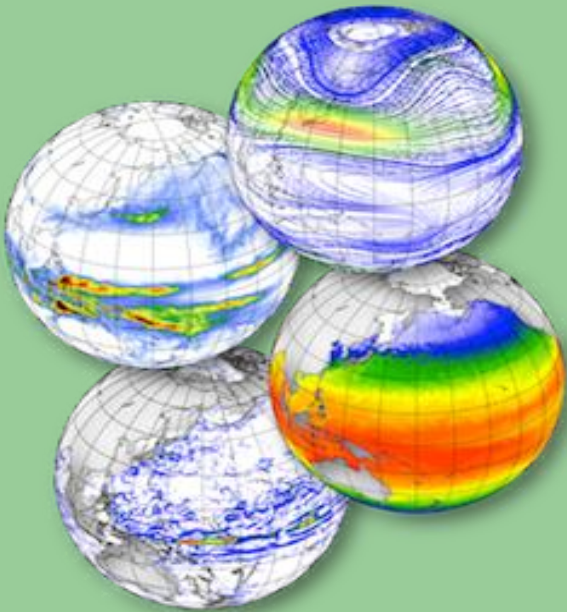
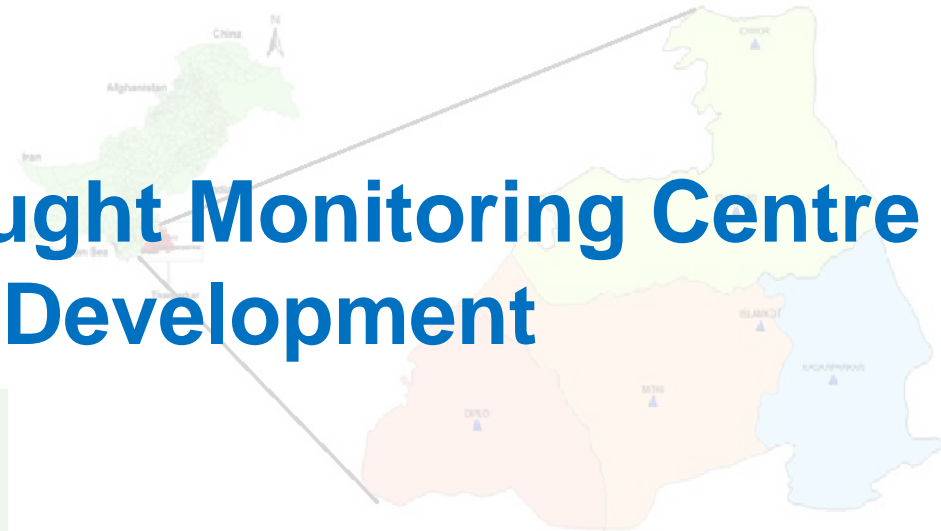


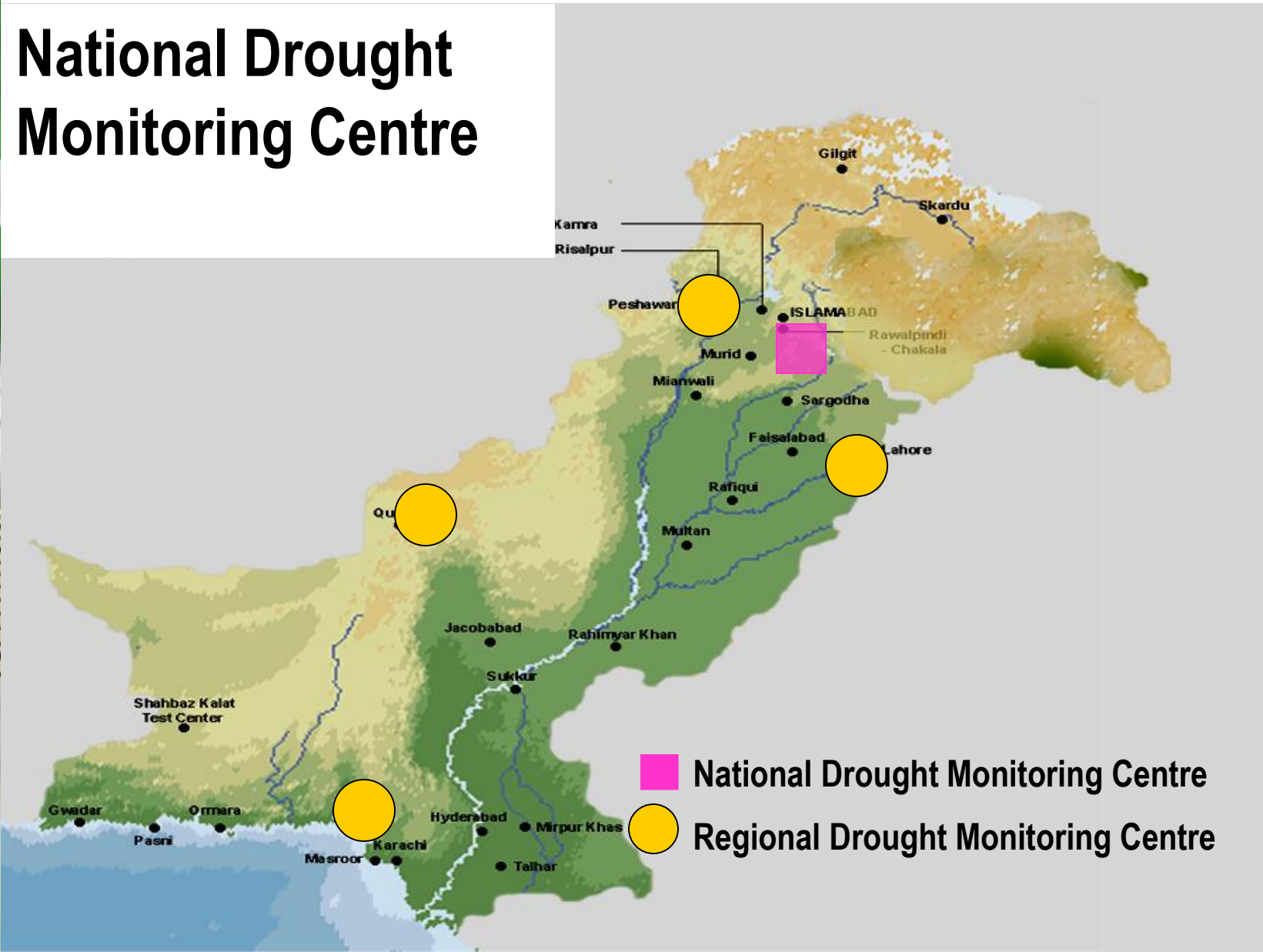
# Role of National Drought Monitoring Centre in National Development



Azmat Hayat Khan

Director PMD / Focal Person on SAARC Monsoon Initiative

# National Drought Monitoring Centre





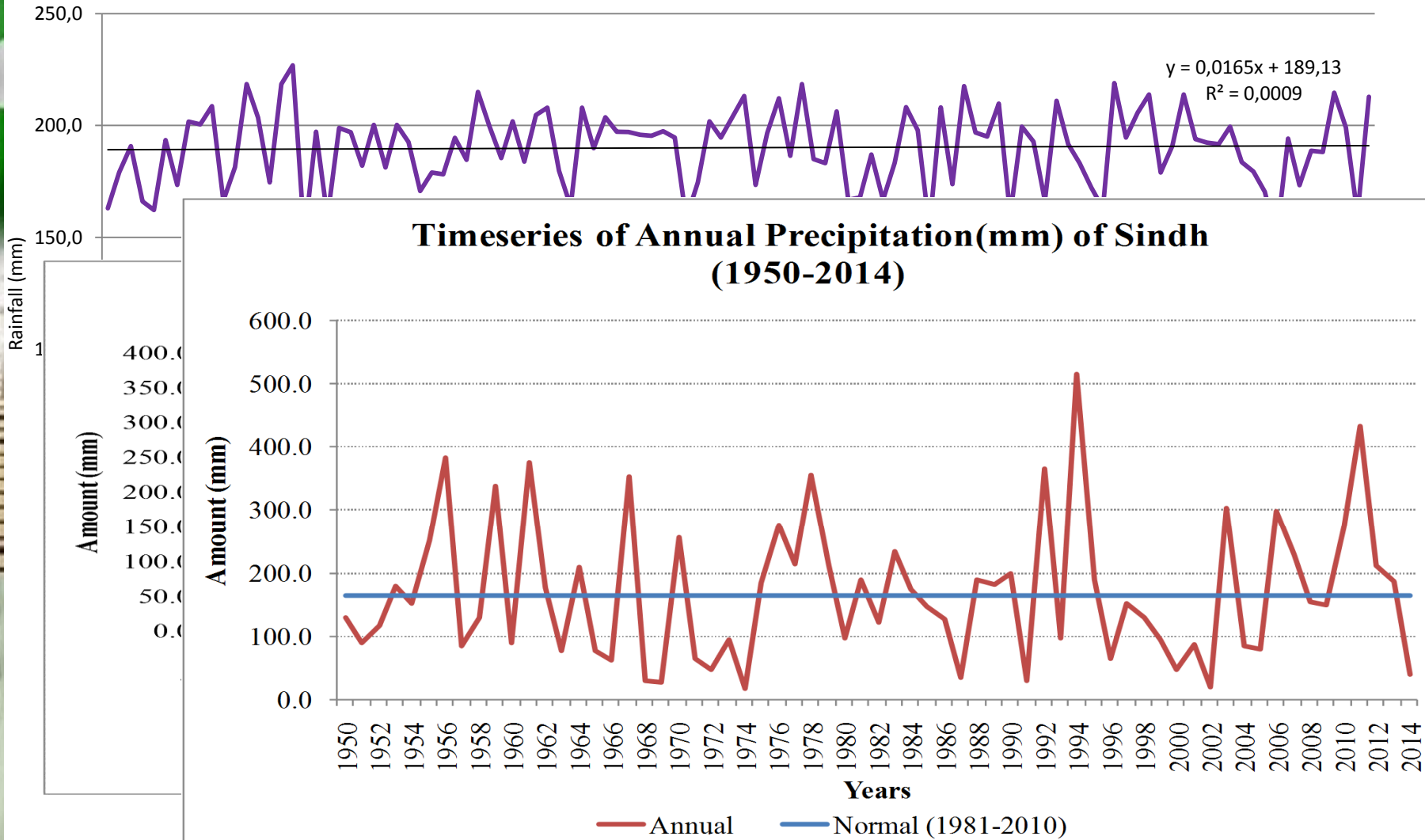
# Structure of Talk

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1. Centre overview
2. Responsibilities
3. Products
4. Drought Update – Case Study of Tharparkar

# Regional Climate

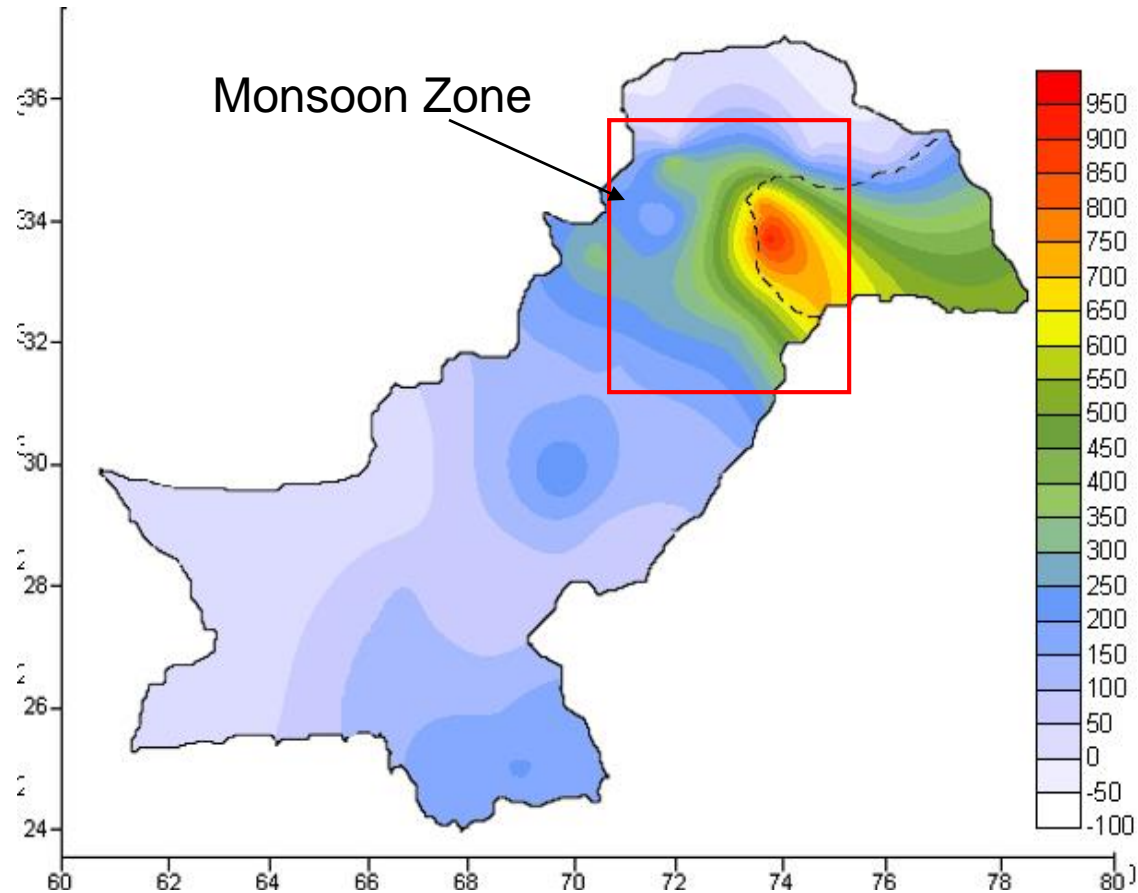
## Rainfall Distribution for SAARC region





