

Short communication

El-niño impact on rainfall and food grain production in Chhattisgarh

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El Niño is fundamentally a warming of the surface waters of the tropical eastern Pacific Ocean from South America coast to the international date line and normally occurs around Christmas and usually lasts for a few weeks to a few months. Sometimes an extremely warm event can develop that lasts for much longer time periods. In general, it is believed that the El Niño event would result in below normal rainfall during southwest monsoon and loss of food grains production of the country. There have been many studies on impact of El Niño events on monsoonal rainfall at national level (Krishnamurthy and Goswami 2000; Pai 2003; Kane 2005). Keshavamurthy (1982) concluded that there was no one to one relationship as El Niño years have not always produced severe droughts.

Studies on El Niño and its subsequent implications on rainfall pattern and agricultural production are meager at state and district level. Victor *et al.*, (1995) and Sudheesh *et al.*, (2004) studied relationship between El Niño / SST and monsoon rainfall over Andhra Pradesh and Kerala, respectively. Case studies belong to particular state like Andhra Pradesh and Gujarat was conducted on the implications of El Niño episodes on crop production or productivity at district level (Rao *et al.*, 2011 and Patel *et al.*, 2014). In the light of above, the present study attempted to find out the effect of El Niño on seasonal and annual rainfall at district level as well as implications of different categories of warm episodes on crop acreage, production and productivity of Chhattisgarh State.

District-wise monthly rainfall data (1951–2012) for the state of Chhattisgarh was obtained from India Meteorological Department, Pune. Area, production and productivity of total food grains (includes rice, wheat, coarse cereals, total pulses) was collected from CMIE (Centre for Monitoring Indian Economy, Mumbai) database for the period 1971-2001 and data for the period 2002-2012 was downloaded from the website of Department of Agriculture

and Cooperation, Ministry of Agriculture, Govt. of India (<http://agricoop.nic.in/Agristatisticsnew.html>).

The El Niño years were classified from 1951 to 2010 as follows (Jan Null, 2011)

Intensity	Years
Weak	1951,1963,1968,1969,1976,1977,2004,2006
Moderate	1986,1987,1994,2002
Strong	1957,1965,1972,1982,1991,1997,2009

Annual rainfall during El Niño years

District-wise percent change in annual rainfall during all El Niño years irrespective of its intensity (Table 1). It can be seen that during all El Niño years, there is negative departure of annual rainfall in the range of -1 per cent to -10 per cent in different districts of the State. However, there is positive deviation in Kanker district of about 1 per cent. In strong El Niño years, negative deviation in rainfall of -3 per cent (Jashpur) to -21 per cent (Dantewada) was observed. Therefore, it is clear that during strong El Niño years, significant reduction in rainfall during the major crop growing season will be experienced. In moderate El Niño years, rainfall pattern was found to be random. In Koriya district +14% positive deviation while in Dantewada negative deviation to the tune of 10 per cent were recorded. In weak El Niño years, the feature remains the same with a combination of positive and negative deviations. Mahasamund and Dantewada district showed positive deviation of 13 per cent while Janjgir-Champa showed negative deviation of 11 per cent.

Effect of El Niño on food grain production

It is observed that during the five strong El Niño years combined production of pulses and cereals has declined by about 13 per cent on an average while average yield has declined by about 8 per cent and the effect was also noticed

Table 1 : District-wise per cent change in annual rainfall (mm) during all El Niño and strong, moderate and weak El Niño years compared to average annual rainfall (1951-2012) in Chhattisgarh state

Districts	All El Niño years			Strong El Niño years			Moderate El Niño years			Weak El Niño years		
	Average Rainfall	El Niño years	% change	Average rainfall	El Niño years	% change	Average rainfall	El Niño years	% change	Average rainfall	El Niño years	% change
Raipur	1169	1073	-8	1169	981	-16	1169	1137	-3	1169	1122	-4
Durg	1114	1004	-10	1114	971	-13	1114	1022	-8	1114	1023	-8
Rajnandgaon	1159	1062	-8	1159	1017	-12	1159	1137	-2	1159	1065	-8
Kawardha	1000	945	-5	1000	876	-12	1000	1079	8	1000	930	-7
Mahasamund	1132	1119	-1	1132	961	-15	1132	1039	-8	1132	1276	13
Dhamtari	1113	1069	-4	1113	1008	-9	1113	1073	-4	1113	1121	1
Kanker	1345	1365	1	1345	1172	-13	1345	1516	13	1345	14559	8
Bilaspur	1197	1127	-6	1197	1003	-16	1197	1228	3	1197	1185	-1
Korba	1396	1333	-4	1396	1265	-9	1396	1431	2	1396	1360	-3
Janjgir champa	1265	1151	-9	1265	1051	-17	1265	1375	9	1265	1126	-11
Raigarh	1352	1247	-8	1352	1154	-15	1352	1345	-1	1352	1279	-5
Chhattisgarh Plain Zone	1204	1136	-6	1204	1042	-13	1204	1217	1	1204	2368	-2
Jashpur	1535	1478	-4	1535	1486	-3	1535	1707	11	1535	1414	-8
Koriya	1212	1115	-8	1212	964	-20	1212	1378	14	1212	1093	-10
Surguja	1300	1285	-1	1300	1249	-4	1300	1465	13	1300	1228	-6
Northern Hills Zone	1349	1293	-4	1349	1233	-9	1349	1517	13	1349	1245	-8
Bastar	1479	1466	-1	1479	1288	-13	1479	1585	7	1479	1561	6
Dantewada	1340	1284	-4	1340	1061	-21	1340	1200	-10	1340	1520	13
Bastar Plateau Zone	1410	1375	-3	1410	1175	-17	1410	1393	-2	1410	1541	10

