ENSO Country Reports

Regional Consultative Workshop on El Niño in Asia-Pacific

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This document has been compiled based on inputs from countries that expressed their interest to contribute to the ENSO Country Reports during the **Regional Consultative Workshop on El Niño in Asia-Pacific** from 7 to 9 June 2016 in Bangkok, Thailand, co-organized by ESCAP and UNDP.

The countries that contributed to this report are **Cambodia, Fiji, Myanmar, Papua New Guinea, Philippines, Palau, Sri Lanka** and **Viet Nam**.

ENSO Country Reports

1. Viet Nam

1.1 Overview of El Niño impacts

Viet Nam has been experiencing impacts of El Niño associated climate variations, manifested in the form of increased local temperature and rainfall that has dramatically decreased since end-2014. These impacts are also the reasons behind drought and saltwater intrusion; both of which have significantly damaged and continue to threaten agricultural production and consequently the livelihoods of people.

The regions that have been significantly impacted include the Mekong Delta, the Central Highlands and South Central Viet Nam. Rice production, typically covering 40,000 hectares (ha) of land, was diminished due to water scarcity in the South Central region and Central Highlands in 2015. Moreover, 12,000 ha of agricultural land was exposed to drought, and thousands of households could not access clean water for domestic use. Low rainfall in 2015 was followed by low river flows and water storage in hydraulic and hydropower reservoirs. This led to drought and saltwater intrusion in the South East and South Central regions, the Central Highlands and in the Mekong Delta. Twenty-two provinces have already been affected by drought; eighteen of which have been severely impacted. It has been predicted that the impacts of events could be felt until mid-2016. The current status as well as measures being taken for drought and saltwater intrusion prevention and control in the South Central region, Central Highlands and Mekong Delta are expanded upon as follows.

a. South Central Viet Nam

In this region, the dry season started in December 2015, and is predicted to continue until the end of August 2016. Water supply for agricultural production and human consumption mostly comes from hydraulic and hydropower reservoirs, and currently the storage level of hydraulic reservoirs from the city of Da Nang to the city of Phu Yen is 60-80% of the designed capacity. In the provinces Khanh Hoa, Ninh Thuan and Binh Thuan, the storage level remains at 20-45% of the designed capacity. Hydropower reservoirs have the same or lower storage levels when compared with the same period in 2015. It is predicted that drought in this region could remain until the onset of rainy season in September 2016, with large-scale impacts and particularly severe impacts in Binh Thuan, Ninh Thuan and Khanh Hoa provinces.

b. Central Highlands and South East Viet Nam

The dry season stress in this region lasted till May 2016. Currently, hydraulic reservoirs are filled up with only 40-50% of their capacity, and the water level is decreasing, particularly when compared with the water level in 2015. Nearly 200 small water reservoirs have dried up, and most of these reservoirs will be unable to supply water sufficiently for the final period of the Spring-Winter crop year (Summer-Autumn, and seasonal farming takes place during the rainy season). Drought was predicted to occur in these regions with small reservoirs or without irrigation projects in relatively large areas.

c. Mekong Delta

The water levels in in this region have been the lowest since the past 90 years, owing to the fact that the rainy season arrived late and ended in early 2015, and due to the lack of upstream flow from the Mekong River. This caused saltwater intrusion to occur nearly two months earlier than normal – expanding to 90 km in 2016.

This is the first time such an event has occurred in the history of monitoring saltwater intrusion. Saltwater intrusion impacted agricultural production and human life till the first rainy season in around June 2016. It adversely affected the economy and human life in 10 out of 13 provinces in the region (Long An, Tien Giang, Ben Tre, Tra Vinh, Soc Trang, Bac Lieu, Kien Giang, Ca Mau, Hau Giang and Vinh Long).

1.2 Overview of the current drought condition

In total, about 358,800 ha of plantations have been affected by drought and saltwater intrusion; specifically 3,900 ha in South Central Viet Nam; 96,700 ha in the Central Highlands; 230,600 ha in the Mekong Delta; and 27,600 ha in Binh Phuoc Province. Additionally, rice production in 25,900 ha of land diminished due to water scarcity (15,400 ha in Binh Thuan; 5,800 ha in Ninh Thuan; 1,800 ha in Khanh Hoa and 2,700 ha in Gia Lai).

Currently about 400,000 households with about 2,000,000 people in the Mekong Delta, Central Highlands and South Central Viet Nam face water scarcity for domestic use, and about 1.1 million people in drought-affected areas suffer from food scarcity and require food relief. Due to the impacts of water and food scarcity, an estimated 27,500 children and 39,000 women are malnourished. Moreover, water shortage and the use of unsafe water have increased the likelihood of outbreaks of water-related diseases. Around 400,000 people are suffering from the incidence of water-borne disease**.**

Drought for extended periods of time is affecting agriculture adversely, as it leaves crops dehydrated with increased salinity – resulting in a decrease in productivity, thereby displacing the livelihood of more than 1.75 million people across 18 provinces.

1.3 Prevention and control measures

a. Directed activities

To confront drought and saltwater intrusion in 2016, the Government, Prime Minister and Standing Office for the National Development Planning Commission have issued a number of directions and regulations as directive Official Orders. They have chaired workshops and organized local site-visits to directly supply concrete guidance for drought, saltwater intrusion prevention and control activities.

Local communities have received funds for drought, saltwater intrusion prevention and control activities in 2016; amounting to about 1,000 billion Viet Nam Dong. The support content includes electricity cost, oil for water pumps, dredging for inlets and canal systems, water trucking for domestic use, undertaking emergency repair services, extended supply of water pipes, and plant varieties, and animal breeds for rehabilitation of production.

b. Emergency measures requiring early implementation

Emergency measures include providing support for affected residents to ensure their acute needs are met (i.e., food, water and healthcare), preventing lack of food and water, incidence of diseases, and the closing of schools during long-term periods of drought. There is also a need to actively implement measures to ensure water is available for domestic use, to use mobile vehicles to truck water for domestic use, to provide water storage containers and water supply equipment for households in areas without centralized clean water supply projects (i.e., plastic water containers, household water filters and water treatment chemicals), to lengthen pipelines of centralized clean water supply projects in order to widen supply coverage, and to drill deep wells to temporarily replace saline groundwater.

Information regarding drought and saltwater intrusion needs to be monitored, provided and projected to the

concerned stakeholders. Communication and experience-sharing on the topic of active drought, saltwater intrusion prevention, and effective water needs to be fostered. Agricultural production in the seasons of Winter-Spring, Summer-Autumn and Autumn-Winter in 2015-2016 needs to be more geared towards changing cropping time, plant varieties and animal breeds. Furthermore, steps need to be taken not to cultivate agricultural lands without sufficient water supply.

The Government has recommended regular review of the demand for water usage and water sources stored in hydraulic and hydropower reservoirs needs to be conducted. A suitable water usage plan, one that is adjusted for the changes in the weather patterns of 2016, needs to be developed. Direction on operating reservoirs to supplement water for downstream areas during dry periods needs to be given to prioritize water for domestic use, animal consumption, and irrigation for perennial crops with high economic value.

Implementation of suitable measures specific to particular areas – such as asking locals to collect, store water and prevent salinity – needs to be undertaken. Prevention of excessive salinity can be undertaken via methods such as canal dredging, installation of mobile pumping stations to supply water for canals and fields when water is available, dam construction for salinity prevention, digging of ponds and wells, as well as underground water well drilling. Construction of irrigation projects in regions with high-risk of drought and saltwater intrusion to supply water for agricultural production and human life needs to be fostered and executed. Additionally, in order to help people affected by drought and saltwater intrusion, policies supporting debt-rescheduling, debt-freezing, and risk treatment for local households need to be implemented. Projects for product rehabilitation and development need to be funded and regulated. Coordination between countries upstream and downstream of the Mekong River needs to be bolstered to facilitate upstream operations of their water reservoirs and to closely monitor water discharge of upstream reservoirs, and water collection for the Mekong River Delta.

c. Long-term measures

Long-term measures to manage and mitigate adverse impacts of scenarios such as the onset of El Niño events would include continuation of monitoring, forecasting and updating climate change scenarios. This would require enhancing national capacity for water and saltwater intrusion monitoring, forecasting capacity to update information in time, and actively deploying adaptation activities in particular periods of extreme weather impacts.

Additionally, the long-term socio-economic development plans of local provinces in the Mekong Delta and the South Central and Central Highlands regions need to be reviewed and adjusted to adapt to the effects of climate change and specific climate events such as El Niño. In the meanwhile, it is recommended that updates and adjustments can be made to sector development master plans – particularly plans for land use, irrigation, agricultural production and water supply to adapt to climate change with more severe drought and saltwater intrusion. Measures to restructure agricultural production towards changes in crops, varieties of breeds, plants and aquatic products, in association with water sources to ensure economic value and social security, also need to be undertaken. The Government recommends the need to develop specific incentive policies allowing people to acquire modern water-saving technologies and practices; such as shallow-exposed dry irrigation, water sprays and drip irrigation etc.

Administrative and economic measures to raise awareness of the need to save water for individuals and groups via calculation of water price increase for socialization in production, supply of water for domestic use, and avoidance of water waste and loss, also needs to be undertaken. In addition, forest protection, foster forest development and rehabilitation (particularly upstream protection forest to improve water sources), and

environmental protection needs to be enhanced. Prioritizing irrigation construction investments is also important; particularly for drought and saltwater intrusion prevention. The total investment capital demand is estimated at US$ 1,415 million, of which the most urgent project which started in 2013 is valued at US$ 233 million. Long-term investment for 2017-2020 is estimated to be US$ 1,182 million.

d. Country-specific needs

To effectively confront continuous drought and saltwater intrusion in South Central Viet Nam, the Central Highlands and the Mekong Delta, the Ministry of Agriculture and Rural Development (MARD) of Viet Nam has proposed the implementation of emergency humanitarian support for drought and saltwater intrusion-affected population, and to deploy measures for drought, saltwater intrusion prevention and control activities. They aim to do so by supporting water trucking, water treatment supplies, providing water storage containers, supplying hygiene kits to poor and vulnerable women, and improvement of school sanitation conditions. The Ministry aspires to provide food or cash for food for households facing starvation, to provide animal feed and seeds for poor households to replant their fields. They also support provision of therapeutic foods and micronutrient supplements to reduce malnutrition at the community and hospital level (27,500 children); particularly provision of micronutrient supplement for pregnant (39,000 people) and lactating women.

