

# EL NIÑO 2014/2015:

## IMPACT OUTLOOK AND POLICY IMPLICATIONS FOR PACIFIC ISLANDS

- *Pacific island countries (PICs) are at greatest risk of experiencing impacts from a potential 2014/2015 El Niño event*
- *The most vulnerable sectors in PICs are agriculture, freshwater resources, reef ecosystems, fisheries, public health systems, and infrastructure.*
- *Regional collaboration will be critical to ensure understanding of El Niño risk, communicating the risk to stakeholders and creating enabling mechanisms to act on risk information.*

Global forecast centers indicate the potential onset of El Niño during the Northern Hemisphere winter (Nov/Dec 2014), or early in 2015 (Box 1). El Niño could impact Pacific island countries during the forthcoming wet season (November 2014 – April 2015).

In the Pacific, El Niño could increase the likelihood of cyclones and severe storms by 30 per cent and increase cyclone intensity (maximum sustained wind speed) and severity (in terms of potential impacts), compared with normal years.

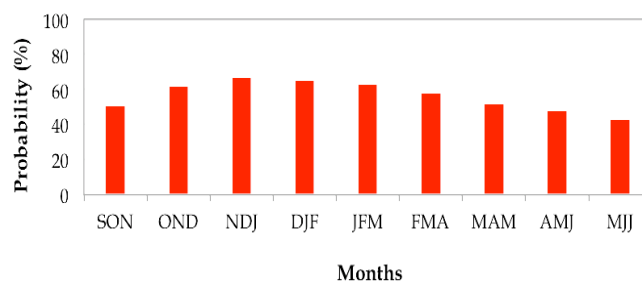
*Box 1. Probabilistic El Niño forecast 2014/2015*

*World Meteorological Organization (WMO), 8 September 2014:* There is 55% to 60% likelihood for El Niño to be established between September and November 2014, rising to 70% probability between November 2014 and February 2015.

*Bureau of Meteorology (BOM), Australia, 7 October 2014:* There is at least 50% chance of an El Niño forming by last quarter of 2014.

*International Research Institute for Climate and Society (IRI), 9 October 2014:* There is 51% probability for El Niño conditions in September – October–November 2014, rising to 67% probability in November – December – January (2014–2015).

*Probabilistic El Niño forecast (CPC/IRI consensus)*



## Historically, Pacific Island Countries have been critically vulnerable to El Niño

Generally, in the Pacific, El Niño is associated with irregular rainfall, increased tropical cyclone frequency, and abnormal sea level conditions. An overview of these impacts is presented in Table 1.

Table 1. El Niño historical impacts on rainfall, tropical cyclone frequency, and sea level

Country	Rainfall	Tropical cyclones	Sea level
<b>Northern islands</b>			
Federated States of Micronesia	Decreased	-	Lower
Marshall Islands	Decreased	(more intense)	Lower
Palau	Decreased	No impact	-
<b>Central islands</b>			
Kiribati	Increased	No impact	Higher
Nauru	Increased	-	Higher
Papua New Guinea	Decreased	Less frequent	Lower
Solomon Islands	Decreased	More frequent	Lower
Timor-Leste	Decreased	No impact	(no data)
Tuvalu	Decreased	More frequent	No impact
<b>Southern islands</b>			
Cook Islands	Decreased	More frequent	Higher
Fiji	Decreased	More frequent	Lower
Niue	Decreased	More frequent	(no data)
Samoa	Decreased	More frequent	Lower
Tonga	Decreased	More frequent	Lower
Vanuatu	Decreased	No impact	No impact

Source: Compiled from Australian Bureau of Meteorology & CSIRO, 2011

### El Niño impact on tropical cyclone movement

Data on the occurrence of tropical cyclones across the Pacific region during previous El Niño years show an increase in the frequency of cyclones affecting the central and southern islands, except Papua New Guinea, which has experienced fewer tropical cyclones. The Marshall Islands have been exposed to cyclones of a greater intensity, while Palau, Timor-Leste, Kiribati, and Vanuatu have experienced no changes in their exposure to tropical cyclones during El Niño years. These observations are mainly due to the shift in the position of cyclone formation towards the northeast during an El Niño event (Chand & Walsh, 2013).

