The El Niño Southern Oscillation (ENSO) is like tango, it takes two — the ocean and the atmosphere — to complete. This year, despite widespread above-average sea surface temperatures (SSTs) across the equatorial Pacific Ocean, the atmosphere has not yet responded. Therefore, only “ENSO-neutral” conditions have prevailed in the region so far.

Although the stage is set for the tango, ENSO may or may not materialize, or just slightly influence some parts of the region.

This situation requires policymakers and disaster managers to closely monitor its evolution. And, considering that El Niño is not the only factor causing climate-related disasters in the region, it is advisable to pay close attention to short and medium-range weather forecasts, as well as the already prevailing conditions that could make societies susceptible to the consequences resulting from the slightest deviations in rainfall and temperature as compared with what is normally expected.

It is against this backdrop that the following advisory assesses the potential repercussions of the present situation, both, in terms of the climate and its possible societal impacts.

This advisory is intended to inform the efforts of Governments, development and humanitarian agencies to understand the risks and to mitigate the potential impacts. Its coverage is regional and therefore, readers working in locations that are potentially at risk are encouraged to further refine the analysis using local exposure and vulnerability data. In this regard, the step-wise assessment tool developed by ESCAP, United Nations Development Programme (UNDP) and RIMES (2016) will be useful in guiding these efforts.¹

¹ ESCAP, UNDP and RIMES, 2016.
The status of El Niño

Slightly above-normal sea surface temperatures that were observed, since mid-August, over some parts of the Pacific have crossed El Niño thresholds as of November 2018. However, the expected effect on atmospheric circulation has not yet materialized.

Over the main theatre of El Niño activity - the equatorial Pacific Ocean - a blend of slightly above- and below-average sea surface temperatures were recorded since August 2018. The westernmost Niño-4 region (close to the South American coast) was the warmest at +0.5°C.

In September, more widespread regions of above-average SSTs were observed across the equatorial Pacific Ocean, but remained ENSO-neutral. In early October, forecasts showed that a weak El Niño was likely (about 75 per cent chance) and would continue through winter in the northern hemisphere.

Widespread above-average ocean temperatures across the equatorial Pacific Ocean have now continued all through October and November, but the traditional equatorial Southern Oscillation indices has remained near zero, indicating a weak coupling between the ocean and the atmosphere.

Figure 1. Development of the 2018 El Niño

According to the World Meteorological Organization’s (WMO) latest assessment, “the probability for an El Niño event to occur is estimated to be about 75-80 per cent for December-February, and about 60 per cent for February-April 2019”. It also adds that, “[e]ven if ocean conditions do remain at El Niño levels for the next several months, the chance for a strong event is currently low”.2

ENSO forecast from global centres also indicate a likely chance of El Niño conditions to develop during December 2018 and February 2019:

- Bureau of Meteorology (BOM), Australia, 20 November 2018: “Most models suggest that the chance of El Niño condition is likely to be 70 per cent by end of 2018”.

- Climate Prediction Center/National Centers for Environmental Prediction (CPC/NCEP) and International Research Institute for Climate and Society (IRI) of Columbia University, 26 November 2018: “The probability for El Niño conditions is likely to be about 80 per cent during December 2018 to February 2019”.

Expected impacts on seasonal climate over the Asia-Pacific region

The current situation is unlikely to produce a large-scale disturbance that can cause wide-ranging global impacts known to be associated with strong El Niños, at least during the coming winter months until February 2019. However, this does not mean that there is no risk of climate-related disasters in the coming season. Extreme climate events could still manifest themselves even during non-El Niño or neutral Pacific SST conditions.

ENSO is the most dominant influence over the weather and climate system; it is known to shift rainfall patterns across the Asia-Pacific region depending on location and season. However, it has to be noted that climate patterns and extreme weather conditions are a result of numerous global, regional and local factors - El Niño, and its cold phase, La Niña - are only two of these several factors.