The Ministry also aims to provide commune health centres, district hospitals and other medical facilities with essential medicines and medical supplies. Furthermore, they wish to strengthen monitoring capacity of provincial preventive medicine centres and support the capacity of health facilities for maintaining daily health services. In terms of agriculture, they aim to clean crop lands affected by saltwater intrusion, to supply water for drought and saltwater intrusion severely affected areas, and to restock animals for poor households in severely affected areas. The Government also hopes to provide ODA loans for drought and saltwater intrusion adaptation projects in South Central Viet Nam, the Central Highlands and Mekong Delta and finally to support institutional drought, and saltwater intrusion management capacity development.

2. Fiji

The El Niño associated climate variations in 2015-16 created significant challenges for Fiji, in that it caused both increased cyclonic activity and prolonged severe drought due to receipt of below average rainfall in recorded history. However, during its wet season, Fiji experienced one of the strongest cyclones, Cyclone Winston – a Category 5 cyclone – which affected thousands of people.

The Government of Fiji responded to El Niño related slow-onset events by advising farmers to plant drought-resistant crops, use diesel powered generators to supplement hydro-electric power generators, and also provide water for over 67,000 people using water trucks and barges. Emergency relief aid was provided by neighbouring countries to help tackle the impacts of Cyclone Winston. The Government also set up evacuation sectors, distributed food rations, clothing, medical supplies, drinking water and tents. Vegetable seeds were given to affected farmers and a state of emergency was declared in order to rebuild Fiji.

While global forecasts from the World Meteorological Organization (WMO) predict a weakening of the El Niño phase with the gradual shift towards "mild La Niña" conditions in the latter half of 2016, it is important to note in hindsight that rainfall data collected from weather stations (Figure 1) across Fiji for the period May-July 2016 clearly show continuing adverse impacts of the El Niño cycle. Only 2 out of about 30 weather stations have reported average rainfall data, with an overwhelming number reporting below average or well-below average rainfall. However, as predicted by WMO, and based on informal observations, significant

rainfall was observed throughout the Fijian group of islands in August, signifying the shift towards the La Niña phase.

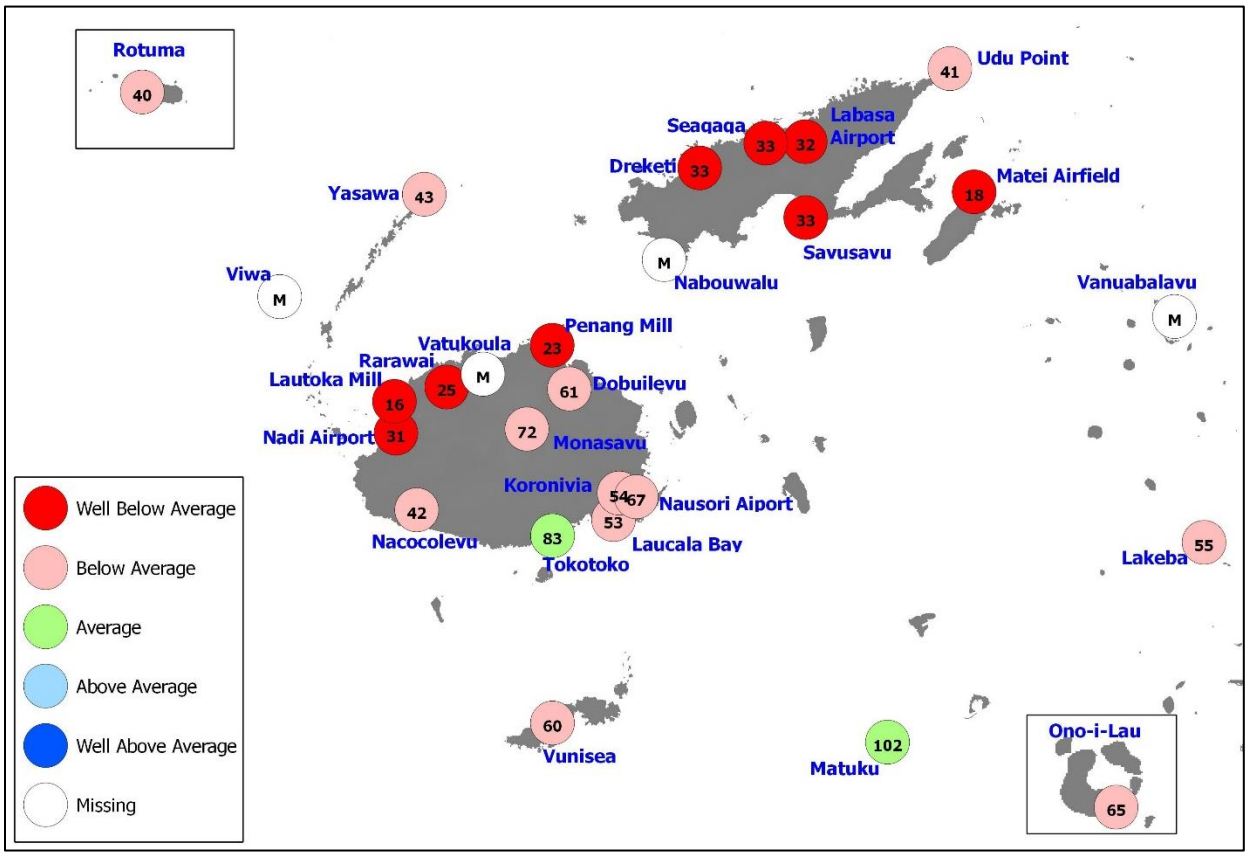


Figure 1: Rainfall data for Fiji for the period May-July 2016

In responding to the crisis, Fiji recognizes that it requires the drafting of a drought plan and a response plan. Significant investments, estimated at around F$300m (USD 150 million; or roughly 10% of the FY budget) in improving water and sanitation infrastructure has also been included in the new fiscal budget with funding support from Asian Development Bank (ADB) loans and grant funding from the Green Climate Fund (GCF).

In terms or pre-planning and improving advocacy towards drought preparedness, it has been observed that the status of drought-onset is determined primarily by recent rainfall data and trends. While annual and bi-annual projections are released by the Fiji Meteorological Services, weak inter-sectoral coordination negates the possibility of proactive actions designed to assist communities most at risk. This reflects the need for Fiji to not only keep pace with new and emerging technologies, but to also ensure that internal capacities are fully utilised to support Government efforts in minimizing losses and expanding the economic base. There is also a need for enhanced capacity in terms of equipment and manpower for disaster risk reduction and mitigation, greater access to technology, ability to retain trained personnel, and encouragement of both inter and intra-regional cooperation. The Government of Fiji has recently completed the post-disaster needs assessment related to Tropical Cyclone Winston, and a disaster recovery framework has been tabled for cabinet approval.

3. Philippines

The Philippines experienced increased losses in the years when there was an onset of a strong El Niño event. In the year 2015-2016 alone, the Philippines experienced an US$ 11.45 billion production loss, which amounted to a loss of 790,239 metric tonnes of produce; a figure that was significantly higher than years with a mild or no El Niño onset. The Philippines created the Roadmap for Addressing the Impact of El Niño (RAIN) to respond appropriately to the crisis at hand, in which it identifies four fields that are most vulnerable to impacts of El Niño events. These are elaborated upon as follows.

Food security is the first area that is impacted by El Niño-induced drought. The production losses during El Niño years indicate reduced food production, which increases food prices, but decreases farm income. Emergency Food Security Assessment data (2016) reflected the direct effects of drought on food security, livelihoods and nutrition of people in affected areas. Drought leaves farmers unable to plant crops, and the proportion of rice and corn farmers able to cultivate their lands dropped as the year went by from 78% to 7%. A similar trend was observed amongst vegetable farmers. Moreover, 77% said water for irrigation was no longer sufficient, and 61% said that water for livestock consumption was not enough. Plans to combat this include improving production support for *palay* (pre-husked rice), corn, livestock and fisheries in areas that would not be severely affected by the El Niño. It also includes increasing credit and technical support available for farmers. Investing in alternative livelihoods and sources of income, such as for example, cash-for-work, handicrafts etc., can enhance income diversification, thereby improving conditions for farmers who were expected to be devastated due to poor yield. Food supply can be improved by increased imports and Government interventions to monitor prices and improve food distribution.

The second field that will be impacted by drought is energy security, as increased drought is common for El Niño events, which can result in reduced hydroelectric power generation. This was expected to be more pronounced in Mindanao Islands, because of the bigger share of hydroelectric power in its energy mix. This can be better managed by implementing an interruptible load programme, by deploying modular generator sets, and by optimizing the dispatch protocol for power plants with hydropower plants serving as peaking power plants that are typically only run when there is a high demand for electricity.

The third field impacted by drought is that of health. Drought results in decreased drinking water, which along with the prevalence of communicable diseases, can result in negative health impacts. This has particular bearing on health; with only 3 in 10 lactating mothers being able to adequately breastfeed their children as they did before the drought, and only 11% of the women being able to consume more than 3 meals a day. 44% of lactating women are consuming three full meals, and 42% consume less than 3 meals a day. In order to prevent this, continuous investigation of health conditions and impacts needs to be conducted. Additionally, conducting inventory stockpiling, and mobilizing logistics for public health, nutrition, water and sanitation, and mental health and psycho-social support would be beneficial. Investigating ways and means for improving nutrition programmes, managing and treating heat-related morbidities, and water quality analysis will also be beneficial.

The final field affected by drought is that of safety, including the incidence of fire, for which procurement of necessary fire-fighting tools is required. For example, forest and grass fires affected drought-stricken provinces of Mt. Apo in Davao and Mt. Kitanglad in Bukidnon. In general, the focus should be on watershed and water resource management and conducting continuous monitoring of hazards, and effective dissemination of information using quad-media. The Government of the Philippines has also effectively

delegated various responsibilities of these above described four fields (food security, energy security, health and safety) to the appropriate Ministries and Departments.

The Government of the Philippines has identified policy issues that certain El Niño characteristics create. For example, a calamity can only be declared after severe conditions have persisted for 3 months, which raises the question: should the implementation of the RAIN programme be implemented only after the calamity is declared? Impacts of El Niño events can be mitigated by implementation of pre-emptive measures, which means that some measures will have to be implemented before the declaration of a state of calamity. Moreover, when drought conditions are declared in a province, even though the entire province is not affected, the request for assistance should be validated, as there may be flow-on effects. For example, Bulacan Province farmers were not benefitting from irrigation services, because water supply in the Angat Dam is being reserved for household consumption. Hence, as conveyed by this case, the spill-over effects of El Niño should be kept in mind.