# Climate of Pakistan

## Rainfall Distribution



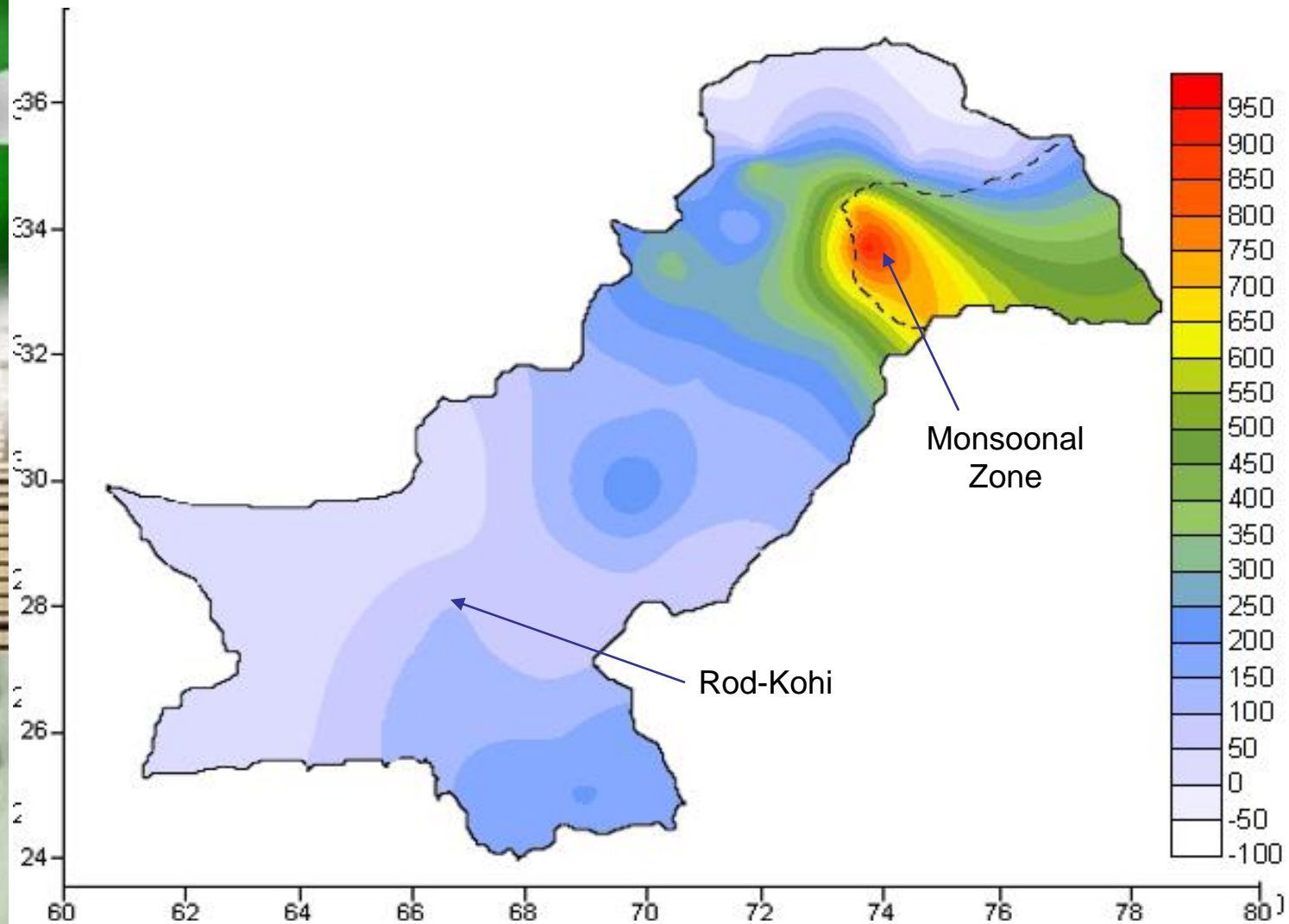
Monsoon (JJAS)

65% of Annual Rainfall



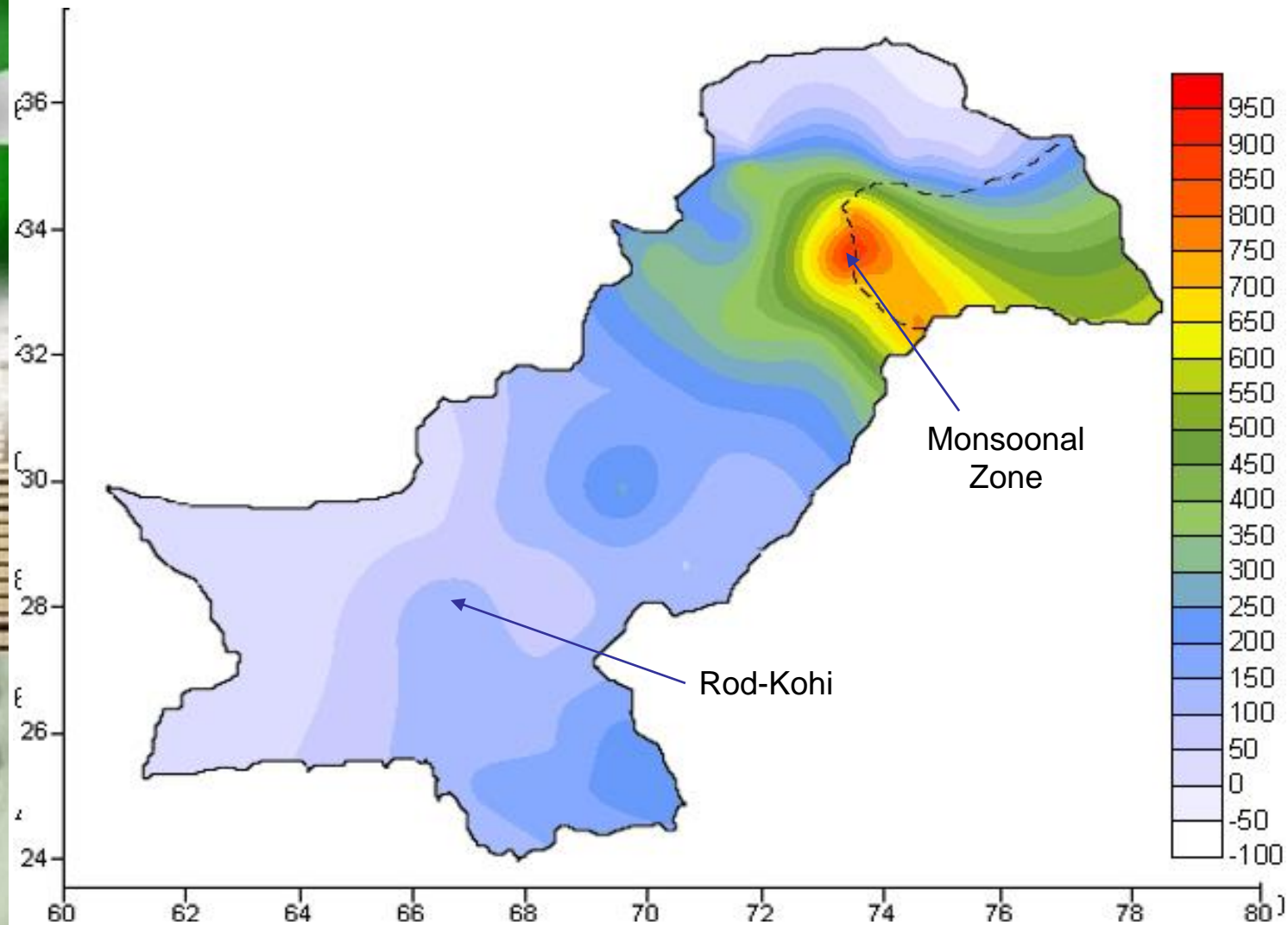
# Introduction to Water Related Disasters in Pakistan

## MONSOON – Rainfall Distribution (1961-1990)

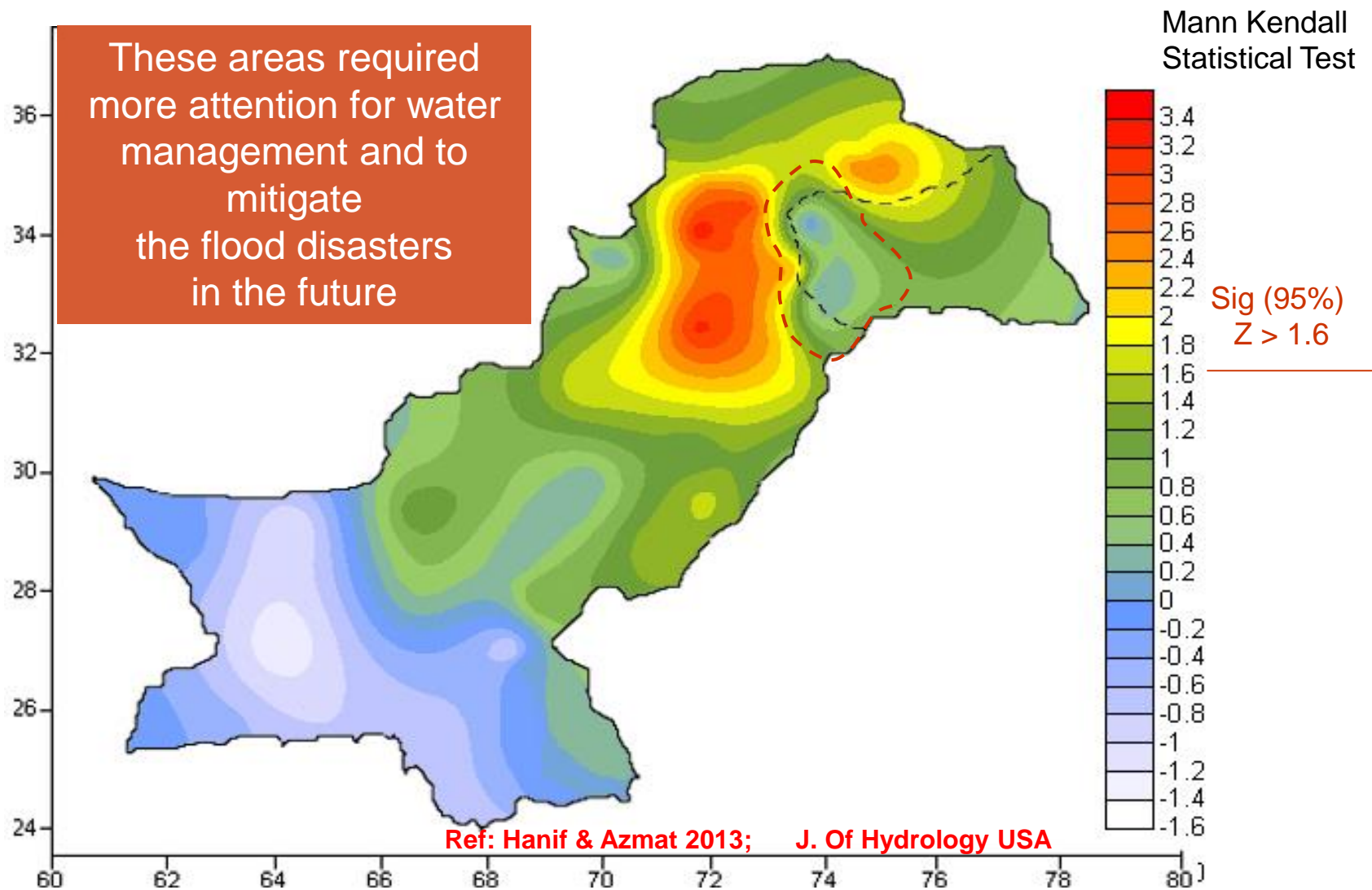


# Introduction to Water Related Disasters in Pakistan

## MONSOON – Rainfall Distribution (1991-2010)



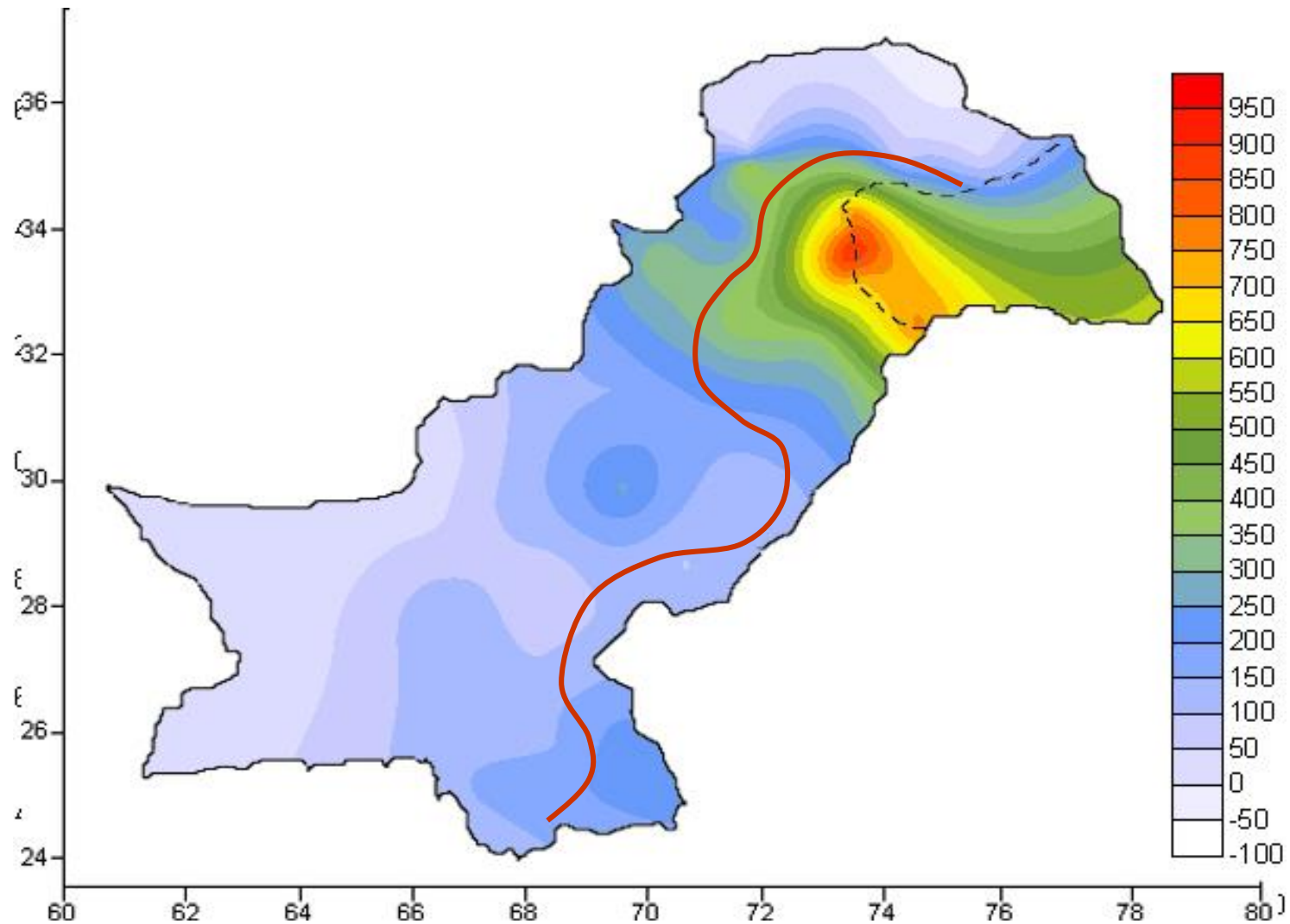
## Water Related Disasters in Pakistan MONSOON – Rainfall Trend (Westward Shift)