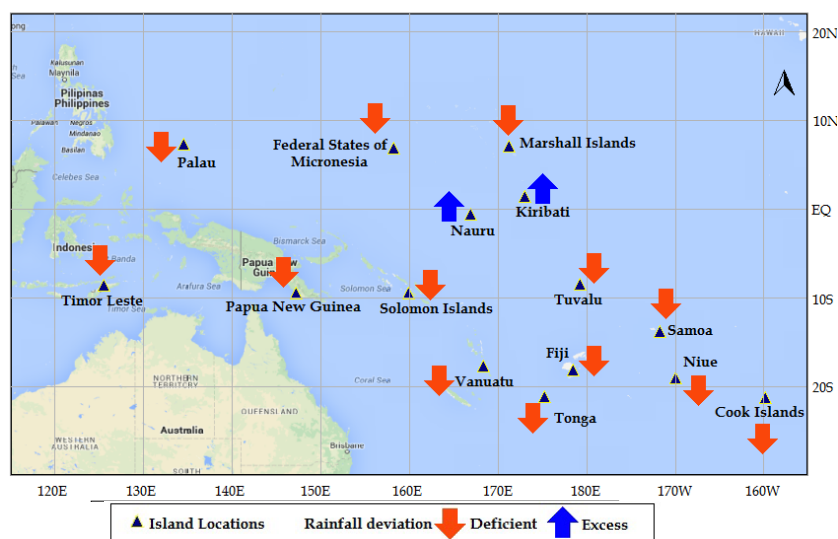
### El Niño impact on sea levels

El Niño historical impacts on sea levels show below average levels for most countries. Conversely, Kiribati, Nauru and the Cook Islands have experienced higher than average sea levels during an El Niño event. Tuvalu and Vanuatu have reported no impact.

### El Niño impact on rainfall

In El Niño years, wet season rainfall has tended to decrease in all Pacific Island Countries, except Kiribati and Nauru (Figure 1). On islands that cover a wide geographical area, such as Papua New Guinea, Tuvalu, and the Cook Islands, El Niño effects vary across different regions within each country. The northern parts of these islands generally experience increased rainfall during an El Niño year, while the southern parts experience decreased rainfall (Thomson, 2009).

Figure 1. November to April rainfall deviation during El Niño years



## El Niño impacts are severe on climate-sensitive sectors

### Agriculture

Subsistence agriculture in Papua New Guinea, Solomon Islands, Fiji, Vanuatu, and Cook Islands is a significant component of GDP, while in Timor-Leste, most of the population also depends on subsistence agriculture (SPC in McGregor, 2006). Reduced wet season rainfall impacts subsistence agriculture the most, causing loss of cash income and reducing people's ability to support themselves. In 1997/98, drought due to El Niño caused failure of staple food crops, such as taro and yam, and forced people to rely on bush crops and food aid (Table 2).

Seawater inundation of agricultural lands, due to surge associated with tropical cyclones, render these

lands unproductive. Recovery often takes years (e.g. 3 years for Cook Islands (FAO, 2008)).

### Freshwater Resources

Small islands in the Pacific depend on freshwater lenses – thin layers of fresh groundwater, overlying seawater. Decreased rainfall threatens these lenses, especially in islands with relatively low mean rainfall, such as Tonga, Cook Islands, and Niue). A 25% decrease in the replenishment of groundwater reduces the thickness of the freshwater lens by about 50 percent (White & Falkland, 2009).

Freshwater lenses are also threatened by seawater intrusion from high sea levels and storm surges caused by tropical cyclones. It can take months or years to recover from drought and seawater intrusion, as lenses require recharge from significant rainfalls. Table 3 lists El Niño impacts on water availability in some islands in the Pacific.

