UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific
Regional Integrated Multi-Hazard Early Warning System RIMES

Science and Policy Knowledge Series

Integration of Disaster Risk Reduction and Climate Change Adaptation into Sustainable Development

Advisory Note August 2014

EL NIÑO 2014/2015

POLICY IMPLICATIONS FOR ASIA AND PACIFIC

A. Context

El Niño, a weather phenomenon frequently associated with large-scale droughts, floods and storms, is likely to affect Asia and the Pacific during the second half of 2014 and in 2015. A recurrent weather/climate event that often lasts between one to one and a half years (refer to Box 1), El Niño does not follow a deterministic trend that clearly indicates its period of occurrence and intensity. However, stochastic models can predict the onset and intensity of El Niño. El Niño forecasts are now relatively precise having improved over past two decades.

For the year 2014-2015, there are predictions of El Niño by major scientific organizations worldwide. The forecasts indicate a 70 per cent probability of El Niño occurring during the Northern Hemisphere's summer and an 80 per cent probability during autumn or winter.[1, 2] However, the most recent forecast on 4 August 2014 highlights the probability of occurrence is close to 60 per cent from September 2014 to over 50 per cent in February 2015 (see Figure 1), which may have significant impacts in Asia and the Pacific due to the region's higher El Niño risk in the past. The climatological probability of El Niño also indicates higher values from September to December 2014. Agriculture has been the most exposed sector and therefore agrarian economies of the region will be most affected in the event of a 2014-2015

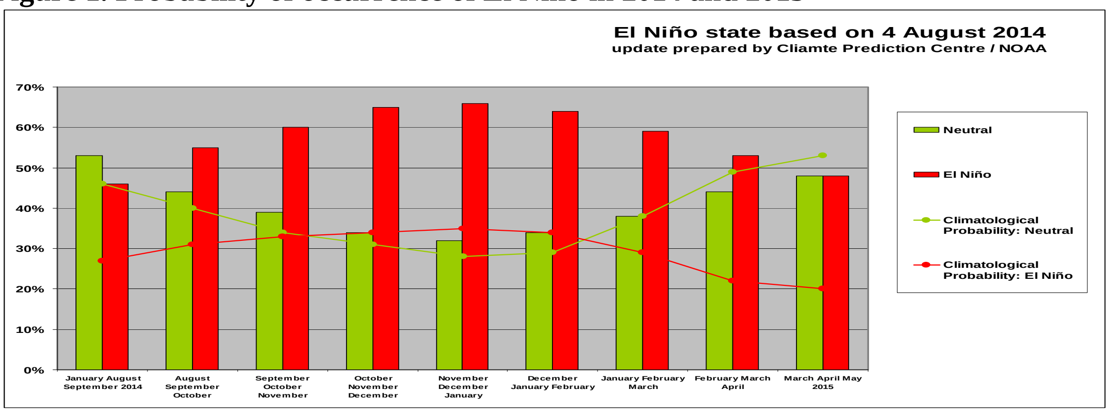
[1] International Research Institute for Climate and Society, Earth Institute, Colombia University, IRI, 5 June 2014, http://iri.columbia.edu/ourexpertise/climate/forecasts/enso/current/?enso_tab=enso-cpc_update

[2] Climate Prediction Center National Centers for Environmental Prediction NOAA/National Weather Service, NOAA, 5 June 2014 http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.pdf

El Niño. However, the precise effect on agriculture will depend on the timing and severity of the El Niño.

It is in this context that awareness among policymakers, as well as stakeholders in key sectors, needs to be raised to manage the potential risk of the 2014-2015 El Niño. Global, regional and national weather services have provided forecasts of the developing El Niño conditions in the Northern Hemisphere during Summer to Autumn 2014. These forecasts drew concern from policymakers - How will El Niño impact their economies? When? What can to be done to minimize the impacts? This Science and Policy Knowledge Series in its first advisory note examines the scientific evidence surrounding the 2014 -2015 El Niño event and analyzes the potential impact on agricultural production in two scenarios across the region in an attempt to address policymakers' concerns.

Figure 1. Probability of occurrence of El Niño in 2014 and 2015



Note: July August Sept –JAS 2014 to March April May -MAM 2015 with the peak ranging from October November December -OND 2014 to December 2014 January February 2015 – DJF

Source: IRI Earth Institute, Colombia University (http://iri.columbia.edu/our-expertise/climate/forecasts/enso/)

Box 1. What is El Niño?