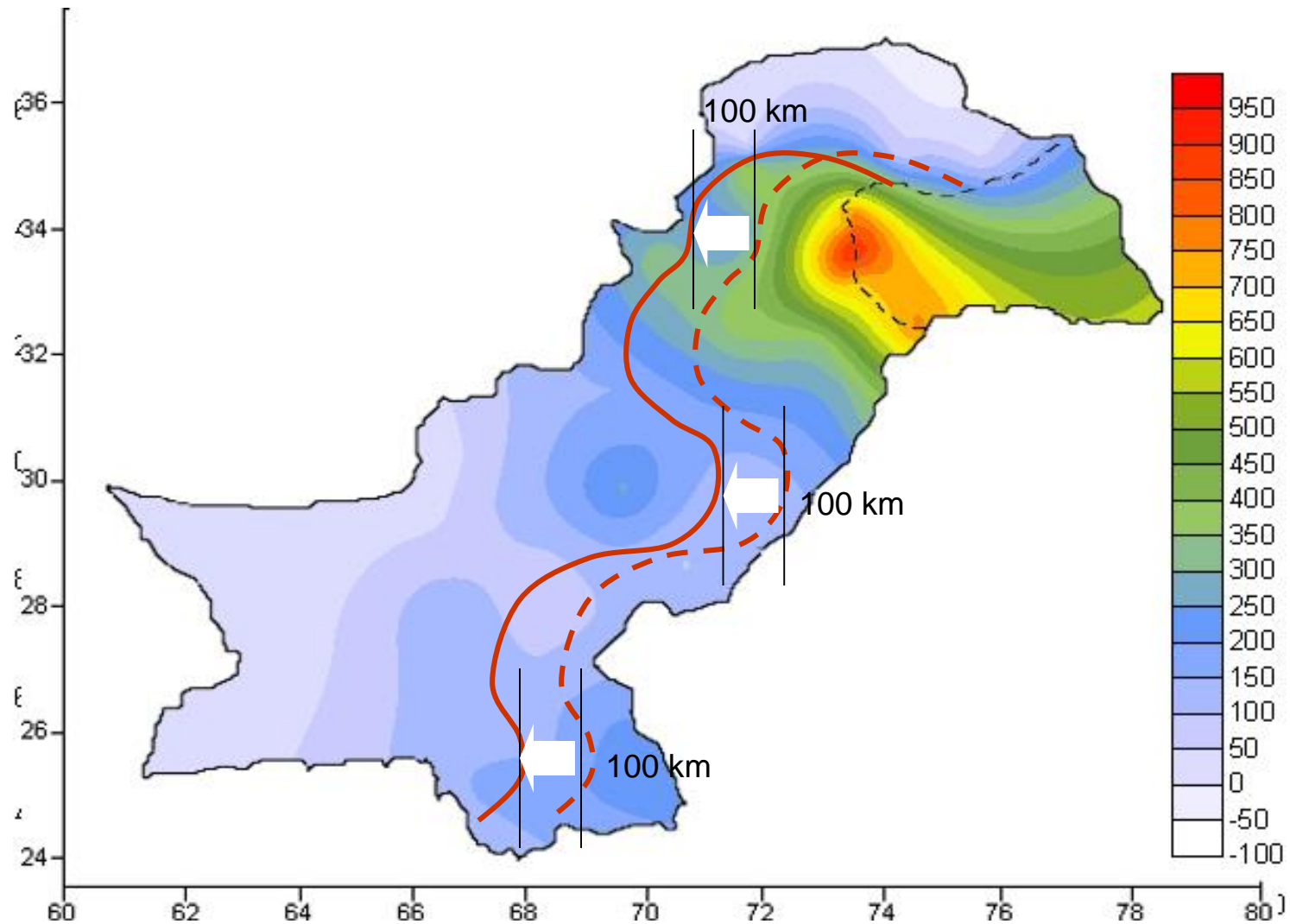
# Monsoonal Weather Systems – Rainfall Shift

## MONSOON – Rainfall Distribution



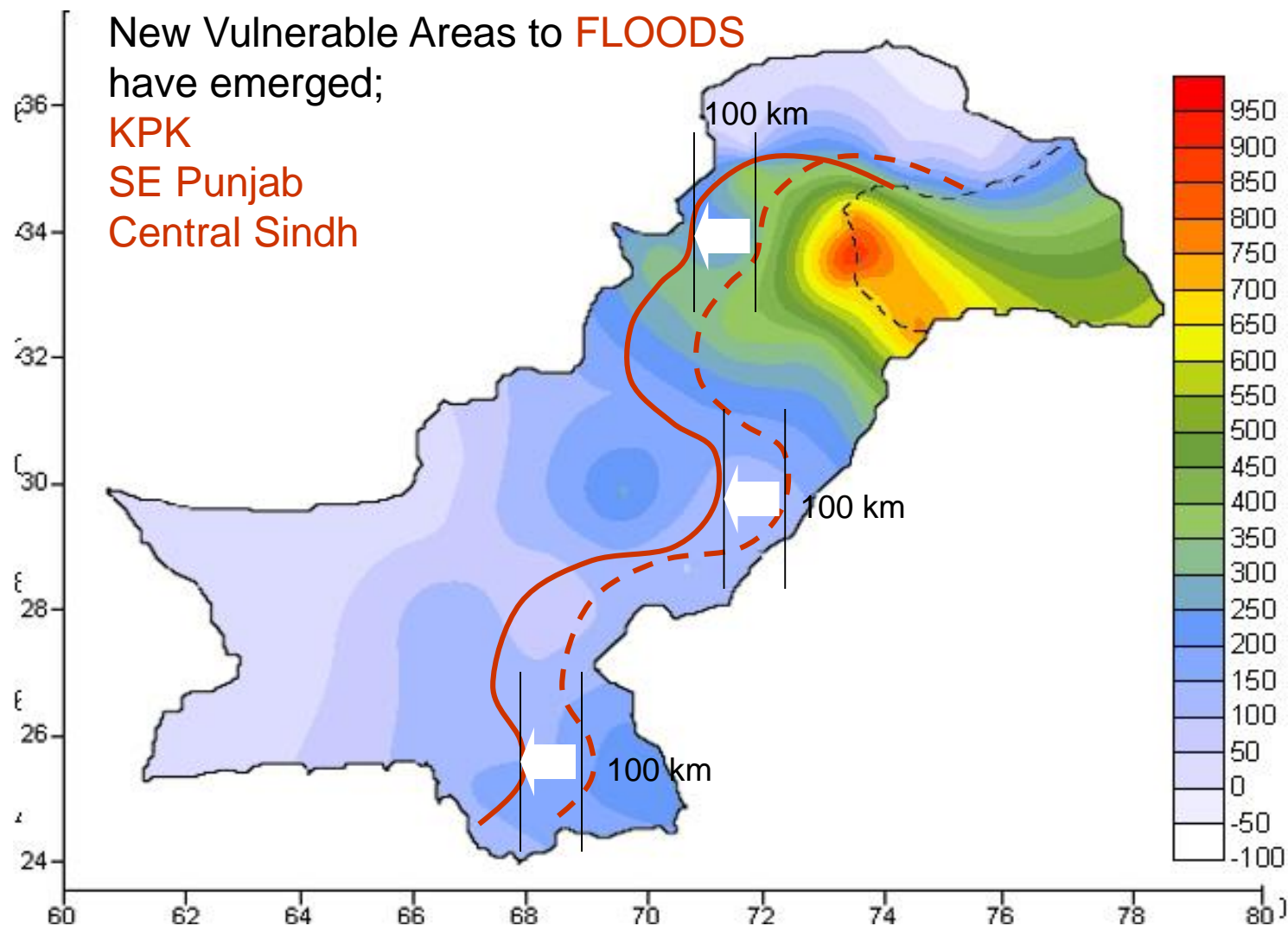
# Monsoonal Weather Systems – Rainfall Shift

## MONSOON – Rainfall Distribution



# Monsoonal Weather Systems – Rainfall Shift

## MONSOON – Rainfall Distribution



# Climate change **shifts**

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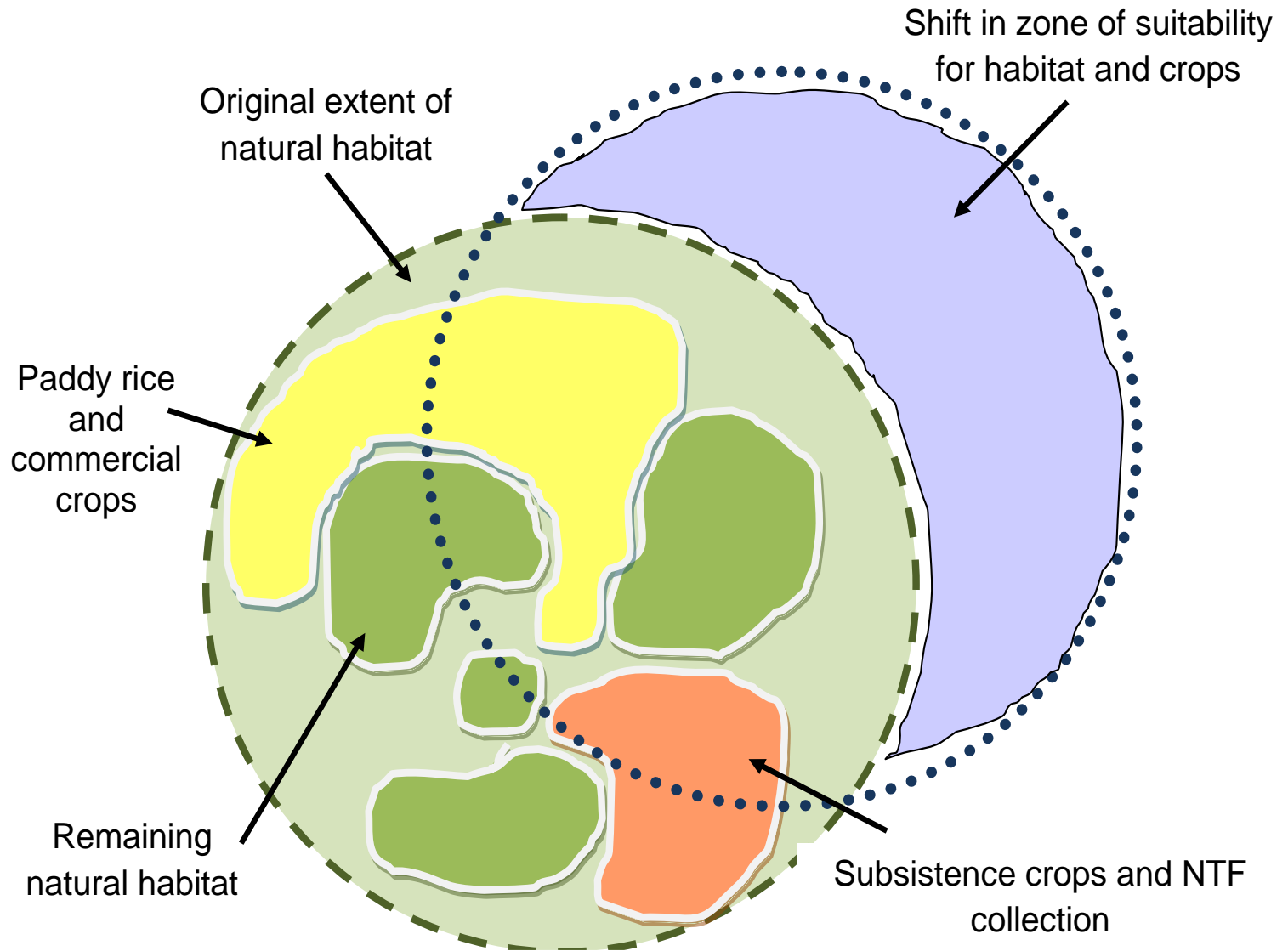
## Regular climate

1. **Geographic shifts** – change in area of suitability
2. **Seasonal shifts** – change in (i) yields, (ii) cropping patterns

