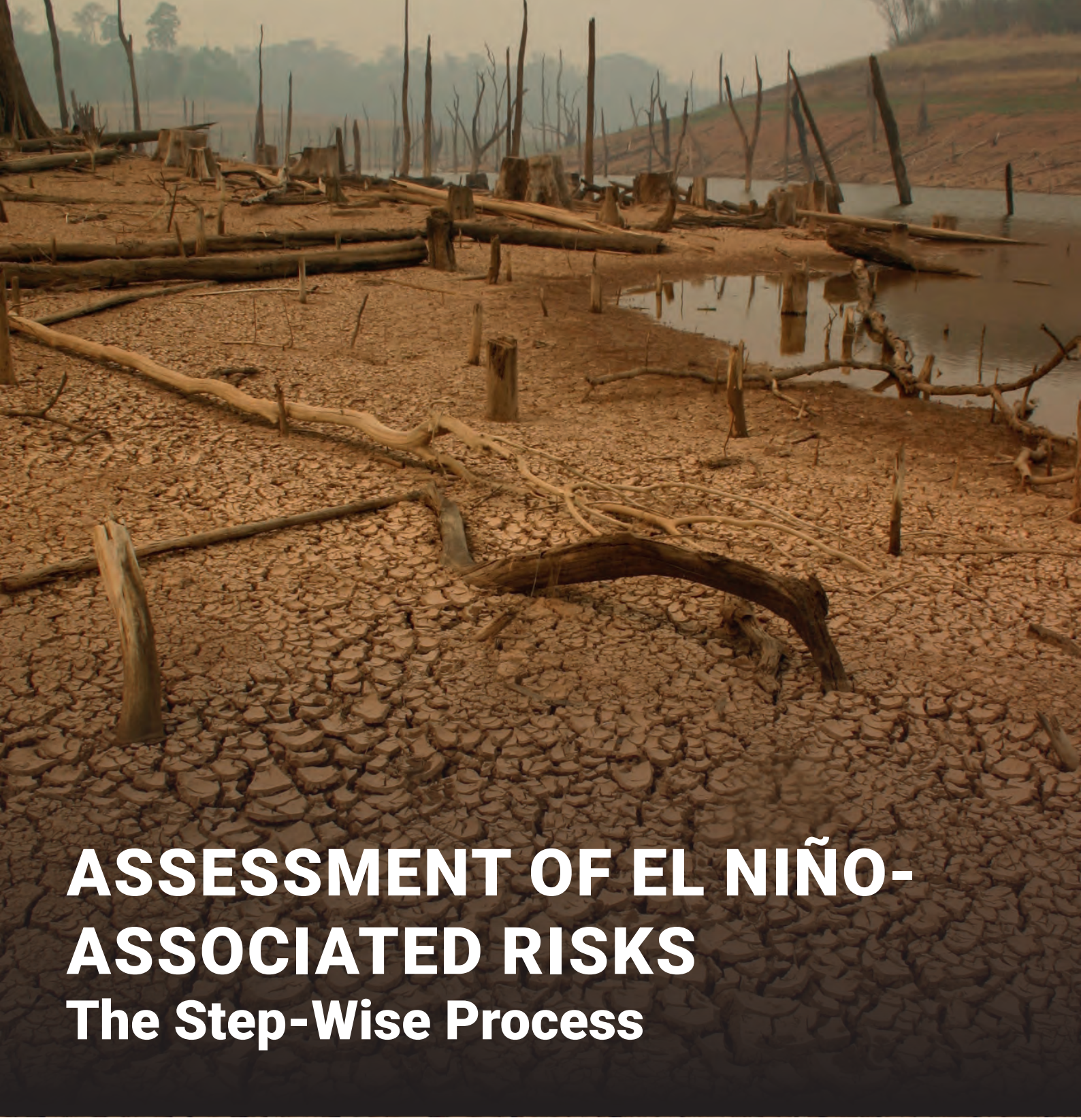

ASSESSMENT OF EL NIÑO-ASSOCIATED RISKS

The Step-Wise Process

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

UNDP
Empowered lives.
Resilient nations.

