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# Presentation from the USDA Agricultural Outlook Forum 2017

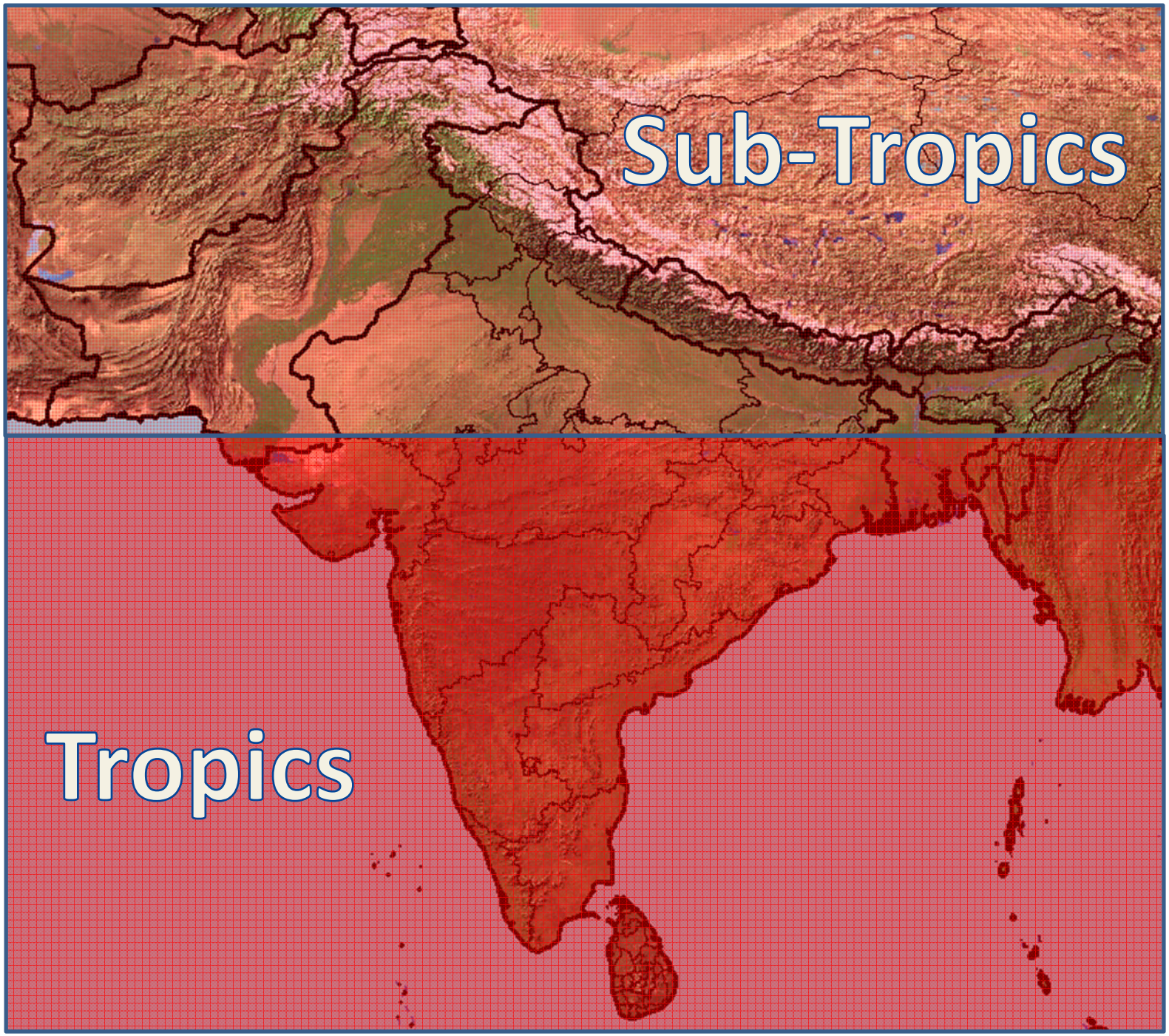
United States Department of Agriculture
93rd Annual Agricultural Outlook Forum
"A New Horizon: The Future of Agriculture"

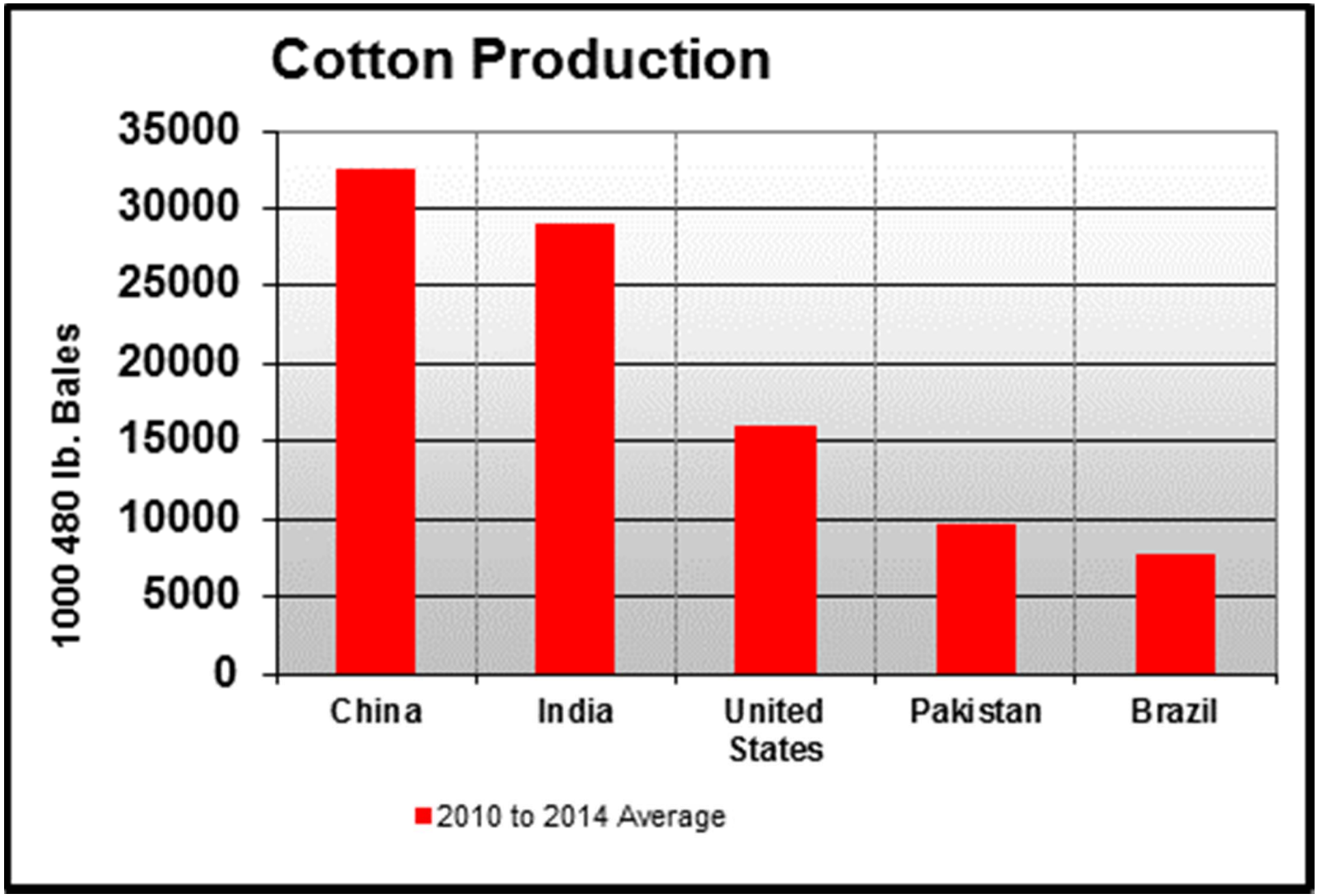
February 23-24, 2017
Arlington, Virginia

USDA's 93rd Annual Agricultural Outlook Forum

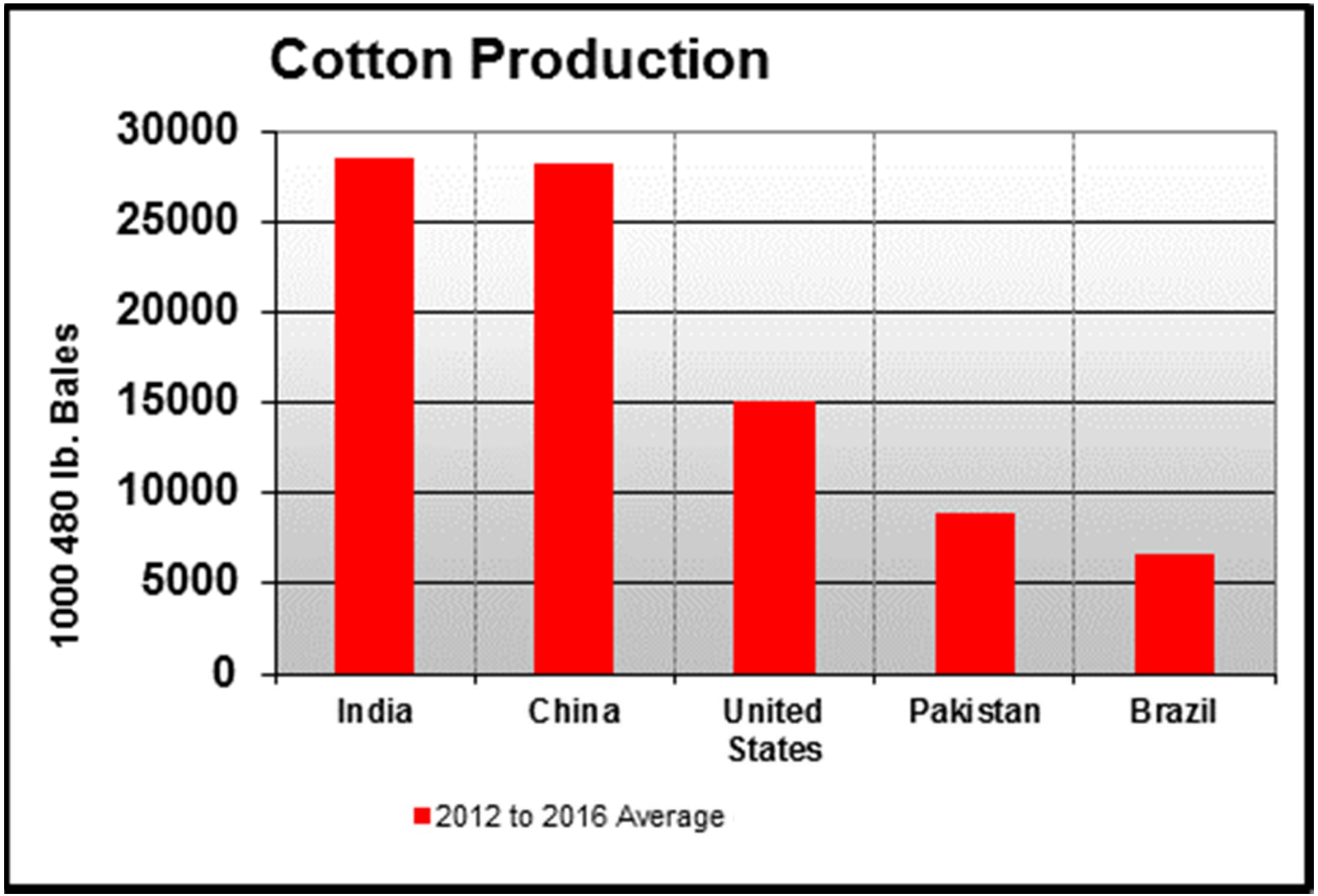
# Weather-Driven Cotton Yield Analysis for India