The **El Niño Southern Oscillation (ENSO) cycle** is a periodic climatic phenomenon affecting different parts of the world in a variety of ways. El Niño refers to a warming of the central and eastern Pacific every three to seven years, which affects trade winds, in turn affecting the atmosphere and weather patterns. It can trigger more dryness or drought in some countries of Asia-Pacific, or more extreme rainfall or storm events. It can also be associated with more favourable conditions on occasion, such as more rain for crops.

The reverse cycle, called La Nina, involves a cooling of the central and eastern Pacific Ocean and can bring more favourable conditions to some countries of the region.

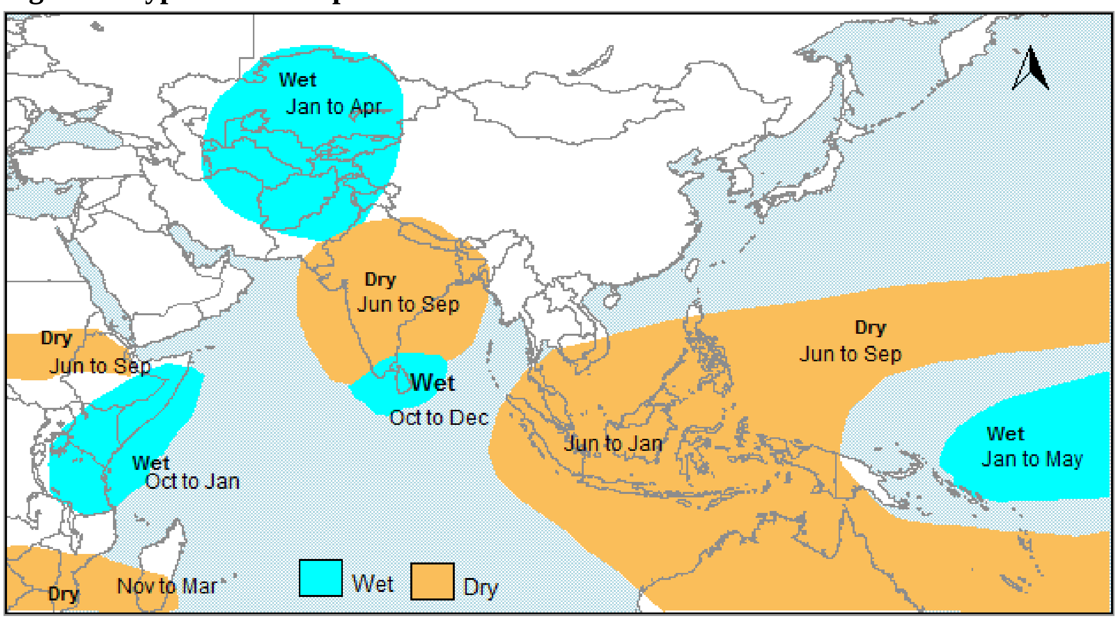
The ENSO cycle stretches across the globe and affects regions differently. As some countries of Asia and the Pacific experience greater dryness during an El Niño cycle, countries in Central and Southern America often see increased rainfall during the same period. The cycle and its climatic impact is complex however, so forecasts need to consider various local conditions.

B. Understanding El Niño Risk in Asia and the Pacific

Over the centuries, human systems have evolved to climatic variations to maximize the gains from beneficial periods while minimizing the risk of bad seasons. Human adaptation to these climatic variations is still not perfect though. Climate extremes, such as wide spread drought and devastating floods, could occasionally overwhelm societal coping capacities and reverse years of development gains. Understanding the key drivers of climate variability and predicting them in advance can help manage the risks associated with extreme climate events.

El Niño is a climatic phenomenon occurring in Asia and the Pacific every three to seven years due to the occasional warming of the central and eastern Pacific. It is linked with various extreme climatic events such as floods, droughts, forest fires, cyclonic storms and epidemics, but it impacts different sub regions in a variety of ways and at different points of time (see Figure 2).

Figure 2. Typical rainfall patterns associated with El Niño in Asia and Pacific



Source: IRI Earth Institute, Colombia University, http://iri.columbia.edu/our-expertise/climate/forecasts/enso/

While the incidence of low to moderate El Niño events have been frequent, one of the most severe was reported in 1997-1998. Indonesia, one of the hardest hit, saw drought leading to a cereal shortfall of over 3.5 million tons and large-scale environmental degradation due to forest fires which was made worse by drought conditions.[3] Mountain populations in Papua New Guinea had to move to lowlands where they contracted malaria at rates higher than normal. Food prices sky-rocketed as crops failed and households, particularly the most vulnerable, adopted erosive coping strategies such as the sale of livestock or seed stock.[4] In Fiji, the sugar production was the lowest in decades and rice crops failed completely. By October 1998, almost a third of the population required food supplies and roughly half

