El Nino, Monsoon and North Eastern Agriculture

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The El Nino

El Nino is a Spanish word, means 'The Child'. It is said so because of its appearance during the Christmas time. El Nino is defined by prolonged warming in the Pacific Ocean sea surface water temperatures when compared with the average value. The warming is of at least 0.5 °C averaged over the east-central tropical Pacific Ocean. This anomaly happens at irregular intervals of 2-7 years, and lasts for 9 months to 2 years. This phenomenon was first discovered by Dr. Luiz Canaza in 1891.

Sir Gilbert Walker (Head of Indian Meteorological Service, 1904-26) in 1920 discovered a see-saw pattern of air pressure between Pacific and Indian Ocean. When the air pressure was high over the southern pacific, it was low over Indian Ocean. But once in every few years the pattern was reversed. Sir Gilbert named it as Southern Oscillation. Later on it was found that Southern Oscillation occurs in tandem with appearance of El Nino. In view of the close relationship between El Nino and Southern Oscillation, the two are jointly refereed as ENSO event.

There are three different categories of El Nino depending on the intensity of Oceanic Neno Index (ONI). They are Strong (Intensity: ≥ 1.5), Moderate (>1.0 to 1.5) and Weak (>0.5 to 1.0) El Nino. Based on ONI, the World Meteorological Organization (WMO) has demarcated 1952-53, 1953-54, 1958-59, 1969-70, 1976-77, 1977-78, 2004-05 and 2006-07 as Weak El Nino years, 1951-52, 1963-64, 1968-69, 1986-87, 1991-92, 1994-95, 2002-03 and 2009-10 as Moderate El Nino years and 1957-58, 1965-66, 1972-73, 1982-83, 1987-88, 1997-98 as Strong El Nino years.

The Monsoon

The term 'Monsoon' was derived from an Arabic word 'Mausim', means 'the season'. What we are discussing here is about Indian monsoon in general and South West Monsoon in particular. It is a seasonal wind mostly regulated by the revolution of Earth around the Sun. The South East trade wind in the Southern Hemisphere crosses the equator and under the influence of Corriolis force turns south west in the Northern hemisphere. This is a very persistent seasonal trade wind, which reverses its direction with apparent movement of Sun very routinely. The Indian industry, economy, hydrology, agriculture and civilization in general are greatly influenced by the behaviour of monsoon every year. There are several factors that govern the movement of south west monsoon over India. These are: The heat low over North West India, Pakistan and Afghanistan during March to May, Near equatorial troughs and the Mascarenes High, Subtropical westerly and tropical easterly jet streams, high pressure over Tibet and change in kinetic energy of wind over Arabian sea.

The official date of arrival of south west monsoon at the coast of Kerala is 1st June. It has two branches- Arabian Sea branch and the Bay of Bengal branch. The later is the most powerful branch and that reaches North East India by 5th June. Due to orographic effect produced by

North Eastern hills, the monsoon wind turn towards the west and moves along the foot hills of Himalayas pulled by the intense low pressure system exists over North West India. Due to it extensive rainfall occurs in North East India, Bengal, Bihar, Jharkhand, MP and UP. Monsoon reaches Delhi by 27th June and covers the entire country (including Gujarat and Rajasthan) by 15th July. The country receives major share (>60%) of its total annual rainfall of 120 cm during from South West monsoon. South west monsoon starts retreating by 15th September from Rajasthan, and by 15th November it completely retreats from the Indian sub-continent.

Connection between El Nino and south west Monsoon

Air pressure is always inversely related with rainfall. As we discussed above, air pressure over Southern Pacific and Indian Ocean are interrelated. If a low pressure zone is existed over Indian Ocean during winter months, it is always indicates a good monsoon in the next year over India. But during El Nino years the trend reverses and that results in a poor or indifferent monsoon in the succeeding year.

The affect of El Nino in India are manifested through abnormal behaviour of monsoon. They may be increased/decreased precipitation amount & intensity, late arrival/early withdrawal of monsoon rain, long dry spell during crop season, increased frequency of torrential rain leading to flash flood, a milder than normal winter, influences cyclonic development and occurrence of abnormally high temperature in some part of the season.

Our research findings have suggested that under Strong and Moderate El Nino years arrival of monsoon delay by av. 4.7, and 0.4 days, respectively, from official date (1st June) at the coast of Kerala. Where as, during Weak El Nino years monsoon arrival is advanced by on an average 3.5 days.