Brian Morris
Agricultural Meteorologist – Asia Specialist
USDA/OCE/WAOB


Sub-Tropics
Tropics




Source: USDA/FAS - PSD

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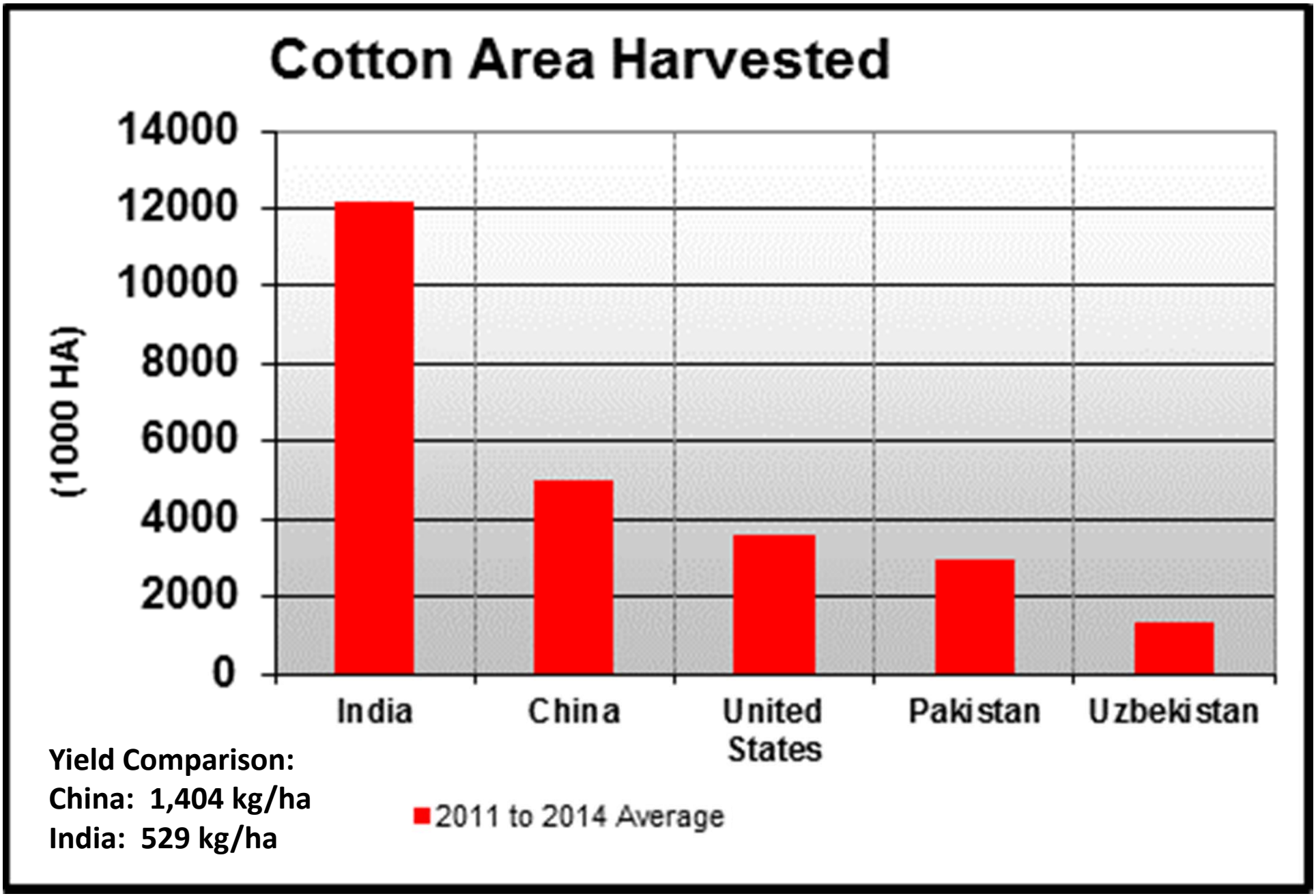
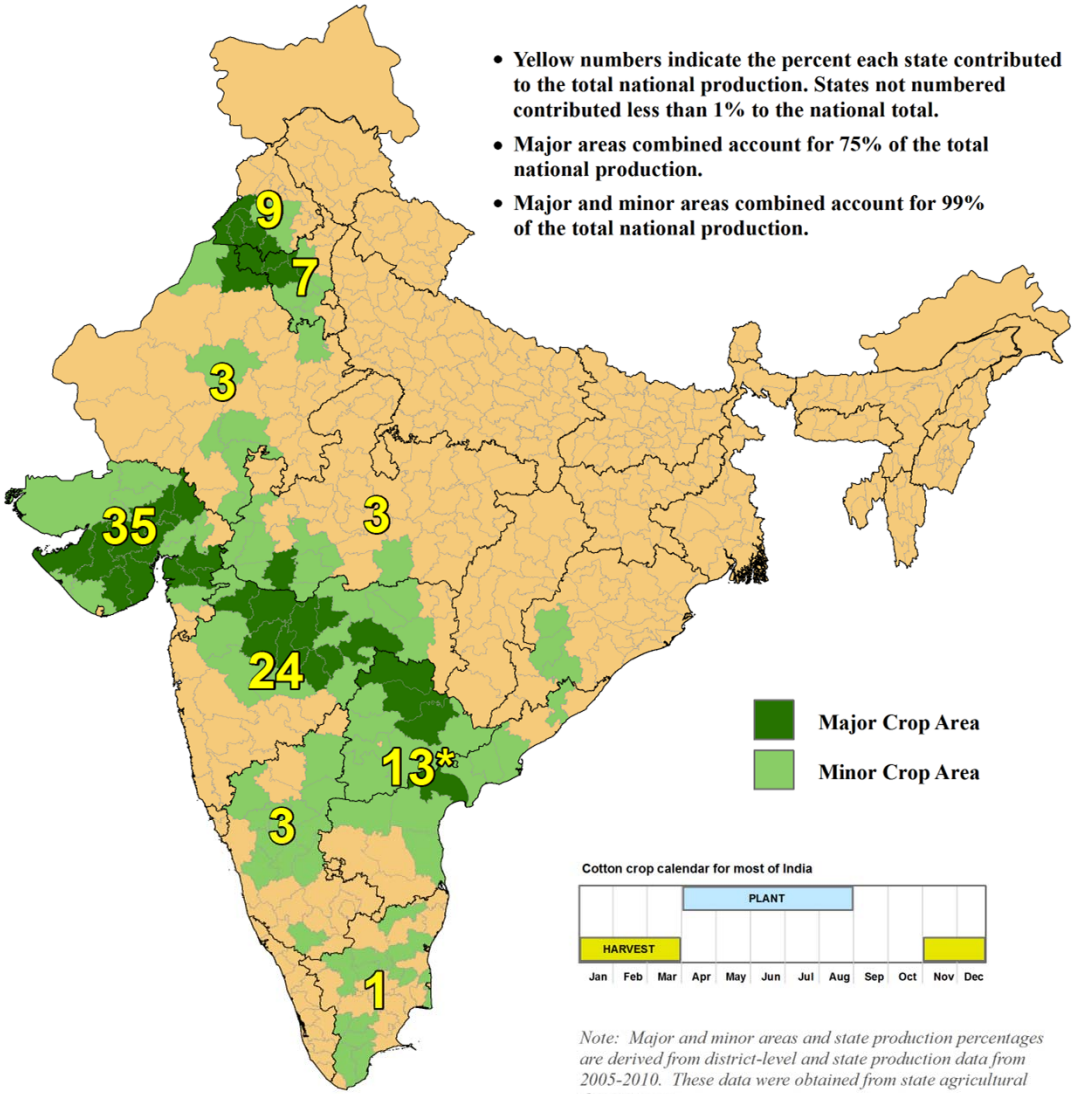



**Yield Comparison:**
**China: 1,404 kg/ha**
**India: 529 kg/ha**

# India: Cotton




- Yellow numbers indicate the percent each state contributed to the total national production. States not numbered contributed less than 1% to the national total.
- Major areas combined account for 75% of the total national production.
- Major and minor areas combined account for 99% of the total national production.

Cotton crop calendar for most of India




*Note: Major and minor areas and state production percentages are derived from district-level and state production data from 2005-2010. These data were obtained from state agricultural departments.*

**Combined average for both Andhra Pradesh and Telangana.*

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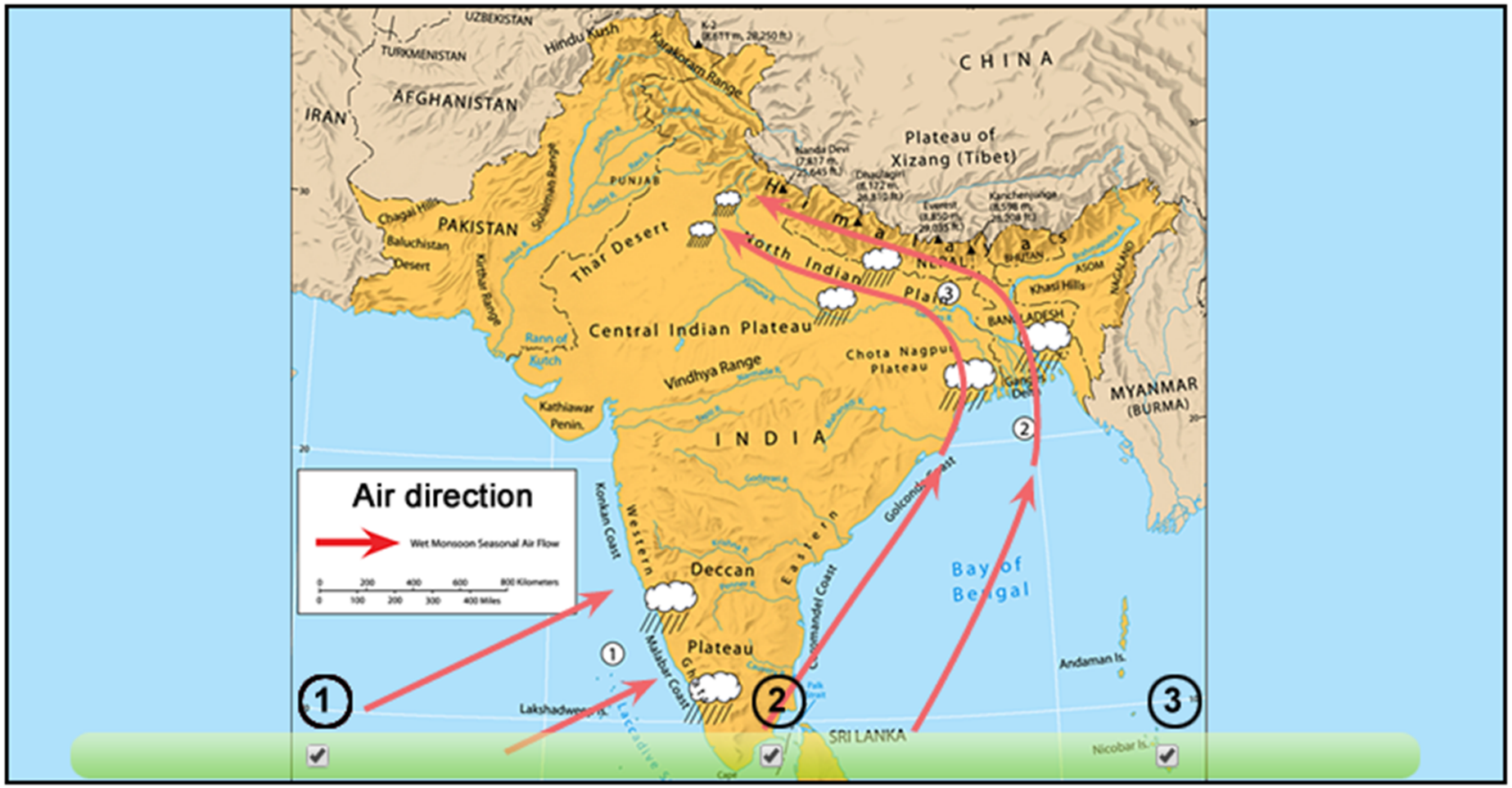
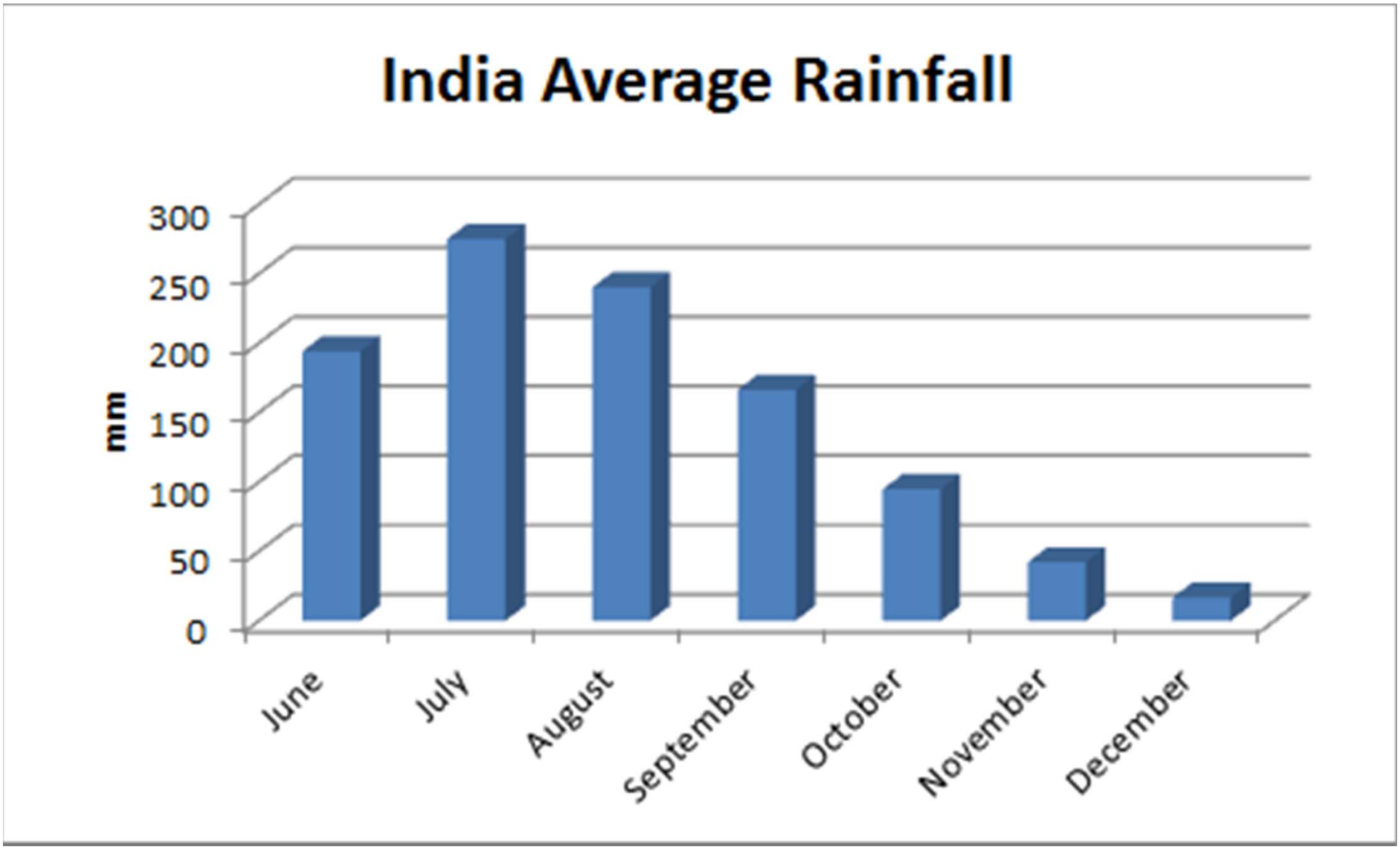
# Monsoon in India

