



## 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.<sup>1, 2</sup> 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

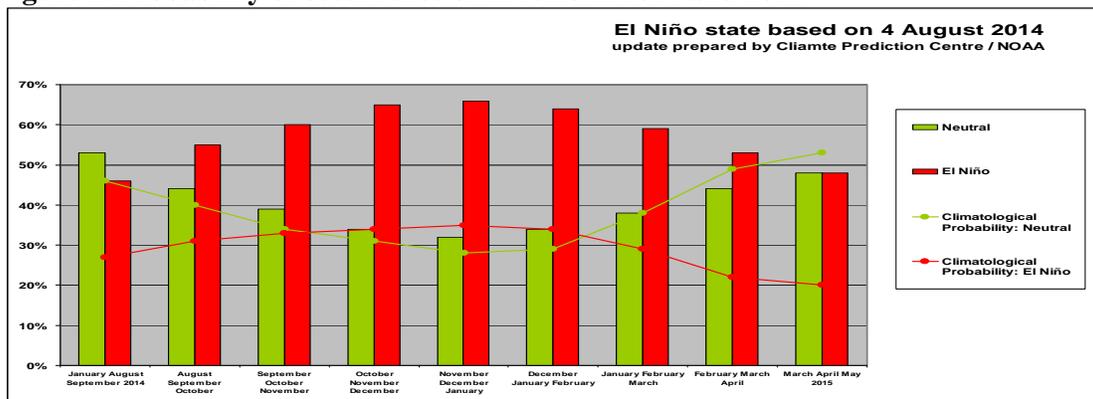
<sup>1</sup> International Research Institute for Climate and Society, Earth Institute, Colombia University, IRI, 5 June 2014, [http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso\\_tab=enso-cpc\\_update](http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso_tab=enso-cpc_update)

<sup>2</sup> 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](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 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.

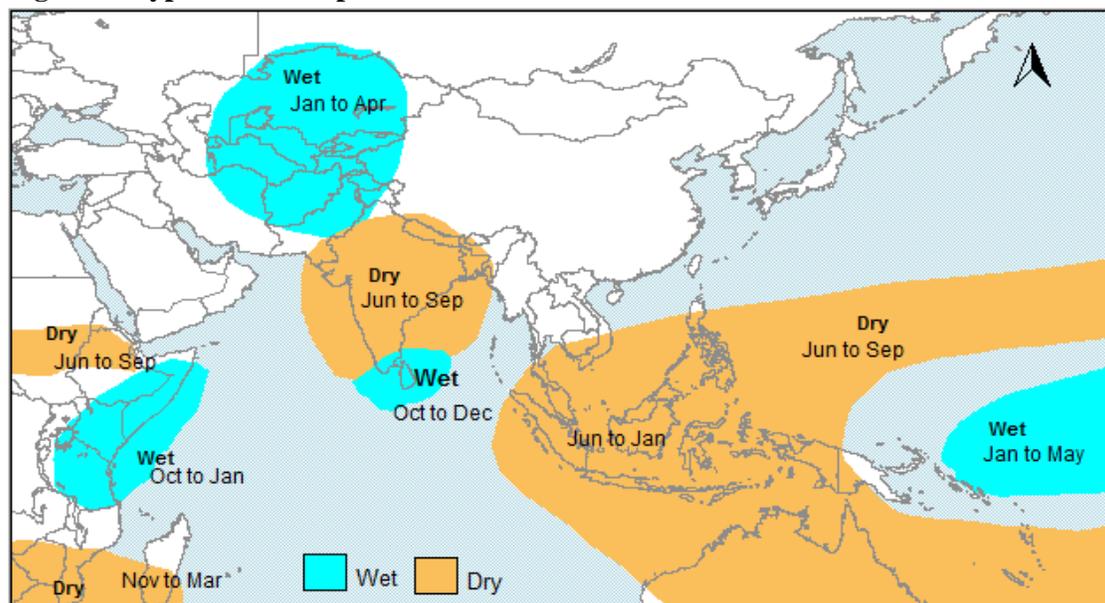
The ENSO cycle stretches across the globe and affects regions differently. As some countries of Asia and the Pacific experience greater dryness during an El Niño cycle, countries in Central and Southern America often see increased rainfall during the same period. The cycle and its climatic impact is 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, Columbia 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.<sup>3</sup> 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.<sup>4</sup> 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

<sup>3</sup> El Niño in 1997-1998: Impacts and CARE's Response, June 1998

<sup>4</sup> El Niño in 1997-1998: Impacts and CARE's Response, June 1998

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

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.

