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CLIMATE CHANGE IMPACT AND DROUGHT SCENARIO IN ARID RAJASTHAN

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ABSTRACT

Arid region is the home of drought and recurring features and one of the biggest truths for the region. Whole arid western Rajasthan was never free from drought. Drought is a result of failure of rainfall from the normal levels that supports livelihood of a region. Drought impacts both human and livestock population due to failure of crops, depletion in surface and ground water resources. Between 1901 and 2010 western Rajasthan experienced 58 moderate to severe droughts. There were five occasions when drought occurred in successive years: 1903-05, 1957-60, 1966-71, 1984-87 and 1998-2000. Droughts of 1918, 1987 and 2002 were most severe, when rainfall departure from the normal was -81, -65 and -70 percent, respectively. The districts of Jaisalmer, Barmer, Bikaner and Ganganagar have the maximum probability of drought recurrence, even in good rainfall years. Production of pearl millet, the major cereal crop of the region grown during kharif, is reduced by 10-30% during mild drought, 35-60% during moderate drought and 75-90% during severe droughts. Surface water availability also declined during drought years with the drought severity creating drinking water problem. Fodder scarcity which is shorter by 20-30% of the demand during normal years, touches 80-100% during severe droughts. Consequently, large-scale animal and human population migration for food, fodder and water, as well as work takes place.
Keywords: Climate change, drought, Rajasthan

INTRODUCTION

Climate change, drought, poverty and attaining food security are the major challenge to India in the 21st century. The food grain requirements by 2020 is estimated to be 30 to 50% more than current demand of 230 million tonne (Paroda and Kumar, 2000). Drought is a result of failure of rainfall from the normal levels that supports livelihood of a region. Drought impacts both human and livestock population due to failure of crops, depletion in surface and ground water resources. When drought prevails for consecutive years, the natural vegetation degrades leading to soil erosion, migration of human and livestock population in search of food and water. Droughts are more common in arid regions occurring at least two out of every five years. Drought is a regular part of the natural cycles affecting productivity and desertification. The rainfed regions encompassing the arid, semi arid and dry humid regions are more prone to climate variability (Ramakrishna *et al.*, 2007). An analysis of frequency of moderate and severe drought in the Indian arid zone (Pratap Narain *et al.* 2000) witnessed an increase in moderate and severe droughts in the last decades 1991-2000 compared to the earlier decade in the last century. Many parts of the world experience drought, only variation in its frequency and its intensity. Indian Technical Committee on Drought Prone Areas Programme and Desert Development Programme identified about 120 million ha of the country's geographical area is drought prone (Anonymous, 1990). Drought in the Indian sub-continent is due to failure of southwest monsoon rainfall. Recent studies on interactions between global circulations and drought showed that the El Nino phase of the Southern Oscillation (ENSO) was the largest impact on India through drought. While (ENSO) events cause summer drought, the winter rainfall enhanced consequently (WMO 1994, Rao and Miyazaki, 1997). The frequency of drought and floods are also influenced by climatic changes as a result of increased concentration of the atmospheric CO_2, methane and nitrous oxide. The Inter-Governmental Panel on Climate Change (IPCC, 2001) projected an increase in global average temperature between 0.15 and 0.3°C per decade for 1990 to 2005. The IPCC (2007) projected globally averaged surface warming, for the low scenario (B_1) 1.8°C (*likely* range is 1.1^0C to 2.9^0C), and for the high

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scenario (A_1F_I) 4.0°C (*likely* range is 2.4°C to 6.4°C) with a general reduction of potential crop yields and a decrease in water availability for agriculture particularly in countries such as Africa, South and Central America and Asia (Parry *et al.*, 1999 and 2004). Such impacts are more likely on fragile eco-systems like arid Rajasthan, where hot environment, low and erratic rainfall conditions prevail, where crops like pearl millet are sensitive to soil water (Rao and Saxton, 1995). The PRECIS (Providing Regional Climates for Impact Studies) model for the Indian arid region predicted for an increase in annual rainfall by 10-15% in the eastern fringe and 20-40% in the south, but the northwest will experience upto 30% reduction in rainfall.

