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A STUDY OF DROUGHT SITUATION IN EL-NIÑO YEARS OVER CENTRAL INDIA HOMOGENEOUS REGION

1. Maximum amount of rainfall in Central India is received during the summer monsoon (June - September) season. Walker Gilbert (1924 & 1928) pointed out the out-of-phase pressure relationship in the south Pacific/ South American region with the Indonesian/Indian Ocean region. Bjerkenes (1969) suggested that the Southern Oscillation (S.O.) had a role in the redistribution of heat sources and sinks in the equatorial region which in turn influenced the related general circulation over the Indo-Pacific region. Sikka (1980) first suggested that during El-Nino year's Indian monsoon performed below normal. Mooley and Paolino (1989) found that the response of Indian monsoon was associated with the changes in sea surface temperature over the eastern south equatorial Pacific. Mooley (1997) suggested that El-Nino also influenced the occurrence of rainfall over India. Walker and Bliss (1932) had also found that drought in India tended to occur with S.O.

1.1. In the present paper an attempt to find out impacts of El-Nino events on the homogeneous region rainfall in India for the Central Indian region is considered. Central Indian region consists of Gujarat, Madhya Pradesh, Maharashtra, Goa, Chhattisgarh and Orissa.

2. For this purpose**,** the rainfall data of monsoon season (June- September) for the homogeneous region of

TABLE 1

Difference of monsoon rainfall received between El-Nino and La-Nina years over Central India Homogeneous Region (period 1901-2009)

Events	Number of years	Mean rainfall (mm)	Standard Dev. (mm)	'*t*' value	Significant .05 per cent level	Significant .01 per cent level
El-nino	26	886.2	116.1	3.83	S*	S
La-nina	22	1018.4	119.2			

*Significant

TABLE 2

Difference of monsoon depressions formed between El-Niño and La-Niña years in both Bay of Bengal and Arabian Sea (period 1901-2009)

Events	Number of years	Mean rainfall (mm)	Standard Dev. (mm)	'*t*' value	Significant .05 per cent level	Significant .01 per cent level
El-nino	26	8.5	2.6	1.83	NS**	NS
La-nina	22	7.5	3.3			

** NS: Non-Significant

TABLE 3

Difference of tropical storms formed between El-Niño and La-Niña years in both Bay of Bengal and Arabian Sea (period 1901-2009)

Events	Number of years	Mean rainfall (mm)	Standard Dev. (mm)	'*t*' value	Significant .05 percent level	Significant .01 percent level
El-nino	26	2.2	1.3	0.61	NS	NS
La-nina	22	2.0	0.9			

** NS : Non-Significant

TABLE 4

Percentage of distribution of rainfall in category wise during El-Niño and La-Niña over Central India Homogeneous Region (period 1901-2009)

Region Central India	Rainfall in Monsoon Season (%)	Rainfall in Monsoon Season (%)
Category of Rainfall	El- Niño Year	La- Niña Year
Excess	0	0
Above Normal	16 %	59 %
Below Normal	84 %	41 %
Drought	20%	5%
Moderate Drought	8%	0
Severe Drought	0	0

Central India is considered. Rainfall data of monsoon and percentage departure from normal (June- September) of the years (1901-2009) are taken from website (2010) of India Meteorological Department. A list of El-Niño (26 years) and La-Niña (22 years) during 109 years is prepared. The percentage of departure from normal is considered and it classified as severe drought-with rainfall deficiency exceeding 50 %, moderate drought-with rainfall deficiency between 26 -50 %, drought-deficient with rainfall 20% or more and excess-rainfall more than 20% as normal. These events are checked; whether, it lies in El-Nino and La-Nina years. The position of rainfall in El-Niño and La-Niña years is compared by '*s*' test. The number of formation of monsoon depressions and tropical storms are also found out from publication of India Meteorological Department (1979) and from the Journal MAUSAM of India Meteorological Department (1971-2009).

3. Table 1 revealed that difference of monsoon rainfall between El-Niño and La-Niña years over central India. It is found that '*t*' value is significant at both the level of confidence. It meant that rainfall over India in El-Niño and La-Niña years differed in significantly. It is also noted that mean value of monsoon rainfall in La-Niña years is greater than El-Niño years.

Table 2 revealed that difference of number of monsoon depressions formed between El-Niño and La-Niña years in Bay of Bengal and Arabian Sea. It is found that '*t*' value is not significant at both the level of confidence. It meant that number of monsoon depressions formed in El-Niño years and La-Niña years did not differ in formation of monsoon depressions in the Bay of Bengal and the Arabian Sea. Also, from Table 3, there is no significant difference between El-Nino and La-Nina years with respect to incidence of tropical storms.

4. In the light of above analysis the following conclusions are drawn :

(*i*) It has been observed that La-Niña years gave good rainfall over Central India as compare to El-Niño years. This is similar to what happens for All India monsoon rainfall as brought out by earlier studies.

(*ii*) There exists no significant difference in formation of monsoon depressions and tropical storms between El-Niño and La-Niña years.

(*iii*) 20 % droughts and 8% of moderate droughts occurred in El-Niño years. Also, no severe drought (excess rainfall) occurred in La-Niña (El-Nino) years. Excess rain did not occur in La-Niña years over central India (Table 4).

(*iv*) Preponderance of occurrence of below normal (above normal) rainfall in El-Niño (La-Niña) years.

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References

Bjerkenes, J., 1969, "Atmospheric teleconnections from the equatorial Pacific", *Mon. Wea. Rev*., **97**, 163-172.

India Meteorological Department, 1979, "Tracks of Storms and Depressions in the Bay of Bengal and the Arabian Sea (1877-1970)", IMD, New Delhi, pp.(vi-vii).

India Meteorological Department, 1971-2009, "Cyclones and Depressions over the Indian Sea and Neighborhood," *Mausam*, 1971 - 2009, Vol., (1-4).

Mooley, D. A. and Paolino, D. A., 1989, "The response of Indian monsoon associated with the changes in sea surface temperature over the eastern South equatorial pacific", *Mausam*, **40**, 4, 369-380.

Mooley, D. A., 1997, "Variation of summer monsoon rainfall over India in El-Nino", *Mausam*, **48**, 3, 413-420.

Sikka, D. R., 1980, "Some aspects of the large scale fluctuations of summer monsoon rainfall over India in relation to fluctuations in the planetary and regional scale circulation parameters", Proceeding Indian Academy Science (*Earth Planet. Sci.*), **89**, 2, 179-195.

Walker, G. T., 1924, "Memoirs of the Indian Meteorological Department", **24**, 275.

Walker, G. T., 1928, "*Quarterly Journal of Royal Meteorological Society*", **54**, 79.

Walker, G. T. and Bliss, E. W., 1932, "World weather V. memories", *Royal Met. Society*, **4**, 53-84.

Website, 2010, "http://www.imd.gov.in" India Meteorological Department", New Delhi.

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