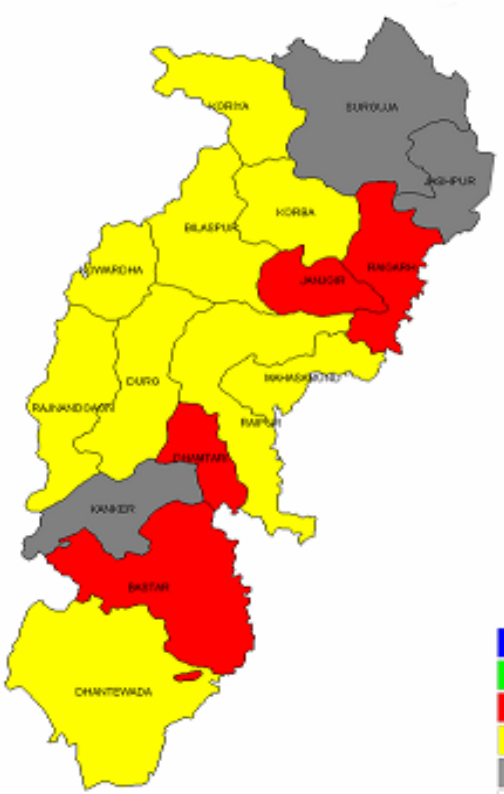
Visakhapatnam: 16 October

Kolkata: 21 October

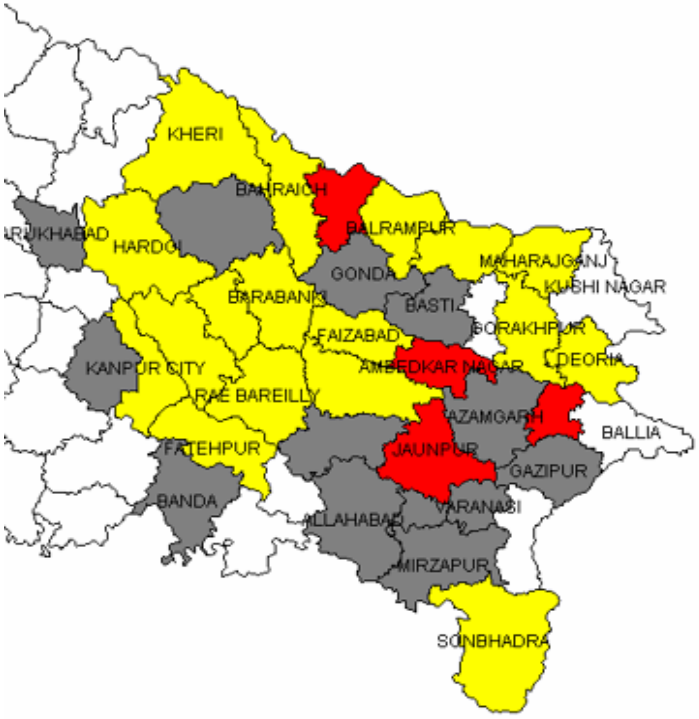
Bangalore-22 October

Chennai: 26 October

Week	Week ending	All India % rainfall departure		No of deficient/ scanty sub-divisions		% Realized Rainfall out of Season's Normal
		Weekly	Cumulative for the period beginning from 1 June	Weekly	cumulative for the period beginning from 1 June	
1	08-6-2005	-54	-51	27	26	2%
2	15-6-2005	-67	-59	27	31	3%
3	22-6-2005	-31	-49	24	28	6%
4	29-6-2005	+32	-20	13	19	14%
5	06-7-2005	+34	-2	11	13	24%
6	13-7-2005	+3	+1	15	8	32%
7	20-7-2005	-6	0	13	7	39%
8	27-7-2005	+1	+2	18	5	48%
9	03-8-2005	+16	+5	16	5	57%
10	10-8-2005	-25	+2	20	6	63%
11	17-8-2005	-46	-2	28	7	67%
12	24-8-2005	-17	-3	22	8	73%
13	31-8-2005	-51	-6	27	5	76%
14	07-9-2005	-27	-8	20	9	79%
15	14-9-2005	+34	-5	9	9	87%
16	21-9-2005	+61	-2	11	5	94%
17	28-9-2005	-1	-1	20	4	99%



Chattisgarh

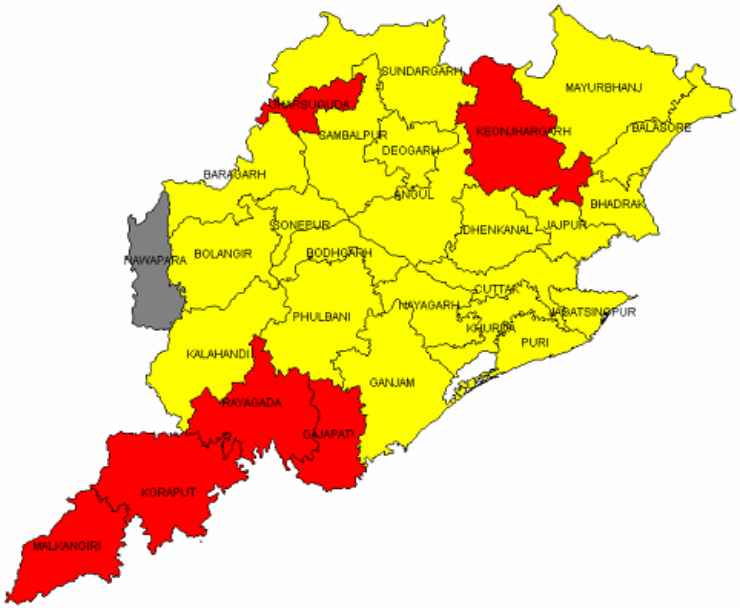


East UP

Excess
Normal
Defecient
Scanty
No Rain
No Data

Excess
Normal
Defecient
Scanty
No Rain
No Data

1-22 June



Orissa

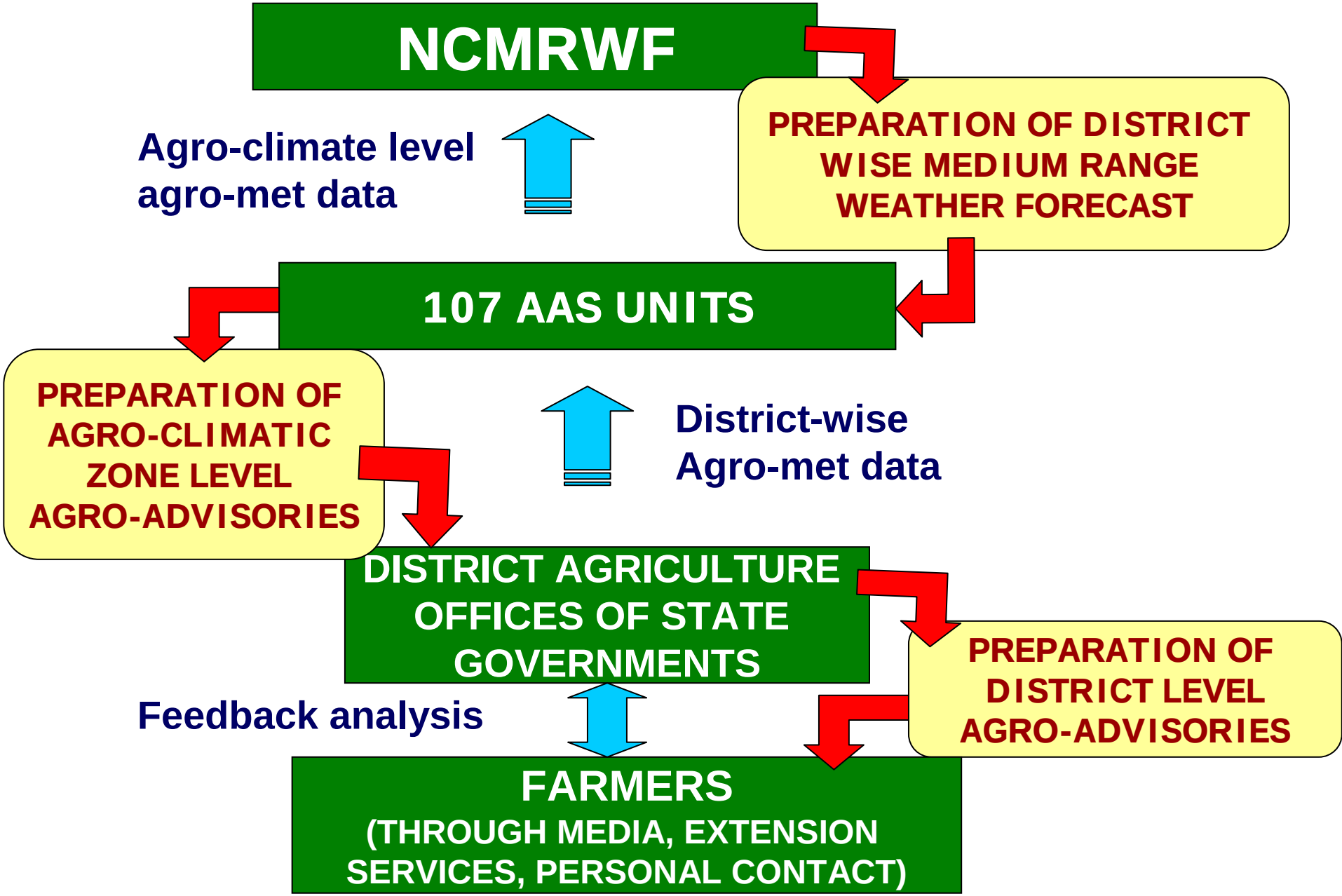
Excess
Normal
Defecient
Scanty
No Rain
No Data