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<sup>5</sup> UNDAC Mission Report Fiji Drought 1998

<sup>6</sup> 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.

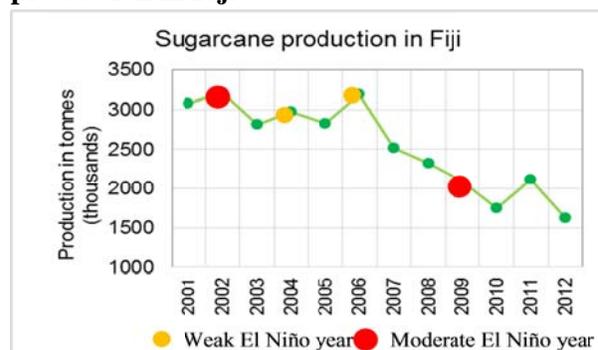
**Pacific Islands:** During previous El Niño years, the North-West Pacific islands from May to October have tended to experience suppressed rainfall while South-West islands received less rainfall between November and March.

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.

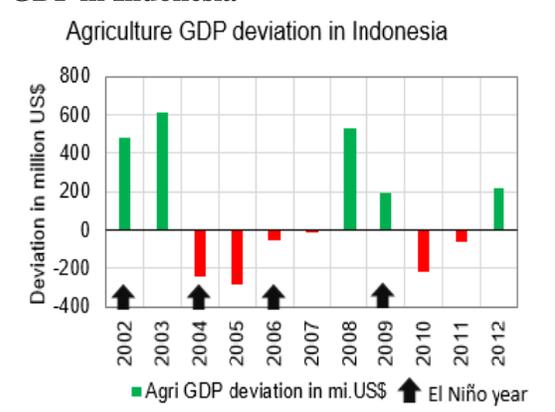
**South-East Asia:** During the South-West monsoon period from May to October, the rainfall deficiencies have previously been in the order of 15 to 50 percent depending on the severity and timing of the El Niño onset. Most areas suffer from drought during this season. At the same time, the number of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

**Figure 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/>

**Figure 4. El Niño impact on agriculture GDP in Indonesia**

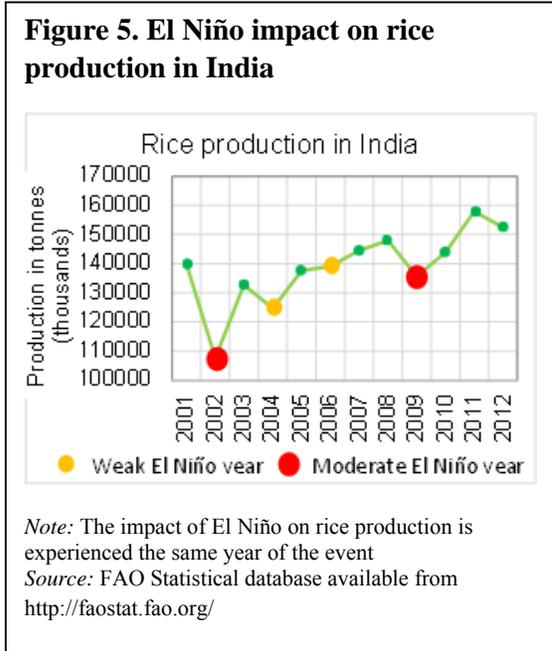


The severe El Niño of 1997-1998 resulted in substantial reduction in agricultural production. Indonesia had to import 5 million tons of rice and the country experienced severe inflation of food commodity prices to the extent of 138 per cent. The impacts of subsequent El Niño events were less, but still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