WILEY




In early summer the land heats up faster than the water due to the larger heat capacity and volume of the oceans. A low pressure system forms drawing moist air inland from the ocean and bringing the wet monsoon to India in June.

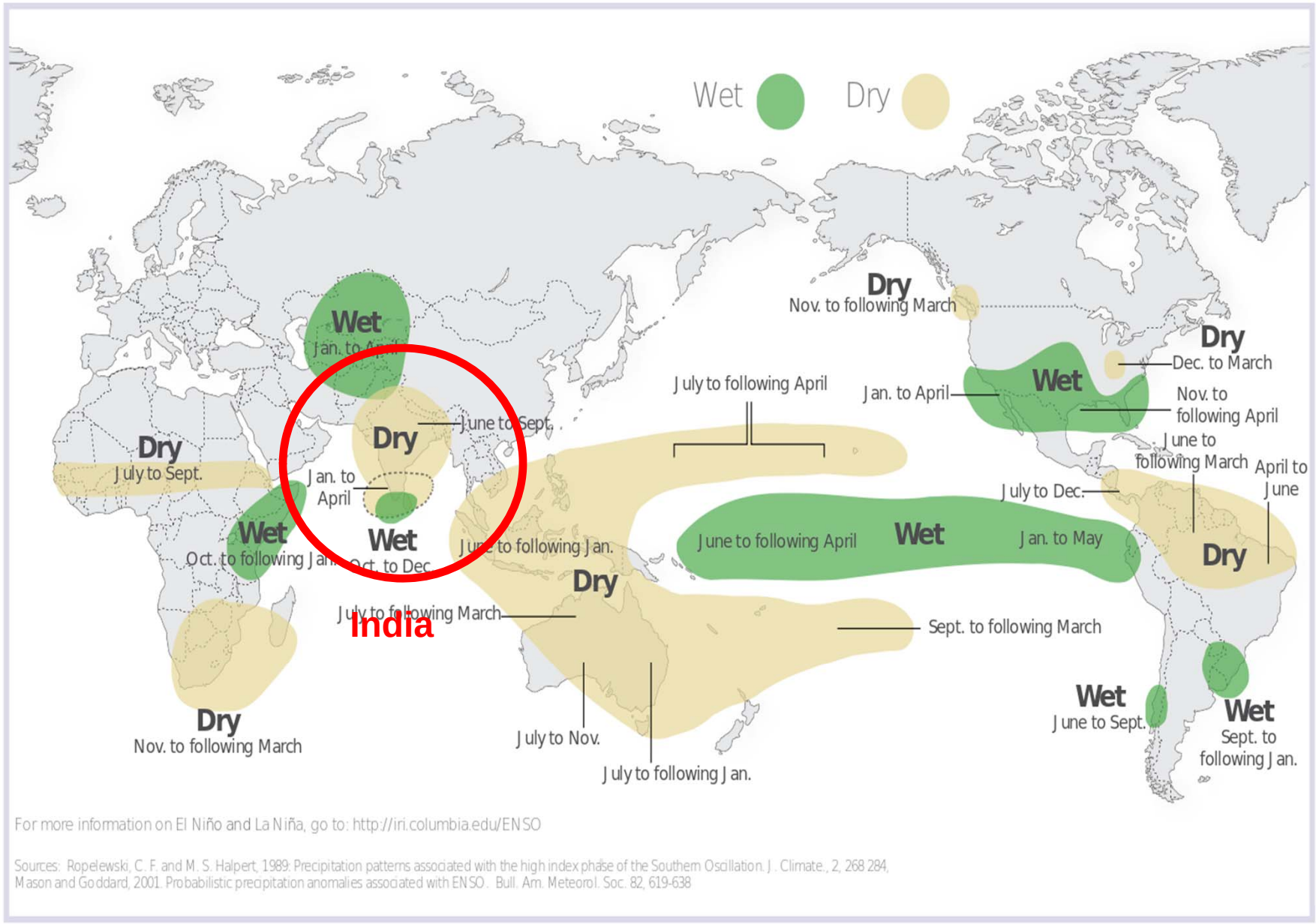
Click on each button at points 1, 2 and 3 to view air directions.
1. As the air cools over the Western Ghats rain begins in the area for a duration of up to 60 days.
2. North east airflow from the Bay of Bengal




80% of yearly rainfall between Jun-Sep

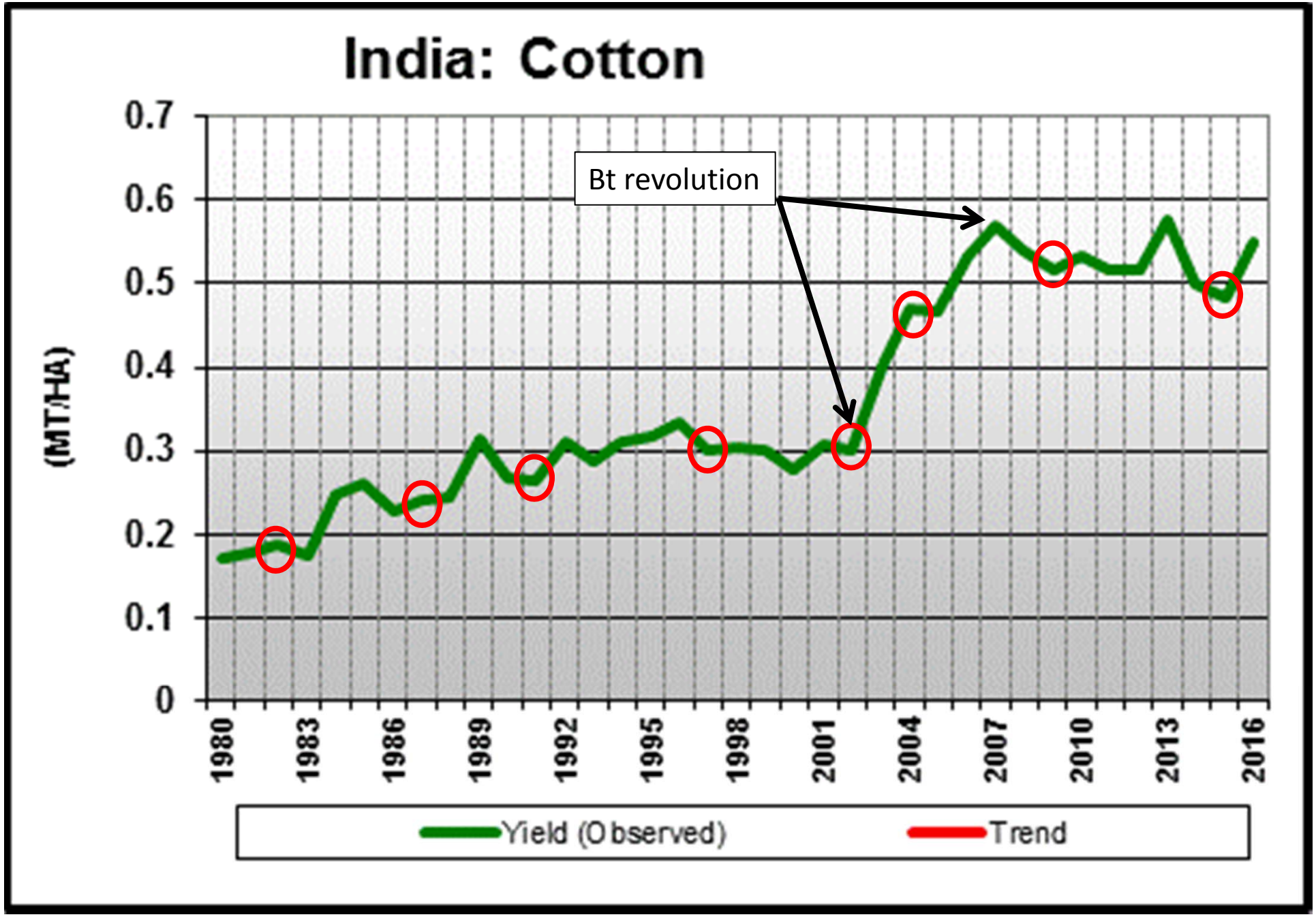
# El Niño and Rainfall

El Niño conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. Although they vary somewhat from one El Niño to the next, the strongest shifts remain fairly consistent in the regions and seasons shown on the map below.