Kinds of Drought: Drought can be classified into three kinds depending upon the purpose for which it is applied for;

Agricultural drought: It occurs when soil moisture and rainfall are inadequate during the growing season to support a healthy crop growth till maturity and cause decline in food grain production. It may also cause decline in fodder production from grazing lands, pastures and trees.

Meteorological drought: It is a situation when there is a significant decrease (more than 25%) in rainfall from the normal value even the area.

Hydrological drought: Meteorological drought, when prolonged results in hydrological drought with a marked depletion of surface water and consequent drying up of reservoirs, lakes, streams and rivers, cessation of spring flows and also fall in groundwater levels.

Under these classifications, if drought occurs in 20% of the years in any area, it is classified as drought prone area and if the drought occurs in more than 40% of the years, it is classified as chronically drought prone area.

RESULT AND DISCUSSION

Impact of drought on livelihood: Droughts considerably influence both human and livestock directly and indirectly through reduction in food, fodder and water resources. During drought years, especially in the arid regions, crop farming is uncertain due to erratic and low rainfall since it could not provide adequate employment to the people in this region. In that case, even in the normal years, some of the people migrate in search of livelihood in neighboring states. But during drought, situation gets worse, although relief measures provide temporary employment to the people but it is not sufficient, so women get employed and men go out in search of employment. Large number of people from arid region Although in normal years woman play a vital role in arid farming system, during drought years, women work as labour under relief schemes.

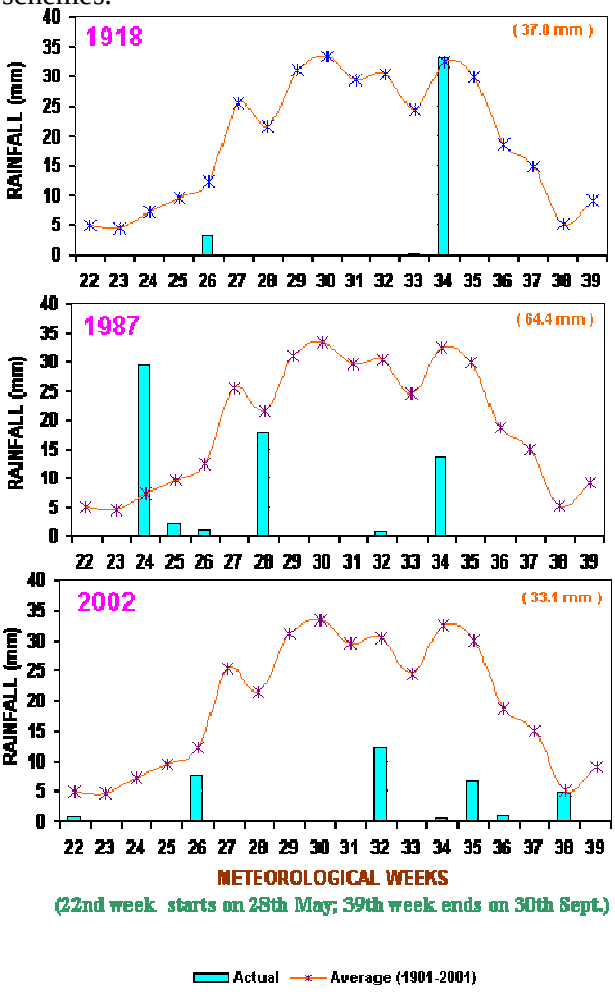

Fig.1 Weekly rainfall in *kharif* season during drought years at Jodhpur

Between 1901 and 2010 western Rajasthan experienced 58 moderate to severe droughts. There were five occasions when drought occurred in successive years: 1903-05, 1957-60, 1966-71, 1984-87 and 1998-2000. Droughts of 1918, 1987 and 2002 were most severe, when rainfall departure from the normal

was -81, -65 and -70 per cent, respectively (Fig. 1). The 2002 drought during July in India was unique with reference to its climate anomalies, their impacts as well as the institutional responses. However, the country was equipped with better coping mechanism. The month of July, normally expected to be wettest month turned out to be the driest in the recorded history since 1877 causing a loss of around 24 million tonnes of foodgrain reported across the country. The estimated crop loss works out to be Rs 240 thousand crores.