## Extreme events

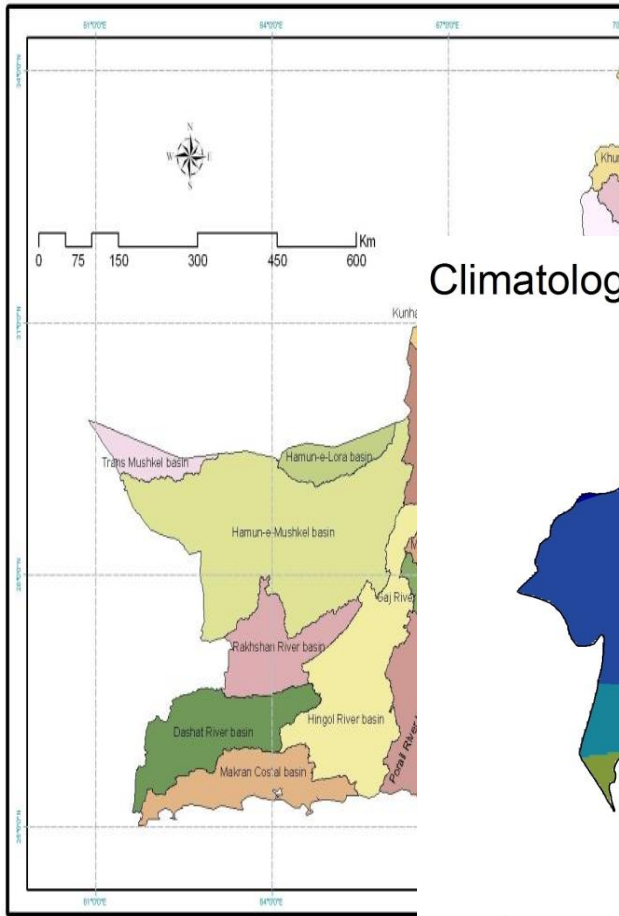
3. **Extreme event shifts**
  - Micro – eg flash flooding and soil loss in uplands
  - Macro – eg saline intrusion in Delta; cyclone landfall

# Geographic shift



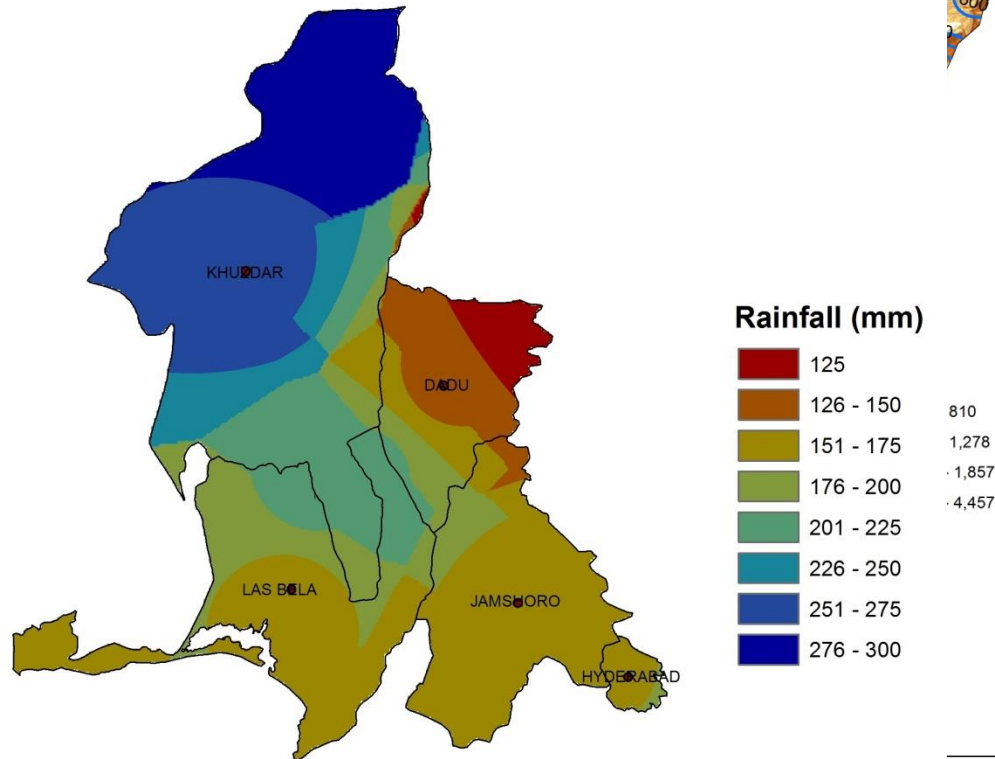


# Rainfall in Rod Kohi

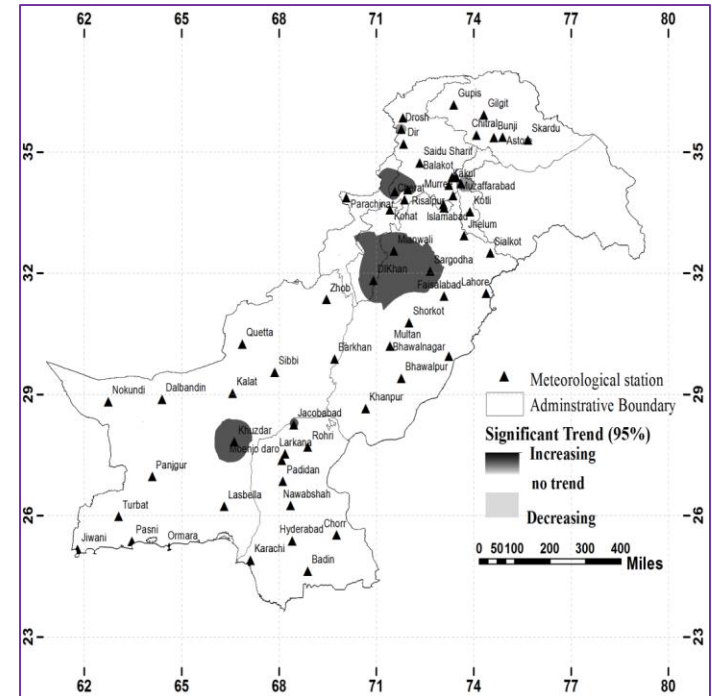
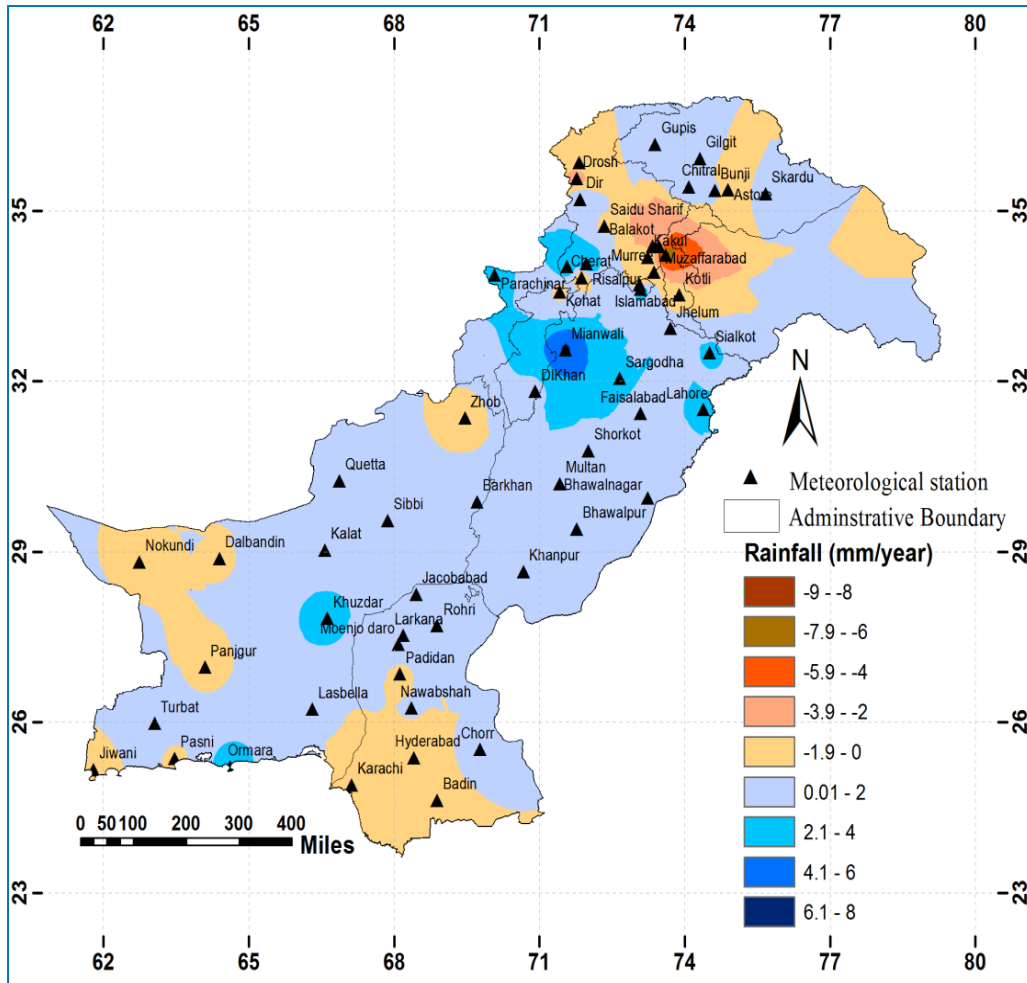


Gridded Average Precipitation Over Rod-Kohi on a DEM

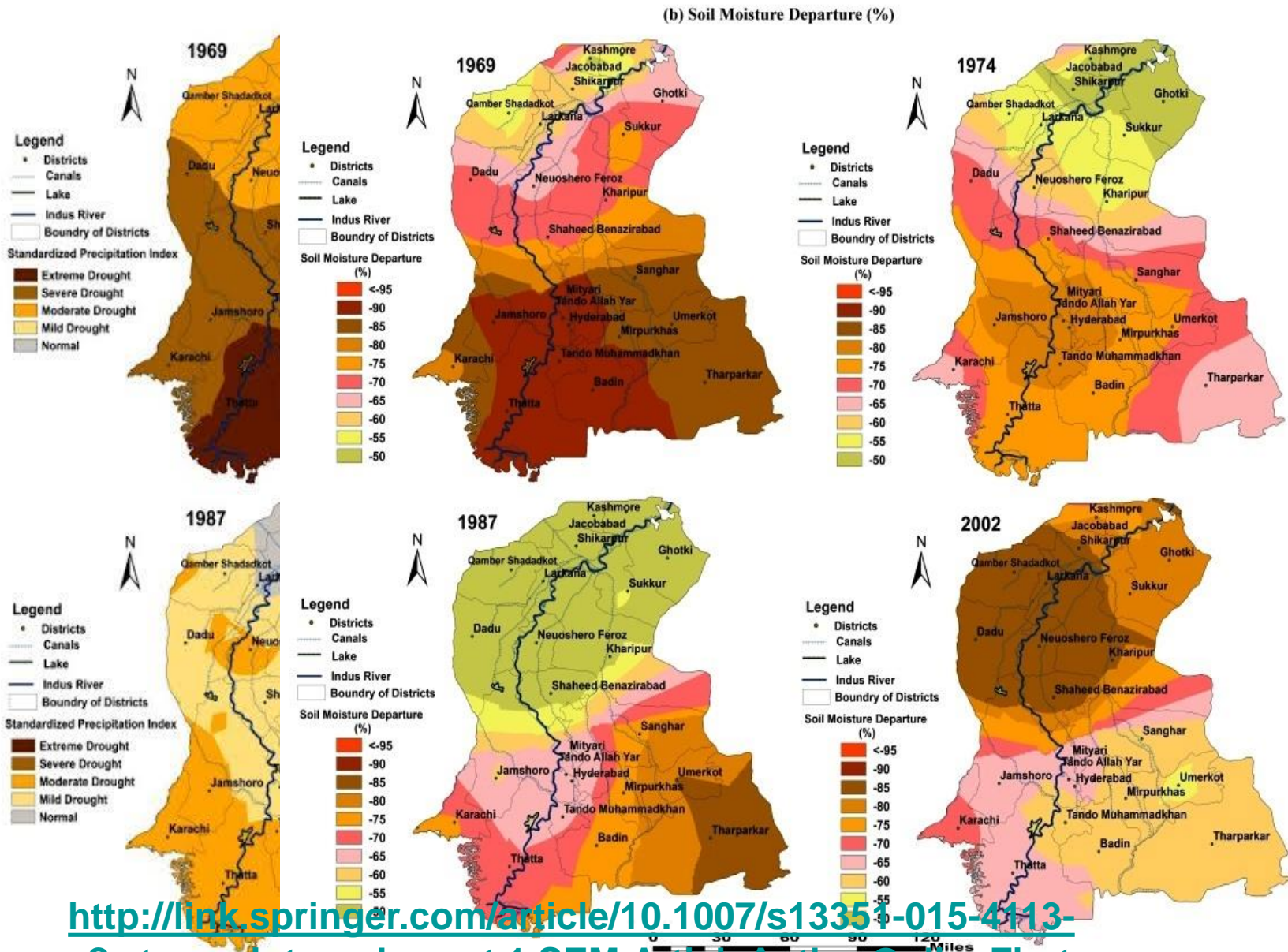
## Climatology of Hyderabad and Khuzdar Division



# Significant Trend of Precipitation across Pakistan (1951-2014)



# Spatial Analysis of Drought Episodes & Impact



[http://link.springer.com/article/10.1007/s13351-015-4113-z?wt\\_mc=internal.event.1.SEM.ArticleAuthorOnlineFirst](http://link.springer.com/article/10.1007/s13351-015-4113-z?wt_mc=internal.event.1.SEM.ArticleAuthorOnlineFirst)