Regional Integrated Multi-Hazard Early Warning System
RIMES

Contents

1. Introduction

The combination of global, regional and local climate drivers causes variations in the climate over space and time. The El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), and North Atlantic Oscillation (NAO) are a few of the known dominant global climate drivers. Among the global climate drivers, ENSO accounts for more than 20-30% global climate variability (Anderson and Strahler, 2008) and therefore ENSO is considered as one of the key climate drivers for predicting climate variability over different parts of world.

The El Niño Southern Oscillation (ENSO) is a periodic climatic phenomenon with 3-7 years of cycle. ENSO's warm phase is referred as El Niño and its cold phase is referred as La Nina. El Niño refers to warming of the central and eastern Pacific or the entire Pacific basin, which affects trade winds, in turn affecting the atmosphere and weather patterns. The reverse cycle, called La Nina, involves cooling of the central and eastern Pacific Ocean, which is the strengthening of the normal conditions in the Pacific. ENSO's phases affect the weather system in various ways and thereby cause biophysical and socioeconomic impacts. Especially, during the El Niño years, the change in weather patterns poses a huge socio-economic threat across the Asia-Pacific region. The 1997-1998 El Niño, for example, caused 23,000 fatalities from natural disasters, increased poverty rates by about 15 percent in many countries, and cost governments up to USD 45 billion from impacts of severe droughts, storms, and other related hazards (World Bank, 2015). The 2015-2016 El Niño triggered weather extremes, from severe drought in South and Southeast Asia to intense rainfall in the Pacific. UNOCHA's (2016) preliminary estimates highlighted that the event had affected 60 million people globally.

El Niño impacts on weather systems over Asia-Pacific have been predominantly interpreted as wet (flood) or dry (drought) conditions. However El Niño impacts on weather patterns in complex ways that are highly variable over space and time due to various factors. The existing methodologies to assess the impacts of varying weather and climate characteristics on bio-physical and societal systems are inadequate to capture these complexities. Therefore it is critical to evolve a methodology to interpret, translate and communicate El Niño associated risks. In addition, El Niño is the main driver for seasonal prediction and its effects on ocean and the atmosphere lend better confidence to these predictions. Hence the lag time between El Niño onset and its impact on weather patterns offers opportunities to assess socioeconomic impacts, as well as management strategies.

A draft methodology was prepared and discussed with stakeholders from Asia-Pacific countries during the regional consultative workshop 7-9 June 2016 held at Bangkok Thailand, organized by United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and United Nations Development Programme (UNDP). The feedback on the methodology from the participants have been incorporated in this updated methodology document.

The step-wise risk assessment process is shown in Figure 1.1, and each step is elaborated from chapters 2 to 9. This methodology provides a guideline to aid

decision makers in preparing response options. However, the response options or strategies for the assessed impacts are not dealt with in this methodology.