Currently, 58% of the population has resorted to emergency coping strategies such as selling their last female animals, asking for alms or for remittances or assistance from relatives. Moreover, 18% are practicing crisis-coping strategies such as selling productive assets, and reducing non-food expenses on health and education. Keeping this in mind, as the Government attempts to mitigate impacts of El Niño related hazard events, it faces several challenges. It recognizes that there is a need to strengthen ties with local Government units. It also faces logistical difficulties such as an election ban, the difficulties in implementing the RAIN programme in hard-to-reach areas, and the fact that regular procurement processes take more time than they should. Another identified challenge is that the current intervention design is not suited to address the required response for slow-onset events such as El Niño. For example, the duration for cash-for-work and family food pack distribution is limited. Moreover, there are limitations in relation to the use of the Quick Reaction Force and access to the National Disaster Risk Reduction and Management Fund. The Government requires support for assessment of the impacts of the RAIN programme, and capacity development for local Government units for assessing impacts and responding to slow-onset events like El Niño. It also needs humanitarian assistance particularly for severely affected areas, and support for rehabilitation and recovery.

In the short-term, the Government aims to form a rehabilitation and recovery plan, and strengthen partnerships with local Government units. In the long-term, it plans to enhance current designs and the nature of assistance; which include cash-for-work, food packs, and technical vocational education and training assistance. It also plans to utilize the Quick Response Fund and amend the Philippine Disaster Reduction and Management Act (RA 10121) to include the protocol for addressing impacts of El Niño.

4. Palau

The El Niño associated climate variations in 2015-16 led to severe drought in Palau, causing serious water shortages across the country. As per a National Oceanic and Atmospheric Agency (NOAA) weather report dated March 21 2016, Palau was experiencing an extreme Drought Level 3 of 4, and the cumulative rainfall for Koror over the past 4 months was the lowest recorded since 1951 at 17.65 inches. About 80% of the areas in Palau are now experiencing a decrease in water supply and have incurred undue hardship. More than 3,700 households and business establishments in the states of Koror and Airai are connected to the water system, and constitute 75% of the total connections. The average household water usage is about 169 gallons per person per day. There are currently 18 small water systems located throughout the remaining states of Babeldaob, servicing a total of 965 households and businesses. While these outlying water systems have

holding capacities of over 1 million gallons, their monthly consumption is that of over 7.4 million gallons, creating a water deficit. Moreover, storage volumes in the tanks and at the low head dams for stream intakes are small and not sufficient to substantially supplement stream shortfalls during dry periods. Four states (Ngiwal in Babeldoab), Peleliu and Angaur (limestone atolls), and Kayangel (coral atoll) are especially vulnerable to drought as they each have water systems that have groundwater supply sources, signifying that they are dependent on the rains to recharge their groundwater sources and water lenses. It is probable that these water sources will experience increased salinity. The outlying states of Sonsorol and Hatohobei rely heavily on individual home and community water catchments and wells. It is probable that these water sources will also be affected by increased salinity

Palau Public Utilities Corporation (PPUC) reported that the two water sources for the Koror-Airai Water System were declining for the last few months and at that time one of the sources (Ngerimel Dam) was shut down. The remaining source of water was from the Ngerikiil River, which produced only 750,000 gpd (gallons per day), 19% of the normal production of 3.8 million gpd. Currently, the Ngerikiil River production is down to 500,000 gpd. It also reported that the water levels have been declining since January 20, and placed Koror and Airai on an Emergency Water Rationing Schedule on Saturday March 12 2016. At that time, the water rationing permitted five hours in the morning and five hours in the evening for all areas. As of Saturday March 19 2016, the water rationing was reduced to four hours in the morning and evening. Effective March 22 2016, water rationing was further reduced to three hours in the morning and evening. One more reduction in water rationing followed this. Due to the continuous decline in water level, Palau Public Utilities Corporation (PPUC) also reports that other parts of Babeldaob, including the larger states of Ngaraard, Ngarchelong and Aimeliik, as well as the outer islands of Kayangel, Peleliu, Angaur and the Southwest Islands, are experiencing diminished water resources and have placed their communities on water rationing schedules.

In addition to the fact that water needs are not being met, water shortages also affect water quality, as low levels of water at water sources leads to increased turbidity. This poses a major health risk to those relying on the public water systems for potable water. Farming and crops are – and will be – damaged; health issues such as bacteria in water and food, lack of food, and dehydration will most likely increase. The most vulnerable sectors affected by this prolonged dry period are health (hospitals and clinics), pregnant women, infants, the elderly, the bed-ridden, persons with disabilities and education (schools). The Ministry of Health (MOH) reported that the health impacts associated with the current drought could lead to disease outbreaks (such as diarrhoea, pink eye, etc.), food and water-borne illnesses and air quality related illnesses. MOH facilities continue to rely on the public water system to operate. The Ministry of Education (MOE) reported that they had 3-4 day onsite water storage, but also continue to rely on the public water system to refill their water storage facilities. With the water rationing implemented by PPUC, MOE recognizes the increased risk to student health and hygiene.

The drought also has significant economic impacts. Many water-bottling companies in Palau have temporarily stopped production of bottled water due to the water shortage. Small businesses, such as retail stores and hotels and motels (less than 50 rooms), will likely have their operations restricted or may have to completely shut down. The Division of Fire will have limited access to water supplies in case fires occur. Critical infrastructure like the Palau International Airport will be affected, and tourism arrivals may decrease. According to Belau Tourism Association (BTA), average arrivals are nearly 13,000 visitors per month. With the water rationing implemented by PPUC, BTA is concerned that the level of water service may not be able

to support those many visitors. This is particularly damaging, as Palau's economy is primarily tourism oriented.

A decrease in water levels, production and rationing will compromise existing pumps and valves and related components causing operational setbacks. PPUC's primary base load generators at the Malakal Power Plant (MPP) have a cooling tower system which uses excessive water and is not circulated but exposed and evaporated. PPUC has made changes to its operational scheme at its main power plants wherein Aimeliik Power Plant (APP) now provides the bulk of generated electricity. However, this will have significant impacts on delaying the scheduled overhaul of the Mitsubishi (APP) generators.

In response to the grave impact the drought was having on the nation of Palau, the National Emergency Committee (NEC) convened on March 21, 2016. Given the above reports and information, the NEC recommended that a State of Emergency be declared in accordance with Article VIII, Section 14 of the Constitution of the Republic of Palau. His Excellency President Tommy E. Remengesau, Jr. issued an Executive Order No. 389 on March 22 2016, declaring a State of Emergency due to an Extreme Drought. Any State of Emergency, by law, will continue for ten days. At the end of the initial 10-day emergency period, conditions in Palau had not improved. In fact, the situation had significantly deteriorated to the point that water from the main water source at the Ngerikiil Reservoir could no longer provide adequate amount of water to all hamlets in Koror and Airai, and water distribution by truck became necessary for certain areas. Demands on local retailers completely exhausted all available stocks of drinking water. As a result, the Ministry of Health, Ministry of Education, and Environment Quality Protection Board have implemented their emergency plans to increase awareness on the need to take precautions regarding the quality of drinking water and to educate the public about water conservation measures.

On April 1 2016, due to the worsening water situation, the NEC recommended to the President that the State of Emergency be extended for another 10-day period. Later the same day, President Remengesau wrote to the leadership of the Palau National Congress requesting an extension of the State of Emergency and the related temporary legislative powers for an additional ten days as of April 1 2016. On the evening of April 4 2016, the Congress approved the continuation of the extension of the State of Emergency to take effect on April 1 2016 immediately after the expiration date of the initial declaration. The State of Emergency continued through April 11 2016, allowing the NEC to effectively and efficiently mitigate the ongoing efforts to address the effects of the drought. In response to the continued extreme drought conditions, a Presidential Directive No. 16-17 was signed and issued on April 18 2016 by H.E. President Tommy E. Remengesau, Jr. directing the Executive Branch to continue responding to the emergency situation and operating as if there was a continued constitutional State of Emergency.

On May 9 2016, the amount of collected rainfall was sufficient enough for PPUC to resume back the 24-hour water service for Koror and Airai States. PPUC reported that water levels at the Ngerimel Dam and the Ngerikiil Reservoir were adequate to fill water intake tanks even after filling water delivery tanks to optimal heights. PPUC expressed the importance of keeping water delivery tanks at optimal level, which allows continuous water flow to hamlets at higher elevations. In summary, PPUCs decision to resume the 24-hour water service was due to sufficient water collection, water levels at both intakes maintained at optimal level, to relieve water pressure on fragile water system.

The NEC continues to operate under the Presidential Directive No. 16-17, and meets every week to discuss updates and coordinates efforts to better assist the remaining States that continues to experience water

shortfalls. The NEC has also taken a number of concrete actions aimed at providing immediate relief from the severe drought. These actions may be divided into two major strategies: augmenting the available water supply from the Ngerikiil Reservoir, and developing a distribution system to deliver water to areas most affected, elaborated upon as follows.

4.1 Augmentation of the available water supply

PPUC has been working with the Bureau of Public Works to identify traditional water sources that could be tapped and used to provide additional water. To date, PPUC has identified six well sites in Airai that could produce a total of about 120,000 gpd. Three of these sites are existing wells, of which two have been activated. The other three sites are boreholes, of which one has been tapped and is feeding water directly into the Ngerikiil Reservoir Intake. PPUC contracted local vendors in activating the wells in Airai. To access the boreholes, the Civic Action Team was utilized to clear access to the sites. PPUC was then able to install pumps and powerlines to link them to the power grid. Public Works identified two sites within Koror State where fresh water could be obtained, but the existing pumps were not operational. They have installed temporary pumps to activate these two wells, and have set up public water stations accessible to the public.

The NEC has contacted several contractors with the capacity to restore existing wells by installing new pumps, acquire and lay power lines to serve the pumps at these sites, properly test the water, and begin pumping and distributing the water from these wells. However, due to limited local capacity to further explore and make reliable estimates of the quantity and quality of water from underground sources, the NEC has had to outsource this to off-island qualified contractors who would be readily available to perform this type of work. In particular, this work requires a qualified hydrologist to assist in exploring and estimating the quantity and quality of water from underground sources.

Five of the States in Babeldaob continue to have a sufficient level of water to supply to their small communities. Three of these States are now supplementing the water supply for Koror and Airai, as well as the other States that experience severe water shortages. Currently, about 20,000 gallons of water are being hauled each day. It should be noted however that these small water systems may also experience water depletion if the lack of sufficient rainfall continues.

4.2 Developing an emergency water distribution system

The NEC began the process of acquiring – whether through donation, direct purchase, rent – water containers, tanks and bladders, as well as small pumps, hoses and valves, etc. In the event of a complete water shortage in Koror, Airai, and other States, these materials and equipment are necessary to collect, test, transport and distribute water from productive water sources to communities.