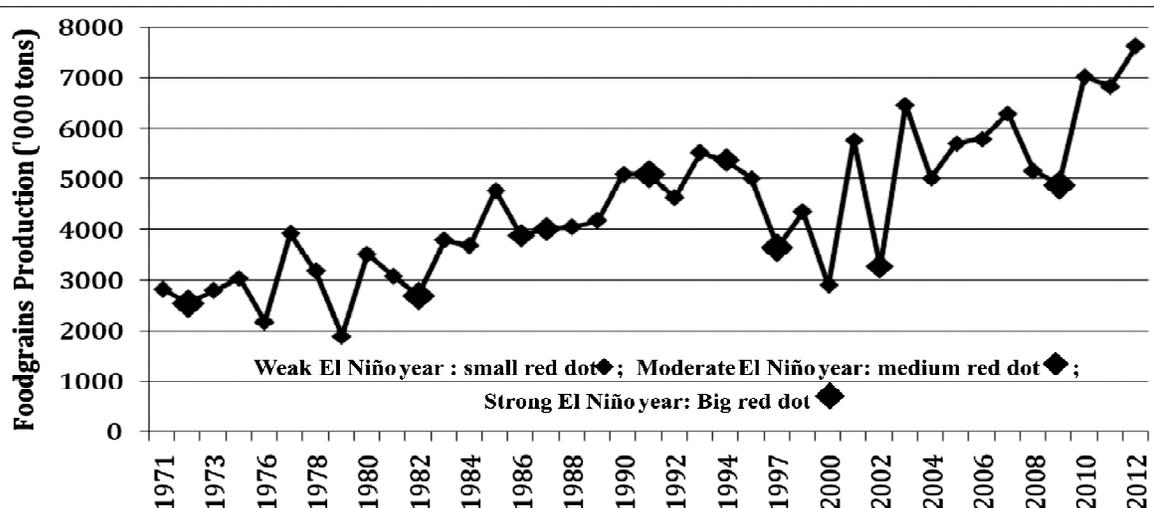


Fig. 1 : Variation in food grain production* during 1971-2012 in Chhattisgarh

* Food grain production means total production of rice, wheat, coarse cereals and total pulses.

Table 2 : Effect of different intensities of El Niño (strong, moderate, weak) on area, production and productivity of major food grain crops in Chhattisgarh state

Type of El Niño year	Area ('000 ha)	% change	Production ('000 tons)	% change	Yield (kg ha ⁻¹)	% change
Weak	4699	1	4233	-3	880	-4
Moderate	4920	5	4142	-5	862	-6
Strong	4375	-6	3782	-13	848	-8
All	4642	-1	4032	-8	862	-6

on crop acreage as it has been affected to the tune of 6 per cent (Table 2). Likewise, during 1997-98 warm episode which is defined as “the climate of the century” the state food grains area, production and productivity plummeted by 5, 16 and 10 percent, respectively. Decrease in acreage in different years ranged between -5 and -23 per cent. The recent strong El-nino 2009 resulted in increased area under foodgrains, its production and yield in the state of Chhattisgarh when compared to averaged values of area, production, yield of food grains of all strong El-nino years. Nevertheless, food grain production at national and state level declined by 7 and 5 percent when compared to previous year 2008 record.

In four moderate El Niño years, on an average there was increase in acreage by about five per cent, and highest reduction in acreage was noticed in the year 1994 by about 10 per cent. In this category, production loss has been about five per cent and the worst affected year was 2002, when loss in food grain production was about 25 per cent.

During weak El Niño years, on an average acreage of

cereals and pulses has increased by about 1% while production (cereals and pulses group) has declined by about 3%. Yield was affected to the tune of four per cent in this category. It is interesting to note that in the year 1976 which was a weak El Niño year on all India basis, Chhattisgarh region was affected severely even more than strong El Niño year of 1972. In 1976, production was affected by about 50 per cent and yield was affected by about 32 percent and loss in acreage was about 25 per cent. In the year 1977, though there was an increase in the area by about 10 per cent, there was a decline in production by about 10 percent in cereals and pulses and productivity by about 16 per cent. Therefore it is inferred from the analysis that there has been acreage loss by about 1 per cent in El Niño years and production loss in cereals and pulses group has been about 8 per cent while productivity loss has been about 6 per cent (Fig. 1).

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