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Research Article

Impact of El Nino and La Nina Episodes on Wheat Productivity in Punjab

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ABSTRACT

An analysis was carried out to study the impact of El-Nino and La-Nina on regional variability of rainfall (1980-2011) in Punjab. During the El-Nino year in Hoshiarpur, Patiala, Ludhiana, Sangrur, Gurdaspur, Amritsar and Bathinda in which no significan impact on wheat yield was observed. During La-Nina years Hoshiarpur, Patiala, Ludhiana, Sangrur, Gurdaspur, Amritsar and Bathinda in which yield was more then 60% chances are higher compared to average. Overall results the El-Nino and La-Nina episodes not much more effect to wheat yield in Punjab because there less dependency on monsoon, artificial irrigation and other water resources are available.

Keywords: *El-Nino and La-Nina, Rainfall, Yield, Impact*

INTRODUCTION

The inter-annual monsoon rainfall variability in India leads to large-scale droughts and floods, resulting in a major effect on Indian foodgrain production (Parthasarathy and Pant 1985; Parthasarathy et al., 1992) and on the economy of the country (Gadgil et al., 1999). The relationship between the El- Nino southern oscillation (ENSO) and variations in Indian summer monsoon rainfall (SMR) has been demonstrated by many studies (Sikka, 1980; Pant and Parthasarathy 1981; Bhalme et al. 1984. During the warm ENSO phase, the total food grain production frequently decreased (12 out of 13 years) by 1 to 15%. In 10 out of 13 cold ENSO-phase years, the total food grain production increased from normal. The relationship between the SST-based NINO3 ENSO index and the kharif season (June-September) food grain production anomalies (r=-0.52) was greater than for the rabi season (October-February) food grain production (r=-0.27). The ENSO impact on rice production was greatest among the individual crops. The average drop in rice (kharif season crop) production during a warm ENSO-phase year was 3.4 million tonnes (7%). In a cold ENSO-phase year the average production increase was 1.3 million tones (3%).

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Wheat (rabi season crop) production was also influenced by ENSO, as it depends on the carryover soil water storage from the kharif season. Sorghum and chickpea production are not significantly influenced by ENSO extremes. Inter-annual fluctuation of the gross value of Indian food grain production was very large, reducing up to US$2183 million in a warm ENSO year and increasing up to US$1251 million in a cold ENSO year. On average, a warm ENSO year costs US$773 million and a cold ENSO year had a financial gain of US$437 million from normal. The cumulative probability distributions of food grain production anomalies during cold and warm ENSO phases are shifted positively or negatively, relative to the neutral distribution. The warm ENSO forcing significantly (1% level) reduced the probability of above-average production. The cold ENSO forcing moderately increased the above-average food grain production over the neutral ENSO phase (5% level). A simple conditional probability forecast based on annual and JJA NINO3 SST predicted the category of food grain production in 11 of the 14 years.

MATERIALS AND METHODS

The state of Punjab state receives rainfall ranging from 1000 to 1100 mm in the northern part of Punjab and less than 400 mm extreme in south western Punjab. The Punjab state is divided in 5 agro climatic zones-1. Central plain zone 2. Sub-mountain Undulating Zone 3. Undulating Plain Zone 4. Western Plain Zone 5. Western Zone. The climate is generally very hot in summers and remarkably cold in winters. High temperatures of 45°C magnitude is recorded during the month of May in most parts of the sub-divisions, whereas, in winters the temperature goes down to –2 to –3°C for a few days

The rainfall data of past 31 year were collected from school of climate change and agricultural meteorology, India Meteorological Department, Statistical Abstracts, Website of CRIDA.

The historical crop production data was be collected from the statistical abstract of India and Indiastat.com and other available sources.

The data and other information related with the *El Nino* and *La Nina* episodes was collected from Climate Analysis Center of NOAA and other agency/secondary sources where data is available.

The relationship of *El Nino*, *La Nina* year has been analysed on the basis of excess or deficit rainfall, the productivity of wheat was assessed on the basis of *El Nino*, *La Nina* year.

RESULT AND DISCUSSION

Hoshiarpur

During the periods from 1980-2011, in which total of 10 *El Nino* year (1982, 1986, 1987, 1991, 1994, 1997, 2002, 2004, 2006, 2009) were reported. Out of the 10 years, a yield lower than the average has been observed in 5years and another 5 years were the higher yield than the average. On the other hand during the *La Nina* years a total 12 years (1983, 1984, 1988, 1995, 1998, 1999, 2000, 2005, 2007, 2008, 2010, 2011) were observed where in lower than average yield and higher than average yield years were categorised for 50 percent time span (6years each).

