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Drought Risk In India

Drought is a complex, slow-on set phenomenon of ecological challenge that affects people more than any other natural hazards by causing serious economic, social and environmental losses in both developing and developed countries. The period of unusual dryness (i.e. drought) is a normal feature of the climate and weather system in semi-arid and arid regions of the tropics, which covers more than one-third of the land surface and is vulnerable to drought and desertification.

In India, the Ministry of Agriculture classifies droughts as:
Meteorological Drought: *It is based on rainfall deficiency w.r.t. long-term average – 25% or less is normal, 26-50% is moderate, and more than 50% is severe.*

Hydrological Drought: *It is defined as deficiencies in surface and sub-surface water supplies leading to a lack of water for normal and specific needs. Such conditions arise even in times of average (or above average) precipitation when increased usage of water diminishes the reserves.*

Agricultural Drought: *It is identified by 4 consecutive weeks of meteorological drought, weekly rainfall is 50 mm from 15/5/ to 15/10, 6 such consecutive weeks rest of the year and crop planted is 80% in Kharif season.*

The disaster risks associated with drought is a recurring feature in India. On an average, 28 % of geographical area of India is vulnerable to droughts. Meteorologically, +/- 19 % deviation of rainfall from long-term mean is considered "normal". Deviation between 20-59 % is considered "moderate" while more than 60 % deviation is considered "severe" drought.

Peninsular and western parts of India are mainly drought-prone regions with some pockets in central, eastern, and northern parts. Over the past 200 years, India has experienced more than 50 droughts. Some of them were very severe. Most drought prone regions have experienced several droughts for two consecutive years while some areas such as Western Rajasthan, Saurashtra faced drought for three consecutive years.

About 107 million hectare (mha) of India that includes several districts are impacted by drought frequently. Table 1 below shows list of such districts.

Table 1 Administrative Districts frequently affected by drought

State	No of Districts	Name of Districts
Andhra Pradesh	5	Anantapur, Chittoor, Cuddapah, Kurnool, Prakasam
Bihar	7	Aurangabad, Bhojpur, Gaya, Munger, Nawadah, Palamau, Rohtas,
Gujarat	12	Ahmedabad, Amrely, Banaskanta, Bhavanagar, Bharuch, Jamnagar, Kheda, Kutch, Meshana, Panchmahal, Rajkot, Surendranagar
Haryana	4	Bhiwani, Gurgao, Mahendragarh, Rohtak
Jammu &Kashmir	2	Doda, Udhampur
Karnataka	14	Bangalore, Belgaum, Bellary, Bijapur, Chitradurga, Chickmangalur, Dharwad, Gulbarga, Hassan, Kolar, Mandya, Mysore, Raichur, Tumkur
Madhya Pradesh	11	Betul, Datia, Dewas, Dhar, Jhabua, Khandak, Khargaon, Shahdol, Shahjapur, Sidhi, Ujjain

State	No of Districts	Name of Districts
Maharashtra	11	Ahmednagar, Aurangabad, Beed, Nanded, Nashik, Osmanabad, Pune, Parbhani, Sangli, Satara, Sholapur
Orissa	4	Phulbani, Kalakhandi, Bolangir, Kendrapada
Rajasthan	12	Ajmer, Banaswada, Barmer, Churu, Dungarpur, Jaisalmeer, Jalore, Jhunjhunu, Jodhpur, Nagaur, Pali, Udaipur
Tamil Nadu	8	Coimbatore, Dharmapuri, Madurai, Ramanathapuram, Salem, Tiruchirapalli, Tirunelveli, Kanyakumari
Telangana	3	Hyderabad, Mehaboobnagar, Nalgonda
Uttar Pradesh	7	Allahabad, Banda, Hamirpur, Jalaun, Jhansi, Mirzapur, Varanasi
West Bengal	3	Bankura, Midnapur, Purulia
Total	**103**	

Drought Indices

A drought index value is a single number used for decision making. There are several indices that measure on how much precipitation for a given period of time has deviated from historically established norms. Some commonly used indices are:

Meteorological indices: *This type of drought considers the degree of dryness, duration of the dry period, and specific atmospheric conditions that result in deficiencies for its description.*

i. Normalized Deviation
ii. Dryness Index
iii. De Martonne's index
iv. Pluvothermic quotient
v. Aridity Anomaly Index
vi. Negative Moisture Index
vii. Percentage of Normal Precipitation
viii. Standard Precipitation Index
ix. Palmer Drought Severity Index

Hydrological indices: *Droughts are those periods of time when natural or managed water systems fail to provide enough water to meet the established human and environmental uses, due to natural short falls in precipitation or stream flow. The persistence of hydrological drought for 20 or more years is due to several land surface feedback combinations. Some hydrological indices are:*

i. Water budget method
ii. Surface water supply index is calculated for a river basin, stream flow, precipitation, and reservoir storage. It represents water supply conditions unique to each basin or water management requirements of each basin
iii. Reclamation drought in dexis calculated at the river basin-level. It is a tool for defining drought severity and duration, in addition to prediction of onset and end of drought periods. It allows states to seek assistance for mitigation measures.