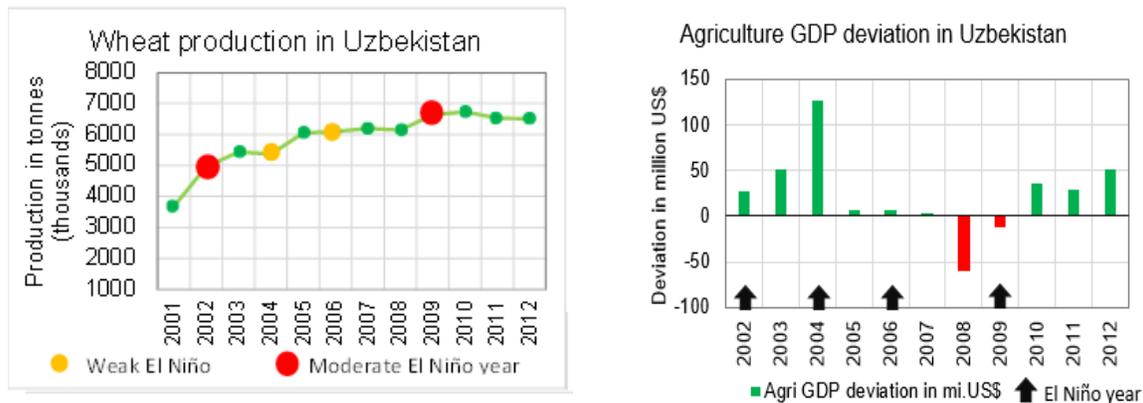
Production fell by 8.4 percent or 12 million tons during the moderate El Niño of 2009, while the weak El Niño of 2004 depressed rice production by over USD 8 million tons (refer to Figure 5). By contrast, in neighboring Sri Lanka El Niño years are often favorable for rice production - the moderate El 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.

**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.<sup>7</sup> 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).<sup>8</sup>

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	<p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p>
Bureau of	29 July 2014	Despite the tropical Pacific Ocean being primed for an El Niño

<sup>7</sup> Climate Prediction Centre and International Research Institute for Climate and Society, USA and Bureau of Meteorology, Australia

<sup>8</sup> NOAA Emily Becker - Details on the August 7<sup>th</sup> 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>

<p>Meteorology Australia (BOM)</p>		<p>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.</p> <p>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.</p> <p>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 50 per cent per cent, which remains significant at double the normal likelihood of an event.</p> <p>The Indian Ocean Dipole (IOD) index has been below <math>-0.4\text{ }^{\circ}\text{C}</math> (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.</p>
<p>Climate Prediction Center/ National Centers for Environment Prediction, US (CPC/ NCEP)</p>	<p>28 July 2014</p>	<p>ENSO Alert System Status: El Niño Watch</p> <p>ENSO-neutral conditions continue.</p> <p>Sea surface temperatures (SST) are above-average in the eastern equatorial Pacific Ocean.</p> <p>Tropical rainfall is slightly enhanced over Indonesia and in the western equatorial Pacific.</p> <p>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.</p>
<p>International Research Institute for Climate And Society (IRI)</p>	<p>17 July 2014</p>	<p>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 conditions by the middle or late portion of northern summer.</p> <p>IRI/ CPC plume-based probabilistic ENSO forecast indicates a 60 per cent probability for El Niño conditions in August-September-October, rising up to 75 per cent in November-December-January.</p>

*Note:* IRI, BOM, etc. generate ensemble forecasts integrating outputs from all major global prediction centers.

**Potential Impacts:** Based on the above forecasts, two scenarios have been visualized – (1). El Niño onset in August and (2) El Niño onset around or after September. In the case where El Niño had developed earlier, as predicted by global models in April/May 2014, scenario 1 would have applied. However, scenario 2 is still possible but could be updated later in September.

*Scenario 1:* If the onset is in August, South Asia, East Asia, and the Pacific could be impacted by less than normal rainfall conditions. Although this likelihood is 60 per cent, as already the monsoon conditions have set in, the impact could be moderate in this scenario (Table 1). The cumulative impacts in the representative countries could have been in the order of USD 30 billion, as elaborated in Table 1.

**Table 1. Potential Impacts on macro-economy: Scenario 1 (onset in August)**

Sub-region	Country	Agriculture GDP Growth Fall in 2014 with respect to 2013 (per cent, estimated)	Impact on GDP	
			per cent	million USD
South Asia	India	-3.00	-1.56	-23,290
	Sri Lanka	2.00	0.49	195
South East Asia	Thailand	-1.00	-0.43	-983
	Indonesia	-3.50	-1.75	-7,774
Pacific	Fiji	-5.00	-0.90	-29
Central Asia	Uzbekistan	1.00	0.56	151
West Asia	Afghanistan	1.50	3.03	423
<i>Cumulative across sub-regions in representative countries</i>				<i>-31,307</i>

The impact of the event on agriculture and on the overall GDP varies across countries, ranging from USD 23 billion in the case of India, USD 7.7 billion for Indonesia, USD 983 million in Thailand and USD 29 million in Fiji. Afghanistan, Uzbekistan and Sri Lanka could benefit from the favorable conditions contributing to a positive impact of USD 423 million, USD 151 million and USD 195 million respectively (methodology details at Box 2).