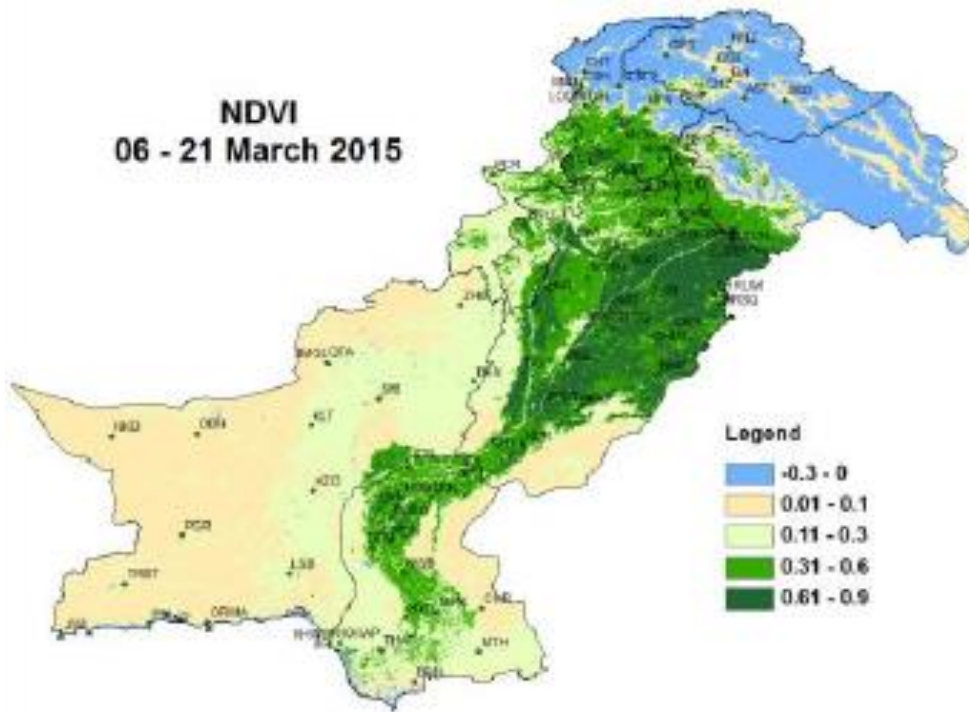
## Products for Drought Monitoring

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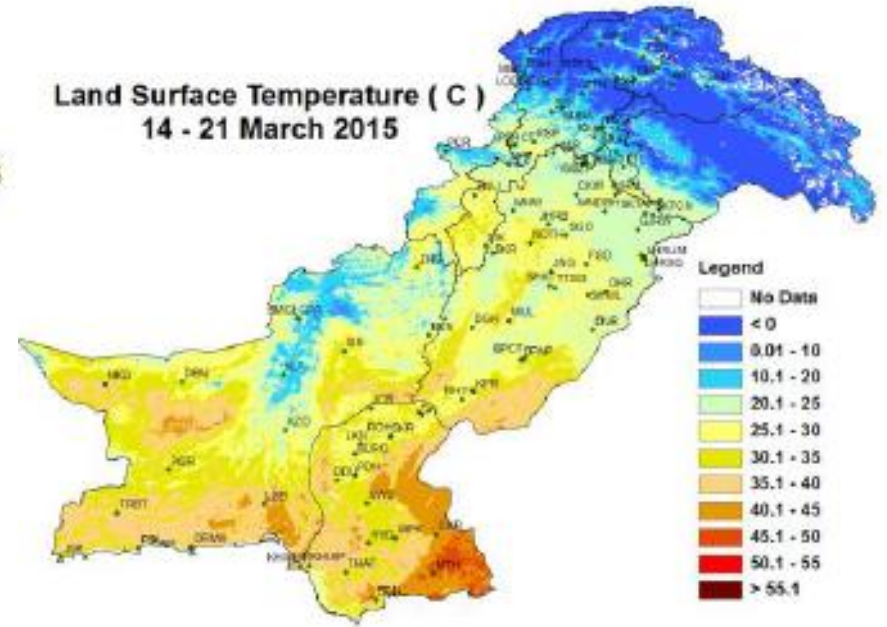
- Percentage Area Weighted Departure of Rainfall
- CPA(Cumulative Precipitation Index)
- Soil Moisture Anomaly
- SPI (Standard Precipitation Index)
- Reservoir Data. (Tarbela, Mangla, Rawal, Simly, Khanpur)
- Calculating Returns of Period (Frequency) of Drought on regional/ Provincial level by using Regional Drought Identification Model(REDIM)
- Satellite derived Products (NDVI, LST, TVDI)



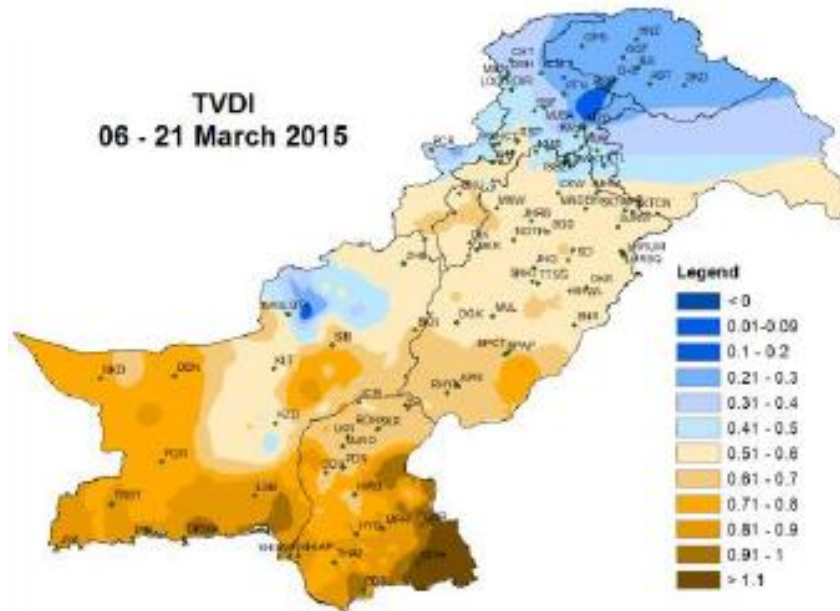
**NDVI**  
06 - 21 March 2015



**Land Surface Temperature ( C )**  
14 - 21 March 2015



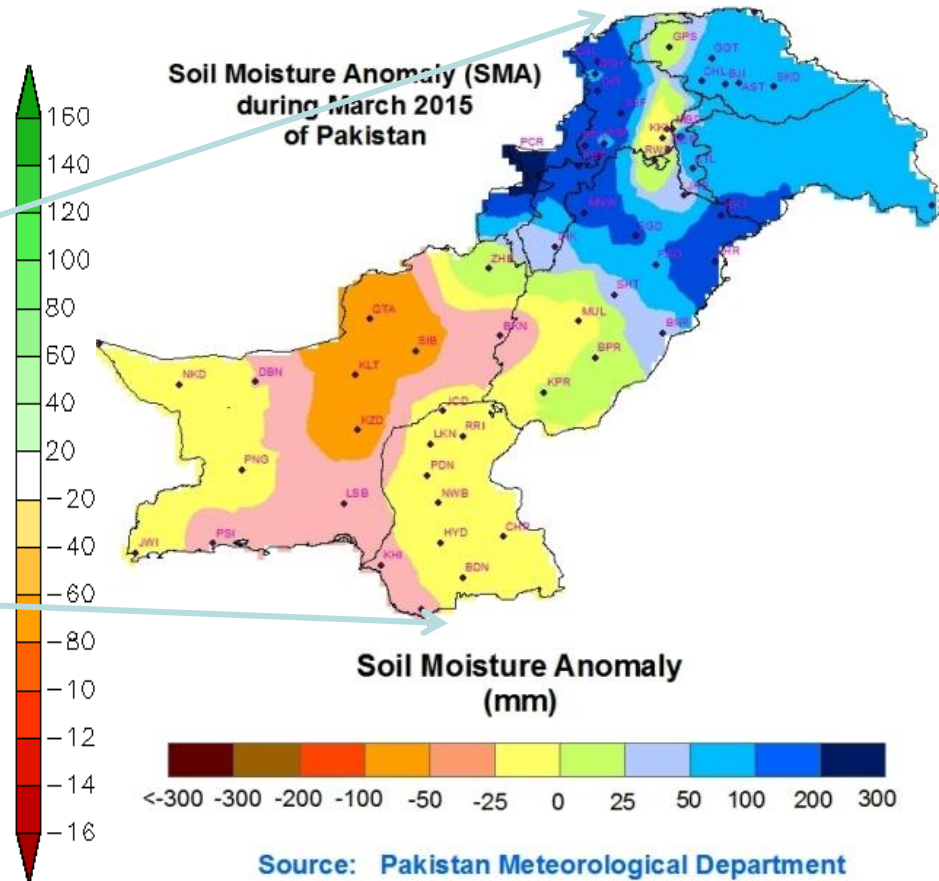
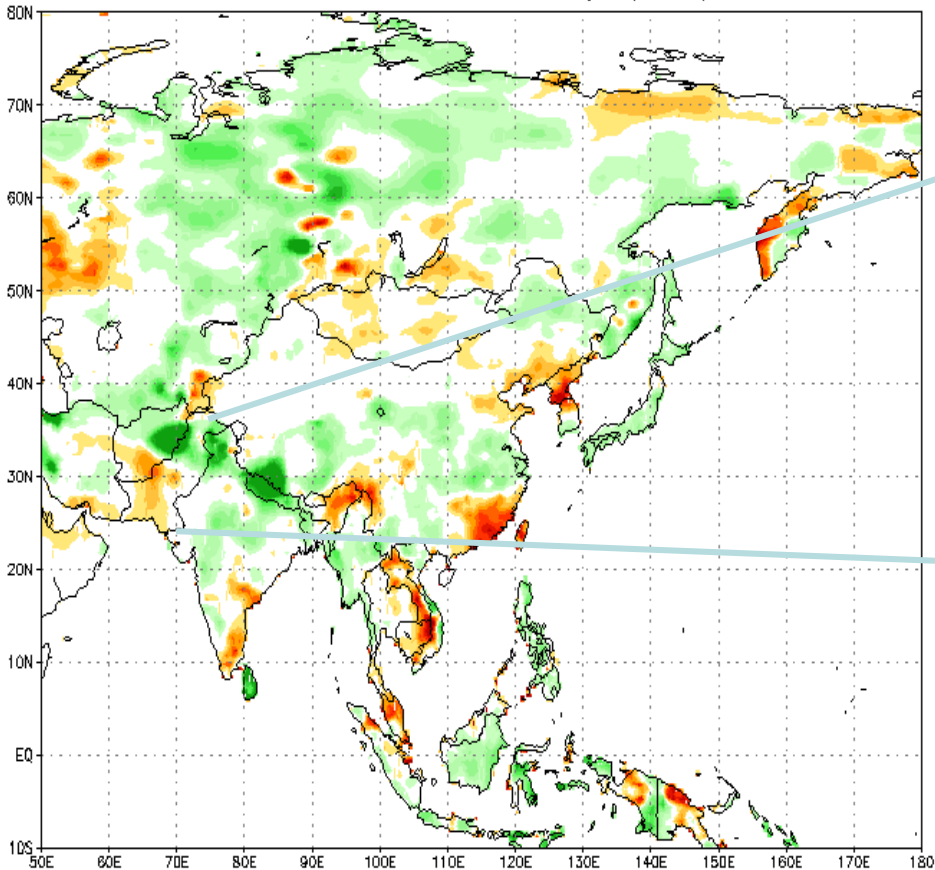
**TVDI**  
06 - 21 March 2015