[3] El Nino in 1997-1998: Impacts and CARE's Response, June 1998
[4] El Nino in 1997-1998: Impacts and CARE's Response, June 1998

needed emergency water supplies.[5] During this period, some countries also experienced an increase in social problems such as absenteeism from school and ethnic strife.[6]

In the Pacific, South-East and South Asia, climatic risks are fairly consistent during El Niño events. Meanwhile, our understanding of the less consistent risk patterns in West, Central and East Asia is improving. While the proportion of the population employed in the agricultural sector has decreased over last a few decades, many people in the region are still dependent on agriculture for their livelihood. Furthermore, negative El Niño impacts not only effect those reliant on agriculture, but also cascade to other industrial and service sectors, specifically those reliant on agricultural inputs, servicing of the agriculture sector, or government programmes which need to provide social support during these times of hardship. Hence, El Niño associated risks are major concerns for livelihood protection and macroeconomic management for many countries of Asia and the Pacific region.

Though many countries of Asia-Pacific associate El Niño events with negative climate impacts, some countries actually benefit from increased rainfall during times that are favourable for agriculture. For example, Uzbekistan occasionally benefits from more rainfall for winter crops, resulting in improved production.

Recent advances in climate science have enhanced our capability to model ocean-atmosphere interactions and predict El Niño associated seasonal-to-inter-annual climatic variations from six months to one year in advance for different regions of the world. These forecasts have improved to the stage that various global, regional and national weather service organizations, release forecasts of El Niño to the public with the aim of informing decision makers of the potential risks or possible beneficial weather events.

The severe impacts of El Niño in Asia-Pacific from 1997-1998 served as a wake-up call for countries. Indonesia for example enhanced its capacity in terms of technical, institutional and response measures to reduce El Niño associated risks based on lessons learned from this event. Though subsequent El Niño events were not comparable to 1997-1998, there has been a resultant discernible reduction of impacts (refer to Box 3).

However, gaps exist between the potential value and actual use of El Niño forecast information due to technical, institutional and policy constraints. Technical constraints include lack of capacity to translate global El Niño forecasts into locally usable information. Institutional constraints include inadequate mechanisms and capacity to assess potential risks and communicate them to various stakeholders and communities at risk. Policy constraints include a lack of recognition that El Niño is a transboundary phenomenon leading to differential impacts across regions and seasons. Enabling national policies to evolve regional cooperation could address some of these constraints that require the integration of science and policy across borders and time.

---

[5] UNDAC Mission Report Fiji Drought 1998

[6] UNDAC Report 1997 1998, OCHA Regional Office for the Pacific (ROP) 2012

C. Regional Trends of El Niño Impacts

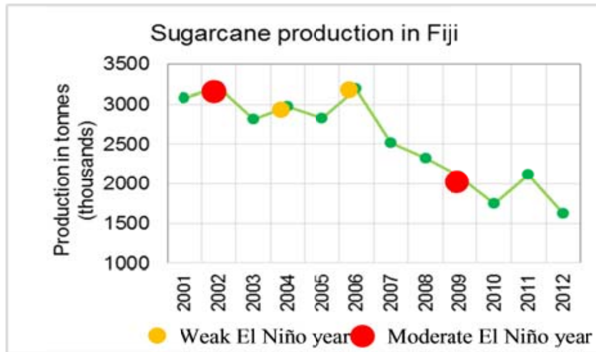
The relationship between past El Niño events and agricultural production across four of the subregions of Asia and the Pacific were analyzed. The analysis utilized time-series data of the production of a major food crop for that country, along with the agricultural GDP, to assess the fall in production and deviation in GDP attributable to each El Niño.

Pacific Islands: During previous El Niño years, the North-West Pacific islands from May to October have tended to experience suppressed rainfall while South-West islands received less rainfall between November and March.

Fiji's major crop is sugarcane which is sensitive to climate variability. Though El Niño is not the only factor affecting sugarcane production, El Niño associated losses seem to be evident from the fall in production in the subsequent year, as depicted in Figure 3.

The severe 1997-1998 event caused sugarcane production losses of more than 33 percent. The 2006-2007 episode registered a reduction of 21 percent, and the 2009-2010 event witnessed a production fall of over 16 percent.