Table 2. Historical impacts of El Niño on agriculture

Country	Observed impacts
Federated States of Micronesia	Prolonged drought due to 1997/98 El Niño caused stress on staple crops, especially taro, and depleted food supplies (UN OCHA, 1998)
Fiji	1997/98 drought caused 26% decline in sugarcane production, and led to decline in GDP of at least 1.3% (World Bank, n.d.); losses from livestock death amounted to around USD 7 million (McKenzie et al, 2005). During 2009, the western island received over 45 cm of rain in 24 hours that resulted to severe flooding of up to 3 to 5 meters, and severely damaged agriculture and infrastructure worth F\$ 100 million (SPC, 2010)
Marshall Islands	Significant yield reduction in most crops during 1997/98 (FAO, 2008)
Papua New Guinea	The 1997/98 drought severely affected subsistence farming, and significantly affected production of coffee and cocoa. About 1 million people suffered from food insecurity due to failure of food crops. The Australian government provided AUD 30 million in food aid to areas affected by drought (SPC, n.d.).
Samoa	Drought-associated forest fires during the dry seasons of 1982/83, 1997/98, 2001/02, and 2002/03 (Australian Bureau of Meteorology and CSIRO, 2011)
Tonga	Severe droughts in 1983, 1998, and 2006 caused stunted growth in sweet potatoes & coconuts; livestock sector, particularly swine, were badly affected (The Kingdom of Tonga, 2012)

Table 3. Historical impacts of El Niño on water resources

Country	Observed impacts
Federated States of Micronesia	Prolonged drought due to 1997/98 El Niño caused many areas to be without water, or on water rationing (UN OCHA, 1998)
Kiribati	1997/98: shallow groundwater reserves became brackish (World Bank, as cited in FAO, 2008)
Palau	Water shortage due to prolonged drought in 1997/98 led to water rationing (Australian Bureau of Meteorology & CSIRO, 2011)
Timor-Leste	Reduced ground water availability is most significant El Niño impact (Australian Bureau of Meteorology & CSIRO, 2011)
Tonga	Prolonged droughts, such as in 1997/98, significantly impact shallow groundwater systems; seawater intrusion, due to storm surge associated with Hurricane Isaac in 1982, adversely affected freshwater lenses (The Kingdom of Tonga, 2012)
Vanuatu	Decreased rainfall and increase in evaporation associated with increased temperatures reduce the rate of groundwater recharge, affecting freshwater availability (FAO, 2008)

## Public Health

Increased incidence of dengue during El Niño years is attributed to warmer temperatures, which increase the replication rate of the virus, and to storage of water due to less rainfall, which increases the number of mosquito breeding sites (Gagnon, Bush & Smoyer-Tomic, 2001). Dengue, associated with the 1997/98 El Niño event, affected 24,000 people and claimed 13 lives in Fiji (Government of the Republic of Fiji, 2013) and cost FJ\$ 12 million (equivalent to USD 6 million) in medical care and other direct costs (Raju in Singh et al, 2005). Tonga also reported dengue outbreaks during drought years (The Kingdom of Tonga, 2012). In Papua New Guinea, the incidence of malaria increased, as drought forced people living in mountain areas to move to lowlands, where they became more exposed to mosquito-borne diseases (CARE, 1998).

## Reef Ecosystems

Coral reef ecosystems sustain fishermen's livelihood, support tourism, and mitigate storm surge impacts, hence are valuable assets for small island developing states. Increased sea surface temperature (SST) and tropical cyclone frequency during El Niño years threaten coral colonies. Abnormal SSTs in 1997/98 caused the observed bleaching of corals in the Pacific (see Table 4).

Table 4. Historical impacts of El Niño on reef ecosystems

Country	Observed impacts
Fiji	Coral bleaching cases reported due to warm SSTs in 1997/98 (World Bank, n.d.); increase in sea level, SST changes, and alteration of the mixing layer thickness affect plankton productivity (Government of the Republic of Fiji, 2013)
Solomon Islands	Coral bleaching cases reported due to warm SSTs in 1997/98 (World Bank, n.d.)
Tonga	Coral bleaching cases reported due to warm SSTs in 1997/98 (World Bank, n.d.)
Vanuatu	Cyclone Ivy in 2003 caused considerable damage to coral reefs at Efate (FAO, 2008)

## Fisheries

Tuna is the main fisheries resource in the region. In Papua New Guinea alone, the industry is valued annually at more than USD 4 billion in retail fish, USD 8 million in wages, and about USD 14 million in direct domestic commerce (Nicol et al., 2014). An El Niño event extends the skipjack tuna habitat towards the east (e.g. Kiribati); the later part of an El Niño event increases primary tuna productivity in the west (e.g. Papua New Guinea and Solomon Islands) (Nicol et al., 2014). Table 5 lists the documented impacts on fisheries.