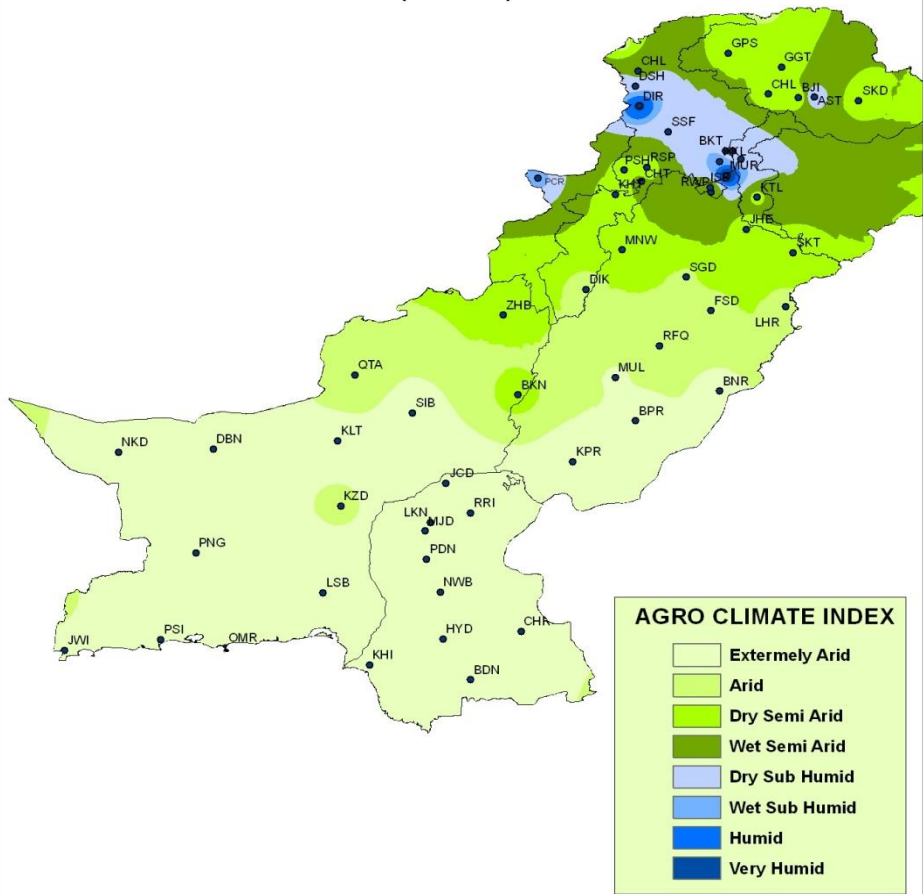
# Soil Moisture Anomaly

Calculated Soil Moisture Anomaly (mm) MAR, 2015

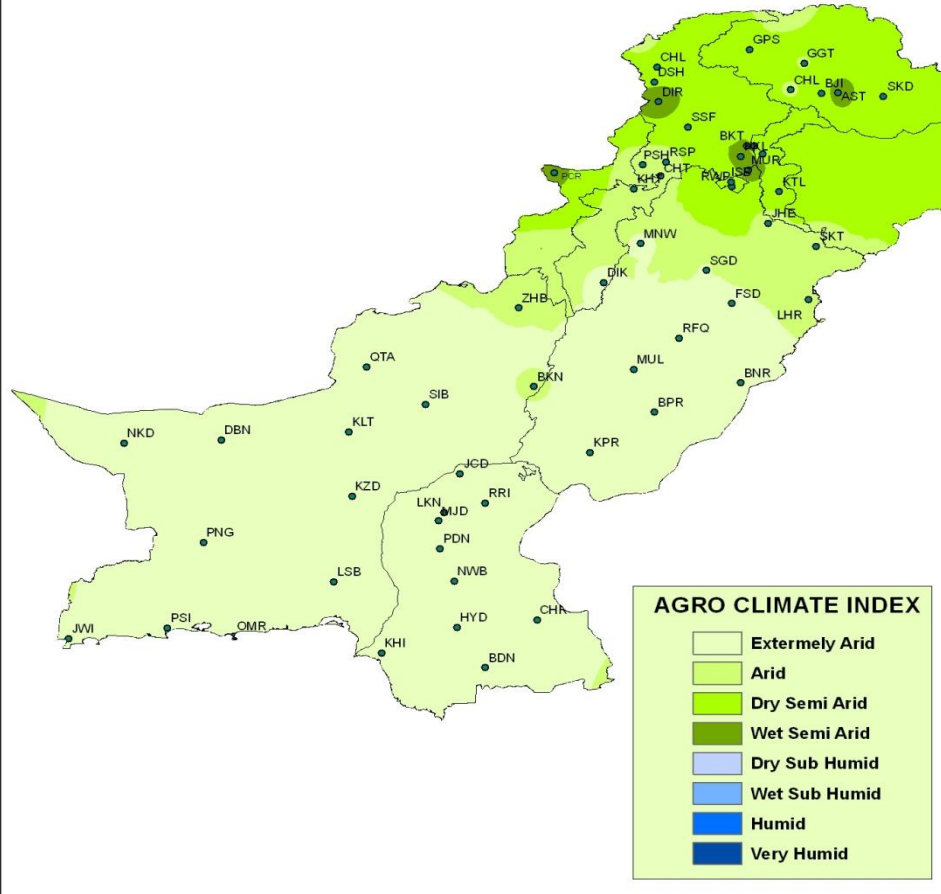


Source: Pakistan Meteorological Department

**CLIMATIC CLASSIFICATION ON THE BASIS OF MOISTURE INDEX(%) DURING APRIL (1971-00) OF PAKISTAN**



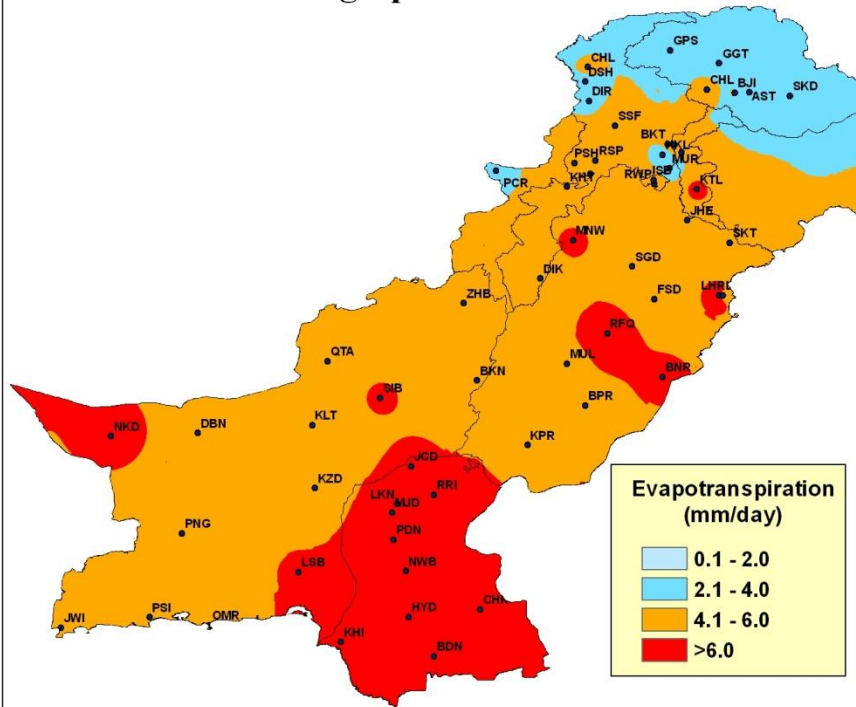
**CLIMATIC CLASSIFICATION ON THE BASIS OF MOISTURE INDEX(%) DURING MAY(1971-00) OF PAKISTAN**



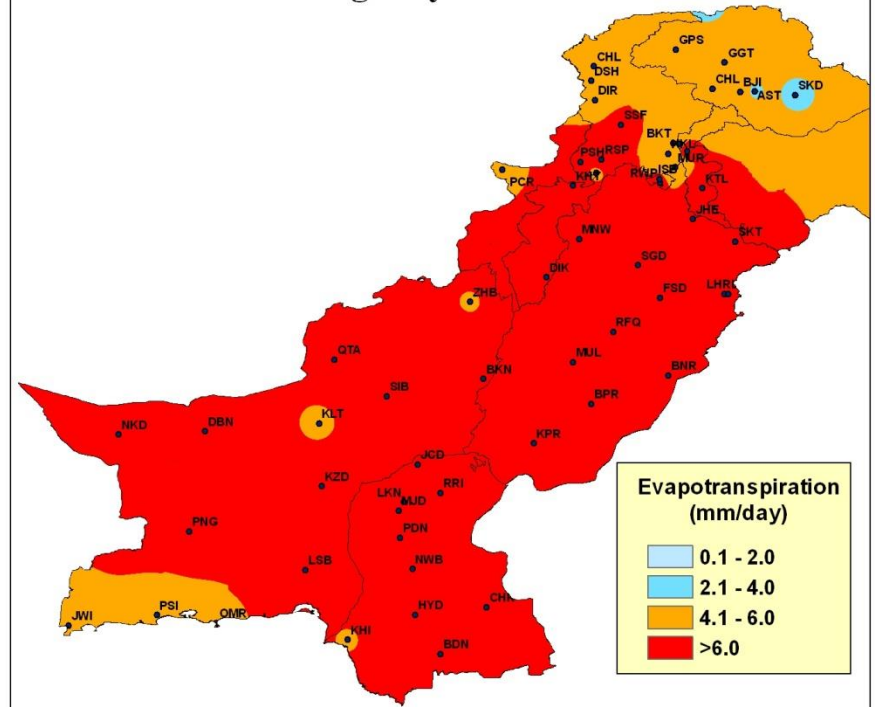
Source: NDMC, Pakistan Meteorological Department

# Normal Reference Crop Evapotranspiration(1971-2000)

Normal Reference Crop Evapotranspiration(mm/day)  
during April in Pakistan



Normal Reference Crop Evapotranspiration(mm/day)  
during May in Pakistan

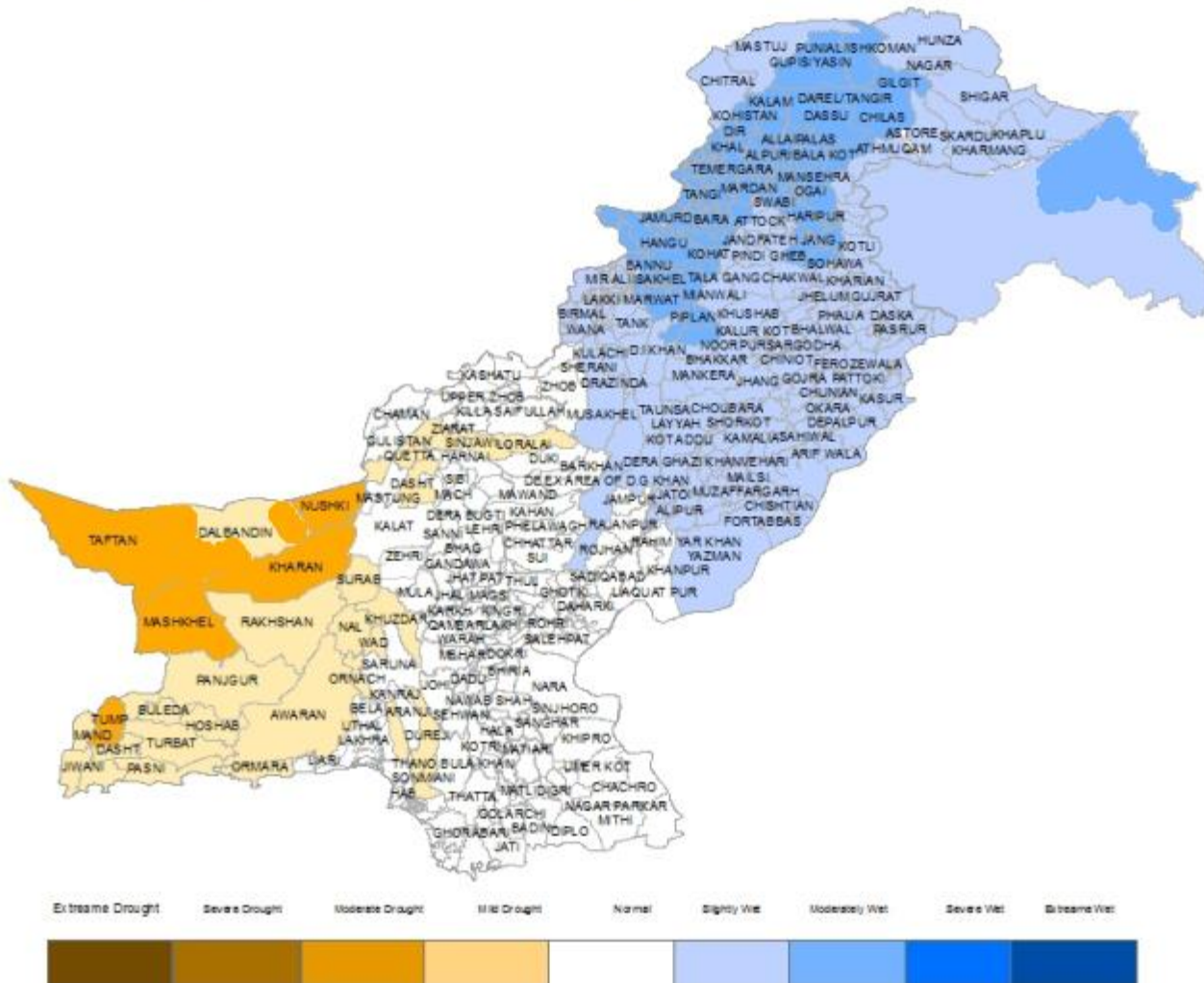


Source: NDMC, Pakistan Meteorological Department

# Duration 01 Nov to 15 Nov 2015

Drought Monitor

Updated 16 November, 2015





# Information Dissemination

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## Information dissemination through

- Fortnightly/Monthly and Quarterly Drought Bulletin.
- Emails/Fax/telephone ...
- Web: <http://www.pmd.gov.pk/ndmc>



# Information Dissemination

*Handwritten notes:*  
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FAK NO. 105-9205037  
Jan. 05 2015 10:58AM P.  
MOST IMMEDIATE / BY FAX

Government of Pakistan  
National Disaster Management Authority  
(Prime Minister's Office)  
ISLAMABAD

Subject: Drought Monitoring

Please find attached a copy of Pakistan Meteorological Department Drought Bulletin for the month of December 2014. You are requested to please monitor the drought situation in the affected areas and take necessary mitigation measures as deemed necessary.

2. A priority action is requested, please.

*Signature*  
Lieutenant Colonel  
For Chairman NDMA  
(Raza Iqbal)  
Tel. 051-9205035  
Fax. 051-9205086

- ✓ DG, PDMA Punjab, Lahore 042-99204405
  - ✓ DG, PDMA Sindh, Karachi 021-99204405
  - ✓ DG, PDMA Balochistan, Quetta 081-2 820189
  - DG, GBDMA Gilgit Baltistan, Gilgit
  - ✓ DG, PDMA Khyber Pukhtunkhwa, Peshawar 091-9205035
  - ✓ DG, SDMA Azad Jammu & Kashmir, Muzaffarabad 05722-9205035
- FATA Disaster Management Authority, Peshawar  
No F.2 (E) / 2014-NDMA (Flood/Gen) dated 5 January 2015

cc  
i. Pakistan Meteorological Department, Islamabad



## Pakistan Meteorological Department

# Drought Bulletin Of Pakistan

**MARCH, 2015**

### Highlights:

- ✓ March 2015 was the wettest month on record over Punjab during last 55 years
- ✓ Occasional heavy rainfall associated with hailstorms for short periods is a significant feature of weather over sub-mountainous areas of Punjab and KP during April.
- ✓ Farmers are advised to keep abreast of weather updates for timely precautionary measures to minimize weather induced losses.
- ✓ Despite widespread rains in upper half of country, drought affected areas of Sindh (Tharparkar, Thatta, Mirpurkhas) did not receive any appreciable rainfall that could help to alleviate drought conditions in the area.
- ✓ Moderate to severe drought conditions prevail across rainfed areas of Sindh
- ✓ No significant rainfall is likely over most parts of Sindh during April 2015
- ✓ El-Nino conditions are strengthening across equatorial Pacific that may result to further aggravate drought conditions in Sindh by the end of monsoon season.