S. No.	Met Sub-divisions	%Cumulative Rainfall Dep. From normal as on 24 Aug.,2005	%Cumulative Rainfall Dep. From normal as on 31 Aug.,2005	Change of Status
1	West U.P.	-20% (D)	-26% (D)	D
2	West Rajasthan	-28% (D)	-34% (D)	D
3	East Rajasthan	-10% (N)	-17% (N)	D
4	Haryana, Chandigarh and Delhi	-12% (N)	-18% (N)	D
5	West Madhya Pradesh	-12% (N)	-19% (N)	D
6	East Madhya Pradesh	+32% (E)	+22% (E)	D
7	Gujarat	+42% (E)	+33% (E)	D
8	Orissa	-5% (N)	-10% (N)	D
9	Chattisgarh	-11% (N)	-17% (N)	D
10	Telangana	+14% (N)	+9% (N)	D
11	Marathwada	+12% (N)	+6% (N)	D
12	Vidarbha	+7% (N)	0% (N)	D
13	Bihar	-20% (D)	-11% (N)	I
14	Rayalaseema	+16% (N)	+26% (E)	I
15	South Interior Karnataka	+27% (E)	+34% (E)	I
16	Tamilnadu & Pondicherry	-30% (D)	-11% (N)	I

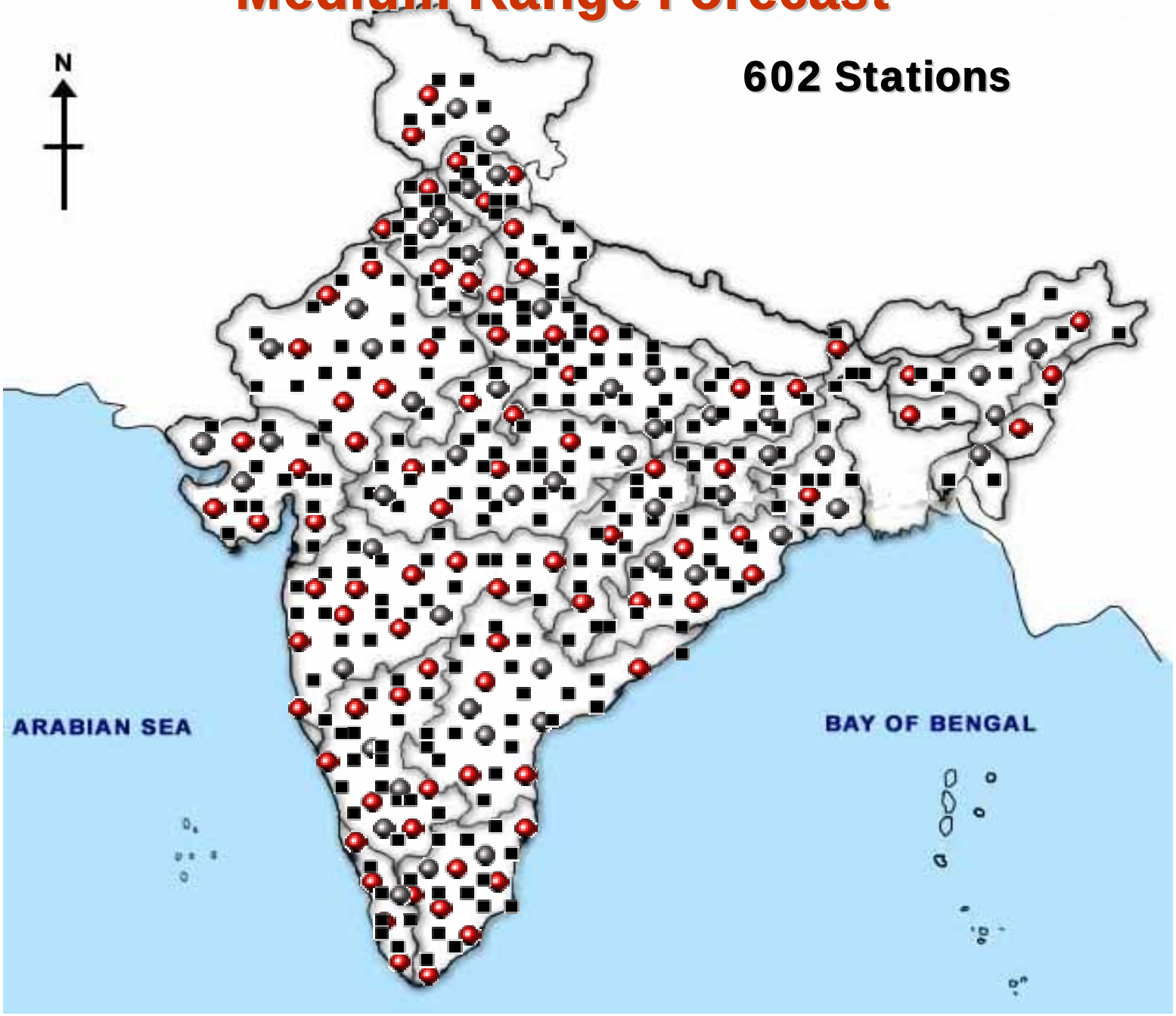
S.No.	Sub-Divisions	R/F % Dep. for the period 1 June-14 September	Assessment of situation till end of next week based on current weather situation and medium range prediction of rains for next week
1	Assam & Meghalaya	-24%	Sub-dued rainfall activity is expected during next week. Not much improvement likely
2	Nagaland, Manipur, Mizorum & Tripura	-29%	Some rainfall activity is expected during next week. Marginal improvement likely
3	Jharkhand	-33%	Scattered rainfall activity is likely during the week. Marginal improvement likely.
4	Bihar	-20%	Scattered rainfall activity is likely during the week. Marginal improvement likely.
5	East Uttar Pradesh	-22%	Currently experiencing scattered to fairly widespread rains and the same conditions are likely to prevail. Some improvement likely.
6	West Uttar Pradesh	-29%	Currently experiencing fairly widespread with isolated heavy rains and the same conditions are likely to prevail. Good improvement likely.
7	West Rajasthan	-27%	Isolated to Scattered rainfall activity is expected during the week. Some improvement likely.
8	East Rajasthan	-21%	Scattered to fairly widespread rainfall activity is expected during the week. Good improvement likely.
9	West Madhya Pradesh	-21%	Scattered to fairly widespread rains are expected during the week. Good Improvement likely.