Further impacts on macro-economic indicators such as fiscal balance, current account deficit, inflation and diversion of resources from development to relief and associated activities, along with increased import and decreased export opportunities, need to be assessed with reference to the current structure of the economy and sensitivity to El Niño droughts or floods. With regard to poverty incidence, the El Niño could impact rural populations in a number of ways, such as contraction of employment opportunities, forced migration, indebtedness, food insecurity and malnutrition, all of which can contribute to people falling into poverty traps.

### Box 2. Methodology for assessing potential impacts

The immediate shock of rain failure is experienced in the agricultural sector, and then cascades to secondary and tertiary sectors through four major ways:

- i. A backward linkage in the shortage of raw materials for agro-processing industries;
- ii. A forward linkage in the reduced demand of industrial goods because of reduced agricultural income;
- iii. A shift in the share of consumer demand away from industrial products because of high cost of food and agro processing necessities; and
- iv. A potential shift in public sector investments for development in order to finance activities such as drought relief, etc.

A fall in aggregate demand in the agricultural sector in India is likely to cause serious constraint in production and demand of the industrial sector. Experience of past decades indicates that 1 percent fall in agricultural GDP causes a 0.52 percent fall in industrial output and a 0.24 percent fall in the service sector, with an overall deceleration of 0.52 percent in GDP (*Sastry et al.*).

The following steps were followed to assess the potential impacts due to the anticipated El Niño in 2014:

- i. An anticipated fall in agricultural GDP (in comparison to the previous year) is estimated based on past impacts of similar El Niño events;
- ii. A factor of 0.52 (for India) and slightly adjusted factors for other countries (based on contribution of agriculture to overall economy) was used to multiply the agriculture growth rate impact to estimate the likely impact on overall GDP growth;
- iii. The fall (or rise) in overall GDP was converted to absolute terms to arrive at the estimated impact in USD.

*[Cascading impacts of a fall in agriculture growth rate on overall GDP is based on Economic and Political Weekly pp-2394 June 14, 2003. Sastry DVS et al. Sectoral Linkages and Growth Prospects-Reflections on the Indian Economy]*

*Scenario 2:* As the South-West monsoon would have already ended, there could be less significant impacts of El Niño in South Asia and South-East Asia. The North-East monsoon could be favourable for Southern India and Sri Lanka, but unfavourable for the Philippines, Indonesia and South-West Pacific islands. West and Central Asia could get favourable rains that are good for winter crops. Cumulative impacts in the representative countries could be in the order of 7 billion USD, as elaborated in Table 2.

**Table 2. Potential Impacts on macro-economy: Scenario 2 (onset in or after September)**

Sub-region	Country	Agriculture GDP Growth Fall in 2014 with respect to 2013 (per cent, estimated)	Impact on GDP	
			per cent	million USD
<b>South Asia</b>	India	0	0	0
	Sri Lanka	2.00	0.49	195
<b>South-East Asia</b>	Thailand	0	0	0
	Indonesia	-3.50	-1.75	-7,774
<b>Pacific</b>	Fiji	-5.00	-0.90	-29
<b>Central Asia</b>	Uzbekistan	0	0.56	151
<b>West Asia</b>	Afghanistan	0	3.03	423
<i>Cumulative across sub-regions in representative countries</i>				-7,034

The 2014 event is more likely to be a moderate event as per latest forecast. Hence the potential impacts of the event on agriculture across Asia Pacific regions are estimated based on analysis of past impacts.

**Table 3. Summary of El Niño impacts on agriculture in select countries in Asia Pacific under scenarios 1 and 2**

Country	Major Crop	Impacts Observed	Impact characteristics
<b>India</b>	Rice	Same year	Negative
<b>Thailand</b>	Rice	Same year	Negative
<b>Fiji</b>	Sugarcane	Following year	Negative
<b>Uzbekistan</b>	Wheat	Following year	Positive
<b>Philippines</b>	Rice	Partially same and following year	Negative
<b>Afghanistan</b>	Wheat	Following year	Positive
<b>Indonesia</b>	Rice	Partially same and following year	Negative
<b>China</b>	Maize	Partially same and following year	Positive and Negative
<b>Sri Lanka</b>	Rice	Following year	Positive