Because the pump-drawn water from wells in Koror is not capable of supplying optimal amount of water to the main line, platforms for water bladders were constructed at various water dispensing sites to provide water accessibility to communities. The Palau Red Cross Society was tasked to deliver potable water to all vulnerable individuals, including the homebound and the elderly, throughout Palau based on a list provided by MOH and Ministry of Community and Cultural Affairs (MCCA). The Bureau of Agriculture (BOA) built a 1000-gallon water tank at its Ngchesar Agriculture Station. BOA has already been delivering water from this tank to livestock farms using a makeshift arrangement of water buffalos. Other farmers report that their crops are suffering from the lack of rain. This situation, unabated, is sure to lead to heavier reliance on imported meats and fresh produce.

MOH has expressed the need for at least one additional ambulance, in view of the increased risk of injury and illness. Public Health is closely monitoring encounters with health providers. They have increased vector-control surveillance and have also increased visitations to restaurants and other food handling establishments to inspect their level of sanitation. In addition, they are expanding the water storage capacity at community health centres. Finally, they have escalated their community outreach efforts to increase public awareness about hygiene and sanitation practices that can minimize water-borne diseases.

MOE activated their emergency response plan. They have taken several measures to conserve water; including the decision to use disposables rather than use precious water to wash utensils and dinnerware. MOE bought every last hand sanitizer available and distributed it to all teachers and students. To date, MOE has not reduced school hours, but nevertheless they have monitored daily attendance and reported increased absenteeism.

4.3 Planning and Logistics Subcommittee

The NEC created a Subcommittee to compile a list of all donations. The master inventory listing ensures the precise accounting of all donations and supplies on-hand to effectively coordinate distribution of resources. The donations include monetary funds as assured by the Government of Korea; 16 water tanks as assured by the Government of Taiwan; 20 water bladders and a water system unit as assured by the Government of Japan; and a desalination unit as assured by the Government of Israel. The Government of USA has also assured aid, in the long-term, by offering monetary funds. The Committee is chaired by the Director of the Palau National Weather Service, Ms. Maria Ngemaes.

4.4 Recommendations

Planning and Logistics Subcommittee of the NEC:

- Palau National Emergency Management Office (NEMO) to procure 2 additional 40-footer containers that will be utilized as NEMO storage.
- Procure a Forklift and Hand Trucks:
    - 2.5 tonne max. lifting Capacity
    - Hand truck (4 pcs.)
- Come up with a Memorandum of Understanding between NEMO and Private Enterprises regarding utilization of their Appropriate Assets.
- Bore holes and wells to continue being developed/commissioned and maintained.
- Tax relief for small businesses (in support of drought mitigating measures).
- National Government appropriate funds to National Development Bank of Palau (NDBP) to soften the impact on loan interest rates.

5. Papua New Guinea

Papua New Guinea (PNG) is experiencing severe drought Categories 2-5 affecting 2.7 million people, as a result of El Niño associated hazard Nationalevents. Cash crop production was adversely affected, as were food and water resources. 94% of the total budget is estimated to be required for food assistance, as 60-70% of the population needs immediate relief assistance. The education sector also had to face distress, having to close down schools temporarily and resume with half days. The health sector had to scale down operations

and the risk of disease has overall increased. There were also several socio-cultural issues and the economy has suffered in general.

In response to the impacts of El Niño events, PNG conducted rapid assessment of the situation, and improved intra-governmental coordination through weekly coordination meetings. The Government has received humanitarian aid relief worth US$ 20 million Papua New Guinea Kina, and 2,683 metric tonnes of relief aid (Figure 2). Aid has been received from UN Agencies and bilaterally from agencies such as AusAID and USAID amongst other partners. Several faith-based groups as well as INGOs have extended assistance to the PNG Government. PNG has also received aid from a number of private sector entities.

The Government faces significant challenges in managing its communications and logistical capability to access remote areas to provide relief. Moreover, the Government has identified the need to work on coordination issues with National Disaster Centre (NDC) in conjunction with Provincial Disaster Centres (PDCs) and district level authorities and gather appropriate data as well as manage information. Quality of assessment and situation reports must also be maintained. The Government requires support in relation to its water security issues, awareness campaign and training programmes. It needs assistance to enhance information management systems and review contingency, response plans and standard operating procedures (SOPs).

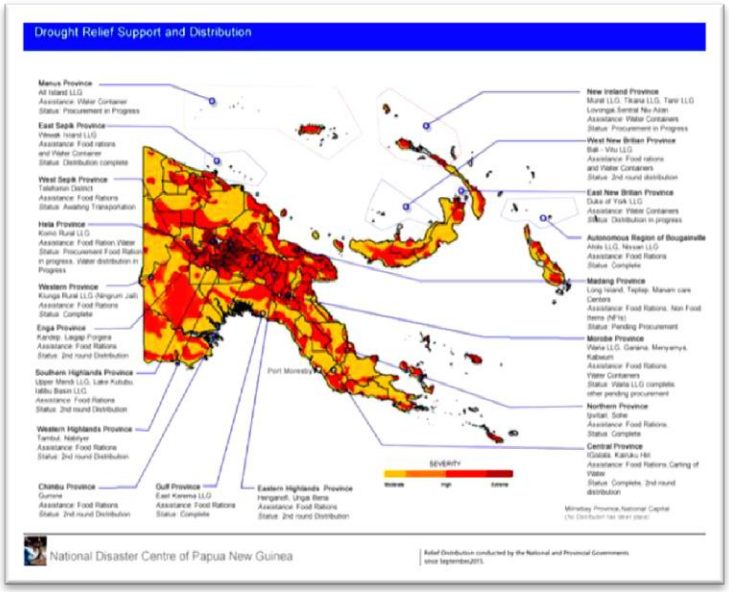
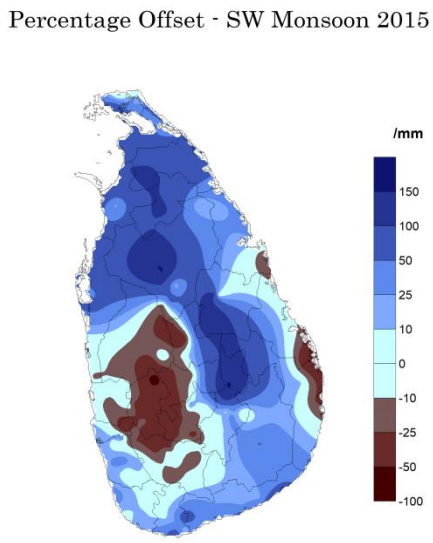


Figure 2: Showing the drought relief support and distribution measures undertaken by PNG in 2015

6. Sri Lanka

Studies of ENSO impacts on the Sri Lankan weather indicate that there are strong influences of extreme phases of the ENSO phenomenon on Sri Lanka's seasonal rainfall. The strongest influence of ENSO extremes is evident during the Second Inter Monsoon (SIM) period, lasting from October to November, in most parts of Sri Lanka that experience an excess of rainfall during El Niño years and a deficit of rainfall in La Niña years. Significant impact on the South West Monsoon (SWM) period (lasting from May to September) rainfall was also evident over central parts of the island, with a deficit of rainfall during El Niño events and an excess of rainfall during La Niña events. Significant impacts on the North East Monsoon

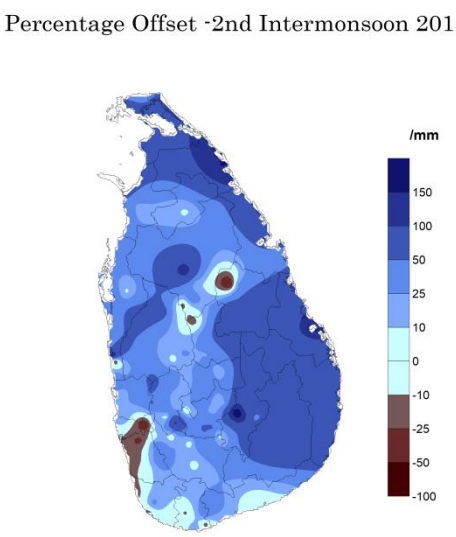
(NEM) period (lasting from December to January) with abnormal rainfall over the north western, north central and central parts of the island, . The weakest influence of ENSO extremes on rainfall is evident during First Inter Monsoon (FIM) period (lasting from March to April).



In 2015, the rainfall during the South West Monsoon (SWM) was significantly below normal over interior parts of the southwest quarter of Sri Lanka (Figure 3). Most of the hydropower reservoirs are located along the western slopes of the central hills and in general, receive substantial amount of rainfall during SWM. But, by the end of September 2015, the water levels in major reservoirs had come down to 35 percent and the hydropower generation had been reduced to 20 percent according to the System Control General Manager of the Ceylon Electricity Board.

Figure 3: Rainfall percentage offset during SWM (May to September) 2015 in Sri Lanka

In the Second Inter Monsoon (SIM) 2015, rainfall was significantly above average over most parts of island as expected (Figure 4), and led to a flood situation. Extremely heavy rainfall (350.9 mm) had been reported in Mannar (Northern Province) and it was the highest-ever recorded 24 hour rainfall at the station. A local flood situation was reported from some parts of the island. Around 79,000 people in 14 districts – including Nuwara Eliya, Badulla, Batticaloa, Gampaha, Trincomalee, Matale, Jaffna, Kilinochchi and Mullaithivu districts – were affected by heavy rain and 3 casualties also were reported due to the flood situation.



The Department of Meteorology issued a weather warning for SIM in time to all stakeholders, including the Department of Irrigation. After careful assessment of the water levels that prevailed in the reservoirs, the Irrigation Department issued special instructions to authorities in-charge of reservoir operations to maintain reservoir water levels 1 metre below the full capacity level, allowing water detention and also for smooth operation of spill gates, and also the farming community was alerted over possible inundation due to excess drainage.

Figure 4: Rainfall percentage offset during SIM (October - November) 2015 in Sri Lanka

North East Monsoon (NEM) rain in 2015 was below average over most parts of the island, including the North Central province, where most major irrigation tanks are located. In general, the north-central part of the island receives significant amounts of rainfall during the NEM period. The main water source of the said area for cultivating paddy is NEM Rainfall. Therefore, NEM rainfall is of immense importance for agriculture. As NEM rain in 2015 was below average in north central parts of the island, agricultural activities were severely affected.

First Inter Monsoon (FIM) rain in 2016 also was below average over most parts of the island, due to the effect of El Niño as expected. Three stations were selected (1 west coast: Colombo, 1 hill country: Nuwaraeliya and 1 east coast: Batticaloa) to analyze variations in temperature of the country during the years 2015 and 2016 (up to April). All stations showed above average maximum (day) and minimum (night) temperatures, and more significantly in the Colombo station during 2016.