Agriculture index: *Crop moisture index use same teorological approach to monitor week-to-week crop conditions and evaluate moisture conditions across major crop- producing regions.*

El Niño and Droughts in India

Scientists observed that since 1950, India faced 15 droughts, and 12 of those were in El Niño years. Further, since 1980, all eight droughts were in El Niño years; but not all El Niño years led to droughts. Since 2000, five El Niño resulted in four resulted in drought in India.

An El Niño triggered drought may result in deficit rainfall that reduces crop production and eventually the entire economy. However, researchers are working on to find direct correlation between El Nino and Indian summer monsoon rainfall. Table below shows drought years as well as El Niño years.

Table 2 Drought Years and El Niño Years

Event	Since 1950s	Since 1980s	Since 2000s
Global El Niño	1951, 1953,1957, 1958, 1963, 1965, 1968, 1969, 1972, 1976, 1977, 1982, 1983, 1986, 1987, 1991, 1992, 1994, 1997, 2002, 2004, 2006, 2009, 2014	1982, 1983, 1986, 1987, 1991, 1992, 1994, 1997, 2002, 2004, 2006, 2009, 2014	2002, 2004, 2006, 2009, 2014
Indian Droughts	1951,1965, 1966, 1968, 1972, 1974,1979,1982,1986, 1987, 1991,2002, 2004, 2009, 2014	1982, 1986, 1987, 1991, 2002, 2004, 2009, 2014	2002, 2004, 2009, 2014
Drought and El Niño	1951, 1965,1968,1972, 1982, 1986, 1987, 1991, 2002, 2004, 2009, 2014	1982, 1986, 1987, 1991 2002, 2004, 2009, 2014	2002, 2004, 2009, 2014
El Niño but Not Drought	1953, 1957, 1958, 1963, 1969, 1976, 1977, 1983, 1992, 1994, 1997, 2006	1983, 1992, 1994, 1997, 2006	2006
Drought but no El Niño	1966,1974,1979	None	None

Source: *Saini S et al "El Niño and Indian Droughts - A Scoping Exercise"*

Drought Assessment

There are three main ways of drought assessment:

Monitoring: Technical/scientific means of monitoring are necessary to provide early warning of droughts and to also provide an objective and transparent definition of droughts to be used in the allocation of resources. But, at present the use of information available is partial and unsystematic. It requires strengthening of the institutional relation ship between early warning and decision making.

Predictability: As drought is very much linked with the performance of the monsoon, it can be predicted by monitoring rainfall over the target region and taking into account previous rainfall history of the monsoon seasons.

Vulnerability Analysis: Vulnerability to drought is dynamic and is influenced by amultitude of factors, including population growth and regional shifts in population, urbanization, technology, government policies, land- use and other natural resource management practices, desertification processes that reduce the productivity and the natural resource base, water use trends, and level of environmental awareness. Individually, these factors are important because they may increase or decrease vulnerability.

Impacts of Droughts

Droughts impact all sections of society. Deficient rainfall reduces crop production which results into price hike and hoarding of those. Buyers need to pay extra price for food.

Farmers lose their investment and are financially hit and, most of the times, unable to repay loans taken which impacts financial institutions and, eventually, the economy. Moreover, the crop loss forces large scale job related migration from villages to cities which puts pressure on resources and urban infrastructure.

As insurance penetration is low in India, and within that, lower in rural areas compared to urban areas, insured losses have been lower which puts pressure on the Government. Table below shows insured and economic losses for drought occurred in 2016 and 2015.

Table 3 Economic and Insured Losses Due to Droughts since 2000

Year	Country	Economic Losses (US$)	Insured Losses (US$)
2016	Tamil Nadu	3 billion	400 million *
2015	Orissa	1.5 billion	120 million *
2002	Almost entire India	910 million #	NA
2000	A.P., Gujarat, M.P., Maharashtra, Orissa & Rajasthan	588 million #	NA

Source: * *Swiss Re, # Gupta Anil et al "Drought disaster challenges and mitigation in India: strategic appraisal"*