Table 5. Historical impacts of El Niño on fisheries

Country	Observed impacts
Kiribati	Tuna catch increased by 10% in 1997; however, relationship is not confirmed (Aaheim & Sygna, 2000).
Papua New Guinea	Increased tuna catch (Lehodey in Nicol et al., 2014)
Solomon Islands	Increased tuna catch (Lehodey in Nicol et al., 2014)
Fiji	No significant effect on tuna fishing (Aaheim & Sygna, 2000)
Marshall Islands	Decreased tuna catch during 2002-2003 event (FAO, 2008)

## Infrastructure

Damage to infrastructure during El Niño years is mainly due to tropical cyclones. Damage from strong winds, intense rainfall, and surge could cost several times a country's GDP (see Table 6).

Table 6. Historical impacts of tropical cyclones on infrastructure

Country	Observed impacts
Niue	Damage from high winds, storm surge, and intense rainfall from Cyclone Heta in 2004 was three times the country's GDP (Australian Bureau of Meteorology & CSIRO, 2011)
Samoa	Damage caused by Tropical Cyclones Ofa (1990) and Val (1991) estimated at four times the country's GDP; flooding due to tropical cyclones in 2008 and 2011 damaged transportation and water infrastructure severely (Australian Bureau of Meteorology & CSIRO, 2011)

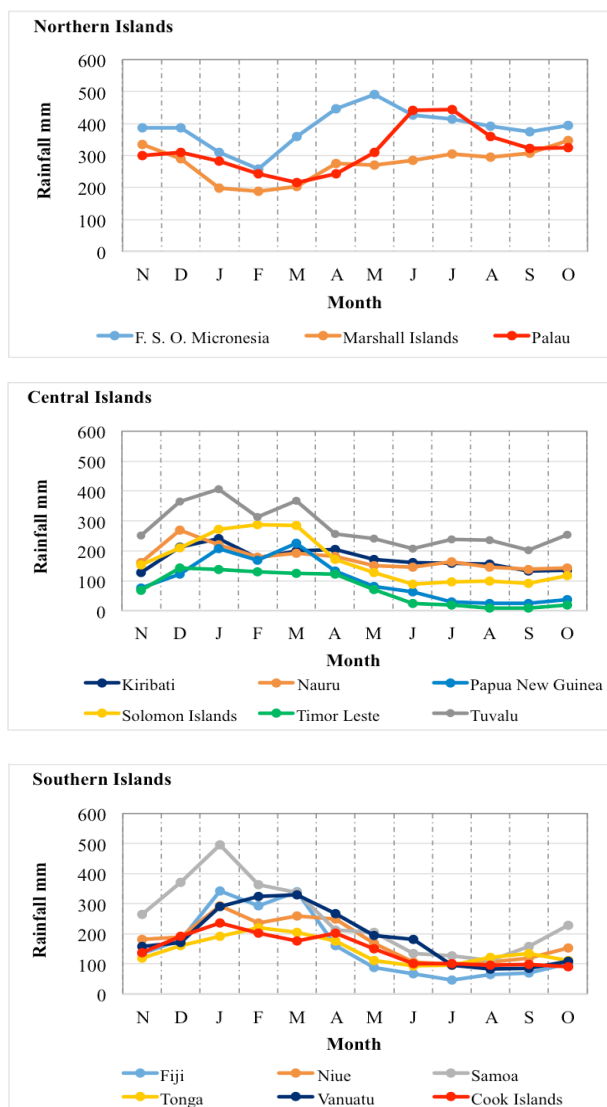


## Potential Impacts of 2014/2015 El Niño in Pacific Islands are likely to be uneven and sector-specific

### Potential Impacts on Climate in PICs

Islands in the Pacific have varying climate conditions, depending on their geographic location and the influence of one or more climate drivers, including El Niño (Figure 2). The central and southern islands have two major seasons: wet from November to April, and dry from May to October, with Timor-Leste and Papua New Guinea receiving much lesser rainfall, particularly during the dry