Patiala

In Patiala during the periods of 1980-2011 in which 10 *El Nino*, yield was lower /higher than the average yield for 5 years each. During the *La Nina* year from 1980-2012, a total of 4 times lower and other 8 year higher yield has been reported compared to average yield.

Ludhiana

Out of 10 *El Nino* years in Ludhiana, 5 years recorded lower and 5 higher yield as compared to average yield. *La Nina* during the period of 1980-2011, out of 12 years, 6 lower and 6 higher yield years has been reported compared to average yield.

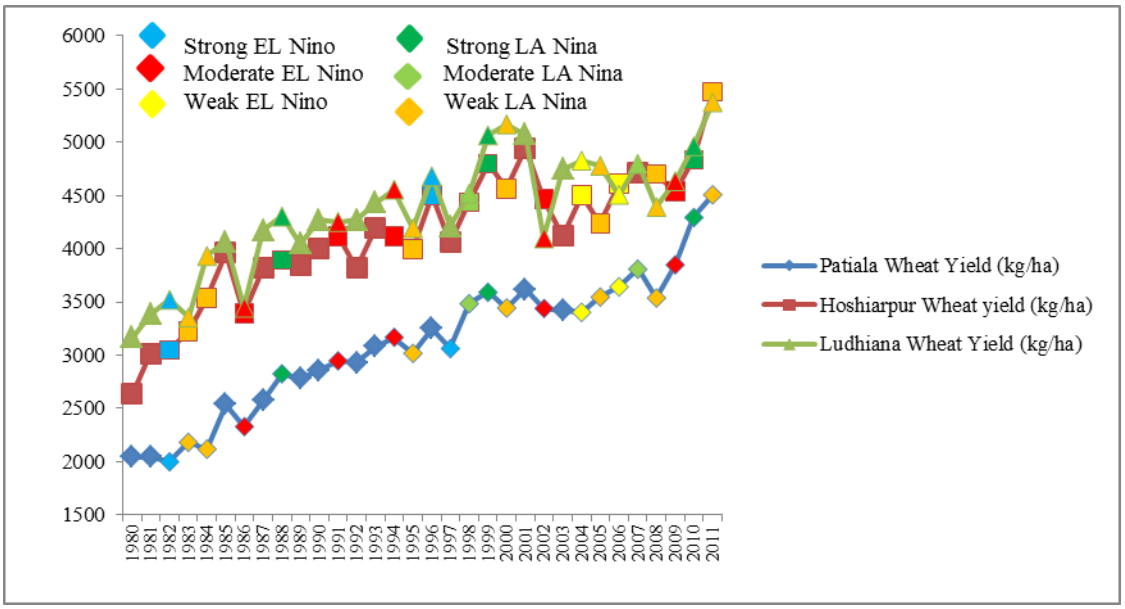

Fig. 4.19 Impact of EL-Nino, LA-Nina on wheat productivity in Patiala, Hoshiarpur & Ludhiana

Sangrur

During the periods from 1980-2011 in which total 10 *El Nino* years *El Nino* were reported in which 4 years lower yield and 6 years higher yield received compared to average yield (4259 kg/ha). On the other hand total 12 *La Nina* years were reported during 1980 to 2011 in which 5 years lower yield and other 7 years higher yield was reported as compared to average yield.

Gurdaspur

During the *El Nino* years from 1980-2011 in which total 10 years in which 5 years lower and other 5 years higher yield has been reported as compared to average yield (3625 kg/ha). Similarly in *La Nina* years total 12 in which 4 years lower and another 8 years higher yield has been reported compared to average yield.

Amritsar

During the period from 1980-2011 in which 10 *El Nino* year were reported in which 5 years lower and other 5 years higher yield has been reported compared to average yield (3918 kg/ha). During the *La Nina* year of 12 in which 2 years lower yield and other 10 years higher yield has been reported compared to average yield.