## National Drought Monitoring Centre (NDMC)

Headquarters Office, Sector H-8/2, Islamabad

Tel : + (92-51) 9250598, Fax: + (92-51) 9250368, URL: <http://www.pmd.gov.pk>

# Tharparkar Climate Statistics

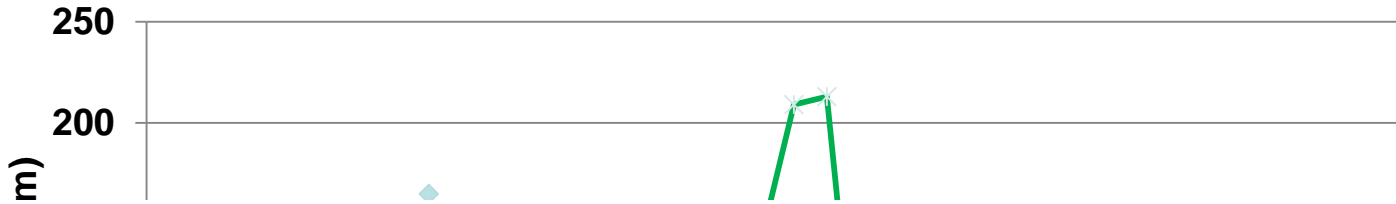
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- Monsoon rainfall (June-Sep) is the main source of water for Tharparkar region in which **87% of annual rainfall is observed.**
- Winter season (Oct to March) remains dry.

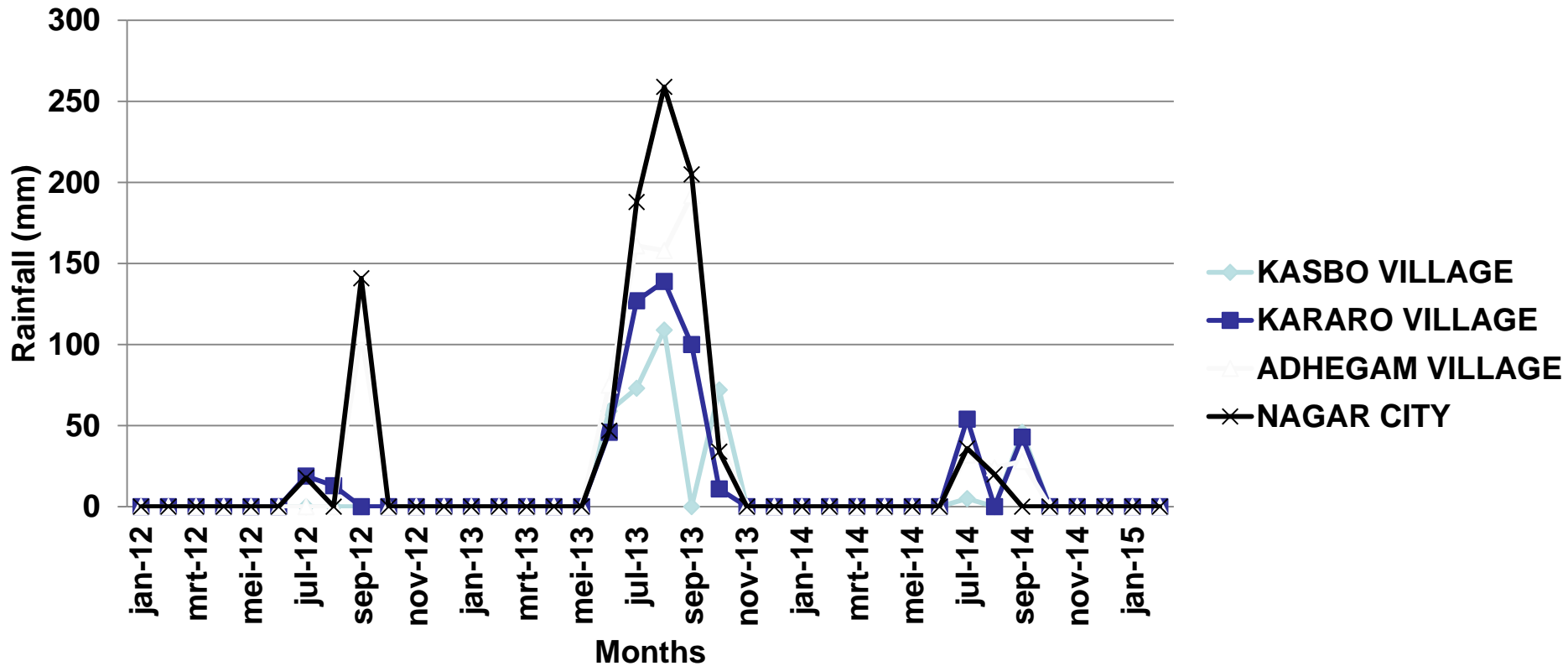
	<b>Monsoon (June-Sep) Normal</b>	<b>Annual Normal</b>	<b>% of annual</b>
	<b>219.3</b>	<b>246.5</b>	<b>87%</b>

# Reported Data

## THARPARKAR DISTRICT



## THARPARKAR DISTRICT SMALL DAMS

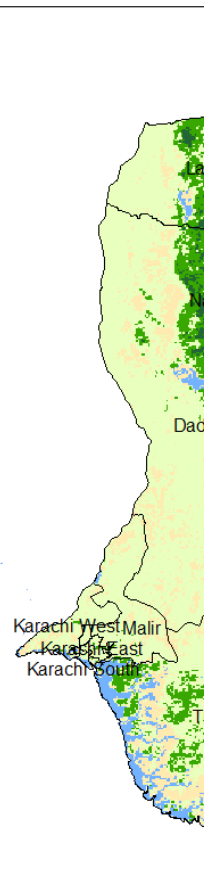
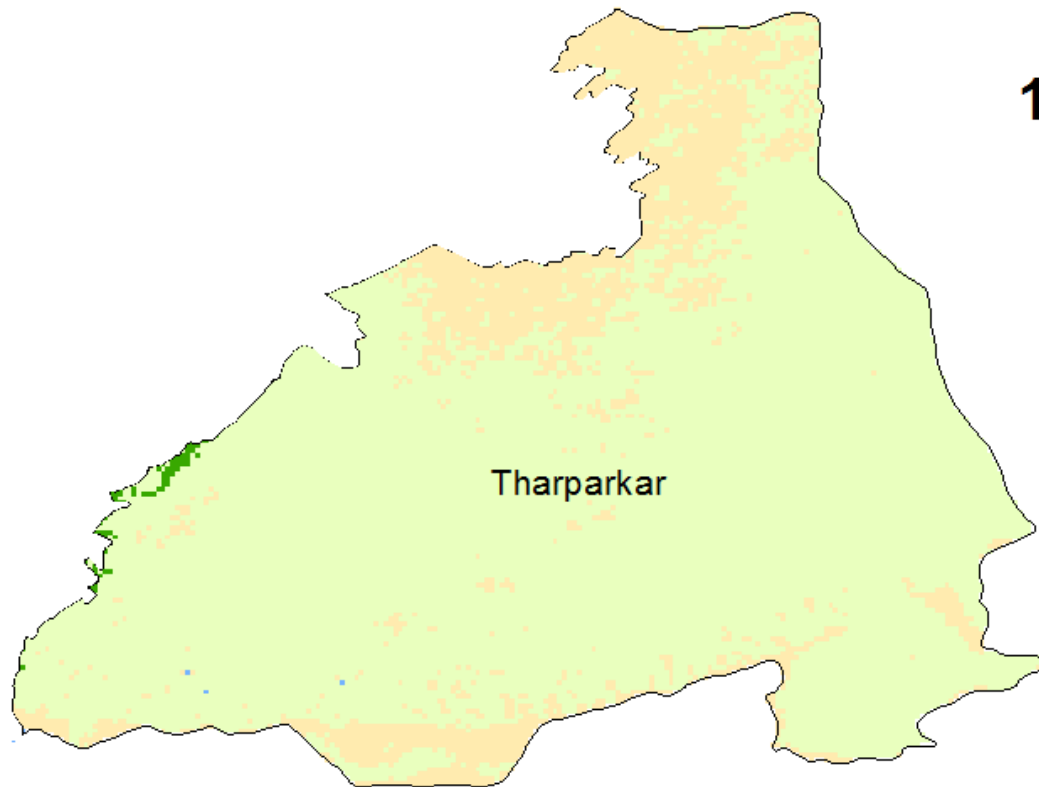
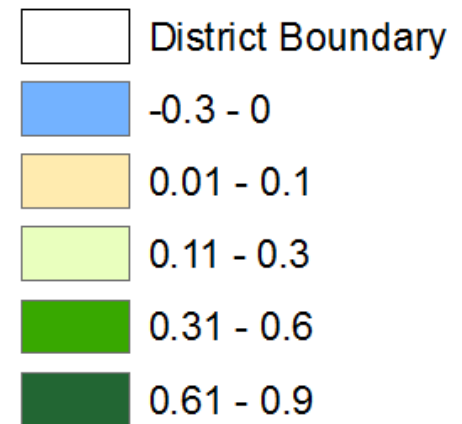