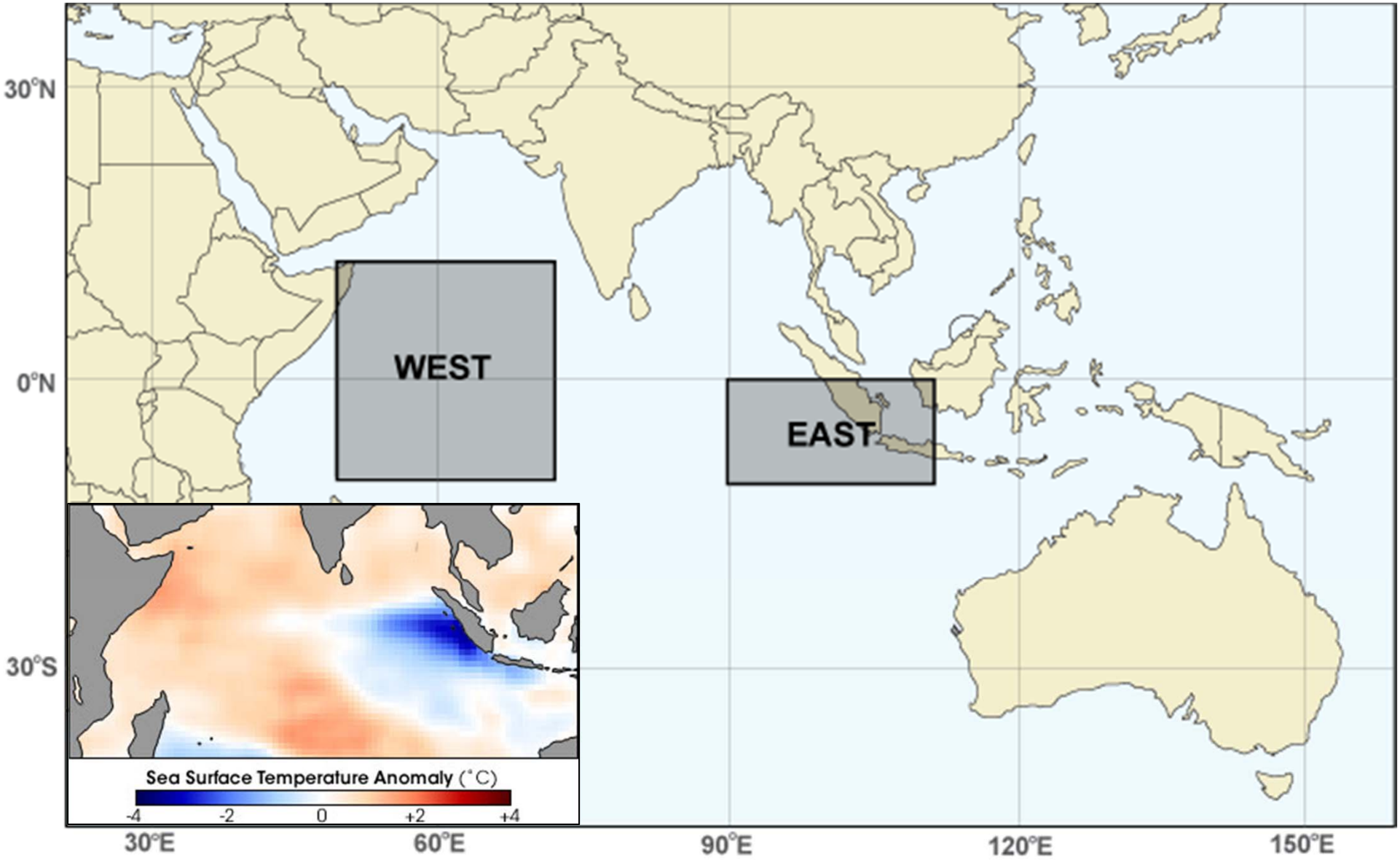

For more information on El Niño and La Niña, go to: http://iri.columbia.edu/ENSO

Sources: Ropelewski, C. F. and M. S. Halpert, 1989: Precipitation patterns associated with the high index phase of the Southern Oscillation. J. Climate., 2, 268 284.
Mason and Goddard, 2001. Probabilistic precipitation anomalies associated with ENSO. Bull. Am. Meteorol. Soc. 82, 619-638


India: Cotton
(MT/HA)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Bt revolution
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
2013
2016
Yield (Observed)
Trend

El Niño

# Indian Ocean Dipole



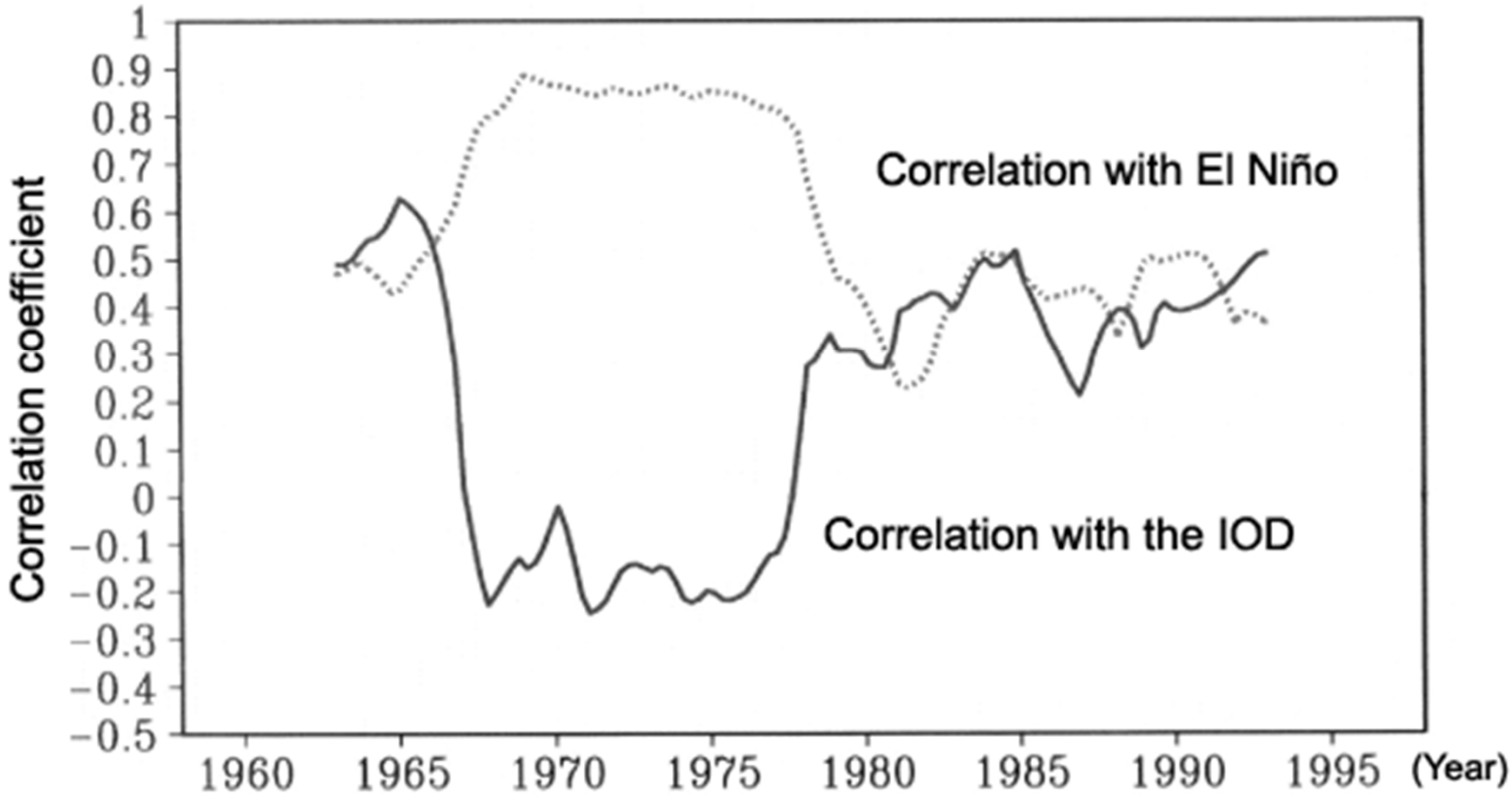
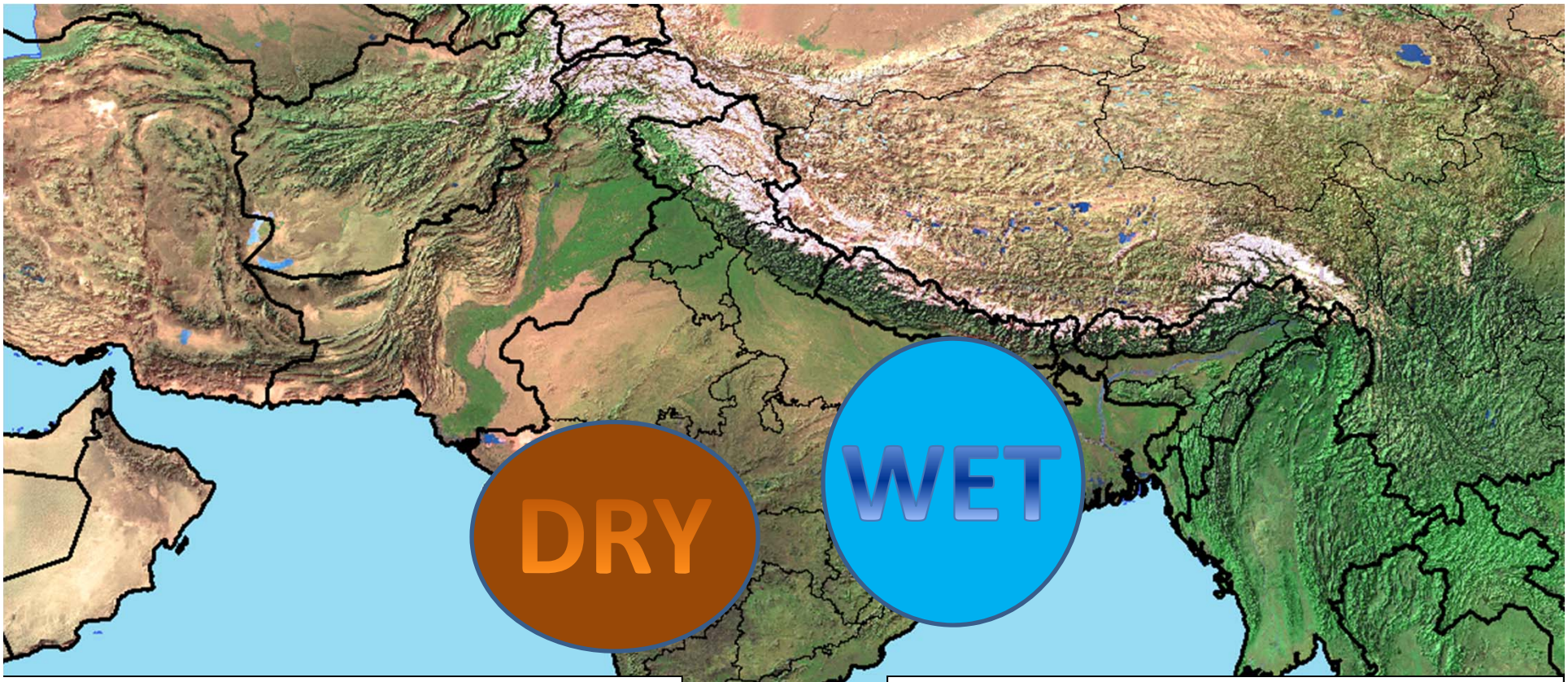


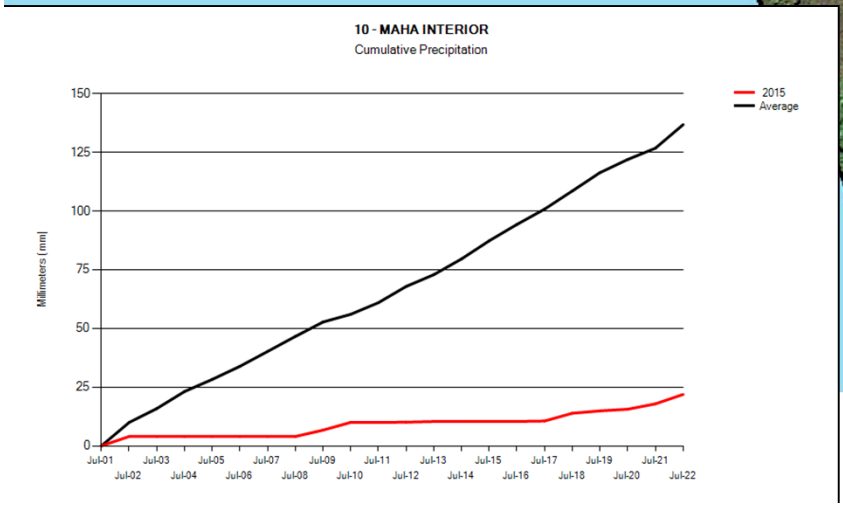

Fig. 1. Relationship of the Indian Ocean Dipole (IOD) and El Niño with Indian Monsoon Rainfall.