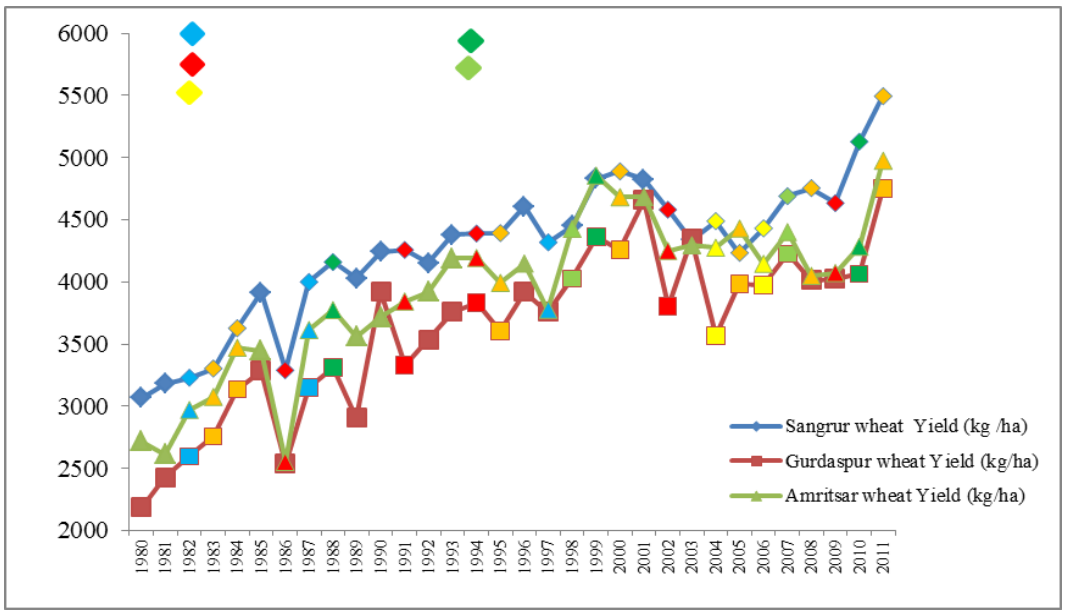

Fig. 4.20 Impact of EL-Nino, LA-Nina on wheat productivity in Sangrur, Gurdaspur & Amritsar

Bathinda

During the period from 1980-2011 in between 10 *El Nino* year was reported in which 6 lower and 4 higher yield has been reported compared to average yield (3728 kg/ha). *La Nina* year which 5 times lower yield and 7 times higher yield has been reported compared to average yield.

Faridkot

During the period from 1980-2011 in between total 10 times *El Nino* year was reported which 6 times lower and other 4 time higher yield has been reported compared to average yield (3967 kg/ha). *La Nina* similarly during this period 3 times lower and 9 times higher yield has been reported compared to average yield.

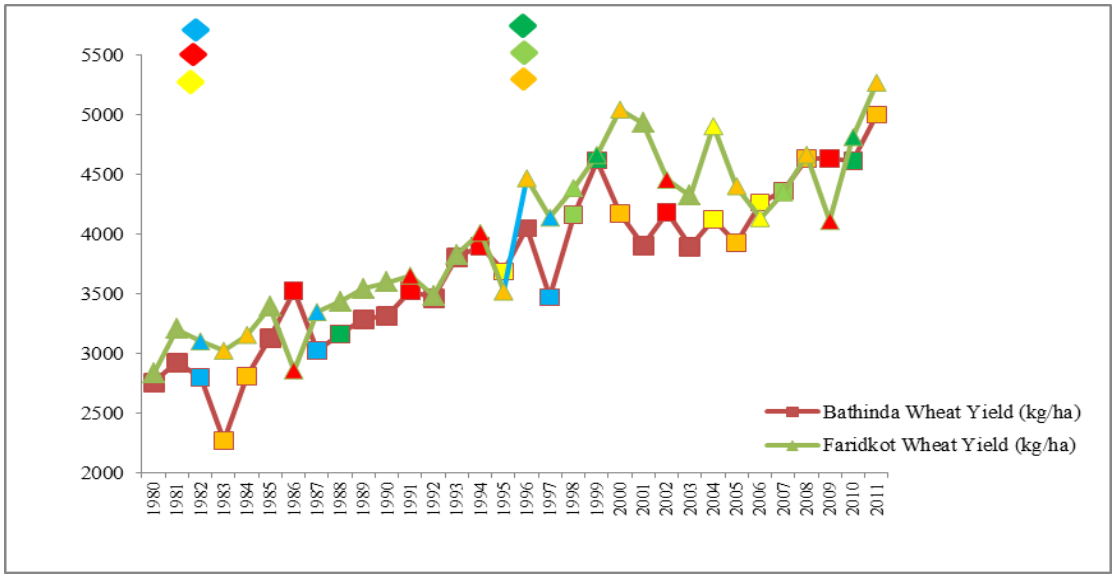

Fig. 4.21 Impact of EL-Nino, LA-Nina on wheat productivity in Bathinda & Faridkot

Jalandhar

During the period from 1980-2011 total 10 *El Nino* years was reported in which 6 years lower yield and other 4 years higher yield has been reported as compared to average yield (4026 kg/ha). During *La Nina* years total 12 years in which 3 times lower yield another 9 years higher yield has been reported compared to average yield.