7. Myanmar

7.1 Overview of El Niño impacts

An overview of El Niño associated climate variation related impacts have been provided based on the following parameters:

a. Annual mean temperature

During the strong 2015-2016 El Niño event, monthly mean temperatures in Myanmar were above normal when compared with the thirty-year period from 1981-2010. The mean monthly temperature increased by as much as from 1.22°C to 3.46°C in January, March, May, June, September, November and December of 2015, and from 1.39°C to 1.45°C in February to May of 2016 (Figure 5). According to the Department of Meteorology and Hydrology's (DMH) observation data, new recorded maximum temperatures were observed in 29 stations during the hot season (covering March, April and May) of 2016. Some stations observed such new records 2 to 3 times.

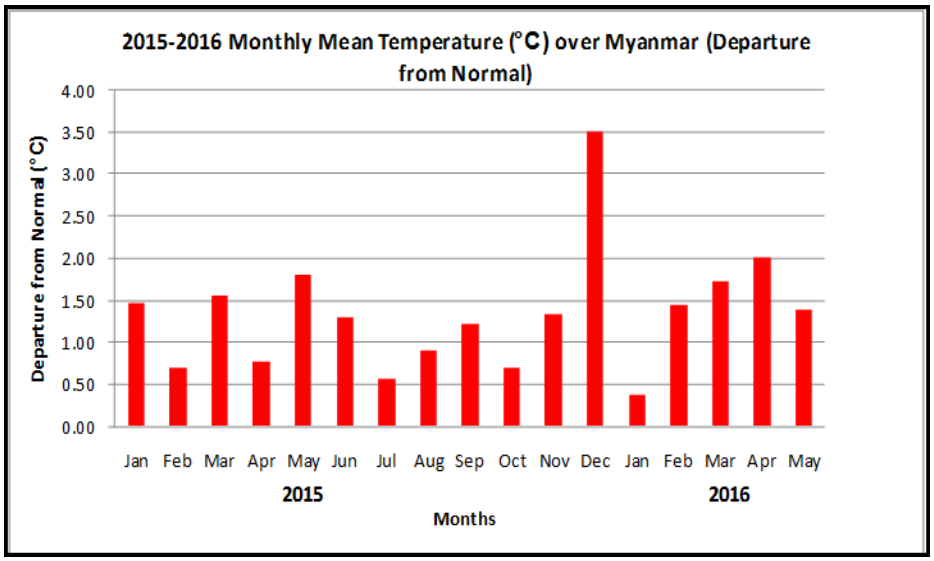


Figure 5: Departure from normal of monthly mean temperature in Myanmar during the 2015-2016 El Niño event

b. Annual rainfall

During the 2015-2016 El Niño event, mean monthly rainfall in Myanmar reflected that the winter months and the dry season of low rainfall were below normal when compared with the thirty-year period from 1981-2010. The mean monthly rainfall decreased by as less as from 24% to 92% of the normal in February, March, May and November and December of 2015, and from 50% to 61% of the normal in February, March and April of 2016.

c. Monsoon rainfall

The relation of monsoon rainfall with the 2015-2016 El Niño event clearly reveals that monsoon rainfall in Myanmar is below normal to near-normal in the monsoon season (June to September, except July) in 2015 (Figure 6).

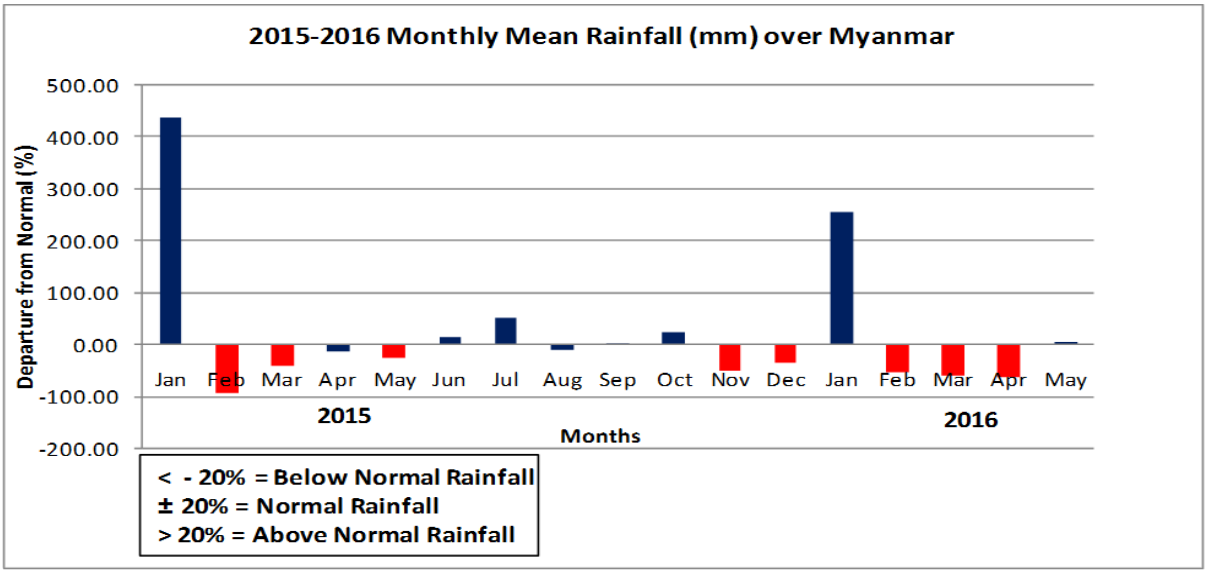


Figure 6: Percentage departure from normal of mean monthly rainfall in Myanmar during the 2015-2016 El Niño event

d. Drought index

The study on the drought index in relation with the El Niño event shows a good relationship exists between them. Thus it could be stated quite confidently that during the 2015-2016 El-Nino event, the drought index in rainfall shows positive values (dryness) in three consecutive months (February till March) in 2016 (Figure 6).

7.2 Overview of current El Niño condition

Drier than average conditions have continued in Myanmar since November 2015, and associated risks such as fire hazard, drought, disease and food insecurity persisted until mid-2016. Currently, water shortages in some parts of the country are being reported. Reports from Sagaing and Magway Regions, as cited by OCHA, indicated that water trucking needs are also increasing. In Kachin State, water trucking is ongoing for IDP (Internally Displaced Person) camps and communities in Hpkant Township. Based on the Department of Rural Development's (DRD) estimates, 1,700 villages are expected to still face water shortages across the country.

According to the Relief and Resettlement Department (RRD), as cited by OCHA, heavy rains have triggered flash floods in Kawlin, Wuntho and Pinlebu Townships in Sagaing Region on 9 June 2016, damaging farmlands and bridges. More than 25,000 people were affected in Kawlin Township. The Sagaing Regional Government is responding to urgent needs, while the Relief and Resettlement Department (RRD) is providing cash assistance. Localized floods were also reported in other parts of the country on 10 and 11 June and damage assessment is ongoing for these calamities.

7.3 Responses to El Niño-related impacts: Some government and partner actions

The National Disaster Management Committee (NDMC) in Myanmar is an apex inter-ministerial body leading early warning, preparedness and response. The Government has been providing assistance in terms of water distribution, pump installation, and awareness-raising activities on reserve seed storage, efficient water usage, disease prevention in crops and livestock, water pond management and other areas. In addition, over 200 humanitarian partners are currently providing assistance to over one million people in Myanmar. This includes 460,000 people who continue to require food security support, following the devastating floods in July-August 2015. For example, the UN Food and Agriculture Organization (FAO) is implementing projects in the Chin State and Sagaing Region; both being areas affected by the 2015 floods.

The Department of Meteorology and Hydrology (DMH) is responsible for providing relevant information, forecast products, alerts and warnings regarding the likelihood of meteorological phenomenon to the public and concerned agencies in order to enable proactive measures for sector-specific planning and minimize the negative impacts of disasters. In this context, DMH issued the El Niño Outlook for Myanmar seven times during five months (January-May 2016) for the 2015-2016 El Niño year. Senior officials from DMH also made efforts to raise awareness through interviews with media about the El Niño event and its impacts. Staff members from State and Region-level offices of DMH engaged in interactions with local governments and communities to share knowledge on El Niño and the possible impacts on weather and climate, as well as how to adapt to this event. In this relation, the El Niño Outlook Forum was held in February 2016 by DMH, in collaboration with the Asian Disaster Preparedness Centre (ADPC).[1] The Forum brought together relevant stakeholders to convey the local El Niño outlook, share knowledge, and to discuss the possible impact and adaptation measures. Government agencies, international organizations, and media representatives were among the participants.

7.4 Country-specific Needs

- Decision-makers need to encourage and better understand forecasts and their specificity to particular locations, seasons and time periods.
- DMH requires high-resolution forecast products on multiple timescales (seasonal, monthly, weekly and daily etc.) from global and regional climate centres.
- DMH requires up-to-date information for future ENSO events.
- DMH requires reliable sources for remote sensing information in near-real-time indicating water bodies, drought index, heat index, and vegetation index in the area, and map interpretative technologies.
- DMH requires capacity-building in terms of short/medium/seasonal forecasting techniques.

[1] The El Niño Outlook Forum was organized under the project on "Strengthening weather and climate services of Myanmar, Bangladesh and Vietnam to deal with hydro-meteorological hazards", supported by the Ministry of Foreign Affairs of Royal Norwegian Government (MFA-Norway) with technical support from MET-Norway.

- DMH suggests further technical cooperation between regional and international climate prediction centres.
- DMH will continue to benefit from experience-sharing at regional and international forums and workshops for future ENSO events.