Figure 2. Average monthly rainfall of the northern, central, and southern islands, 1971-2012



season. The Northern islands have a seasonal climate that is different from the central and southern islands, receiving higher rainfall during May to October. Due to these differing climate patterns, potential impacts of El Niño 2014/2015 on climate in Pacific Island Countries differ (see Table 7).

Decreased rainfall during the wet season is expected in all countries, except in Kiribati and Nauru, where increased rainfall and higher sea levels could increase flood threat. Impacts in Papua New Guinea and Timor-Leste could extend well into the dry season, as these countries have the lowest dry season rainfall in the region (refer to Figure 2).

More tropical cyclones may be expected in the southern islands, particularly Cook Islands, Niue, Samoa, and Tonga, as well as Tuvalu. More intense tropical cyclones may be expected in the Marshall Islands.

It is to be noted though that intensity of El Niño impact varies from one event to another. Therefore there is a need to monitor local, short-term rainfall forecasts, to determine potential local impacts.

Table 7. Likely impacts of El Niño 2014/2015 on climate of Pacific Island Countries

Potentially affected islands	Likely impact
Federated States of Micronesia, Fiji, Palau, Solomon Islands, Vanuatu	Decreased rainfall
Papua New Guinea, Timor-Leste	Drought-like conditions that could persist into the dry season due to normally low rainfall during the dry season
Cook Islands, Niue, Samoa, Tonga, Tuvalu	Decreased rainfall and increased frequency of tropical cyclones
Marshall Islands	Decreased rainfall and more intense tropical cyclones
Kiribati, Nauru	Increased rainfall events and higher sea levels may increase flood threat

## *Potential Sectoral Impacts*

The likely impacts of El Niño 2014/2015 on climate-sensitive sectors, deduced from historical sectoral impacts and considering potential impacts on climate patterns, are presented below.

### *Agriculture*

Agriculture accounts for 30 to 40 per cent of the gross domestic product (GDP) of Papua New Guinea, the Solomon Islands, and Timor-Leste, employing about 70 to 80% of the countries' labor force (FAO, 2014). In Fiji, Kiribati, the Marshall Islands, the Federated States of Micronesia, Samoa, Tonga and Vanuatu, the sector contributes from 10 to 30% per cent to the national economies of these countries, and employs about 20 to 40 per cent of the labor force (FAO, 2014).

Reduced wet season rainfall could have significant impact on agriculture, particularly in central and southern islands that have significant subsistence agriculture (i.e. Timor-Leste, Papua New Guinea, Solomon Islands, Vanuatu, and Fiji). Timor-Leste and Papua New Guinea, which have normally very low dry season rainfall, are at risk for persistent drought-like conditions.

Seawater inundation from increased threat of tropical cyclones in Samoa and Tonga, and possibly more intense cyclones in Marshall Islands, could cause salinity intrusion to agricultural lands.

### *Freshwater Resources*

Reduction in wet season rainfall could threaten freshwater lenses, especially in small islands (except Kiribati and Nauru), and could lead to water scarcity problems particularly during the dry season.

### *Public Health*

Since El Niño 2014/2015 is expected to be moderate, dengue outbreak is not expected. It could become a threat if drought-like conditions persist.

### *Reef Ecosystems*

With a moderate El Niño, sea surface temperatures would generally not pose a coral bleaching threat, except in locations that are already vulnerable.

### *Fisheries*

Island states further to the east, such as Kiribati, could expect increased tuna catch, with the movement of the warm pool - cold water convergence zone eastwards.

### *Infrastructure*

Human settlements and critical infrastructures in Cook Islands, Niue, Samoa, Tonga, and Tuvalu could be at threat from potential increase in frequency of tropical cyclones; including Marshall Islands, where there is potential increase in intensity of tropical cyclones.