Hence, the strength of ENSO may not correspond directly to the impacts and other factors can appear and change the expectations. Regional seasonal climate outlooks and their updates consider these other factors as well and provide a consensus view of the likely seasonal climate, as summarized in table 1.

---

2 World Meteorological Organization (WMO), November 2018.


4 National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Center/National Centers for Environmental Prediction (NCEP), November 2018.
Table 1. Summary of seasonal climate outlook over the tropical Asia-Pacific region

<table>
<thead>
<tr>
<th>Sub-regions</th>
<th>Summary of the temperature and rainfall outlook during December 2018 to February 2019</th>
</tr>
</thead>
</table>
| **South Asia**      | Above-normal precipitation is likely during the winter season (December 2018 to February 2019) over some areas of northern parts of south Asia including north Afghanistan, north Pakistan, north India and some areas of north Myanmar.  
                      | Below-normal precipitation is likely over some southern parts of the region consisting of south-eastern part of India, Sri Lanka and Maldives.  
                      | Normal to above-normal temperatures are likely to prevail over most of the region. |
| **South-East Asia** | Below-normal rainfall is likely over the Philippines and normal to below-normal rainfall is expected over the region surrounding the Java sea and eastern Indonesia.  
                      | Mostly normal to above-normal rainfall over parts of northern Sumatra, Peninsular Malaysia and Borneo are likely. There could be excessive rainfall in certain locations due to local factors, such as orographic effects.  
                      | Above-normal temperatures are likely to prevail over most of the region. |
| **Pacific Islands** | Below-normal rainfall is forecast for countries in the region extending south-eastward from Tokelau to northern French Polynesia and in some countries in the western tropical north Pacific.  
                      | With less confidence, near-normal or below-normal rainfall is forecast for Vanuatu, Fiji and Tonga.  
                      | Near-normal or above-normal rainfall is forecast for Guam, the Commonwealth of the Northern Marianas Islands, and much of the Marshall Islands and, with less confidence, Samoa, Tuvalu and Kiribati.  
                      | Air and sea surface temperatures are likely to be above-normal for much of the tropical Pacific region. |

**Sources:** Consensus statements on the forecast outlook for the winter season (December 2018-February 2019) by the Regional Climate Outlook Forums (South Asian Climate Outlook Forum; South East Asian Climate Outlook Forum; and Pacific Islands Climate Outlook Forum).

Experience from similar weak El Niño conditions in the past show impacts in locations that receive most of their rains during the winter monsoon season, that is, from November to February.

Historically speaking, no two El Niños are the same. But past El Niño records provide a useful guide for anticipating the potential impacts of a given El Niño event. In the last two decades, there are three observed weak El Niño years as shown in table 2.
Table 2. Characteristics of weak El Niño years from 2000 to present

<table>
<thead>
<tr>
<th>Weak El Niño years</th>
<th>Preceding year ENSO condition</th>
<th>Onset</th>
<th>Warming</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004/2005</td>
<td>Normal</td>
<td>August</td>
<td>Eastern Pacific</td>
</tr>
<tr>
<td>2006/2007</td>
<td>Weak La Niña</td>
<td>September</td>
<td>Eastern Pacific</td>
</tr>
<tr>
<td>2014/2015</td>
<td>Normal</td>
<td>November</td>
<td>Whole basin</td>
</tr>
</tbody>
</table>

In terms of magnitude and timing of onset, the current El Niño condition closely resembles the 2014/2015 event. In addition, while the ocean was above the El Niño threshold for several months, the atmosphere was slow to respond in these two events.

As shown in figure 2, the 2014/2015 El Niño caused rainfall levels to fall severely below normal (red colour) in some locations. However, as the main rainy season (summer monsoon) in many locations had already ended, the impacts were not severe in many parts of South and South-East Asia.