El Nino and occurrence of serious flood in Assam

Assam is a flood plain for the surrounding hills. We have found that El Nino years generally results in greater 'positive rainfall anomaly' in NE region. This means during El Nino years the region receives high to very high rainfall during June-September resulting in flash flood in the plains. Serious floods (affecting area of >10 lakh hectare) occurred in Assam during 1958, 1966, 1972, 1973 and 1988 were fell under Strong El Nino years. How ever, El Nino is not the sole reason for occurrence of flood in Assam. Flash floods are mainly caused by the high rainfall events (>75 mm received in a 24 hours) rather than total rainfall received in a given month or season.

El Nino and agriculture in North East India

Rice (upland/lowland) is the main crop grown during the kharif season in North East India. As it is dependent on rainfall, the receipt of summer (April, May) rainfall governs the nursery raising and land preparation and monsoon rainfall (starting with June) regulates the direct seeding or transplanting activities. The average kharif rice productivity of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Sikkim are 1174, 1254, 1978, 1319, 1297, 1220 and 1807 kg/ha, respectively, during the Non-El Nino years. But during Strong El Nino years the rice productivity got reduced by 7.2, 4.1, 11.5, 9.4, 23.7, 7.0 and 7.7%, respectively for the above mentioned states in the same order. But, in contrast to strong El Nino, Moderate & Weak El

Nino may have positive impact on kharif rice yield. Kharif rice recorded 1.4 (Mizoram) to 35.2% (Nagaland) yield increase during Moderate/Weak El Nino years. During Weak El Nino Assam, Manipur, Meghalaya and Sikkim registers 6.8, 21.2, 30.1 and 31.4% yield increase, respectively. The North Eastern region falls in a very high region, where the rainfall receipt usually exceeds the normal crop water requirement (Eg. 125 cm for kharif low land rice in its entire crop duration). The reduction in excessive rainfall and reduced number and intensity of flood may be the reason behind increase in kharif rice productivity in North Eastern states during Moderate/Weak El Nino years. Hence, except Strong El Nino, there is little worry of crop failure during Moderate and Non El Nino years in North East. During Strong El Nino years and from reduction in kharif rice productivity point of view the most vulnerable state of North East is Mizoram, followed by Manipur, Meghalaya, Tripura, Arunachal Pradesh, Nagaland and Assam in decreasing order of vulnerability.

El Nino possibility during 2014-15 and the cautions to be taken

The WMO has apprehended that 2014-15 is likely to be an El Nino year. As the El Nino is likely to start by the year end, hence there is little chance that kharif crops of 2014 are to be affected. But we have to look forward for next year i.e. 2015. However, the North Eastern region faced rainless winter in 2014, followed by deficit to scanty rainfall during summer (Mar-May). The pre-monsoon crops (Ahu, Maize, vegetables etc.) suffered from serious water stress and few spells of hailstorms severely damaged the standing crops. Land preparation and nursery raising were delayed by 15-20 days due to scanty May rainfall. The arrival of monsoon was late by 4 days (9 June) but the farmers are now taking up normal crop activities in their fields. In the mean time heavy rainfall in Assam and neighbouring Arunachal Pradesh caused 1st wave of flood in Lakhimpur, Darrang, Kamrup, Sonitpur and Udalguri districts of Assam causing damage to crops and properties.

Under such circumstances the farmers may be advised to:

(a) Go for preparation of community nursery and sow seeds of long/medium/short duration rice cultivars, which are flood/water stress tolerant, in sufficient quantity. At the time of need share the seedlings among the community members

(b) Grow flood tolerant rice cultivars in chronically flood prone areas

(c) Use harvested rain water or ground water from bore wells to provide life saving/supplemental irrigation in critical stages (active tillering, flowering, grain filling)

(d) To manage water stress repair the field bunds and do weeding as and when required

(e) Provide sufficient drainage in vegetable fields to avoid water logging

(f) Watch for pest/disease out break and consult agri-specialists (in KVK, state/district agricultural officials) for their effective management

(g) Keep your animal vaccinated, provide clean drinking water and do de-worming in regular interval

(h) Access Kisan Call Centres in toll free number 1800-180-1551 for suitable remedies of any agriculture related problem in local languages