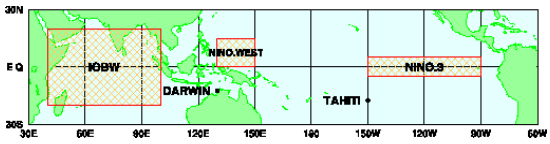
8. Cambodia

8.1 Overview of El Niño impacts

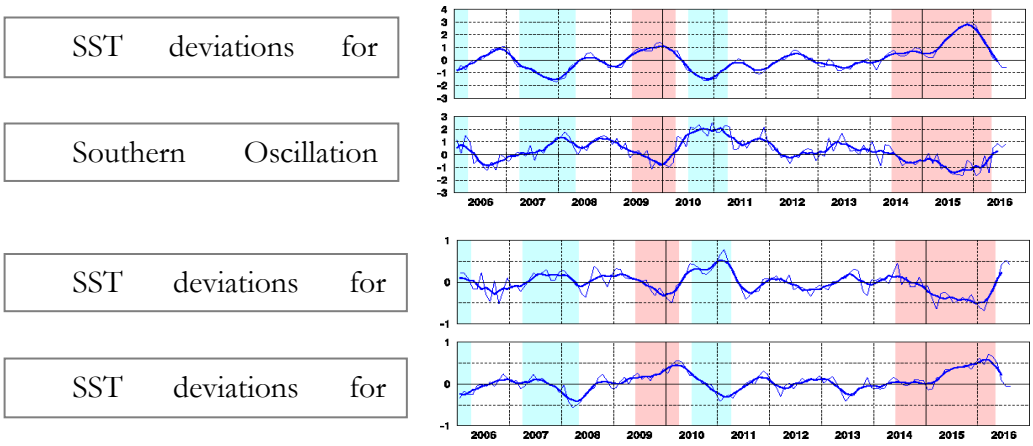
The meteorological assessment undertaken in 2015 conveyed that the El Niño event ongoing since end 2014 was prolonged till May 2016 (Figure 7). It was particularly strong from January 2016 till the third week of May 2016.

Figure 7: El Niño outlook

(a) Outlook of the SST deviation by the El Niño prediction model



(b) Time series of sea surface temperature (SST) deviations from the climatological mean based on a sliding 30-year period for:



a. Temperature pattern

The maximum temperature reached in June 2015 was warmer than the maximum temperature of a 24-year period from 1990-2014. The maximum temperature of coastal areas reached to 37.5 ^{o}C – warmer than the maximum temperature of 24 years by 0.5^{o}C (Figure 8). The maximum temperature in lowland areas reached to 41.0 ^{o}C – warmer than the maximum temperature of 24 years by 1.5^{o}C (Figure 9). The maximum temperature in plateau area reached to 41.5 ^{o}C – warmer than the maximum temperature of 24 years by 2.5^{o}C (Figure 10).

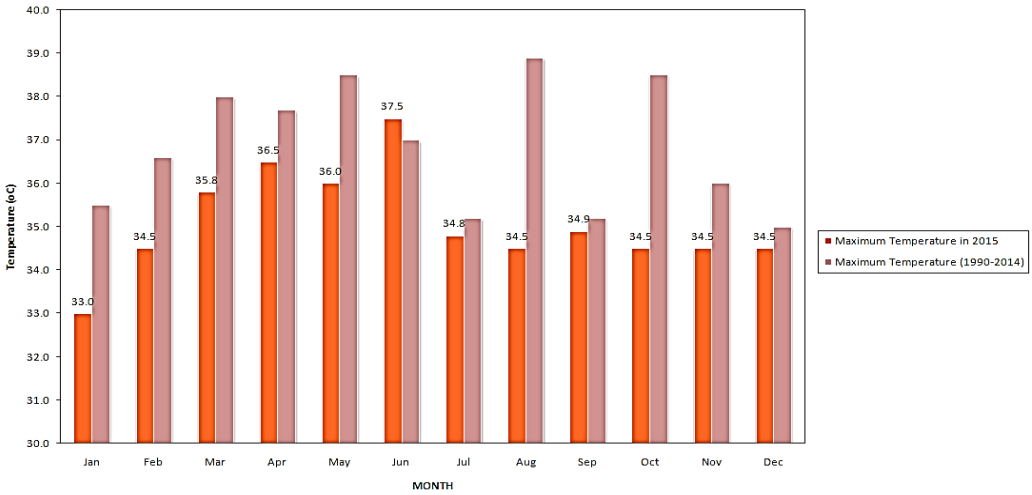


Figure 8: Maximum temperature in coastal areas

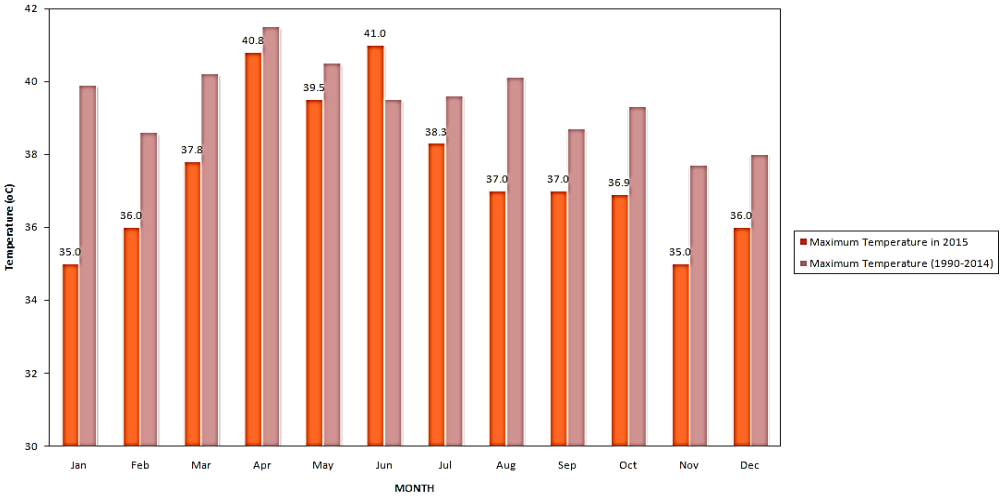


Figure 9: Maximum temperature in lowland areas

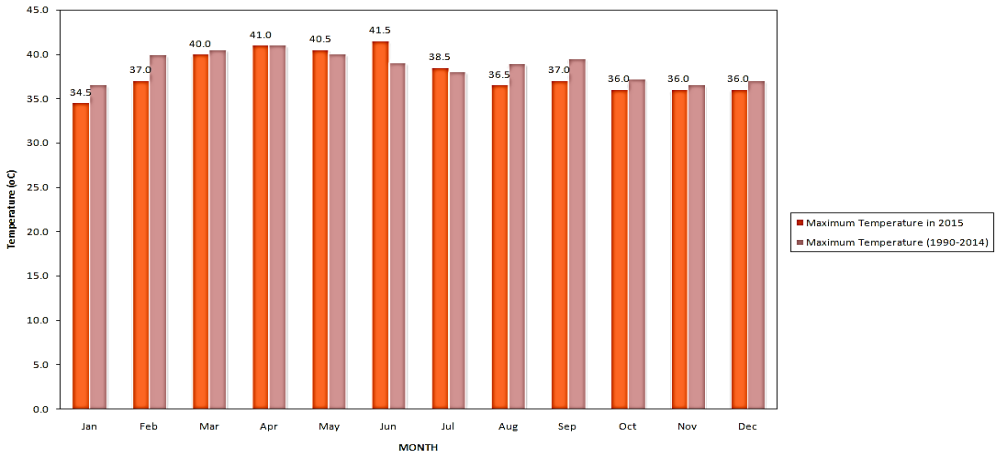


Figure 10: Maximum temperature in plateau areas

b. Rainfall pattern

The onset of the southwest-monsoon was weak and delayed. The amount of rainfall over the country decreased when compared with the average rainfall over 30 years (Figures 11, 12 and 13). Average rainfall in coastal areas was less than the average rainfall in 30 years by about 1162.1 mm. The average rainfall in lowland areas was less than the average rainfall in 30 years by about 227.3 mm. Average rainfall in plateau areas was less than the average rainfall in 30 years by about 313.3 mm.