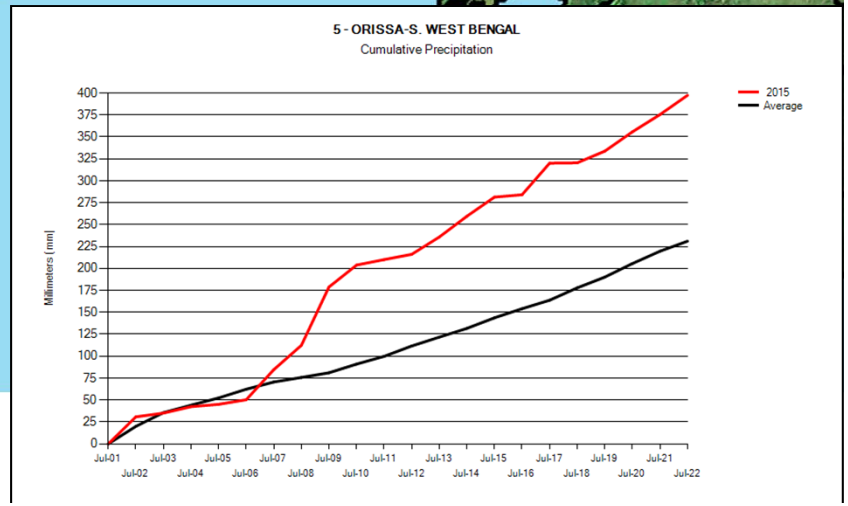
The solid line represents the relationship with the IOD, and the broken line shows the relationship with El Niño. These results, which were obtained by using the statistical method known as moving correlation, show that El Niño and the IOD have opposite impacts on monsoon rainfall.

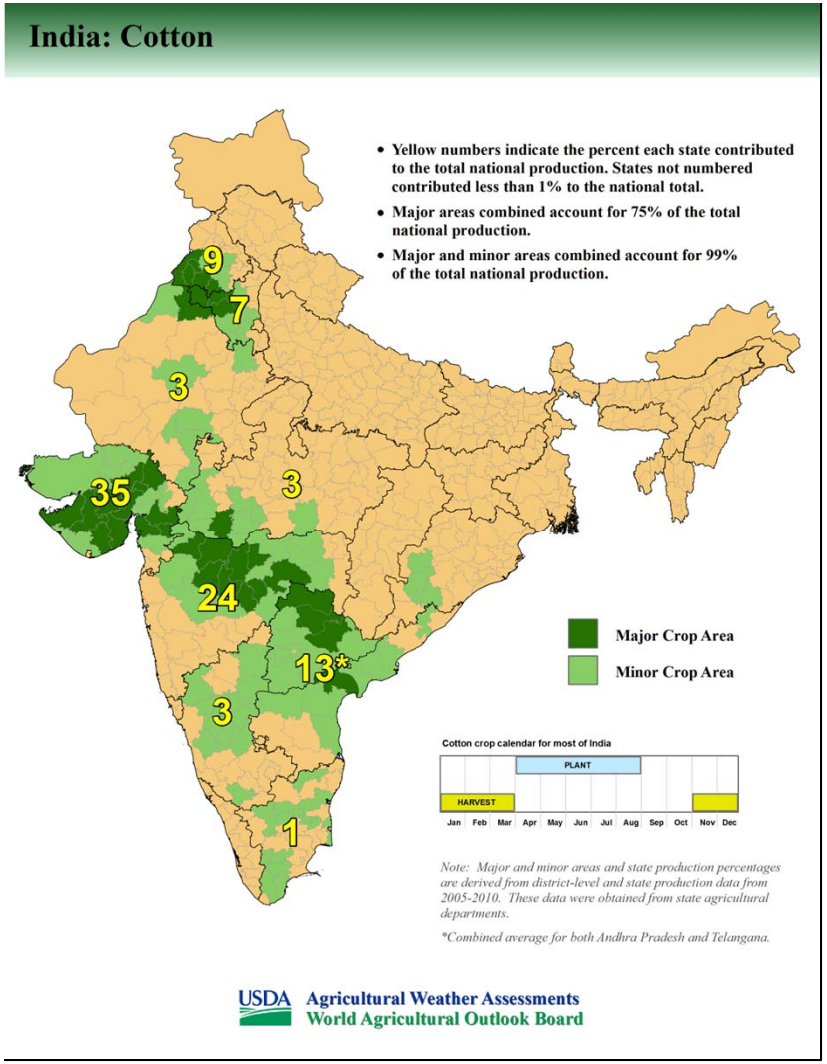
**SOURCE: Indian Ocean Dipole Phenomenon's Impact on Correlation between Indian Monsoon and El Niño/Southern Oscillation**
November 29, 2001; NASDA; JAMSTEC

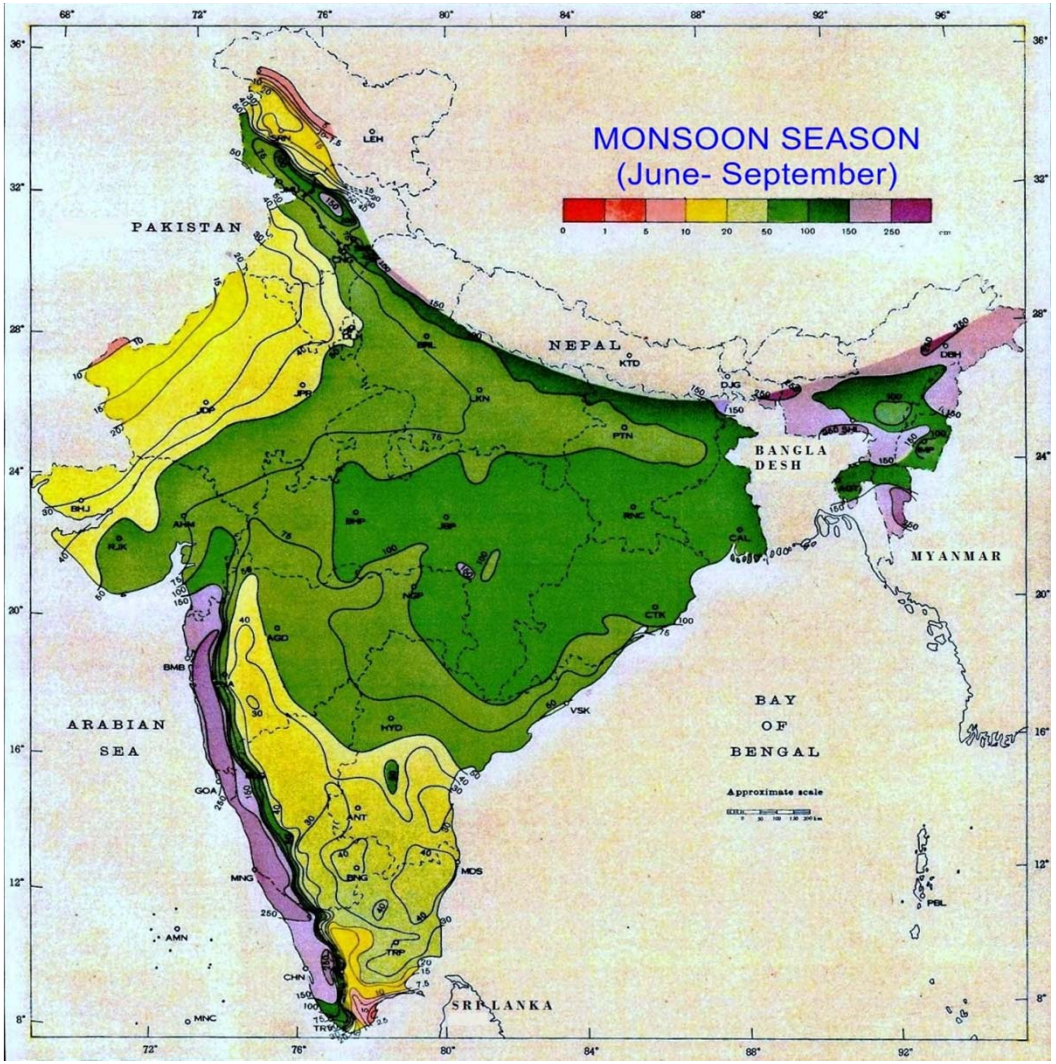
# More Detailed Examination: Polarization of Impacts



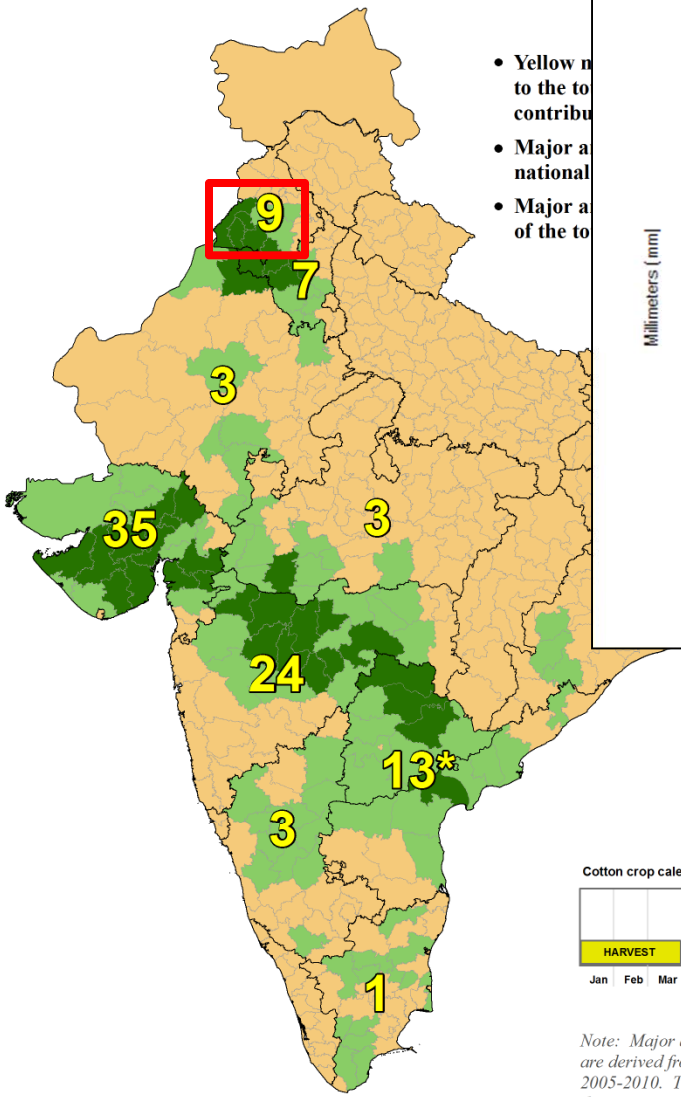






Even without the effects of El Nino and the IOD, cotton is grown along the fringe of the eastern rainfall maxima.