### *Economy*

Agriculture economies, particularly Papua New Guinea and Timor-Leste, could be at threat due to potential reduction in wet season rainfall.

Potential losses due to cyclones, associated with El Niño 2014/2015, may be estimated using World Bank data on annual average losses due to cyclones, with application of a risk factor that is determined based on historical El Niño events, which have

similar atmospheric and oceanic conditions to the 2014/2015 El Niño (called El Niño analogs). Potential losses in Cook Islands, Niue, Samoa, and Tuvalu are estimated from 30 to over 40 percent more than during normal years (see Table 8).

Marshall Islands, with expected increase in cyclone intensity, is likely to bear about three times the annual average loss due to cyclones.

*Pacific Island Countries are disaster hotspots due to their being in the El Niño core zone. Even a weak El Niño event could put these countries at higher risk than countries of other regions. In addition, remoteness and economic fragility render Pacific Island Countries highly susceptible to external shocks from even mild deviation of climate from its normal condition. Hence, potential impacts need to be continuously updated based on intra-seasonal climate/ weather forecasts, and communicating the potential risks as and when needed.*

Table 8. Potential losses due to El Niño 2014/2015-associated cyclones

Country	Annual average losses due to cyclones <sup>a</sup> (million USD)	Potential risk factor <sup>b</sup>	Potential losses due to El Niño 2015/2015-associated cyclones (million USD)
<i>Northern islands</i>			
Federated States of Micronesia	9.8	-	-
Marshall Islands	3.7	2.73 <sup>c</sup>	10.1
Palau	2.8	-	-
<i>Central islands</i>			
Kiribati	0	-	0
Nauru	0	-	0
Papua New Guinea	27.9	1	27.9
Solomon Islands	7.1	1	7.1
Tuvalu	0.1	1.43	0.14
<i>Southern islands</i>			
Cook Islands	6	1.46	8.76
Fiji	94.1	1.04	97.86
Niue	1.1	1.33	1.46
Samoa	8.5	1.41	11.99
Tonga	11.7	1.14	13.34
Vanuatu	44.3	1	44.3

Sources: a-World Bank, 2011; b-NIWA, 2014; c-Wright, 2006

## Policy Recommendations

The inherent characteristics of small island developing states of the Pacific, which include their small size, remote geographic location, and exposure to natural hazards, lend them to be highly susceptible to external shocks. Exposure to El Niño episodes adds yet another layer of vulnerability to their environmental, economic, and social wellbeing. Understanding the risk associated with an El Niño event and communicating it to the right stakeholders, with sufficient time to allow for preparatory action, is key to building resilience to disasters in the subregion.

The objective of the proposed integrated regional strategy for disaster risk management and climate change, titled *Roadmap Towards a Post-2015 Integrated Regional Strategy for Disaster Risk Management and Climate Change in the Pacific*, is to support the process of making “actionable” climate information available for better preparedness and resilient development planning. The information needs to be downscaled at the national and local levels, and contextualized for various climate-sensitive sectors. A regional mechanism could be established for the delivery of climate risk information that is customized for applications at the national and local levels, supported by adequate capacity within climate-sensitive sectors. The Pacific Disaster Net and the Pacific Humanitarian Team could play a key role.

Early warning systems could be strengthened, with innovative technologies and user participation. The ESCAP Regional Drought Monitoring and Early Warning System is an effort in this regard. User feedback, and identification and prioritization of capacity building needs could be facilitated through regular warning generator-provider-user forums. The ESCAP Trust Fund for Tsunami, Disaster and Climate Preparedness through RIMES has supported Monsoon Forums in South East and South Asia that serve as important platforms for risk communication, including related to El Niño. Such multi-stakeholder national forums in the Pacific need to be strengthened to facilitate users' understanding of long-term risks, and harmonization of risk management strategies and development plans. Implementation of the *Roadmap Towards a Post-2015 Integrated Regional Strategy for Disaster Risk Management and Climate Change in the Pacific* could put in place such mechanisms that enable countries to understand the complex climate risk, communicate the risk, and facilitate policy measures and implementation mechanisms for building resilience.

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