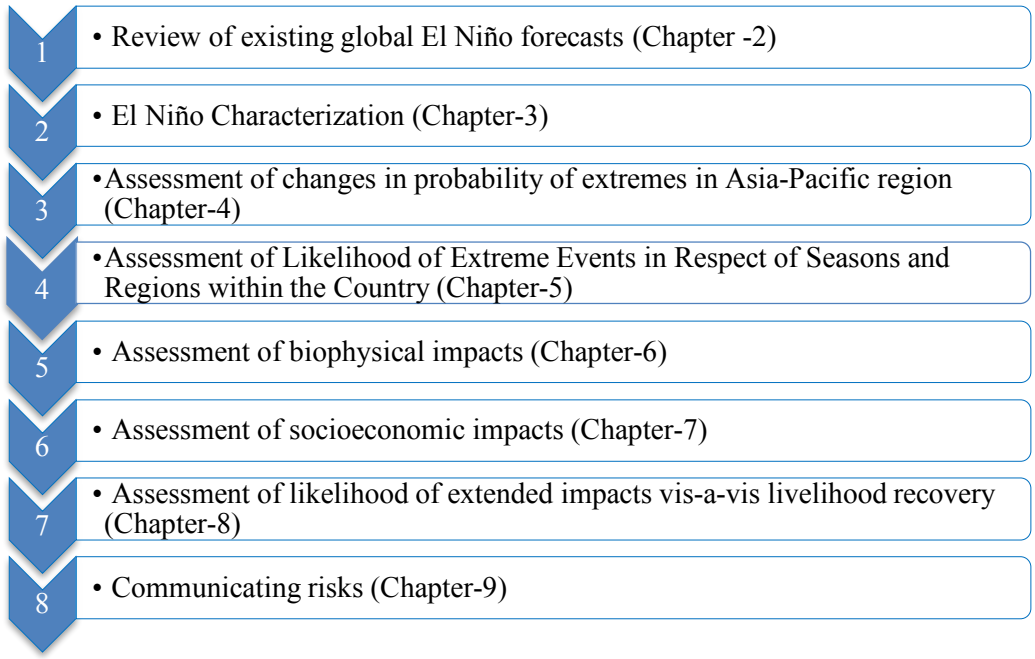

Figure 1.1 Steps involved in the assessment of El Niño-associated risks

"Assumption in Analogue approach – The forecasted El Niño episode that are somewhat similar to the past El Niño episode are likely to cause the similar impacts on weather system. In addition, the sensitivity of sectors to the impacts on weather are likely to experience similar impacts, however it varies based on the capacity and other factors"

As the first step, the El Niño forecasts from the global and regional centers can be reviewed and evaluated. Based on the probability of El Niño occurrence, the El Niño forecast could be considered for informed decision making process with a confidence level (Step-1). By understanding the different flavors of El Niño (Step-2), the characteristics of the forecasted El Niño episode could be matched with the past El Niño episodes that resembles similar characteristics. The impacts on weather patterns during the past El Niño episodes could be considered as an indication for the forecasted El Niño year, as the weather patterns are likely to reoccur. Further, characterizing the weather impacts at country level (Step-3) and also at regional scale for different seasons (Step-4) would help to assess the El Niño impact on regional and local weather patterns. Once the spatiotemporal variation of El Niño impacts are understood on the weather patterns, further, the manifestation on the bio-physical (Step-5) and socioeconomic impacts (Step-6) from the past experiences can be evaluated. Depending on the socioeconomic conditions, the recovery process takes time even though the next season is normal, and this has to be evaluated carefully (Step-7). Responding and adapting to El Niño risks requires significant step-wise assessment of El Niño associated risk, estimating the potential impacts, management strategies and effective risk communication. Not only do El Niño forecast matters, but also participation from decision makers of various sectors – disaster management,

public health, agriculture, water resources, etc. are required (Step-8) to ensure that resources are shared, information is up to date and accurate, and that the response is equitable for all stakeholders (IRI, 2016).

The vulnerability to El Niño risk depends on its unique sociopolitical and economic characteristics (IRI, 2016). If a country has well developed infrastructure, highly organized emergency management, irrigated agriculture, and a well-informed population will be well equipped to respond to fires, floods, droughts or crop failures, and even if it is in a climate-vulnerable region, it will have lesser risk. At the same time, a country with fewer resources may be more vulnerable to climate risks, even if it is in an area that typically sees fewer climate hazards. Therefore, assessing - potential effects of El Niño requires an understanding of the geography, resources available, vulnerability and culture of a given area.

Knowing the boundaries

"The step-wise risk assessment of El Niño risks requires cross-sectoral cooperation, as various steps in the assessment require domain/sectoral expertise such as meteorology, agriculture, water resource, socio-economics, public health, food security, disaster risk management, planning, infrastructure and risk communication. Hence, the risk assessment process has to be carried by evolving cross-sectoral cooperation that knows the boundaries of each section in the process for better outcomes."

2. Review of Existing Global El Niño Forecasts (Step -1)

The aim of step-1 is to review ENSO forecasts from various sources to know the probability of occurrences of El Niño conditions with a confidence level for informed decision-making by anticipating the potential impacts.

ENSO forecasts are available for various Niño regions: Niño 1, Niño 2, Niño 3, Niño 3.4, and Niño 4 (Figure 2.1). The warming over Niño 3, 3.4 and 4 regions has varying impacts across Asia-Pacific. Typically, Niño 3.4 is considered for evaluating El Niño conditions in Asia-Pacific. The SST anomaly over these regions are forecasted by various global centers, and there are standard thresholds available to characterize SST anomalies: El Niño (> +0.5°C), Normal (- 0.5° to +0.5°C) and La Nina (< -0.5°C).