Figure 2. November 2014 to April 2015 rainfall deviation (as a per cent of climatology or 30-year record)

Figure 3 shows the evolution of 2014/2015 El Niño alongside some of the key disasters in the region, which may or may not be attributable to El Niño, but unfolded after a few months following the El Niño onset. For example, the drought in Thailand could not be attributed to El Niño because the onset was in November 2014 and the summer monsoon had already ended in October 2014.
There are some crucial distinctive features this year. For example, sea surface and subsurface temperatures are a little warmer. Therefore, although the 2014/2015 event may provide insights on the types of expected impacts, identical outcomes cannot be predicted.

Furthermore, conditions during preceding seasons caused different impacts even if the rainfall deviations are the same. For example, rainfall in Thailand in 2014 was severely below-normal and therefore, the major dams were dry by the end of the summer monsoon in September 2014. Unlike 2014, Thailand received above-normal rainfall during the 2018 monsoon season and such favourable conditions could potentially buffer Thailand from the forecasted below-normal rainfall during the winter monsoon.

Potential societal impacts of seasonal climate outlook for December 2018 to February 2019

El Niño episodes in the past had wide-ranging impacts on public health and socio-economic sectors depending on magnitude, location, timing of onset, season and societal capacity (figure 4).
Figure 4. Selected historical impacts of El Niño in the Asia-Pacific region

<table>
<thead>
<tr>
<th>Agriculture</th>
<th>Fresh water resources</th>
<th>Reef ecosystems</th>
<th>Fisheries</th>
<th>Public health</th>
<th>Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prolonged drought due to 1997/98 El Niño depleted food supplies.</td>
<td>Coral bleaching due to warming of sea surface temperature (SST)</td>
<td>Increase in tuna catch</td>
<td>Warmer temperature, decrease water storage = increase in dengue and malaria</td>
<td>El Niño associated cyclones cause major damages to infrastructure from high winds, storm surge, and intense rainfall</td>
<td></td>
</tr>
<tr>
<td>Federated States of Micronesia</td>
<td>Fiji Solomon Islands Tonga</td>
<td>Kiribati Papua New Guinea Solomon Islands</td>
<td>2003 SARS outbreak linked to El Niño</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prolonged drought 26% decline in sugarcane production ~ 1.3% decline in GDP</td>
<td>Solomon Islands Tonga</td>
<td>Increase in sea-level</td>
<td>2015 Cyclone Pam damaged 17 medical centers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock deaths = USD 7 million</td>
<td>Federated States of Micronesia Kiribati Palau Tonga Vanuatu</td>
<td>Decrease in phytoplankton productivity</td>
<td>Vanuatu</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture Infrastructure damage = FJD 100 million</td>
<td>Fiji</td>
<td>Fiji</td>
<td>Nauru</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>Decrease in tuna catch</td>
<td>Marshall Islands Vanuatu</td>
<td>Fiji Tonga</td>
<td>Damage to infrastructure = 3 times the GDP</td>
<td></td>
</tr>
<tr>
<td>2009 El Niño cut global rice output by 10 million tons</td>
<td>Cylcone Ivy (2003) causes massive damage to coral reefs in Efate</td>
<td>Vanuatu</td>
<td>Tonga</td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>Vanuatu</td>
<td>Papua New Guinea</td>
<td>Samoa</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What follows is our assessment of the potential societal impacts based on the seasonal climate outlook for December to February 2019, which considers the possible consequences of El Niño and other factors.

It is estimated that at least 9 million people will be exposed to rainfall deviations during November to February.

Using the seasonal forecast for December to February,\(^6\) we estimate that the highest number of people exposed to severely below-normal rainfall live in central Philippines and some parts of Mindanao (those that receive most of their rains during the winter monsoon season or the so-called Type 4 climate locations), southern parts of Thailand and in the adjoining parts of Malaysia.

These numbers could be higher - we estimate that around 18 million people in the region live in locations (white areas in figure 5) that have no forecast skill this season.

Historically, even though Pacific countries have smaller populations, they have been significantly affected by the impacts of El Niño because they are located at the centre stage of the El Niño activity. Even if the coupling between ocean and atmosphere does not materialize, the sheer warming of the ocean will have predominantly negative effects over Pacific rainfall and temperature.