# Satellite Derived Products

Land S  
26

NDVI  
18 Feb-15 to 05 Mar-15

## Legend





# Drought Monitor

Duration 01 Nov to 15 Nov 2015

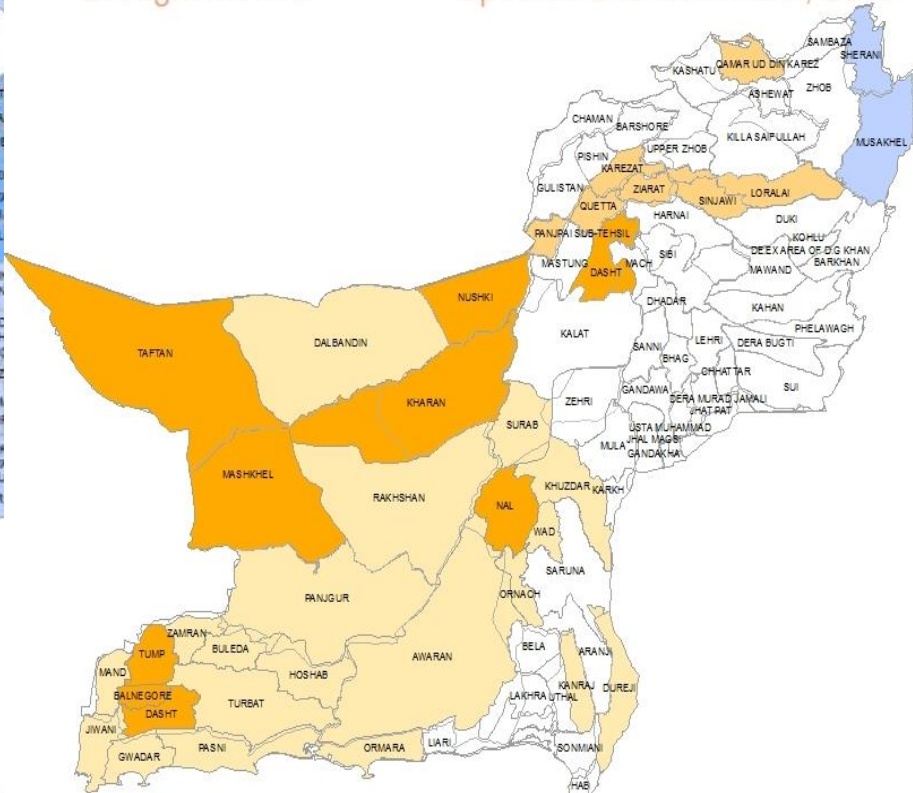
Drought Monitor

Updated 16 November, 2015

Duration 16 Oct to 31 Oct 2015

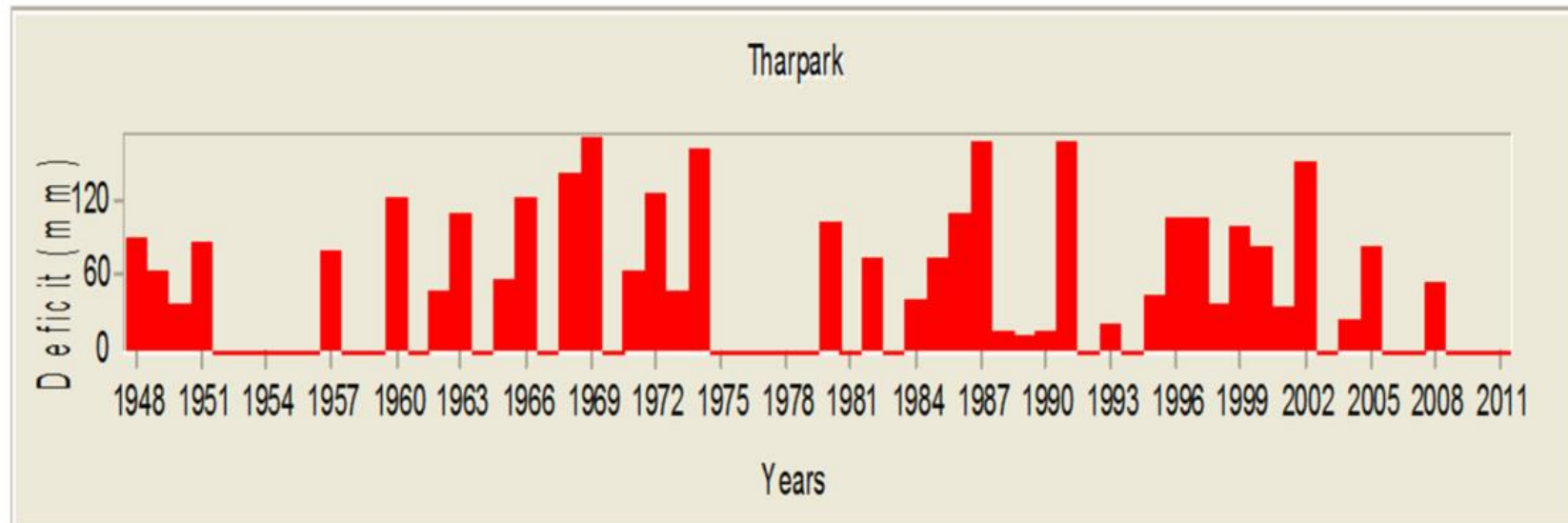
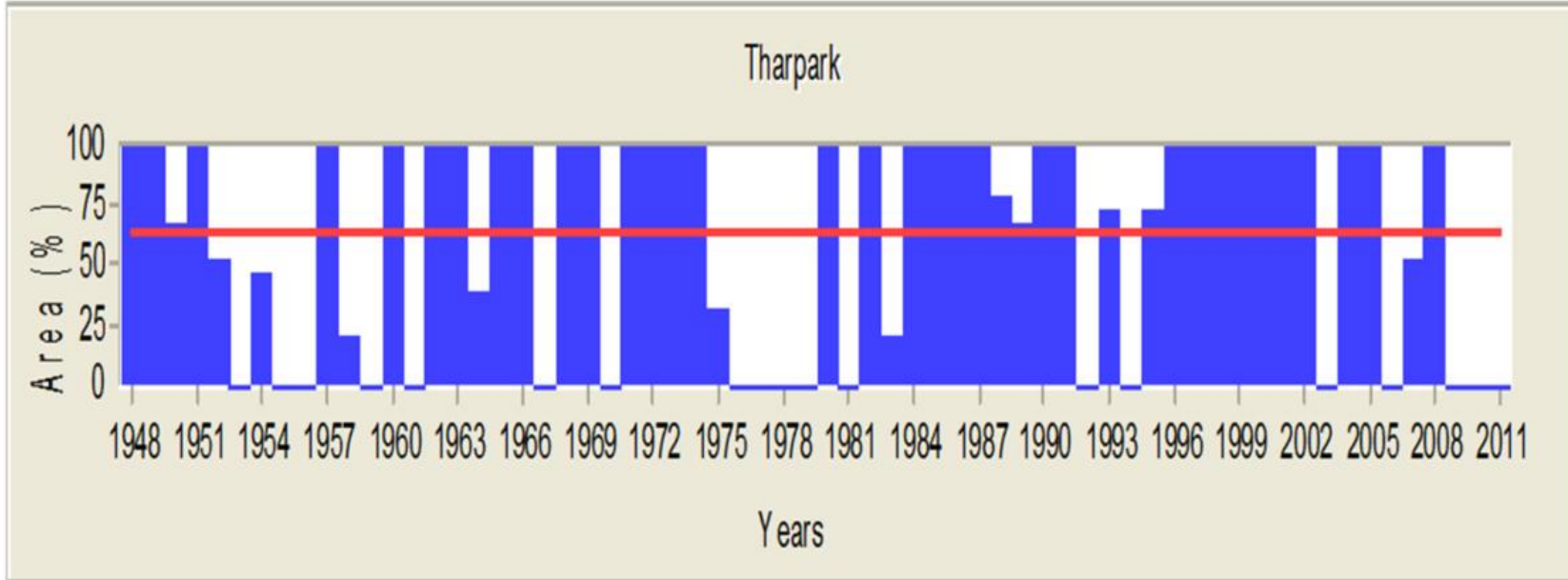
Drought Monitor

Updated 2nd November, 2015





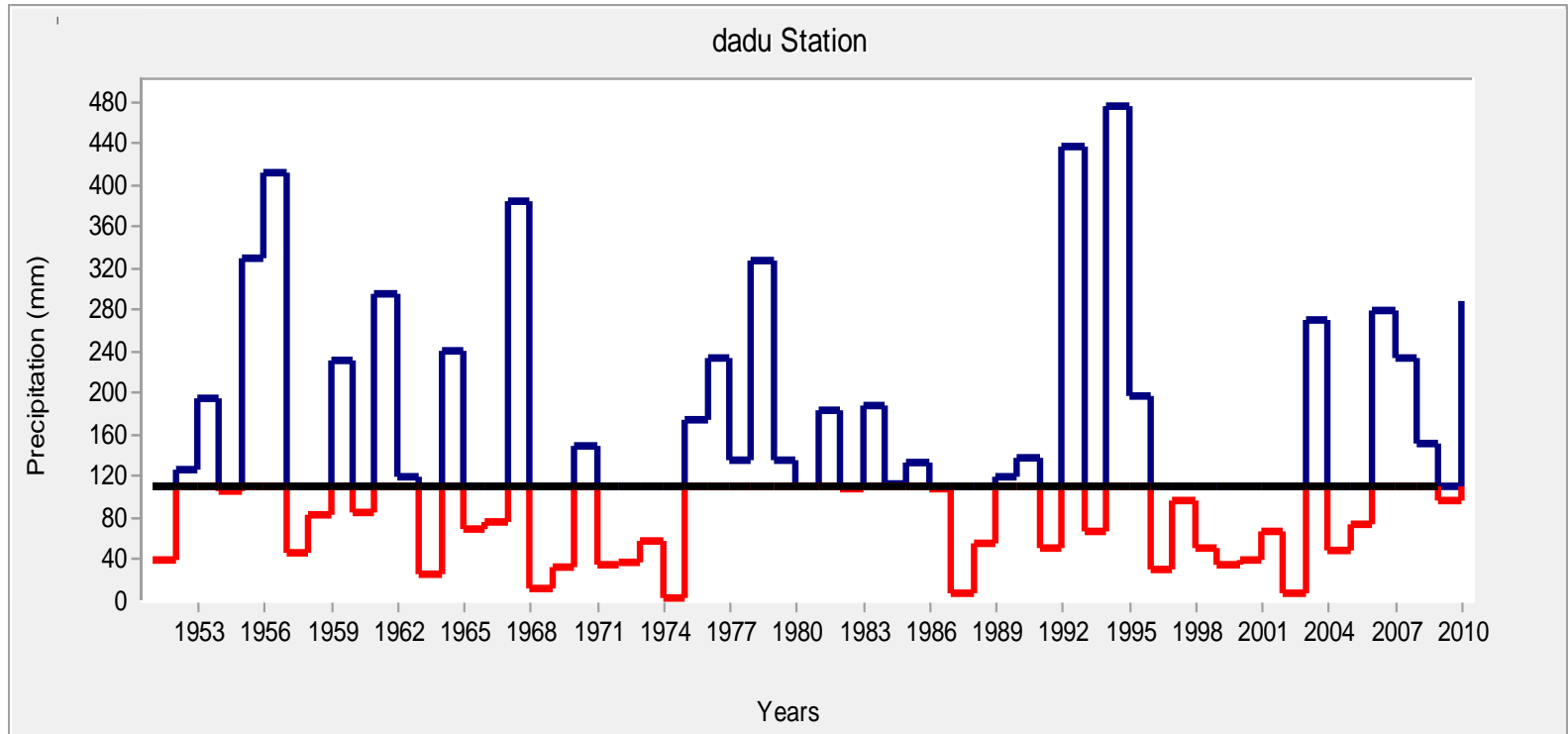
# Drought Statistics (Tharparkar)



# General Characteristics of Drought Events

## Drought identification - Site analysis (trough REDIM)

Threshold (Quantile 50%): 109.25 mm



	Mean	Max	Begin.(Max)	End(Max)	Min
<b>Duration [years]:</b>	<b>2.00</b>	<b>7.00</b>	<b>1996</b>	<b>2002</b>	<b>1.00</b>
<b>Cum. Def [mm]:</b>	<b>109.97</b>	<b>443.95</b>	<b>1996</b>	<b>2002</b>	<b>2.75</b>
<b>Drought Int. [mm/year]:</b>	<b>47.64</b>	<b>88.40</b>	<b>1968</b>	<b>1969</b>	<b>2.75</b>



# Conclusion

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The analysis of ground observations and satellite data is done to delineate **drought conditions**.

**NOAA Satellite derived moisture anomaly is used for vegetation stress.**

**NDVI data from MODIS satellite is used to identify vegetation conditions. The comparison with average is done to detect anomaly; vegetation stress.**



## GFS METEOROGRAM

Latitude: 29.70 Longitude: 67.78

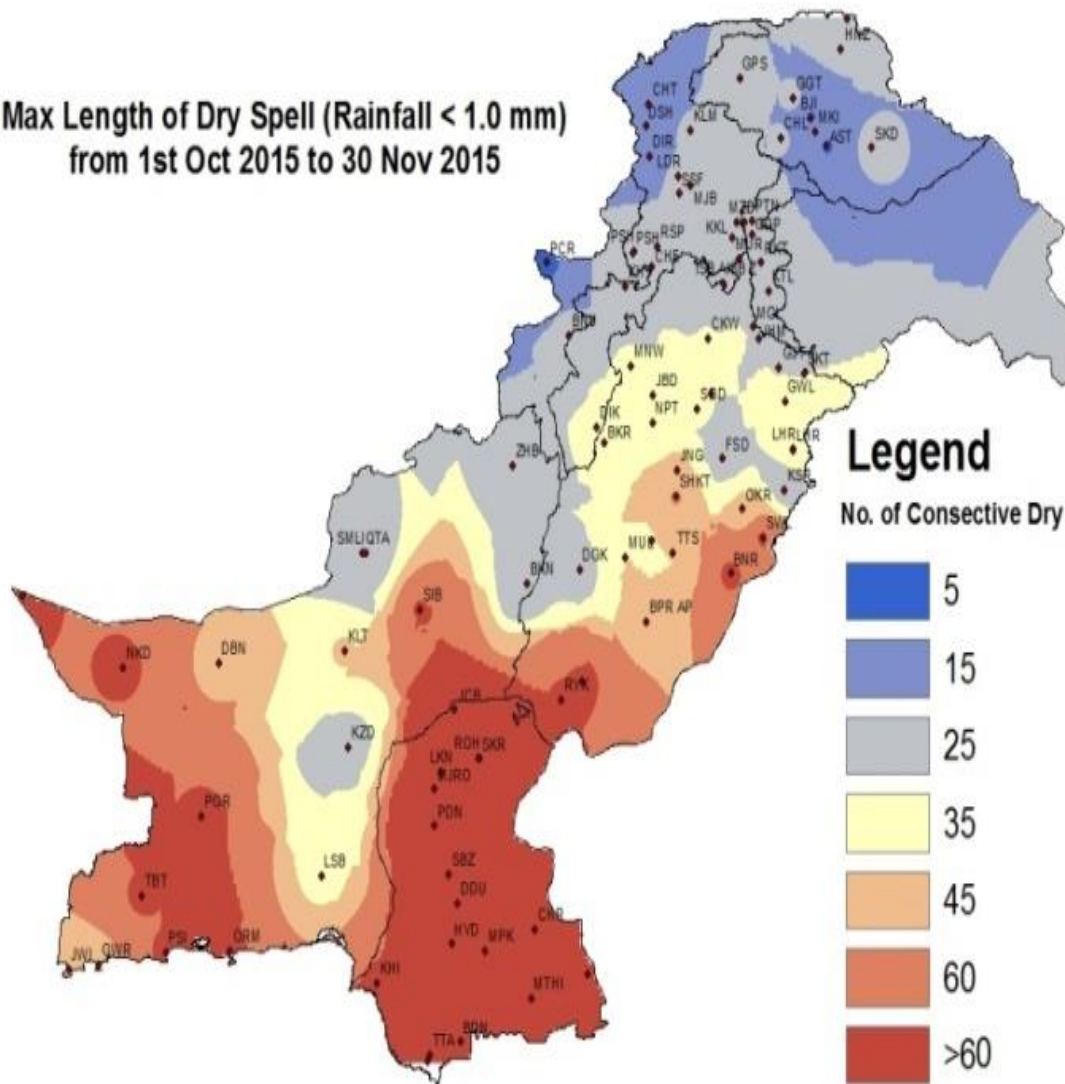
## OROGRAM

Longitude: 68.27

CALCULATION STARTED AT: 28 NOV 2015 00Z  
CALCULATION ENDED AT: 08 DEC 2015 00Z

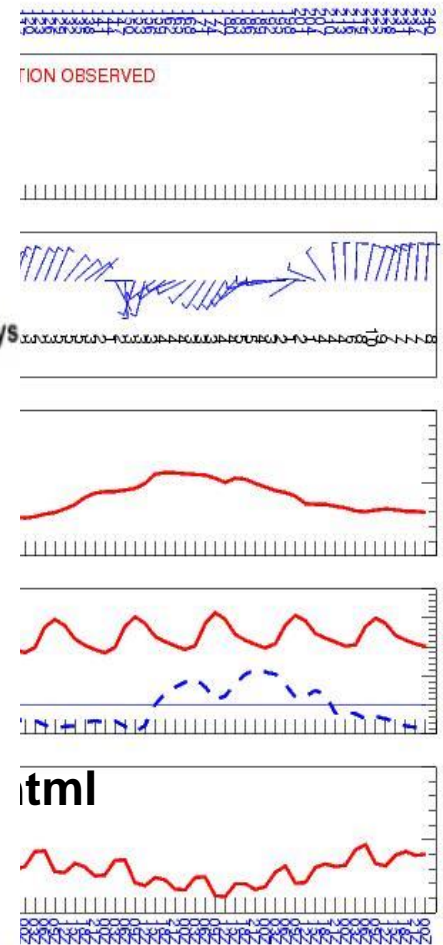
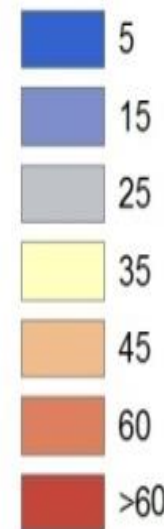
F

Max Length of Dry Spell (Rainfall < 1.0 mm)  
from 1st Oct 2015 to 30 Nov 2015



### Legend

No. of Consecutive Dry Days



Source: National Drought Monitoring Center-PMD-Islamabad

THU 03DEC FRI 04DEC SAT 05DEC SUN 06DEC MON 07DEC



**UNDERSTAND** the Climate Risk

**COMMUNICATE** the Climate Risk

***Thank you!***