Figure 3. El Niño impact on sugarcane production in Fiji

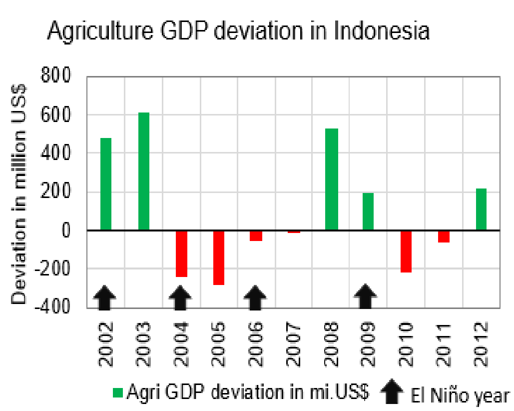


Note: the impact of El Niño on sugarcane production is experienced in the year following the event

Source: Based on data from FAO Statistical database available from http://faostat.fao.org/

South-East Asia: During the South-West monsoon period from May to October, the rainfall deficiencies have previously been in the order of 15 to 50 percent depending on the severity and timing of the El Niño onset. Most areas suffer from drought during this season. At the same time, the number of typhoons affecting South-East Asia becomes significantly less than normal.

Figure 4. El Niño impact on agriculture GDP in Indonesia



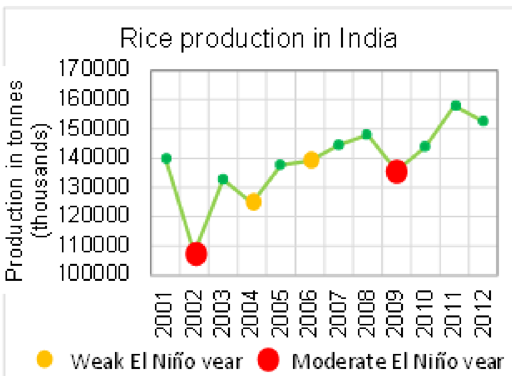
The severe El Niño of 1997-1998 resulted in substantial reduction in agricultural production. Indonesia had to import 5 million tons of rice and the country experienced severe inflation of food commodity prices to the extent of 138 per cent. The impacts of subsequent El Niño events were less, but still a matter of concern.

South and South West Asia: The South-West monsoon often gets affected negatively resulting in drought conditions, but the influence could be modulated by other climate drivers. During the North-East monsoon, parts of Southern India and Sri Lanka could be impacted favourably through increased rainfall.

Rice production in India fell by as much as 23 percent, or 32 million tons, during the El Niño in 2002. Substantial decrease in production quantity was also identified during the 2004 and 2009 El Niño years.

Production fell by 8.4 percent or 12 million tons during the moderate El Niño of 2009, while the weak El Niño of 2004 depressed rice production by over USD 8 million tons (refer to Figure 5). By contrast, in neighboring Sri Lanka El Niño years are often favorable for rice production - the moderate El Niño event of 2009 increased rice production close to 10 per cent with a corresponding increase in agriculture GDP by USD 139 million in 2010.

Figure 5. El Niño impact on rice production in India

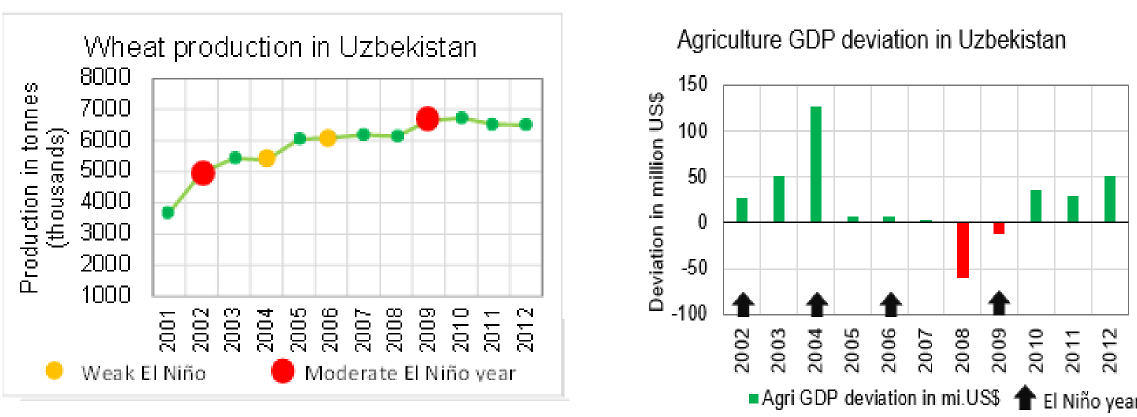


Note: The impact of El Niño on rice production is experienced the same year of the event
Source: FAO Statistical database available from http://faostat.fao.org/

North and Central Asia: Between October and March of an El Niño year, there has been favourable winter precipitation with an immediate beneficial impact on agriculture. Snow deposits could also lead to increased water availability over extended periods of time.