# India: Cotton

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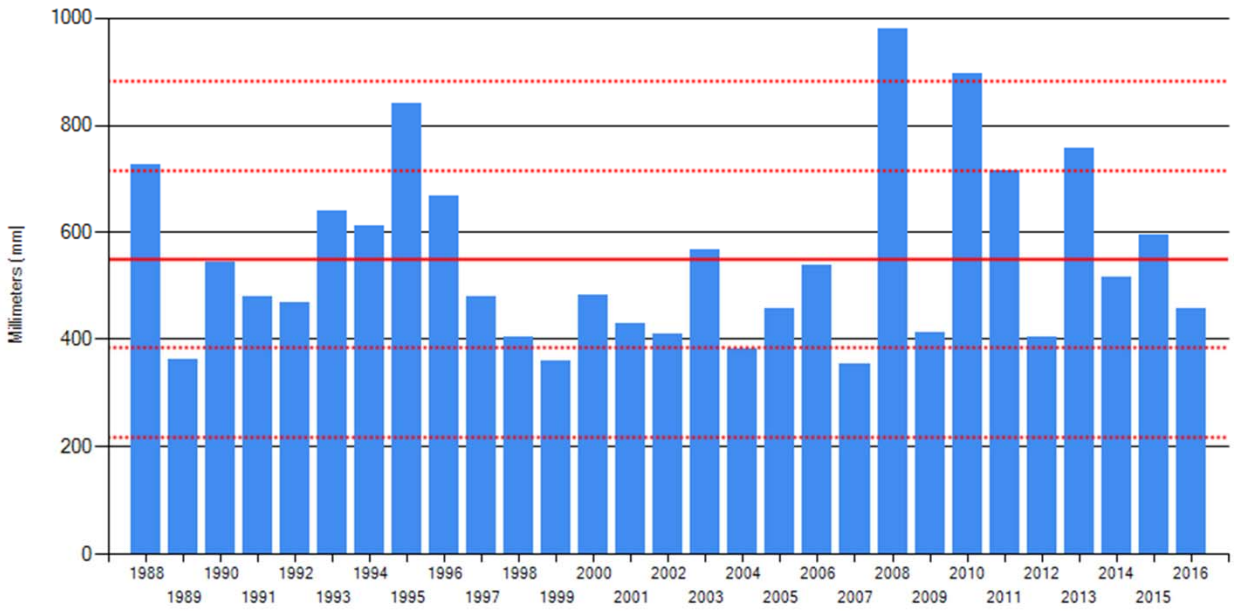
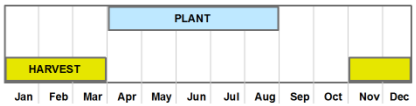



Major Crop Area

Minor Crop Area

Cotton crop calendar for most of India




*Note: Major and minor areas and state production percentages are derived from district-level and state production data from 2005-2010. These data were obtained from state agricultural departments.*

**Combined average for both Andhra Pradesh and Telangana.*

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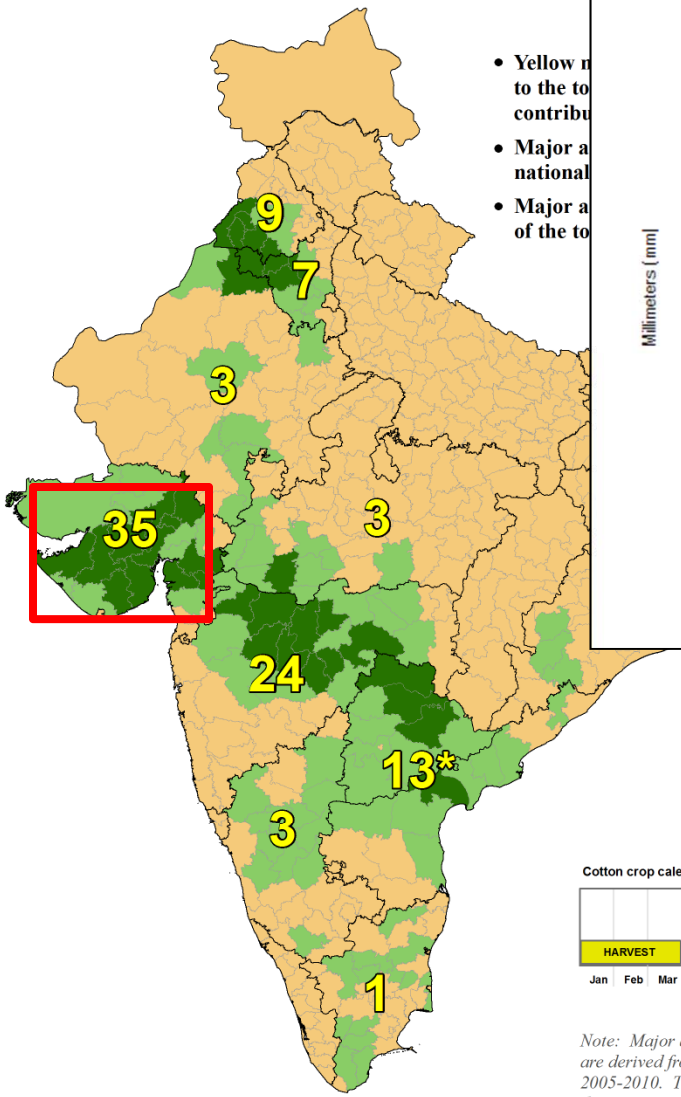
The farther from the rainfall maxima, the more variable the rainfall.

# India: Cotton

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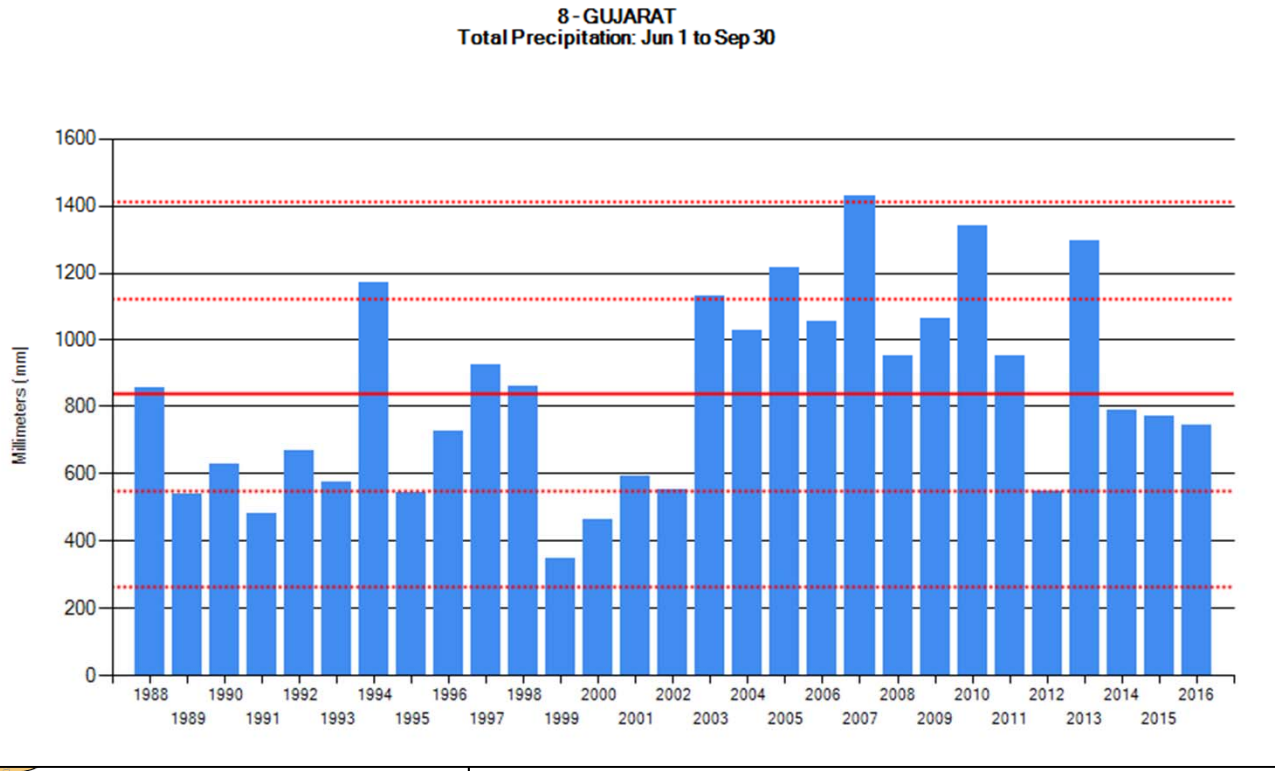
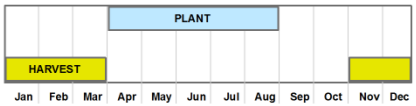



Major Crop Area

Minor Crop Area

Cotton crop calendar for most of India

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**Combined average for both Andhra Pradesh and Telangana.*