Future Plans:
Proposed District Level Forecast and AAS

Proposed District-level Agro-advisory System of NCMRWF



Proposed District-Level Medium Range Forecast



Pilot Initiative for Village Information System

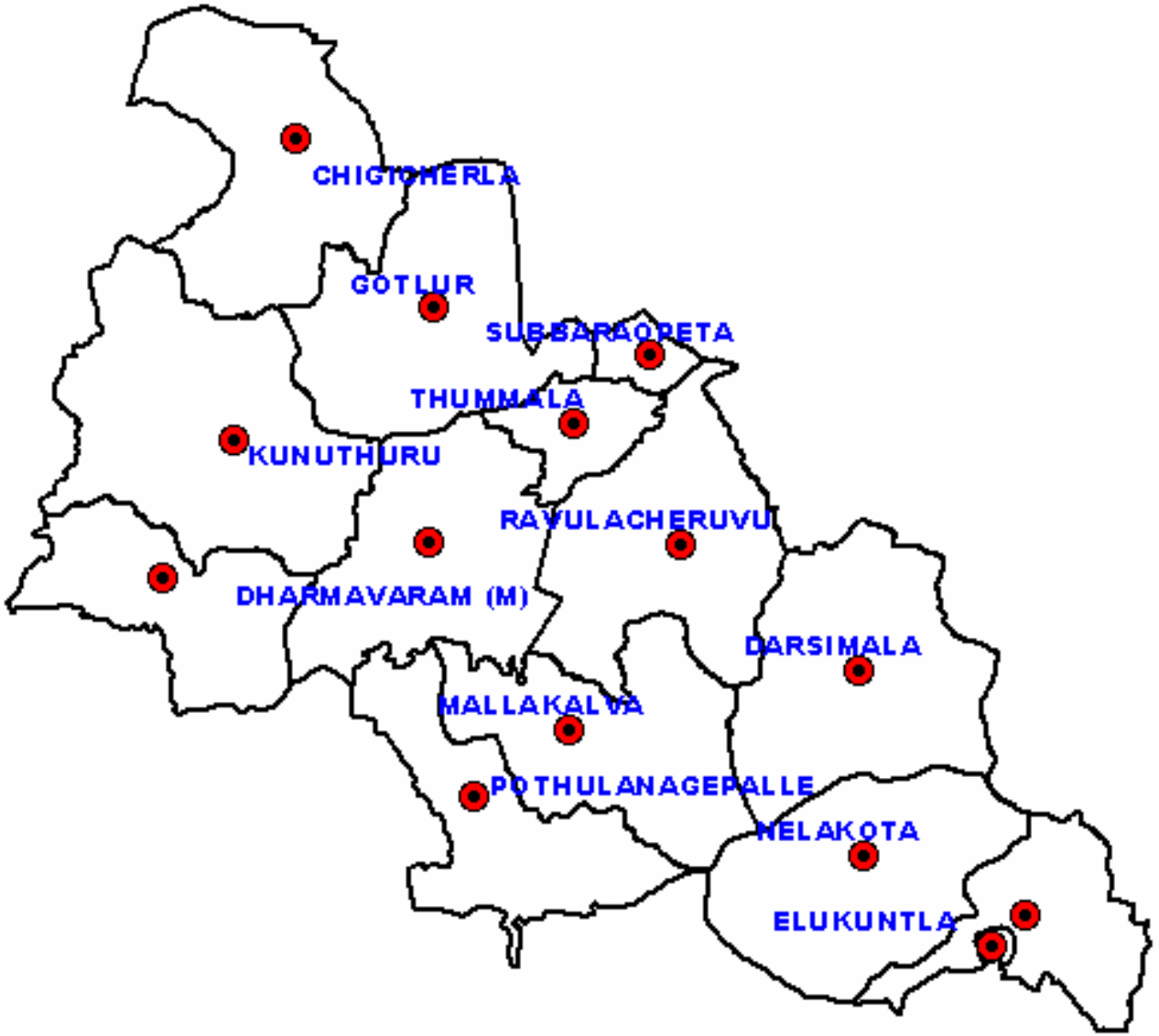
A new programme launched by DST in collaboration with AP Govt.

Pilot Initiative for Village Information System

(Jointly with NRDMS, SOI, APSRAC, APCOST)

1. Study Area: 10 Villages of Nellore Districts of AP for Cyclone & flood vulnerability assessment 10 Villages of Cuddapa District of AP for drought vulnerability assessment
2. Information to be bundled in addition to existing resources and other data at Village level-
    a. Risk & vulnerability assessment
    b. Mapping of Village scale risk & vulnerability
    c. Details of best practices in respect of effective community level response to the disaster scenario
    d. Risk Mapping of infrastructure, houses, crops, & other common facilities
    e. Mitigation Plans to reduce risk & vulnerability for evolving suitable developmental plans
3. Computing & Network infrastructure establishment

A Typical Layout of REVENUE VILLAGES



Topographic Layers

- Habitation
- Revenue Village
- Settlements
- Roads
- Rail Network
- Canal
- Drainage Lines
- Water Bodies
- Wells
- Forest
- Contour
- Elevation
- Symbol

Thematic Layers from Satellite Images

- Hydrogeomorphology
- Slope
- Soil
- Land Use / Land Cover
- Land and Water Resources Development Plans

Non-Spatial Data for every Habitation

- Census
- Land Information
- Infrastructure

Census

- No.of Households
- Population
- Male/Female
- Age
- Caste
- Literacy
- Work Force

Land Use

- Total Geographical Area
- Forest Area
- Barren and Unculturable Waste Land
- Land put to Non-Agricultural Uses
- Culturable Waste Land
- Permanent Pastures / Grazing Lands
- Land put to Miscellaneous use (Trees/Groves)
- Fallow land
- Net Area Sown
- Irrigated Land
  (Canals, Tanks, Tube wells,
  Wells, Check dams, L.I. Schemes)

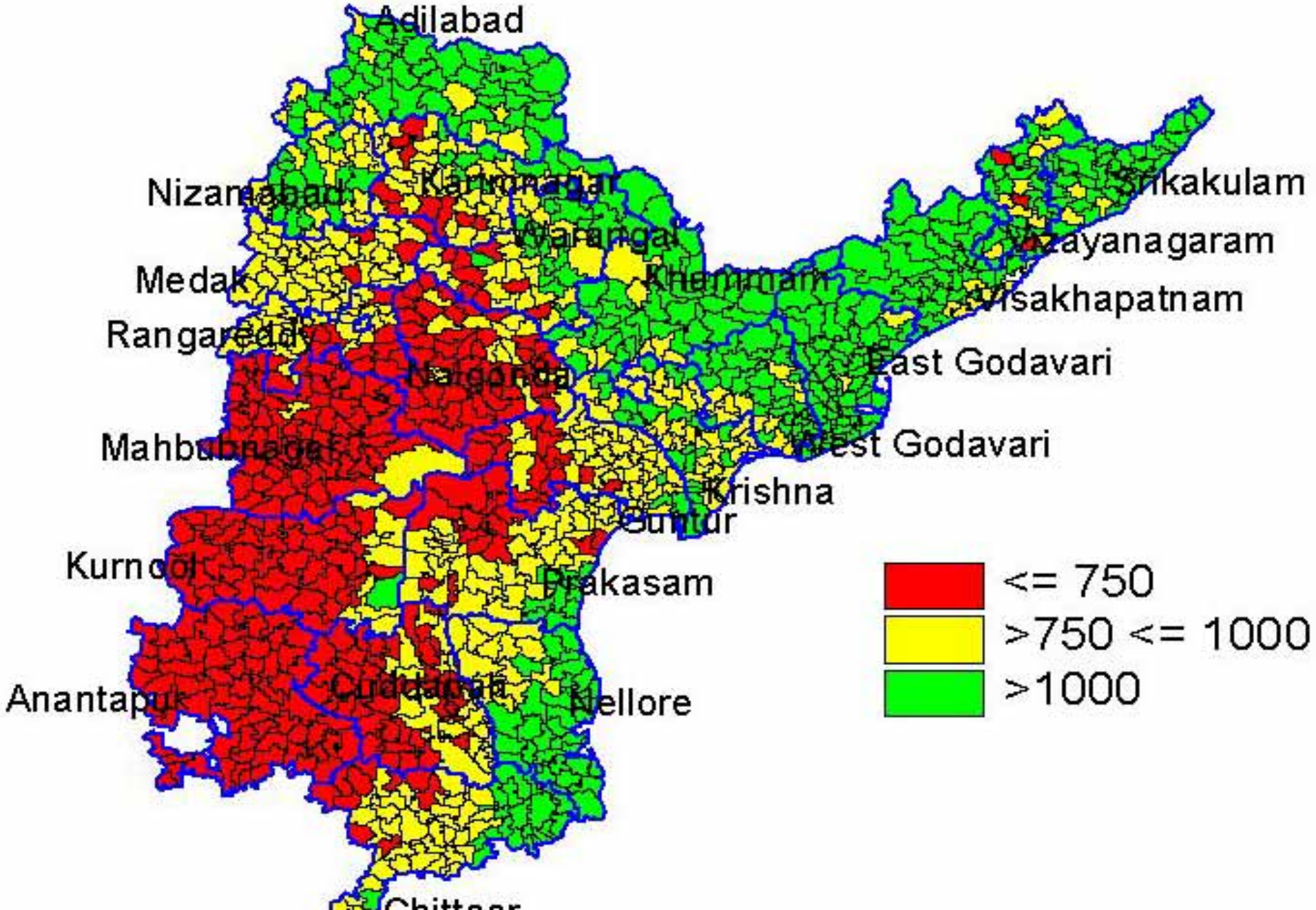
Infrastructure

- Schools
- Colleges
- Hostels
- Health Institutions
- Veterinay Institutions
- Electricity
- Police Station
- Post Office
- Telephone
- Fire Station
- Banks
- Drinking Water Sources
- Irrigation Sources
- Industries
- Public Distribution System