---

\(^6\) International Research Institute for Climate and Society (IRI), November 2018.
The potential below-normal outlook over places that receive most of their rains during the winter monsoon (November to February) could affect food security in those locations.

There is a potential convergence of locations that are expected to experience below-normal rainfall and hence are existing food security hotspots. Critical locations, such as Nusa Tenggara Timur in Indonesia, Timor-Leste, and Papua New Guinea have a history of food insecurity. Missing this year’s major cropping season may further diminish the capacity of households to grow enough food to last them until the next cropping season.

Further, we estimate that around US$160 billion of economic stock is exposed to below- and above-normal deviations in rainfall.

The economic stock that is exposed to potentially below-normal rainfall during December to February is estimated to be highest in southern India, some parts of Sri Lanka, southern Thailand and adjoining parts of Malaysia, southern Indonesia (Java, Nusa Tenggara Barat, and Nusa Tenggara Timur) and northern parts of Australia. The expected variations in Timor-Leste and parts of Solomon Islands are minor but societal sensitivity to rainfall reductions may be high, based on experience.

Between southern Thailand and the adjoining parts of Malaysia and southern parts of Viet Nam, the combined total exposed economic stock is over one billion US dollars. It should be noted that the impacts are confined to the southern provinces of Thailand only; no impacts are foreseen over the rest of Thailand.
Figure 6. Exposed economic stocks at risk of El Niño

These numbers could be higher - we estimate that nearly USD$97 billion of exposed economic stock are located in areas (white areas in figure 6) that have no forecast skill this season.

Some locations are already experiencing severe impacts due to climate variability. Although the predicted impacts of El Niño on rainfall may not be very severe, the high levels of vulnerability already existing in those locations may amplify the potential impacts of El Niño, should it materialize.

Some countries in the Asia-Pacific region are already reeling from the effects of large-scale disasters; quick succession of tropical cyclones, heavy rainfall and drought. Most notably, Indonesia, historically one of the worst hit during El Niño years, is already managing a string of large-scale hydro-meteorological and geophysical disasters this year.

There is also a large-scale drought prevailing in many locations in the Asia-Pacific region which is already straining the coping capacities of affected communities, as shown in figure 7. Eastern and Central Java and Yogyakarta Provinces have been experiencing a large-scale drought since June 2018 affecting hundreds of villages. The below-normal rainfall predicted over the region surrounding the Java sea during December to February is likely to exacerbate these drought conditions.


7 AHA Centre, November 2018.
Similarly, in Pakistan, there are also reported impacts of a drought-like situation in the province of Sindh. The north-western regions of Afghanistan have been suffering from drought since the first half of 2018, due to low precipitation during the winter of 2017/2018 in the mountainous regions of Hindu-Kush affecting nearly 10 million people and displacing over 200 thousand people.

The quick succession of disasters hinders the capacities of societies to respond effectively to further shocks. The interaction of potential El Niño impacts with prevailing conditions therefore needs to be carefully considered in local risk assessment.

---

8 Government of Pakistan, National Disaster Management Authority, 2018.
9 European Commission, Emergency Response Coordination Centre (ERCC), 2018.
Recommendations

Considering the best available scientific information and records of past El Niño impacts, the following measures are recommended:

Assess national and local risks from El Niño in tandem with other climate drivers and socio-economic conditions.

Countries that are at risk from significant climate deviations (either severely below-normal or above-normal rainfall) during the next few months, should assess local risk due to El Niño and other factors. Local assessment is important because the El Niño can affect locations and sectors differently. As discussed above, the prevailing climate and socio-economic conditions, which could also vary dramatically across locations, could either lessen or amplify the impacts.