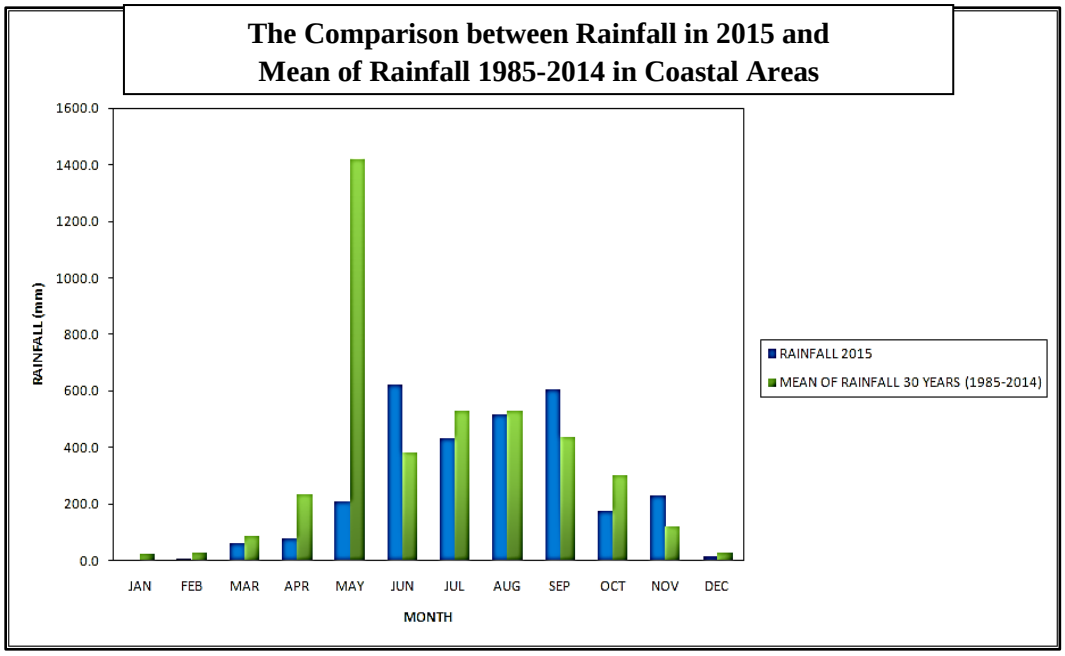


Figure 11: Rainfall amount in coastal areas

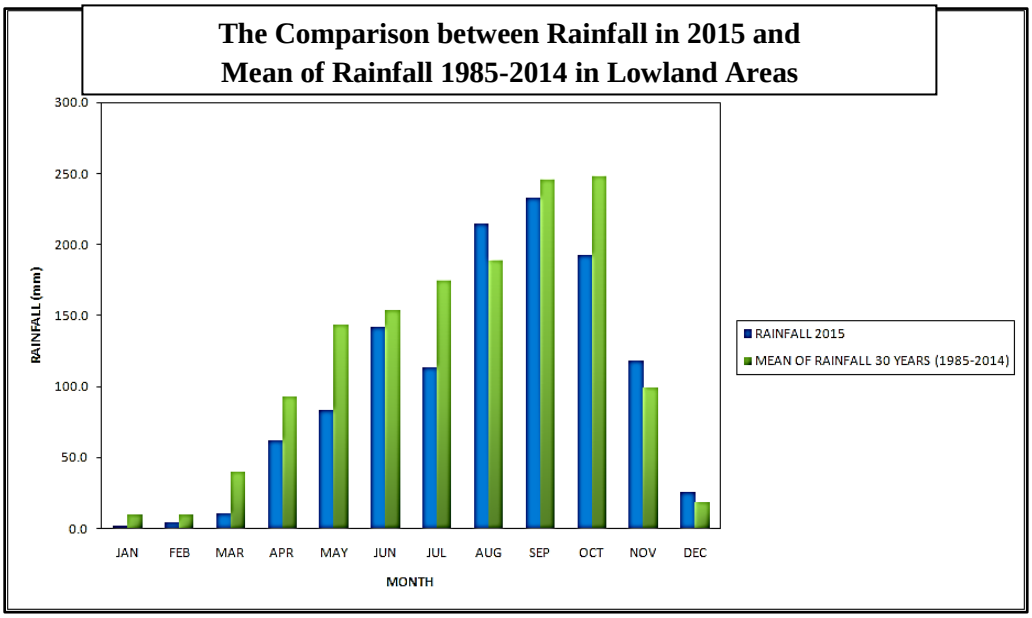


Figure 12: Rainfall amount in lowland areas

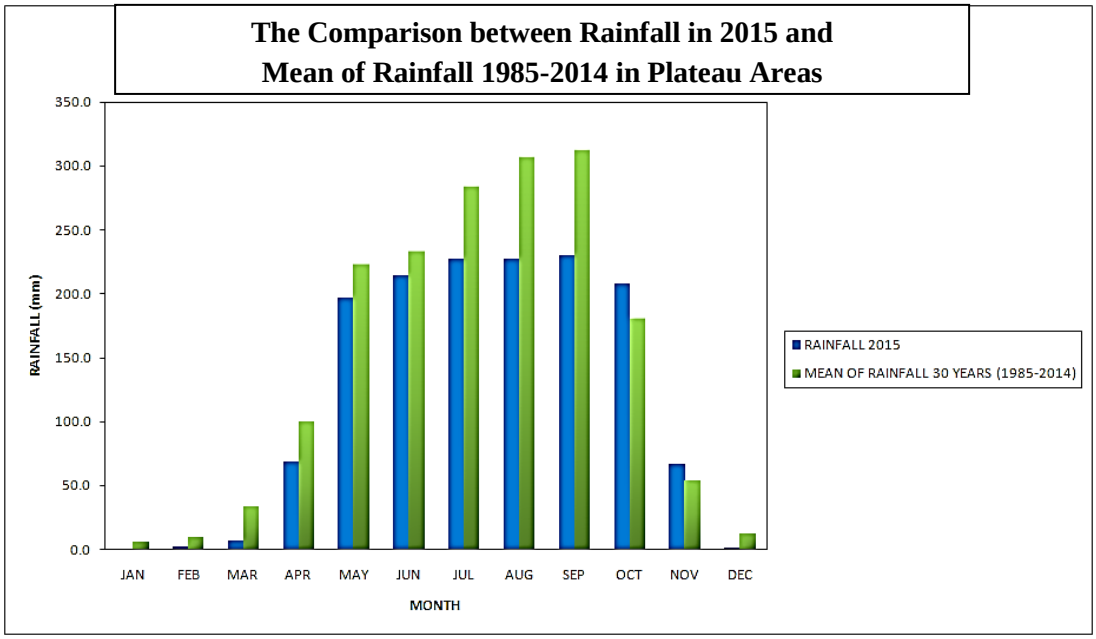


Figure 13: Rainfall amount in plateau areas

According to the assessment of World Food Programme (WFP) in Cambodia, it was reported that many provinces in the country were impacted by drought caused to lack of water available for agriculture (Figure 14). In response to the drought situation, the Ministry of Water Resources and Meteorology officially provided an announcement via different channels before the drought event occurred to the relevant agencies and the public.

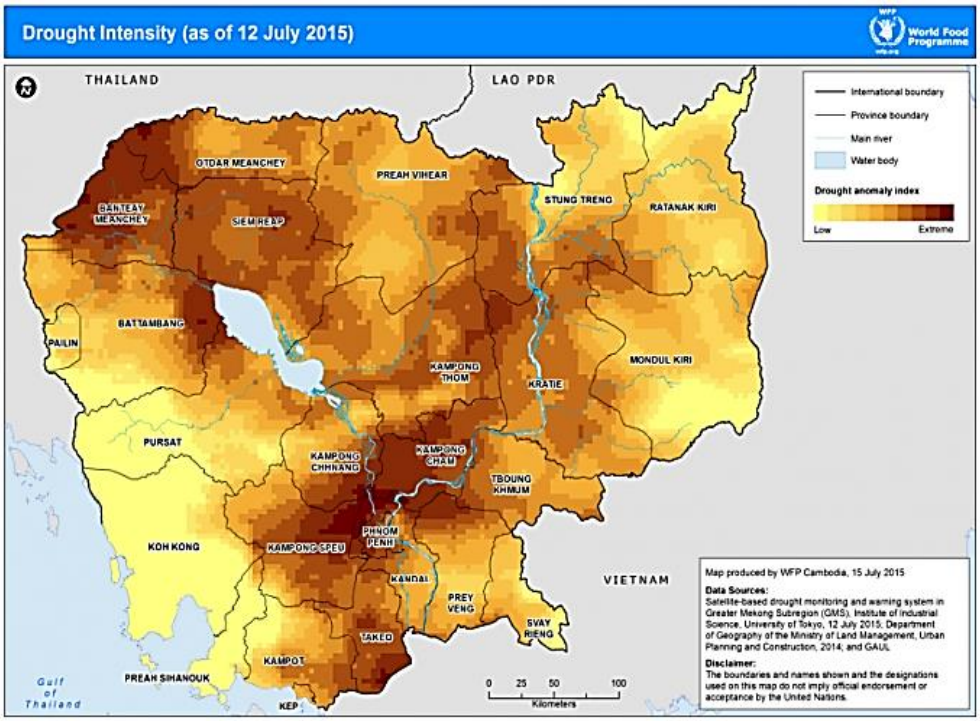


Figure 14: Map of drought intensity in Cambodia as of 12 July 2015 (Source: WFP, 2015)

However, from mid-July to September 2015, there was heavy rain in many parts of Cambodia, except provinces in the north-western region. Other provinces and the city of Phnom Penh frequently experienced flash floods, where homes and other infrastructure was damaged. Some persons died and were injured by lightening that struck during thunderstorms. For example, in Phnom Penh on 31 July 2015 torrential rain was recorded from 50 mm to over 100 mm per hour with a wind gust of 35 Kts, resulting in a flash flood and infrastructural damage (Figure 15).

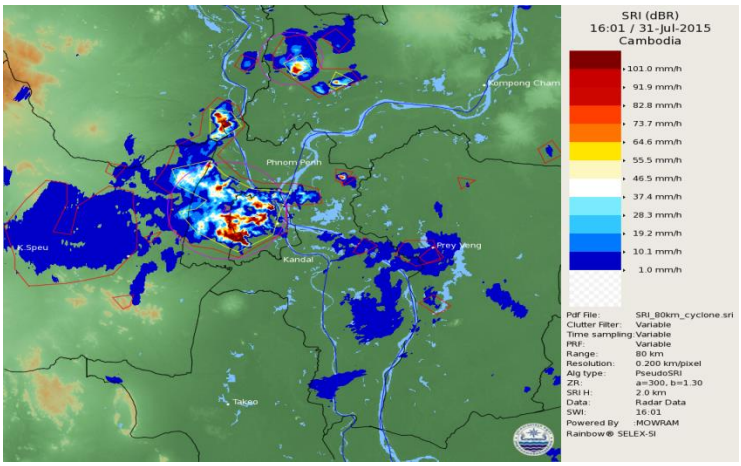


Figure 15: Local thunderstorm in Phnom Penh at 16:01 local time on 31 July 2015

During September-October 2015, one tropical storm impacted Cambodia. The disturbance formed in the South China Sea on 10 October 2015 and developed into Tropical Storm Vamco 13 September 2015. During the lifetime of Vamco that lasted from 13-15 September 2015, heavy rains affected the northern and southern parts of Cambodia, including the coastal inshore and offshore areas (Figure 16, 17 and 18). The Department of Meteorology provided early warning announcements to the public three days ahead of the tropical storm making landfall, and kept updating information every 15 minutes on the website. Channels of communication were left open through the national radio, television and telephone. After making landfall, from 16-17 October 2015 there was continuous heavy rainfall with maximum wind speed of 13.5 m/s in coastal areas which caused flash flood and flooding (Figure 19) in some provinces, especially in Kampot.

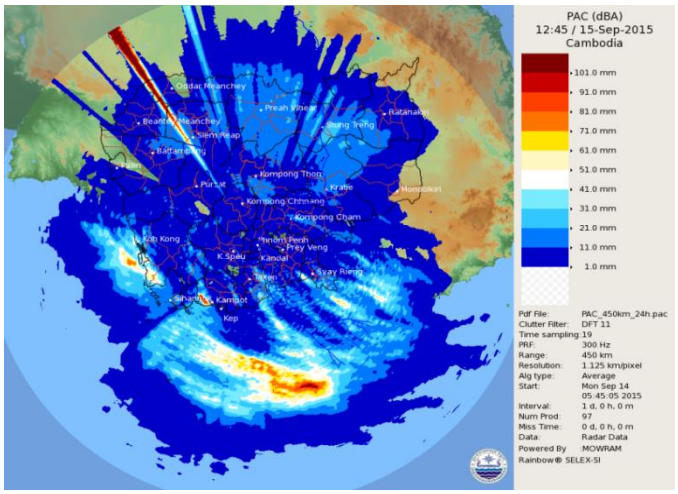


Figure 16: Accumulative rainfall 24 hours from 5:45 UTC on 14 September to 5:45 UTC on 15 September 2015

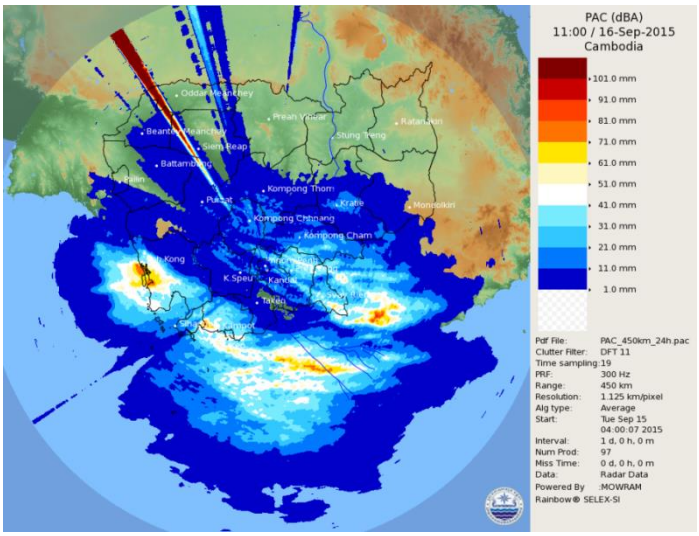


Figure 17: Accumulative rainfall 24 hours from 4:00 UTC, 15 Sep to 4:00 UTC on 16 September 2015