Wheat is Uzbekistan's primary food crop, and El Niño's impacts on its production through enhanced water availability results in increased production in the following year. For example, the 2004 event led to an increase of 0.7 million tons in wheat production in 2005. In Afghanistan, the El Niño years of 2004 and 2006 increased wheat production by 78 and 33 percent in the following years respectively.

Figure 6. El Niño impact on wheat production in Uzbekistan



Note: the impact of El Niño on wheat production is experienced in the year following the event
Source: FAO Statistical database available from http://faostat.fao.org/

El Niño risk patterns are therefore quite complex with respect to the time of its onset and the geographical locations across the region. While it is better understood in terms of the negative impacts in Pacific and South-East Asia, complexities still lie in understanding its impacts in South and Central Asia.

D. Analysis of 2014-2015 El Niño Forecast and Potential Impacts

The WMO El Niño/La Niña Updates (26 June 2014) state that while the tropical Pacific Ocean surface temperatures have reached El Niño thresholds, and exceeded them in the far eastern portion of the basin, atmospheric indicators remain neutral. This means that the onset of El Niño is not yet certain as the atmosphere has failed to respond to the warmer sea surface temperatures. However, there is still a high probability for the onset of El Niño between September and November 2014.7 The most recent observation on 4 August 2014 predicts the chances even as high as 65 per cent. The observation is based on the forecast taking into account state-of-the-art dynamical climate models, including the Climate Forecast System and the eight-model National Multi-Model Ensemble (NMME).[8]

The 2014 El Niño forecast, made by the relevant scientific organizations, is summarized below:

Source	Date of Issue	Official Forecasts
World Meteorological Organization (WMO)	26 June 2014	Chance of El Niño is about 70per cent during the Northern Hemisphere summer and is close to 80 per cent during fall and winter. While the tropical Pacific Ocean surface temperatures have reached El Niño thresholds, and exceeded them in the far eastern portion of the basin, atmospheric indicators remain neutral, and hence an El Niño is not considered to have started. As of early June 2014, model outlooks indicate a continued warming of the central and eastern Pacific Ocean surface through the third quarter of 2014, with peak strength expected during the fourth quarter. Climate models and expert opinion suggest a 75-80 per cent per cent chance of an El Niño becoming established by the October to December period. Although a range of outcomes remain, models surveyed and expert opinion currently favor a moderate strength El Niño, while a strong event would have been more likely if it had manifested earlier in the year.
Bureau of	29 July 2014	Despite the tropical Pacific Ocean being primed for an El Niño

[7] Climate Prediction Centre and International Research Institute for Climate and Society, USA and Bureau of Meteorology, Australia
[8] NOAA Emily Becker - Details on the August 7th 2014 ENSO Discussion: how has the forecast changed? http://www.climate.gov/news-features/blogs/enso/details-august-7th-enso-discussion-how-has-forecast-changed

Meteorology Australia (BOM)		during much of the first half of 2014, the atmosphere above has largely failed to respond, and hence the ocean and atmosphere have not reinforced each other. As a result, some cooling has now taken place in the central and eastern Pacific Ocean. While the chance of an El Niño in 2014 has clearly eased, warmer-than-average waters persist in parts of the tropical Pacific, and the (slight) majority of climate models suggest El Niño remains likely for spring (September- November). Hence the establishment of El Niño before year's end cannot be ruled out. If an El Niño were to occur, it is increasingly unlikely to be a strong event. Given the current observations and the climate model outlooks, the Bureau's ENSO Tracker has shifted to El Niño WATCH status. This means the chance of El Niño developing in 2014 is approximately 50per cent per cent, which remains significant at double the normal likelihood of an event. The Indian Ocean Dipole (IOD) index has been below −0.4 °C (the negative IOD threshold) since mid-June, but needs to remain negative into August to be considered an event. Model outlooks suggest this negative IOD is likely to be short lived, and will return to neutral by spring.
Climate Prediction Center/ National Centers for Environment Prediction, US (CPC/ NCEP)	28 July 2014	ENSO Alert System Status: El Niño Watch ENSO-neutral conditions continue. Sea surface temperatures (SST) are above-average in the eastern equatorial Pacific Ocean. Tropical rainfall is slightly enhanced over Indonesia and in the western equatorial Pacific. Chance of El Niño is about 70 per cent during the Northern Hemisphere summer and is close to 80 per cent during the fall and winter.
International Research Institute for Climate And	17 July 2014	From June through to early-July the observed ENSO conditions remained near the borderline of a weak El Niño condition in the ocean, but the atmosphere so far has shown little involvement. Most of the ENSO prediction models indicate more warming coming in the months ahead, leading to sustained El Niño