Kapurthala

During the period from 1980 to 2011 total 10 *El Nino* years was reported in which 5 years lower yield and another 5 times higher yield has been reported as compared to average yield (3849 kg/ha). Similarly during *La Nina* years 12 times in which 5 years lower and another 7 yeras higher yield has been reported compare to average yield.

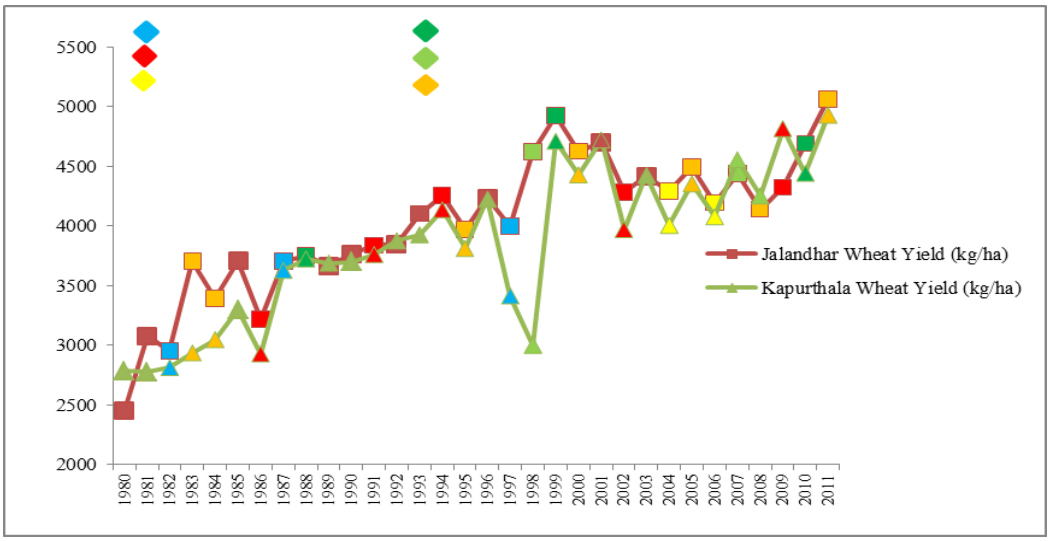

Fig. 4.22 Impact of EL-Nino, LA-Nina on wheat productivity in Jalandhar& Kapurthala

During the periods from 1980-2011, in which total of 10 *El Nino* year (1982, 1986, 1987, 1991, 1994, 1997, 2002, 2004, 2006, 2009) were reported. Out of the 10 years, a yield lower than the average has been observed in 5years and another 5 years were the higher yield than the average. On the other hand during the *La Nina* years a total 12 years (1983, 1984, 1988, 1995, 1998, 1999, 2000, 2005, 2007, 2008, 2010, 2011) were observed where in lower than average yield and higher than average yield years were categorised for 50 percent time span (6years each).

In Patiala during the periods of 1980-2011 in which 10 *El Nino*, yield was lower /higher than the average yield for 5 years each. During the *La Nina* year from 1980-2012, a total of 4 times lower and other 8 year higher yield has been reported compared to average yield.

Out of 10 *El Nino* years in Ludhiana, 5 years recorded lower and 5 higher yield as compared to average yield. *La Nina* during the period of 1980-2011, out of 12 years, 6 lower and 6 higher yield years has been reported compared to average yield.

During the periods from 1980-2011 in between 10 times *El Nino* year was reported of which 4 times lower and 6 time higher yield received compared to average yield of Sangrur (4259 kg/ha). On the other hand 12 *La Nina* during the period 1980-2011were reported of which 5 has lower and 7 times higher yield was reported as compared to average yield.

During the period 1980-2011 in which 5 times lower and other five times higher yield has been reported as compared to average yield (3625 kg/ha). Similarly in *La Nina* years 4 times lower and 8 times higher yield has been reported compared to average yield of Gurdaspur.

During the period from 1980-2011 in which 10 *El Nino* year were reported in which 5 times lower and other 5 times higher yield has been reported compared to average yield (3918 kg/ha). During the *La Nina* year of 12 times, 2 times lower and other 10 times higher yield has been reported compared to average yield.

CONCLUSION

The period of 31 years (1981-2011) in which 10 *El Nino* year were reported in which 5 times lower and other 5 times higher wheat yield has been reported compared to average yield. During the *La Nina* year of 12 times, in which 8 time higher and 4 time lower wheat yield has been reported compared to average yield. The El-Nina are not effect to wheat yield but La-Nina increase the wheat yield.

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