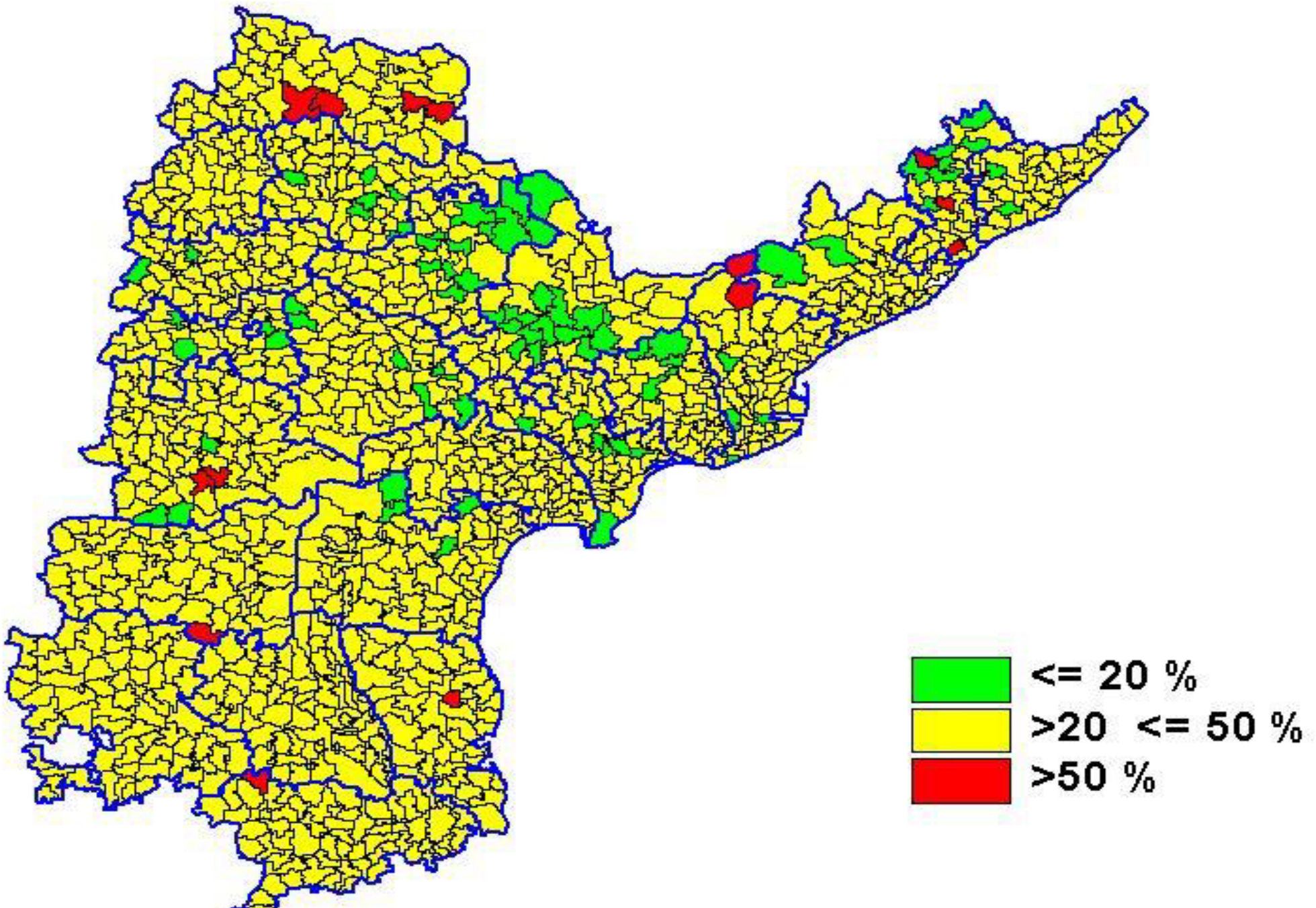
Infrastructure

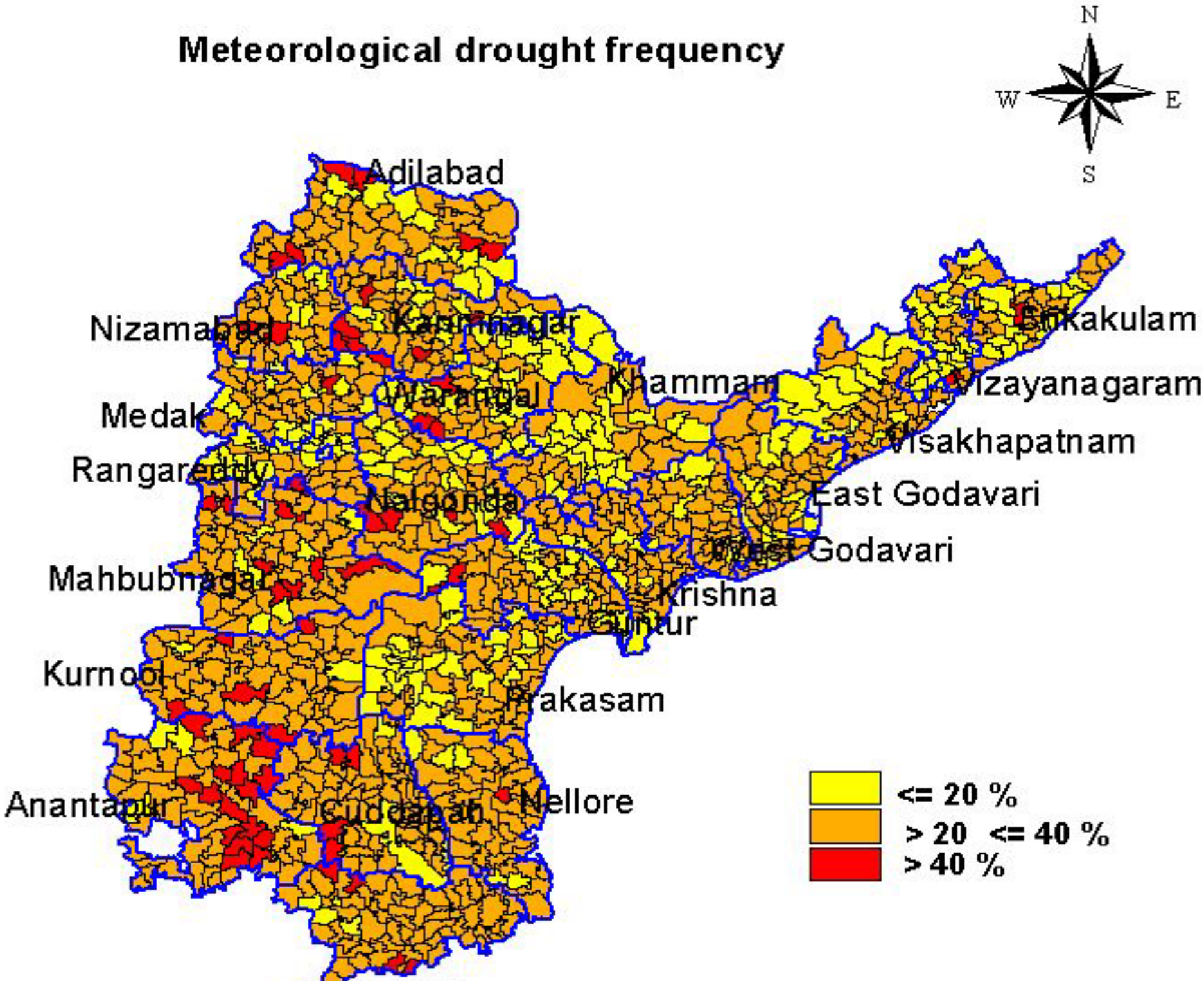
- Bus Services
- Women & Child Development Centres
- Non-formal Education Centres
- Village Library
- Rail Services
- Market Yards
- Cooperative Institutions
- Self Help Groups
- Rural Connectivity
- Cable T.V.
- Burial Ground
- Garbage Yard
- Community Latrines