## **E. Policy Implications for Asia and the Pacific**

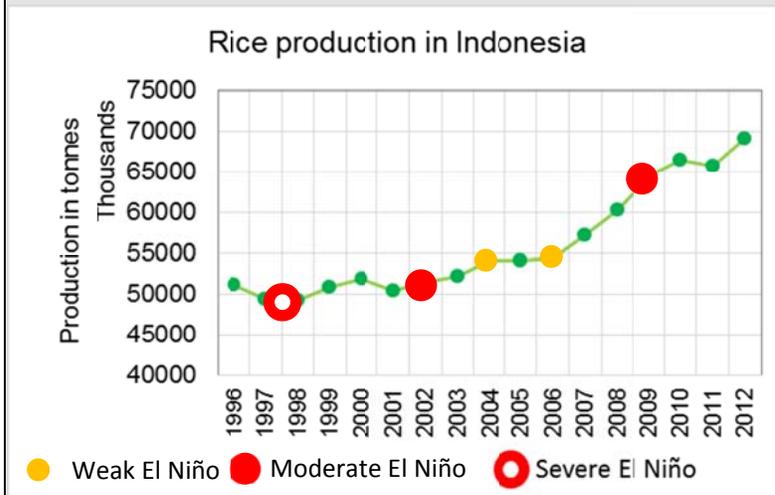
The historical trends of El Niño in Asia and the Pacific clearly indicate that the exposure of agrarian economies to El Niño is quite large with substantial economic losses impacting the vulnerable and poorest segments of the population most often. It is therefore important to have climate resilient policies addressing El Niño sensitive sectors more specifically. After the experience of the 1997-1998 El Niño, efforts were made to reduce the risk to mitigate its adverse economic impact and build resilience. Indonesia, for example, demonstrated how climate resilient policies backed by well-knit institutional arrangements, both horizontally across the various sectoral ministries as well as vertically from the center to provinces and districts, helped reduce El Niño risks in later years. These measures helped adapt to low and moderate levels of El Niño and build resilience to other adverse climate events (Box 3).

From the experience across the region in managing El Niño impacts, a mitigation strategy needs to encompass three components. First, understanding the El Niño risk, where the need for scientific climate information is supported by a regional mechanism which can help generate local forecasts and link with early warning systems. Information from this system must also be ‘understandable’ and ‘actionable’, which will require regional forecasts to be ‘downscaled’. A better understanding is needed of El Niño and its linkages with socioeconomic factors, ranging from macroeconomic variables, health impacts, to forest fires. Understanding such linkages will greatly contribute in addressing climate change adaptation and disaster risk reduction (DRR) issues in conjunction. Second, to communicate the El Niño risk beyond the professional platforms and forums, there is a need for a true community-based public education and community based awareness campaigns. Finally, acting on the risk by putting in place climate resilient policies, institutional arrangements and access to enabling science and technology based solutions.

### Box 3. Lessons learned in Indonesia from the 1997-1998 El Niño event

Indonesia, having learned the lessons from the 1997-1998 El Niño, introduced some important policy and institutional measures which have led to appreciable reduction of risks associated with El Niño:

- i. Improved technical capabilities to provide forecasts down to district levels, with regard to differential impacts of El Niño in both wet and dry seasons. Forecasts now indicate district-wise rainfall onset, characteristics of rainfall during the season and dates of termination of a rainy season.
- ii. A national level task force comprised of climate sensitive sectors is established to assess the impacts on agricultural production, the food security situation and import/export decisions ahead of the likely onset of El Niño and in anticipation of its impacts.
- iii. National forest fire management capabilities have been enhanced through improved regulatory and legislative frameworks.
- iv. Based on El Niño forecasts, the Agriculture Department anticipates the risk for different crops and different seasons, and provides assistance to farmers.
- v. Communication of risks is increasingly improving through various means.



*(Note: The impact of El Niño on rice production is experienced the same year of the event)*

Due to improved agricultural practices and management support, agriculture production has increased steadily, and degree of fall in production during drought years is not as sharp as in the previous decades.

Considering experiences from Indonesia and many other countries who have built resilience to El Niño over the years, the following measures from policy, institutional and technological perspectives are suggested.

**Policy perspective:** The impacts of El Niño induced droughts (and other severe weather events) are often under-estimated, with greater emphasis being placed on tangible direct losses and less attention being paid to the considerable indirect losses. Intangible human and other losses are often not considered, indicating less severe impacts on the overall. Comprehensive assessments would provide a more realistic picture of the impacts and thereby aid policy makers in addressing these risks through appropriate investments to insulate climate sensitive sectors.

Further, climate variability poses a threat almost on a continuous basis through droughts, floods and other climate extremes, substantially impacting development, especially in the countries with a high climate risk and exposure to El Niño. It is possible to reduce the risk considerably by undertaking pro-active anticipatory measures by making use of available forecasts.