Impact of drought on crop production: Drought considerably influence production, the reduction in food grain production depending upon the severity of the drought. The effects of failure of rains on decline in food production depend upon the stage and the water requirement of the crop (Rao 1997; Rao *et al*., 1997). Based on the historical record of India, drought and famine were reported in 120 years between 1291 and 1979 (Jaisal and Kolte 1981. About 34 severe drought/famine were reported during 1769 and 2003. Among them were 1877, 1899, 1908, 1987 and 2002 were of most devastating in nature. The study for arid Rajasthan indicated that out of 106 years (1901-2010), the region experienced agricultural drought in one part or the other in 49 to 60 years, which suggest drought occurs in the region once in three years to alternate year (Table 1). These droughts were assessed not only on quantum of rainfall but also based on its distribution

Table 1: Frequency of agricultural droughts in the western Rajasthan (1901-2010)

District	Moderate drought	Severe drought	Total drought years
Barmer	20	30	50
Bikaner	25	23	48
Jaisalmer	27	43	70
Jodhpur	28	17	45

Frequent drought cause server distress to human, livestock crops and agricultural development and socio-economics of people. Rise in prices, reduced activity in trade and social activities. Drought in 2000 spread in 12 states affecting about 100 million human and 60 million livestock population in the country.

The districts of Jaisalmer, Barmer, Bikaner and Ganganagar have the maximum probability of drought recurrence in one place or the other even in good rainfall years. Production of pearl millet during *kharif* is reduced by 10-30% during mild drought, 35-60% during moderate drought and 75-90% during severe droughts. Surface water availability also declined during drought years with the drought severity creating drinking water problem. Fodder scarcity which is shorter by 20-30% of the demand during normal years, touches 80-100% during severe droughts. Consequently, large-scale animal and human population migration for food, fodder and water, as was the practice also reduced due to better management of drought and resistance from neighbouring states which were earlier more open to irrigation (Plate 1).

Human population migration for food and fodder during drought period in Rajasthan

CONCLUSION

Droughts in India occur more frequently in arid and semi-arid regions. The arid areas are almost subjected to permanent droughts and semi-arid areas are likely to be subjected to intermittent droughts. Therefore, the drought management strategies have to be identified separately both for arid and semi arid areas. Arid region is the home of drought, it will occur in the region in one or another part, with varying severity. Drought preparedness is required at all levels including Government, Society and Individual. Long-term forecast of monsoon /drought has always an element of uncertainty. However, highly advanced forecasting system of IMD and term forecasts of NCMRWF and IAAS drought mitigating technologies developed by the CAZRI and other research institutions with adequate infrastructure and funding information technology has equipped better now to face drought than before. Between 1901 and 2010

western Rajasthan experienced 58 moderate to severe droughts. There were five occasions when drought occurred in successive years: 1903-05, 1957-60, 1966-71, 1984-87 and 1998-2000. Droughts of 1918, 1987 and 2002 were most severe, when rainfall departure from the normal was -81, -65 and -70 per cent, respectively. The 2002 drought during July in India was unique with reference to its climate anomalies, their impacts as well as the institutional responses. However, the country was equipped with better coping mechanism. The districts of Jaisalmer, Barmer, Bikaner and Ganganagar have the maximum probability of drought recurrence in one place or the other even in good rainfall years. Production of pearl millet during *kharif* is reduced by 10-30% during mild drought, 35-60% during moderate drought and 75-90% during severe droughts. Surface water availability also declined during drought years with the drought severity creating drinking water problem. Fodder scarcity which is shorter by 20-30% of the demand during normal years, touches 80-100% during severe droughts. Consequently, large-scale animal and human population migration for food, fodder and water, as was the practice also reduced due to better management of drought and resistance from neighbouring states which were earlier more open to irrigation.

Strategy of drought proofing requires

- Collection of long-term oceanographic and meteorological data and their interpretation for development of forecasting model for monsoon/drought.
- Integration of remote sensing data with meteorological data for refinement of prediction /monitoring of drought models on regional as well as local scales.

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