Classification of mandals based on average annual rainfall (mm)

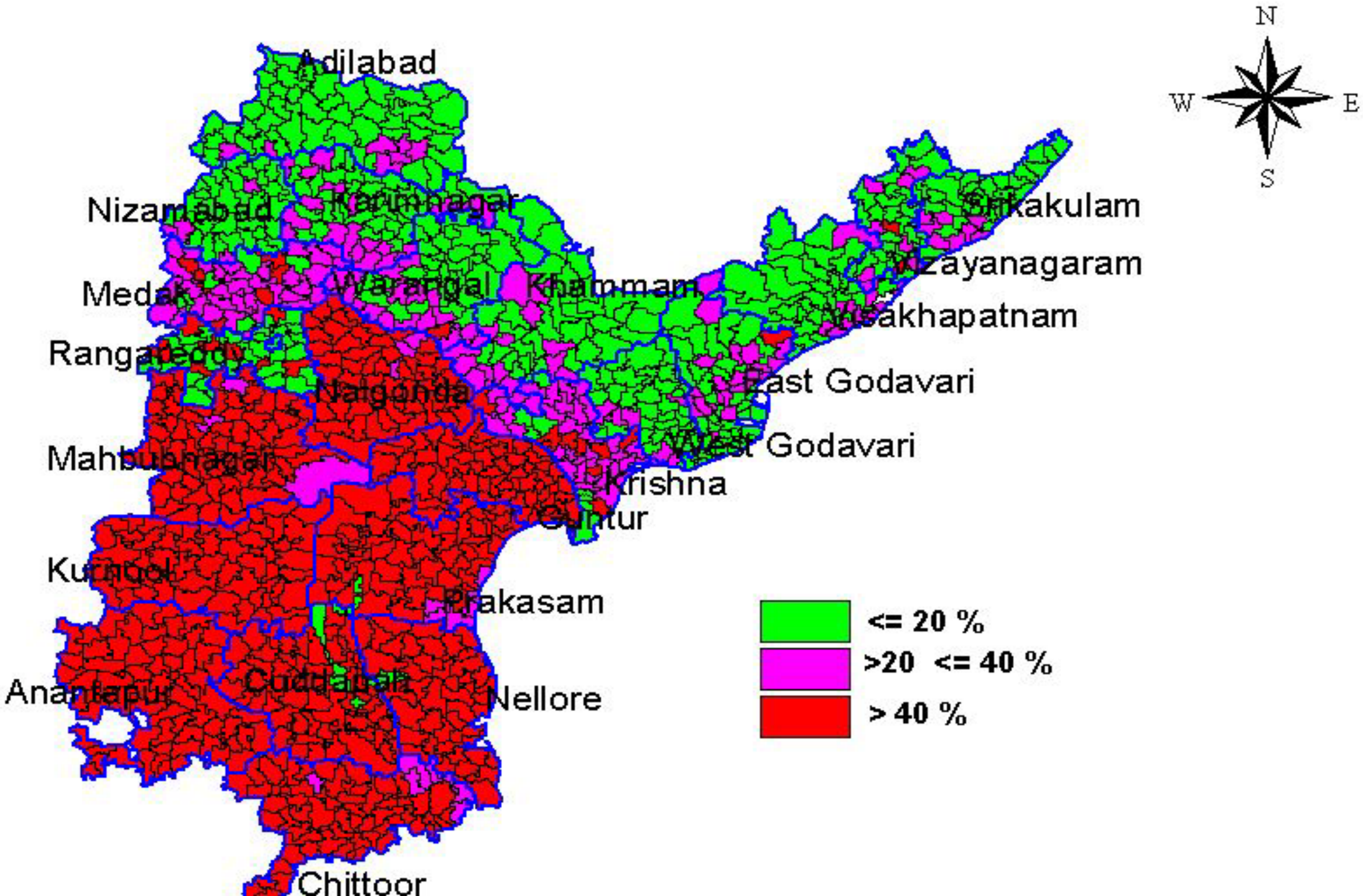


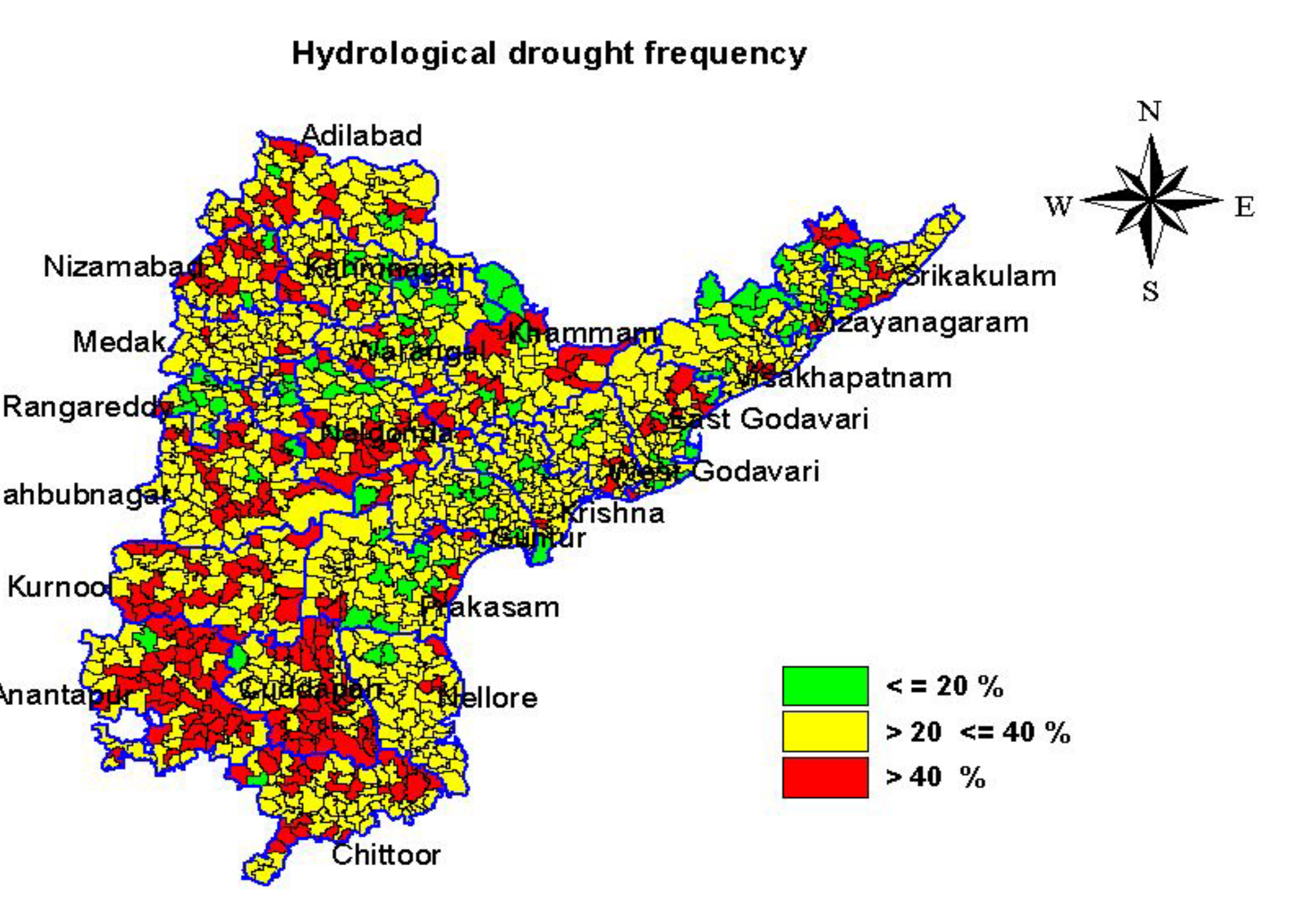
Coefficient of variation of rainfall



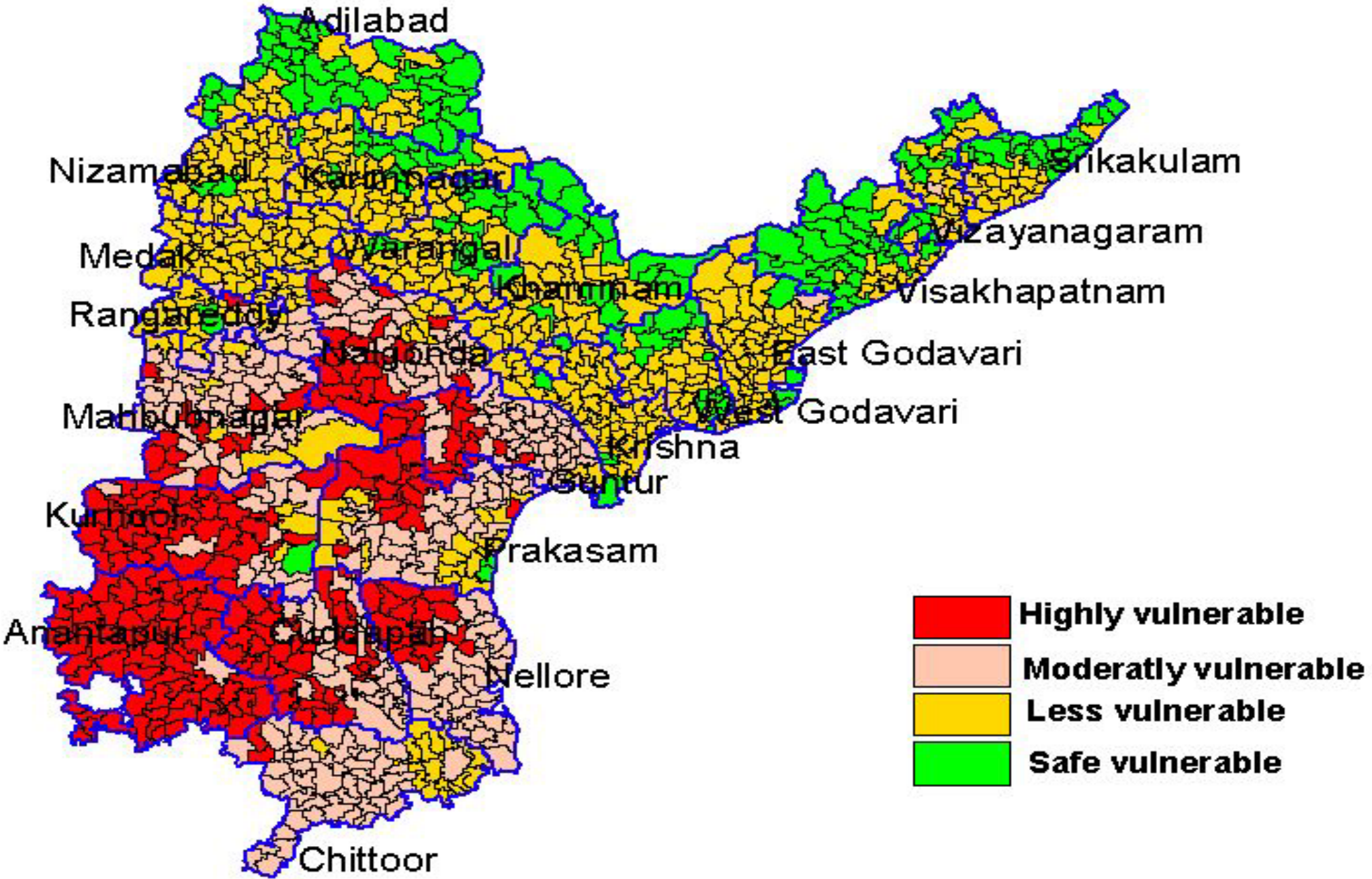

Meteorological drought frequency
N
W
E
S
Adilabad
Nizamabad
Karimnagar
Srikakulam
Khammam
Vizayanagaram
Warangal
Medak
Visakhapatnam
Rangareddy
East Godavari
Nalgonda
West Godavari
Mahbubnagar
Krishna
Guntur