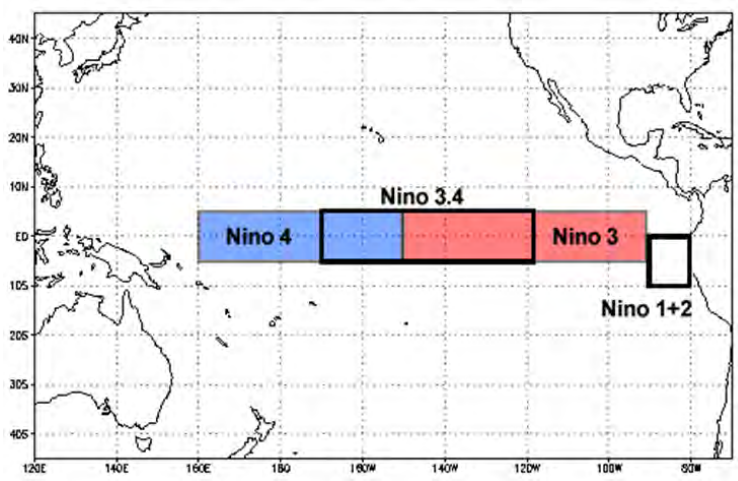

Figure 2.1: Niño regions in the Pacific basin

ENSO forecasts are available from various global and regional centers (Table-2.1). These forecast products are available as texts (summaries and outlooks) and graphics (graphs and maps).

Table 2.1 El Niño forecast products

El Niño forecasts	Description
APEC Climate Center (APCC)	An ENSO outlook is published for a duration of six months, based on six individual models and a composite model. http://www.apcc21.org/ser/enso.do?lang=en
International Research Institute for Climate and Society (IRI) model based ENSO forecast	The IRI model based probabilistic ENSO forecast is published with a monthly frequency for the period of a year, derived from 15 dynamical models and 8 statistical models. http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/
European Centre for Medium Range Weather	The ECMWF Niño plumes long range forecast summarizes the SST conditions over the various ENSO domains in the Pacific basin, from its

Forecast model (ECMWF)	51 forecast ensemble members. The product is published every month for the period of a year. http://www.ecmwf.int/en/forecasts/charts/seasonal/Niño-plumes-public-charts-long-range-forecast
Predictive Ocean Atmosphere Model for Australia (POAMA) long range outlook	POAMA outlooks are updated every 15 days, summarizing a range of possible developments in sea surface temperature (SST) in the equatorial Pacific Ocean (Niño regions) for up to nine months ahead from different ensemble members of the dynamic climate system model within the POAMA model. http://www.bom.gov.au/climate/poama2.4/poama.shtml
Japan Meteorological Agency (JMA) El Niño outlook	JMA publishes a monthly El Niño outlook in advance for a the period of a year, which is derived from the El Niño Prediction System (an ocean-atmosphere coupled model) for monitoring and prediction of the El Niño-Southern Oscillation (ENSO). http://ds.data.jma.go.jp/tcc/tcc/products/elNiño/outlook.html
National Oceanic Atmospheric Administration (NOAA) Climate prediction Center ENSO advisory	NOAA CPC publishes a weekly ENSO update and discussions on the recent evolution, current status, and predictions of conditions in the tropical Pacific related to the El Niño-Southern Oscillation (ENSO) cycle. http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/
World Meteorological Organization (WMO) El Niño/La Niña Update	The WMO update is an advisory issued in a timely manner (as and when there is a need for update from the previous advisory) that is based on assessment of various global ENSO products and climate outlooks. http://www.wmo.int/pages/prog/wcp/wcasp/enso_update_latest.html

The IRI/Climate Prediction Center (CPC) probabilistic ENSO forecast (Figure-2.2) is regularly updated (every 15 days) and available online at http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/. The graph shows the probability of El Niño every three months from April–June 2016 to December 2016-February 2017 (as of 19 May 2016). The forecast indicates the persisting El Niño during May 2016 will cease down from June 2016. The probability level gives a chance of occurrences of the forecasted condition. The higher the probability, the higher the likely ENSO conditions, and thereby the higher confidence in considering this forecast for informed decision-making.