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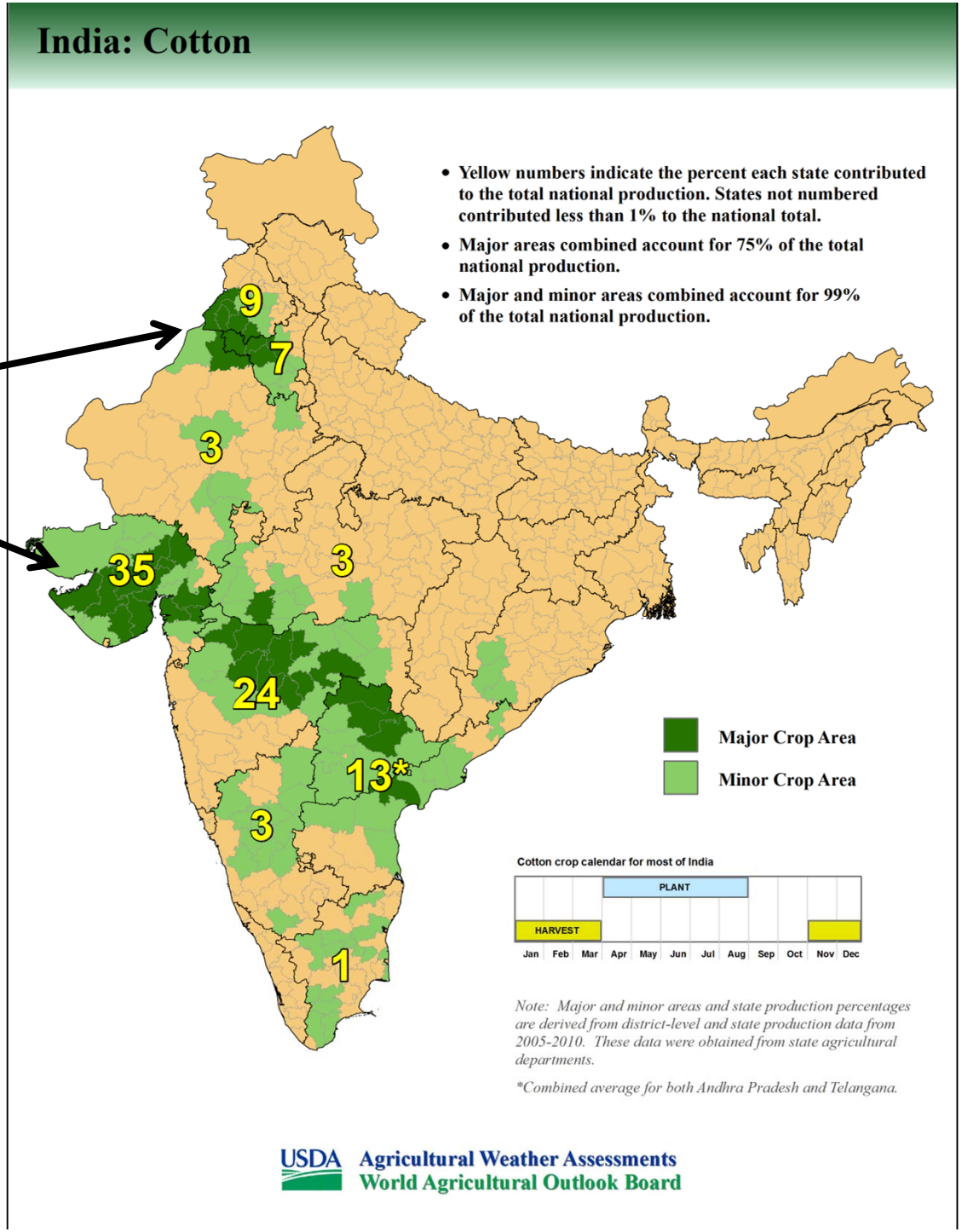
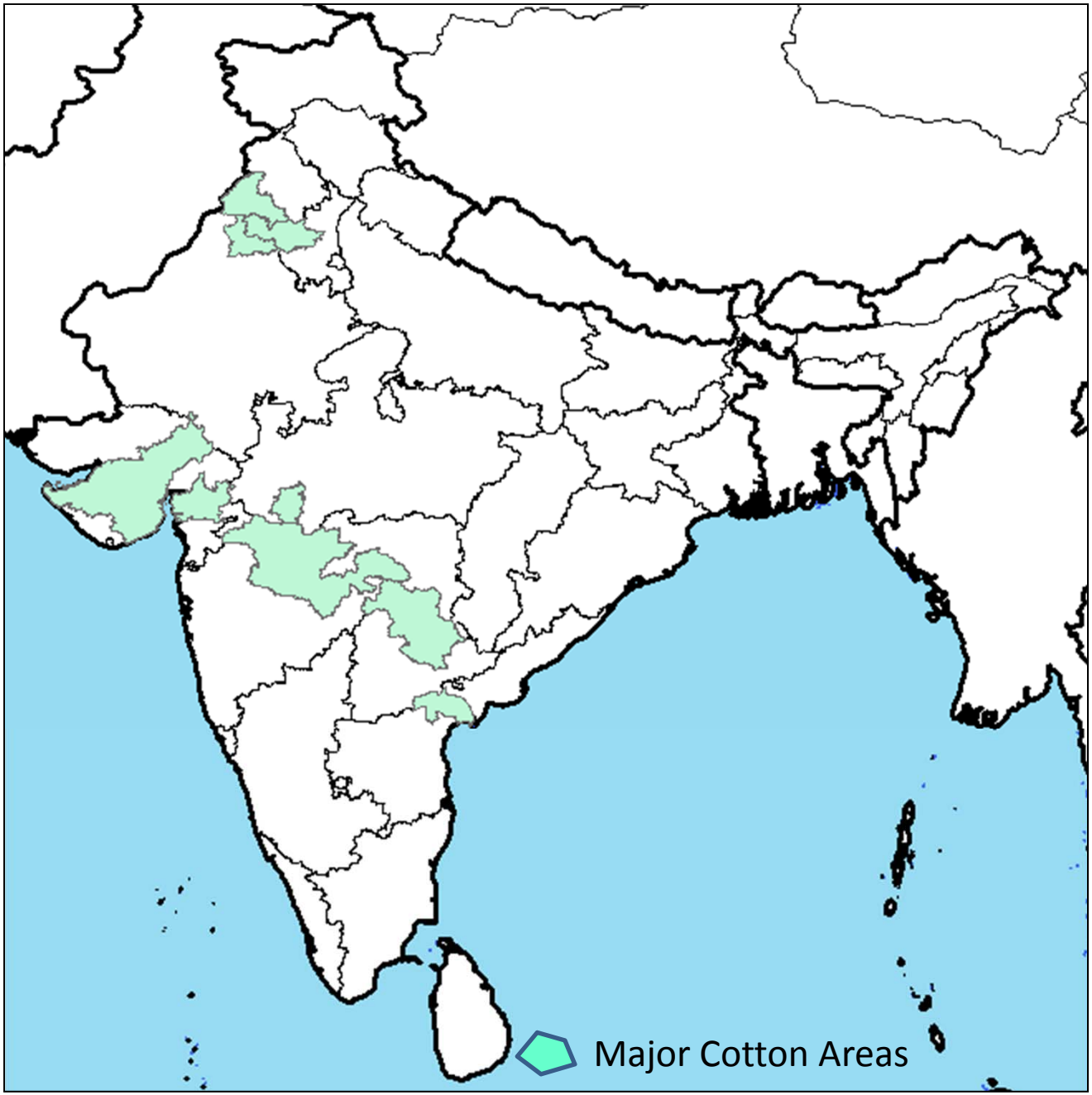
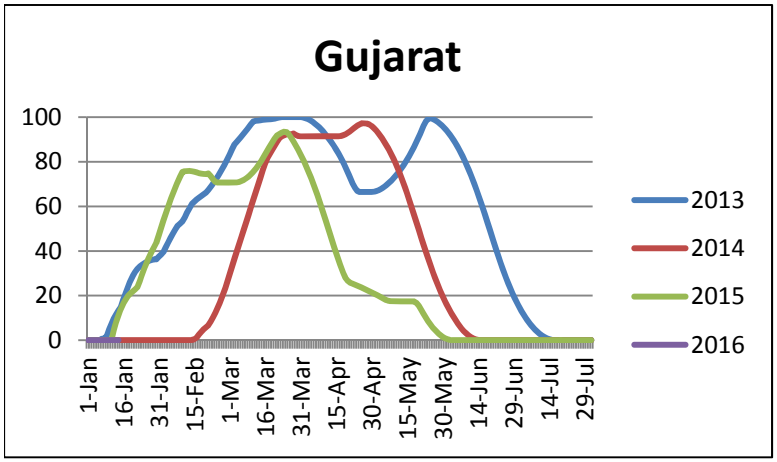
**Irrigation:**
100% in Punjab and Haryana

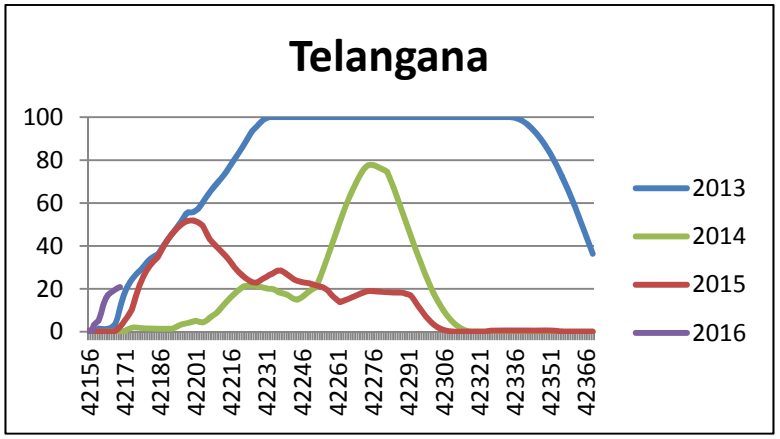
60% in Gujarat.

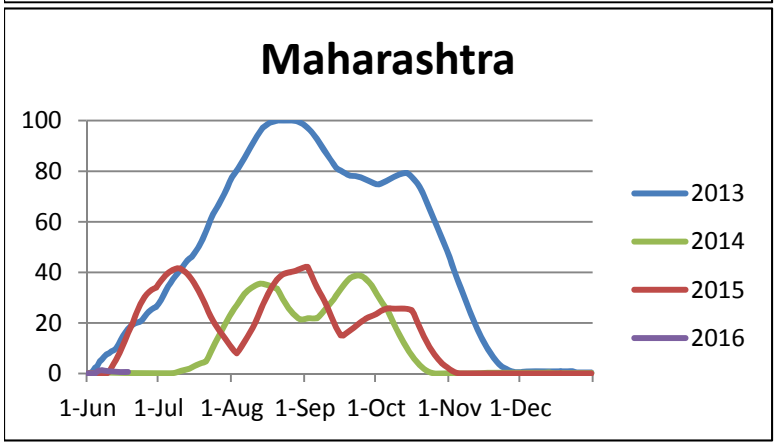


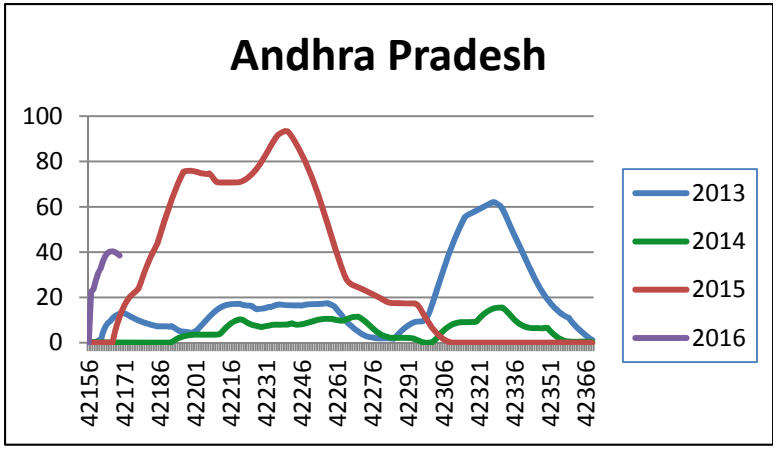

Major Cotton Areas

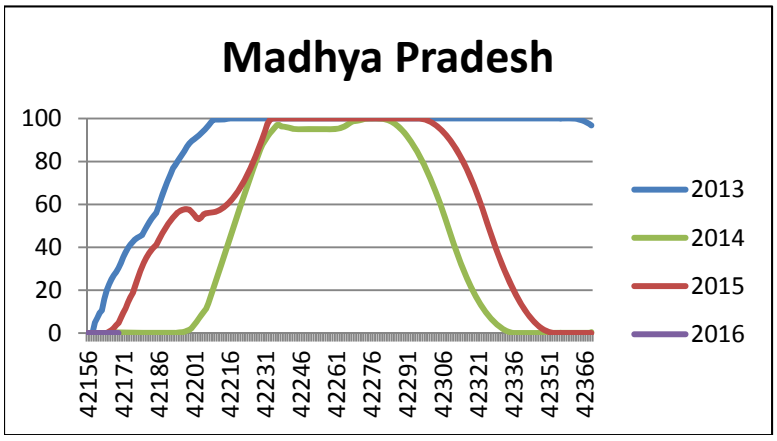
# Volumetric Soil Moisture (10cm) for Rainfed Cotton



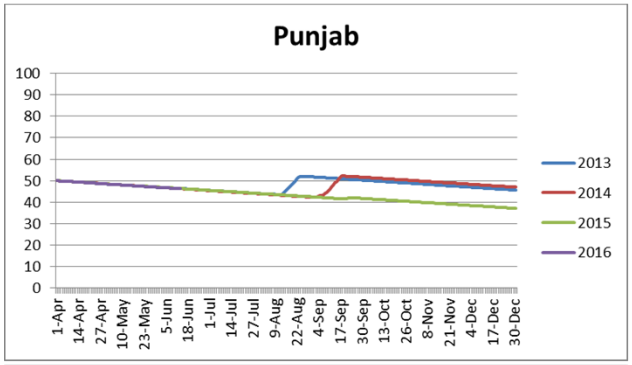



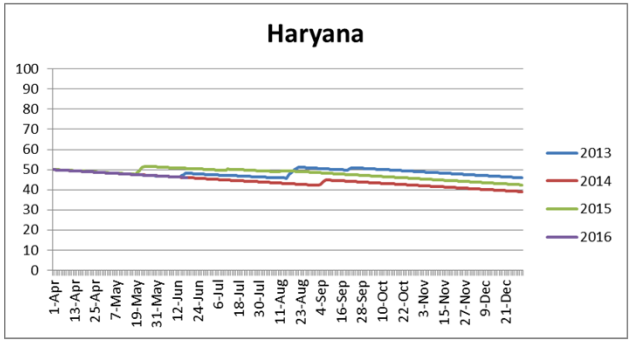



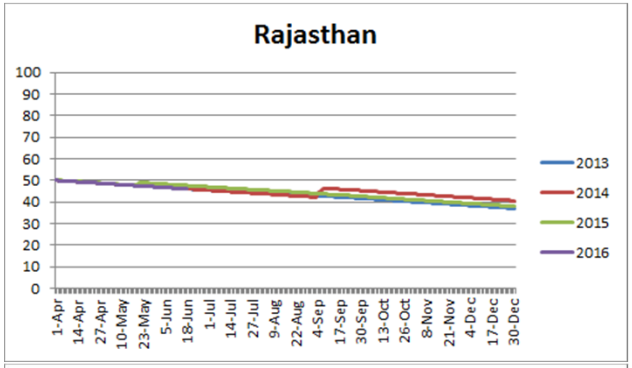



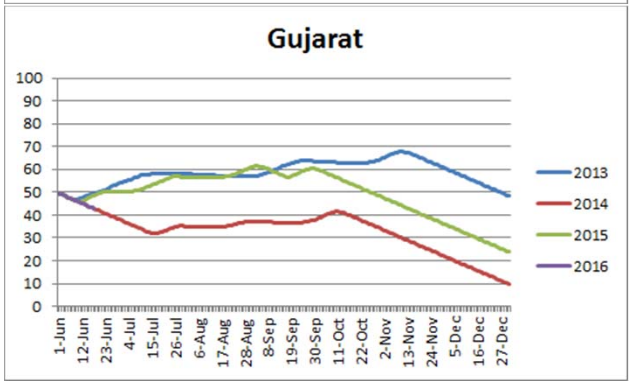

Daily rainfall and temperature data are used along with general regional soil types to calculate a soil moisture.