Kurnool
Prakasam
Anantapur
Cuddapah
Nellore
<= 20 %
> 20 <= 40 %
> 40 %

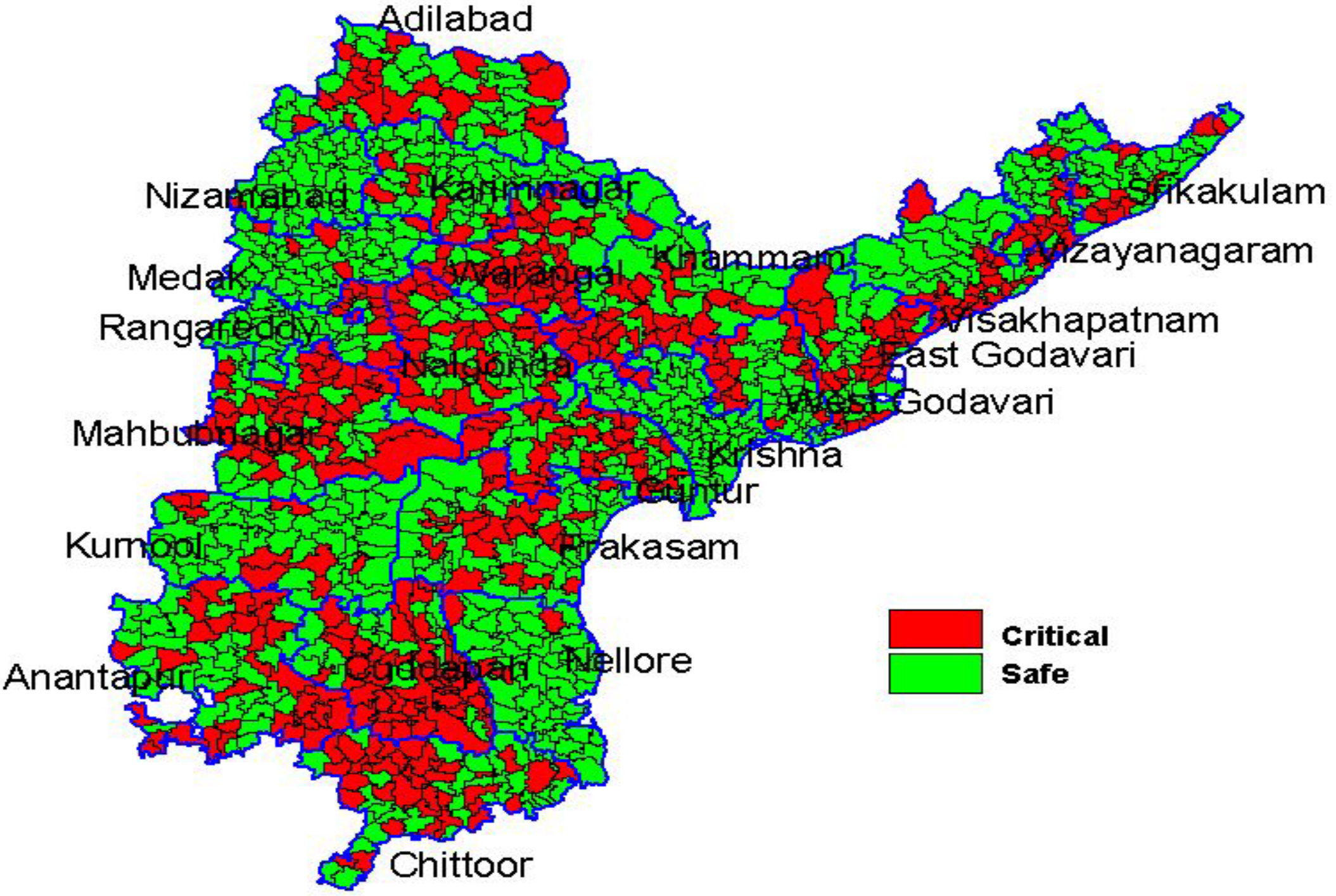
Agricultural Drought Frequency in A.P




Hydrological drought frequency
N
W
E
S
Adilabad
Nizamabad
Karimnagar
Medak
Warangal
Khammam
Rangareddy
Nalgonda
ahbubnagar
Krishna
Guntur
Kurnool
Prakasam
Anantapur
Cuddapah
Nellore
Chittoor
Srikakulam
Vizayanagaram
Visakhapatnam
East Godavari
West Godavari
< = 20 %
> 20 <= 40 %
> 40 %