At regional level, ESCAP has initiated activities to mainstream CCA, which also includes El Niño and DRR, into sustainable development in the region. Recognizing that the planning and finance ministries need to be engaged more closely, ESCAP aims to reach out to them in this regard. ESCAP pilot projects on mainstreaming CCA and DRR in the countries with high El Niño exposure envisages evolving more insightful policy measures for adaptation and resilience as part of sustainable development planning.

***Institutional perspective:*** Since El Niño is a global driver, and Asia-Pacific is disproportionately sensitive in comparison to other regions, it is important to evolve a strategy to deal with El Niño associated climate variability considering El Niño, La Niña and neutral conditions. While an ENSO forecast is available for resource management from a range of three months to one year for policy makers, a key limitation lies in understanding the risk and communicating this to key stakeholders who could act on the information. At the country level, it is important to strengthen the institutional capacity to address these gaps. In this regard, a number of initiatives have been taken up by WMO, FAO and ESCAP. The ESCAP Trust Fund on Tsunami, Climate Preparedness and Disasters has supported institutional capacity development projects towards strengthening climate resilience initiatives in the region. Monsoon forums, for example, are unique platforms to communicate the climate/weather risk information to key stakeholders in a form and manner that the information could be used for mid-term interventions to reduce risk.

A complacency set in during neutral conditions of ENSO is being addressed through national monsoon forums. National monsoon forums supported by ESCAP in Myanmar, the Maldives and Nepal have been serving as the primary institutional mechanism to communicate and integrate hazardous and favourable weather conditions associated with ENSO. Monsoon forums are designed to address climate variability on a continuous basis by anticipating risks and opportunities associated with it.

El Niño forecasts are probabilistic and communicating associated risks to different stakeholders with a lead time of three to six months poses a challenge. The national monsoon forums foster trust among the stakeholders through understanding the limitations of science and encouraging regular use of forecasts and could also enhance uptake of the El Niño forecast information, considering trade-offs.

***Technological perspective:*** Despite greater connectivity being established between El Niño and local climate services, El Niño Global Forecasts cannot be directly used for local level decision making. The Global ENSO forecasts need to be downscaled to generate locally usable information. A multi-disciplinary applied research mechanism needs to be institutionalized to translate climate forecast data into potential impact advisories to meet the information needs of different users.

Support to the National Meteorological and Hydrological Services (NMHSs) to provide actionable forecasts, spatially and temporally, is found to be a critical requirement articulated through the national monsoon forums. A capacity building programme is required to improve

observation, monitoring, data communication and processing capabilities of the key stakeholders, including NMHSs, and the disaster management, agriculture and water management agencies.

At the operational level, it is always challenging to integrate climate risk information into decision-making. The ESCAP Regional Cooperative Mechanism for Drought Monitoring and Early Warning is a unique initiative that enables integration of climate risk into seasonal forecasting and in-season monitoring for providing alert and early warning. Climate scenarios and seasonal forecasts are used for targeting in-season monitoring of agriculture/vegetation by earth observation satellites. The Regional Drought Mechanism pilot project in Sri Lanka, for example, demonstrates how climate scenarios, including 2014 El Niño possible scenarios, could be coupled with seasonal forecasts and followed by monitoring and early warning of drought. The monitoring and assessment of real-time, dynamic in-situ agricultural conditions by earth observation satellites, in conjunction with appropriate ground information, provides key scientific information that addresses the critical gaps in knowledge towards integrating climate risk information into the decision making process.

## **F. Recommendations**

### To Governments:

- Strengthen monitoring and early warning systems, including institutions such as Monsoon Forums, to ensure that timely information reach all key stakeholders and groups at risk.
- Use critical early warning and risk information to decision-making, building on regional best practice.
- Build DRR and CCA into national development plans, creating a culture of resilience.
- Promote contingency planning and preparedness actions, especially in agriculture and other most vulnerable sectors.
- Strengthen institutions such as Monsoon forums.
- Conduct thorough, multi-sector risk and impact assessments.
- Engage in regional cooperation to share information and take collective action.

### To International/regional institutions:

- Support countries in ensuring adequate policy, institutional and technical responses to El Niño.
- Provide platforms for sharing of information, knowledge and solutions.

### To development partners and financial institutions

- Provide financing for preparedness actions in the context of El Niño, and consider this an investment that will save costs due to reducing potential impacts associated with climate variability.