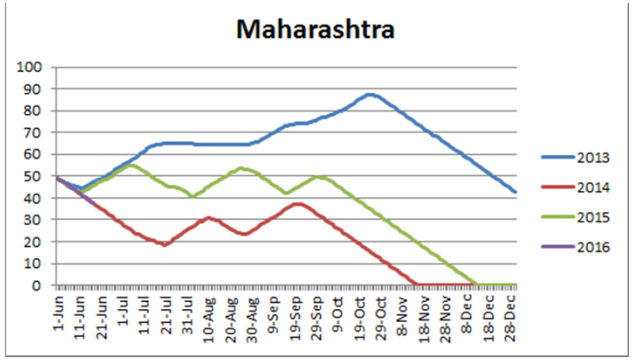
# Cotton Condition Index

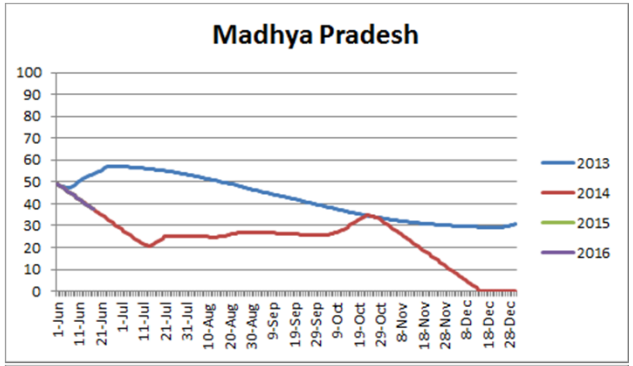


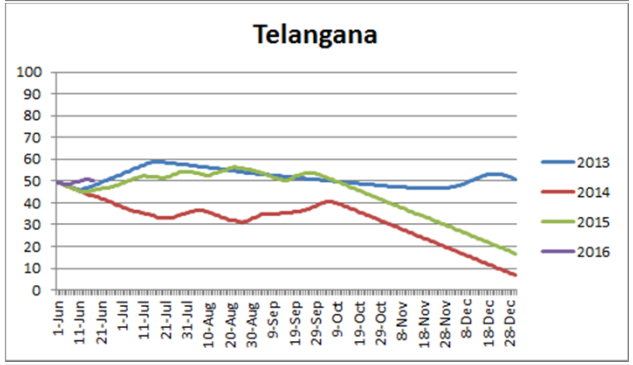



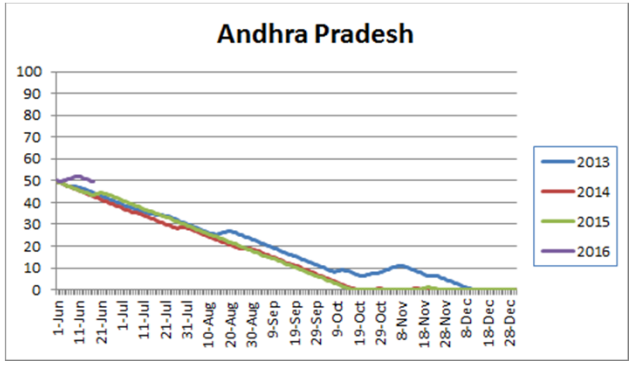



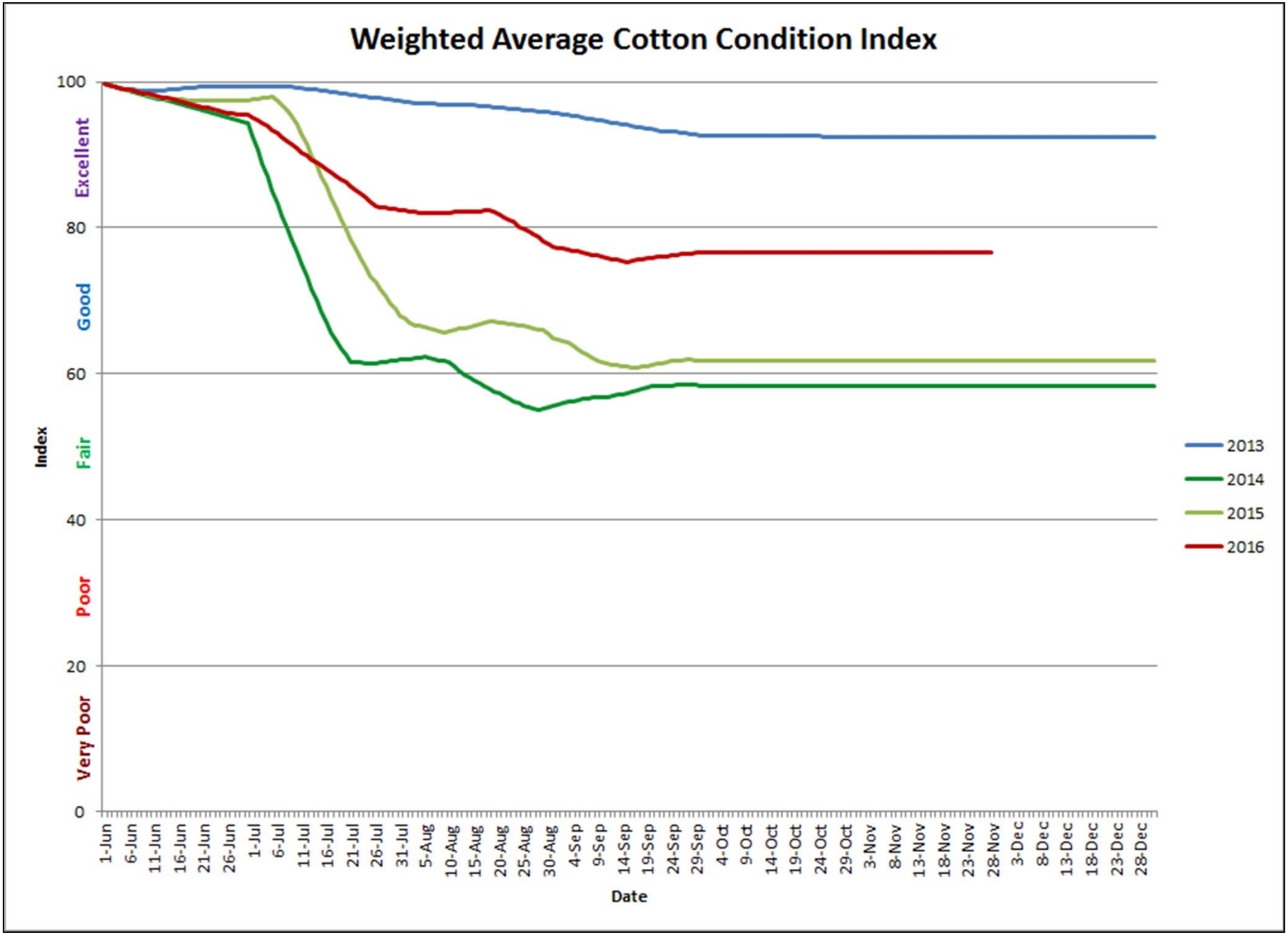




Weighted Average Cotton Condition Index
Index
Date
Excellent
Good
Fair
Poor
Very Poor
100
80
60
40
20
0
1-Jun
6-Jun
11-Jun
16-Jun
21-Jun
26-Jun
1-Jul
6-Jul
11-Jul
16-Jul
21-Jul
26-Jul
31-Jul
5-Aug
10-Aug
15-Aug
20-Aug
25-Aug
30-Aug
4-Sep
9-Sep
14-Sep
19-Sep
24-Sep
29-Sep
4-Oct
9-Oct
14-Oct
19-Oct
24-Oct
29-Oct
3-Nov
8-Nov
13-Nov
18-Nov
23-Nov
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3-Dec
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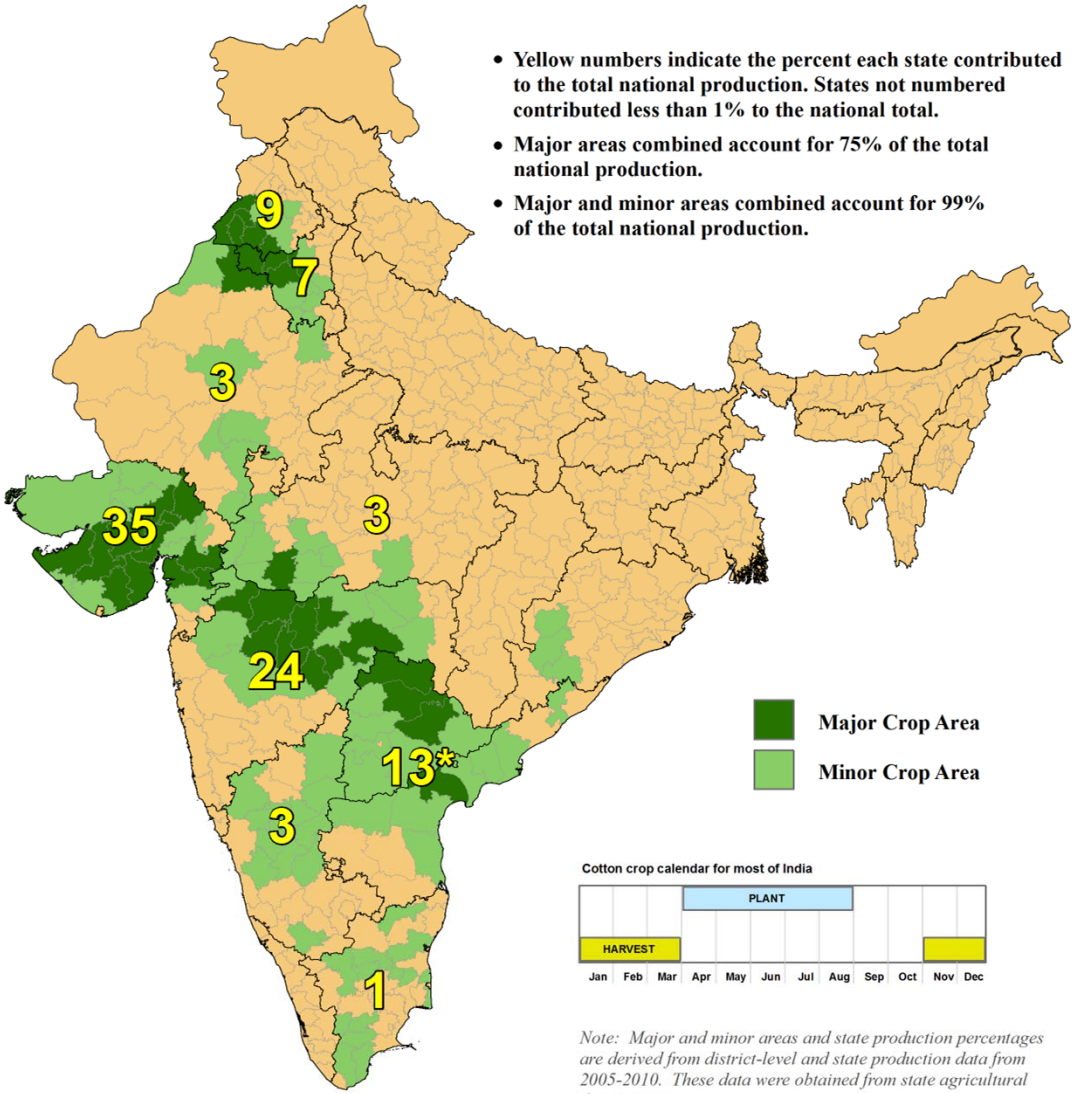
13-Dec
18-Dec
23-Dec
28-Dec
2013
2014
2015
2016

# India: Cotton

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