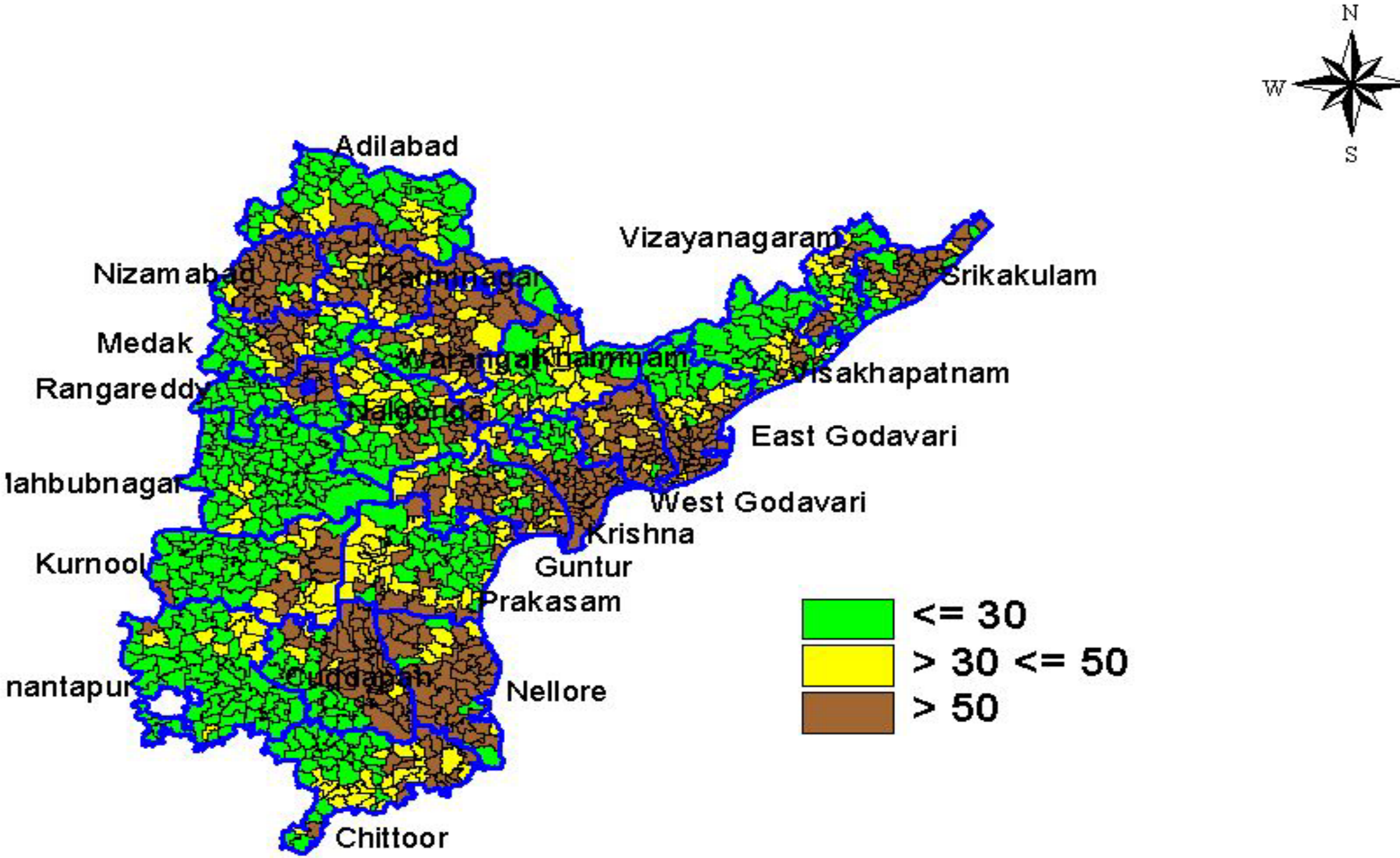
Drought severity status



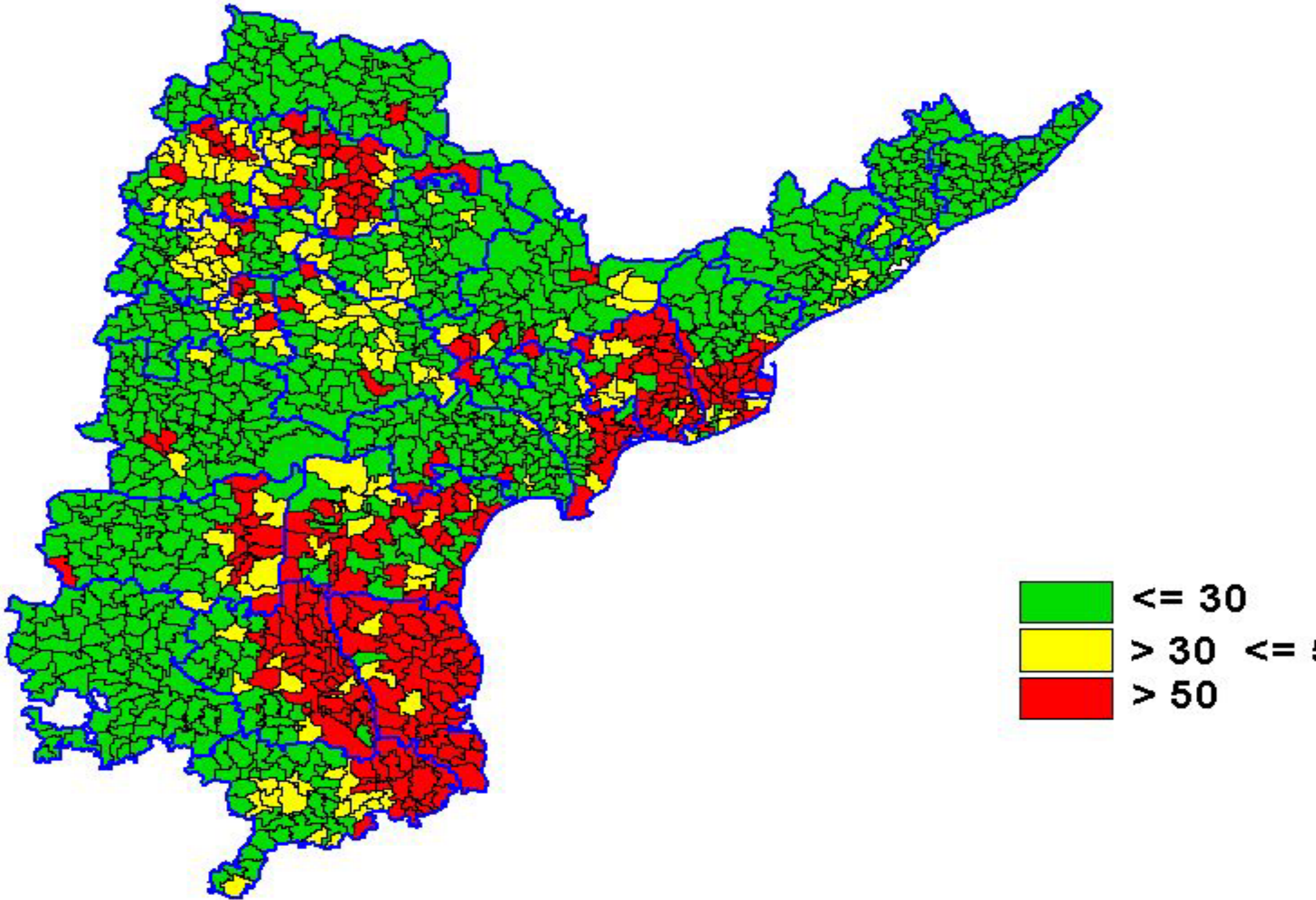


Feed & fodder availability status

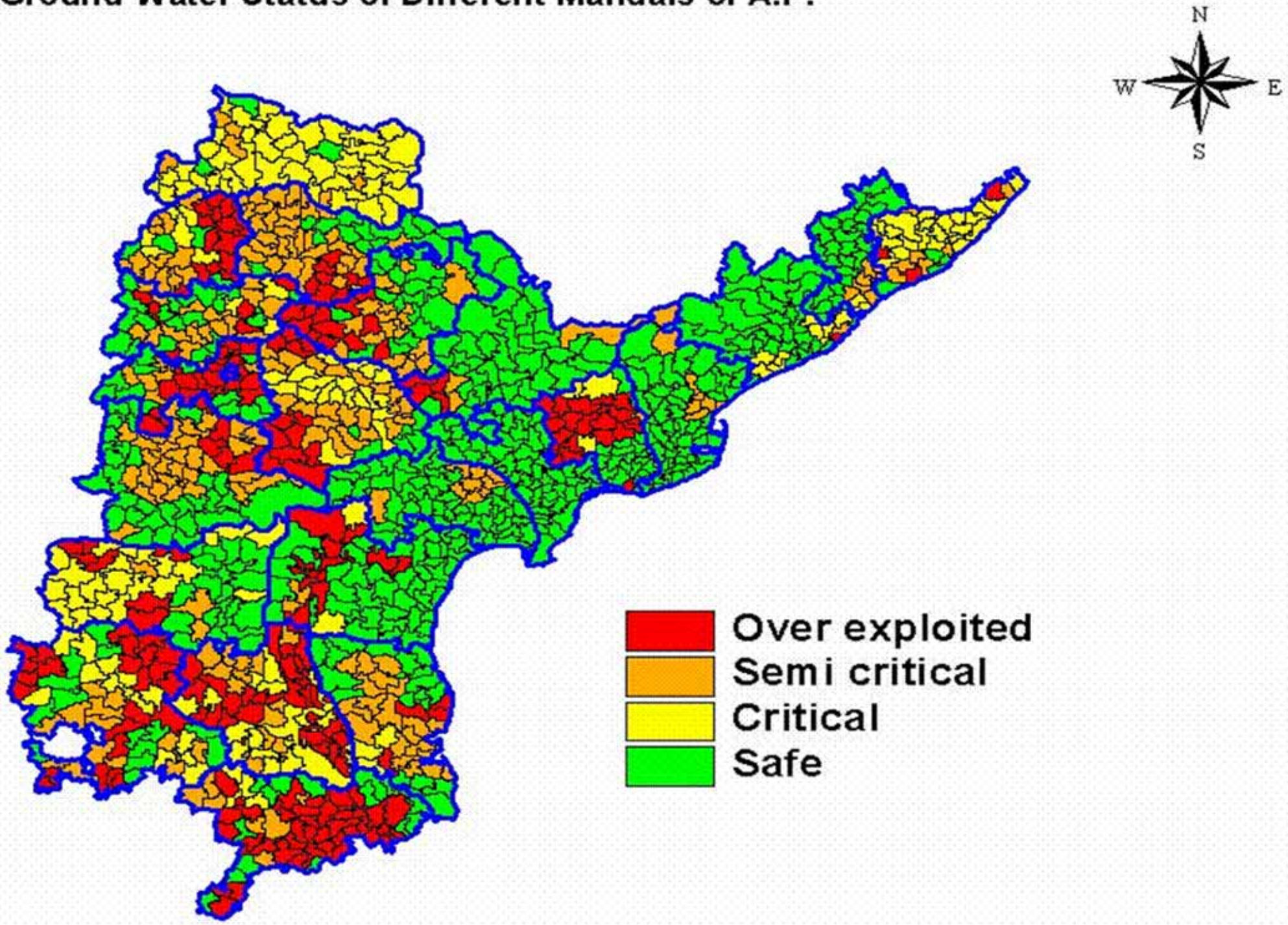
Percent Irrigated Area (Kharif)

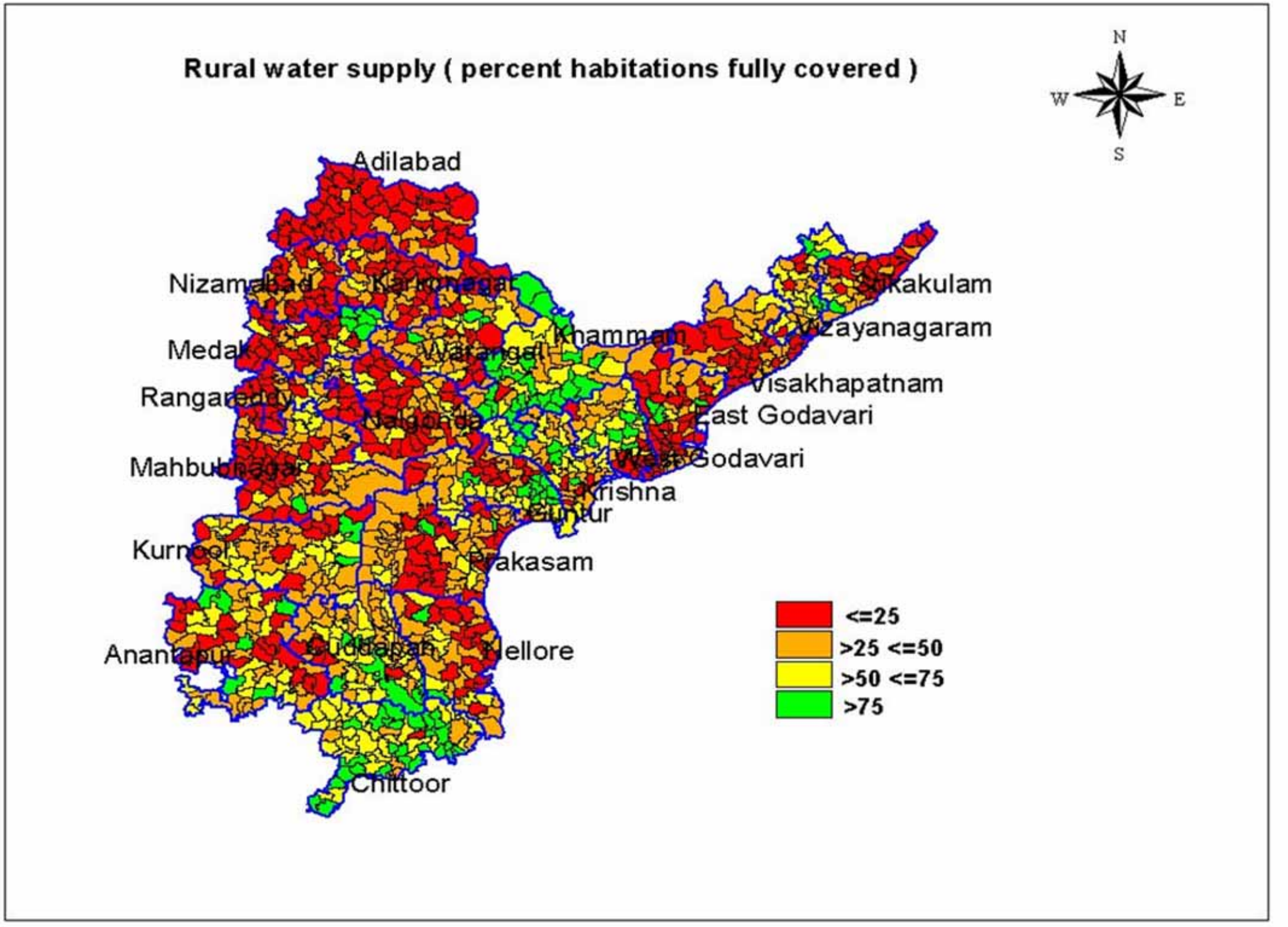


Percent Irrigated Area (Rabi)



Ground Water Status of Different Mandals of A.P.




Rural water supply (percent habitations fully covered)
N
W
E
S
Adilabad
Nizamabad
Karimnagar
Medak
Warangal
Khammam
Rangareddy
Nalgonda
Mahbubnagar
Krishna
Guntur
Kurnool
Prakasam
Anantapur
Cuddapah
Nellore
Chittoor
Srikakulam
Vizayanagaram
Visakhapatnam
East Godavari
West Godavari
<=25
>25 <=50
>50 <=75
>75


Thanks
for your kind attention !