While El Niño is the biggest driver of seasonal climate variability in tropical Asia and the Pacific, there are regional and local drivers that can potentially diminish or intensify the impacts of El Niño. Communities that are still recovering from recent disasters may be predisposed to the adverse impacts of even the slightest of deviations in rainfall. Therefore, risks have to be considered dynamically. In this regard, the ADAGE tool developed by ESCAP and RIMES, which provides a framework for dynamic risk assessment, may be useful.10

Places that are sensitive even to small rainfall variations need to take precautionary measures even if the chance of occurrence of El Niño impacts is currently low.

While this current regional analysis does not foresee very severe impacts due to El Niño which is comparable to 2015/2016 El Niño, it is recommended that sectors and locations which are sensitive even to small rainfall variations and those historically exposed to hazards during December to February, should update their contingency plans and put in place appropriate risk mitigation and preparedness measures.

Adjust preparedness measures in light of short- and medium-range weather forecasts in conjunction with monitoring data.

Considering the evolving situation, all sectors are advised to continue monitoring and adjusting their contingency plans and actions based on weather forecasts. Coordination between socio-economic sectors and national hydro-meteorological services (NHMSs) is required. The Monsoon Forums, which are regularly convened in several countries in the Asia-Pacific region, offer a platform for coordinating risk mitigation and preparedness measures across sectors.

Countries interested in monitoring vegetation conditions in near-real time may request satellite data from the ESCAP Regional Drought Mechanism (escap-sas@un.org).

Make investments for long-term resilience.

The El Niño is a recurring climate phenomenon. Typical impacts of El Niño – dryness or drought in some countries, extreme rainfall or storm events in others, are consistent with the types of weather and climate extremes which are projected to increase in a warming global climate. Investments in understanding the risks at the local level as well as in measures that strengthen the capacity of societies to respond are warranted.

10 ASEAN Dynamic Risk Assessment Guidelines and Experiences (ADAGE).
Updates

All global models indicate further weakening of the 2018 El Niño beyond February 2019. However, the historical evolution of El Niño during 1986, 1991 and 2014 show that El Niño continued through 1987-88, 1992-93, and 2015-2016 respectively, with enhanced intensities and prolonged duration of El Niño conditions, that spanned over several seasons in many countries.

An update of this advisory is due to be released in mid-February 2019.

Acknowledgements

Under the joint direction of Tiziana Bonapace (Director, ICT and Disaster Risk Reduction Division, ESCAP) and A.R. Subbiah (Director, Regional Integrated Multi-Hazard Early Warning System for Africa and Asia), this advisory was prepared by a multi-disciplinary team comprising of Govindarajalu Srinivasan and Jothiganesh Shanmugasundaram (RIMES), Sanjay Srivastava, Kareff Rafisura, Madhurima Sarkar-Swaisgood, Maria Bernadet Karina Dewi, Laura Hendy, and Hyun-mi Kang (ESCAP). Amin Shamseddini (Asian and Pacific Centre for the Development of Disaster Information Management) provided valuable comments. Anoushka Ali served as the editor. Comments and feedback are welcome at escap-dr@un.org.

Disclaimer

The designations employed and the presentation of materials on the maps do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.
References

AHA Centre (November 2018). Available at: http://adinet.ahacentre.org/


ASEAN Dynamic Risk Assessment Guidelines and Experiences (ADAGE). Available at: https://sites.google.com/view/adage-approach

Asia and Pacific Centre for the Development of Disaster Information Management (APDIM) and Economic and Social Commission for Asia and the Pacific (ESCAP). Asia-Pacific Disaster Risk Atlas. Available at: https://gicait.maps.arcgis.com/apps/MapSeries/index.html?appid=b15b6e0ba4714fc6a8abde29ec9dd12&folderid=0e43a4f16dff4cee72d7745b076c02c


Global Precipitation Climatology Project (GPCP). Available at: https://www.esrl.noaa.gov/psd/cgi-bin/composites/printpage.pl


National Oceanic and Atmospheric Administration (NOAA), Climate Prediction Center/National Climate Data Center (2018). Available at: https://www.emc.ncep.noaa.gov/mmb/nwm/


This series is part of a larger effort within ESCAP to support its member States in building resilience and foster sustainable development.