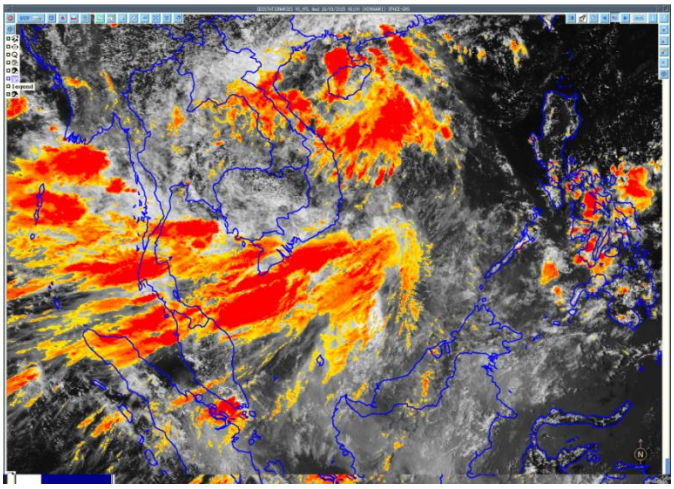


Figure 18: Infra-red satellite image from Himawari-8 of Japan at 06:00 UTC on 16 September 2015

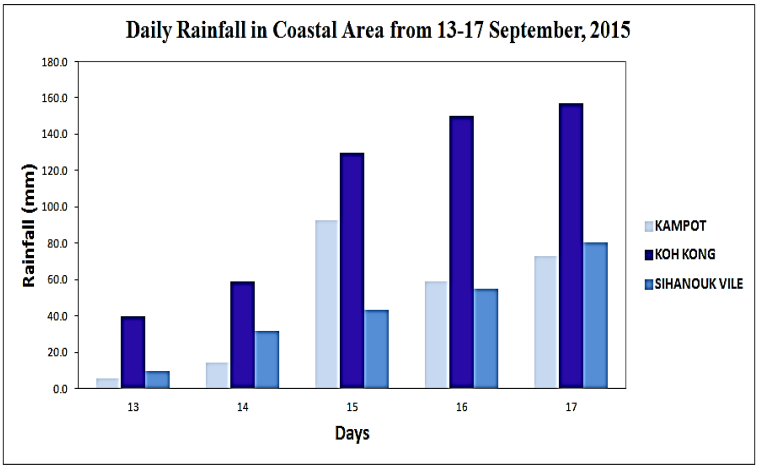


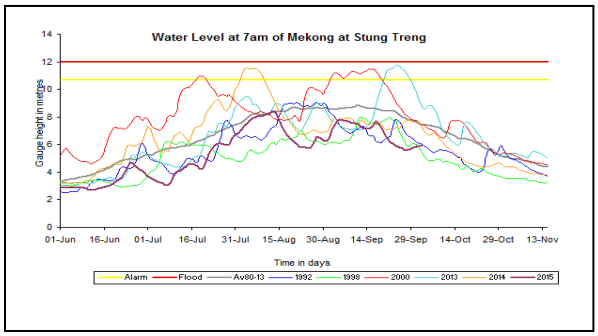
Figure 19: Rainfall amount in coastal areas from 13-17 September, 2015

8.2 Hydrology assessment

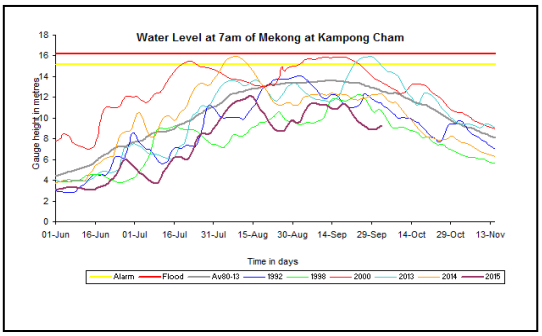
Referencing source information from the Mekong River Commission (MRC), the hydrology graphs below (Figure 20) indicate that the line for water levels in 2015 is under the line for the water alarm, so there was no flooding in the areas of Cambodia situated along the Mekong River and around Tonle Sap Lake. However, there was a flash flood in Phnom Penh that was caused by heavy rainfall. Kampot Province also experienced flash floods and was flooded during and after Tropical Storm Vamco

Figure 20: Water levels recorded in different stations of Cambodia

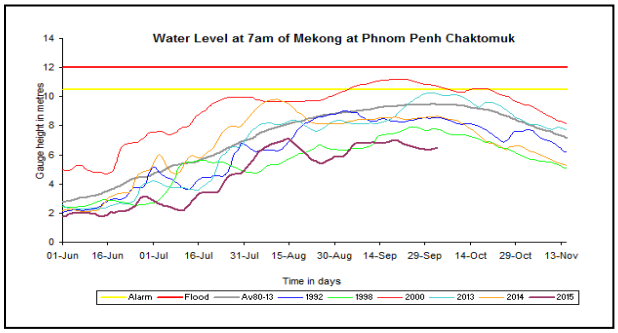
Stung Treng Station



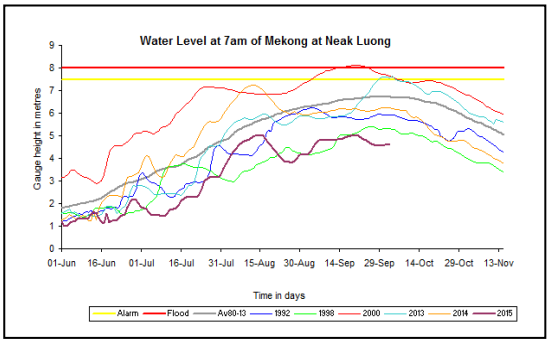
Kampong Cham Station



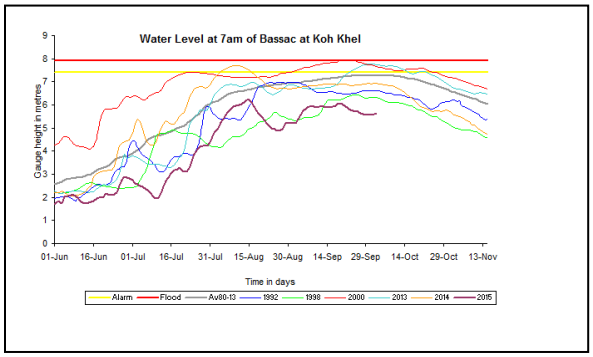
Phnom Penh Chatomuk Station



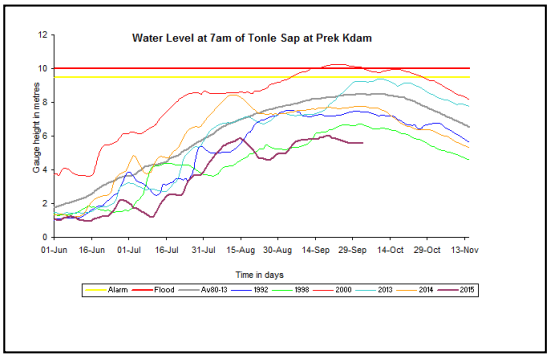
Neak Luong Station



Koh Khel Station



Prek Kdam Station



8.3 Meteorological assessment during five months (January-May) in 2016 under the El Niño Event

The rainfall amount during the pre-southwest monsoon (March-April) 2016 was decreased when compared with 2015 and the mean rainfall of 31 years (1985-2015). Onset of the southwest monsoon was delayed and weak. The maximum temperature over the country reached to 42.2 °C, which was hotter than the maximum temperature of 25 years (1990-2015) by about 0.7 °C (Figure 21, 22, 23).

Figure 21: Maximum temperature in coastal areas in 2016 and maximum temperature of 25 years (1990-2015)

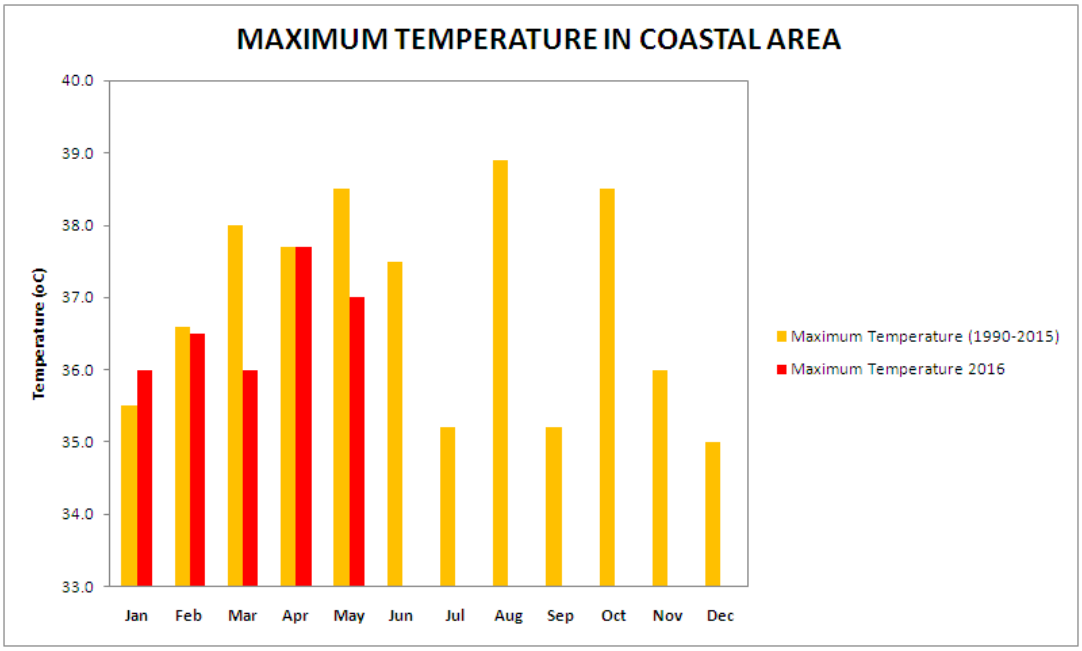


Figure 22: Maximum temperature in lowland areas in 2016 and maximum temperature of 25 years (1990-2015)

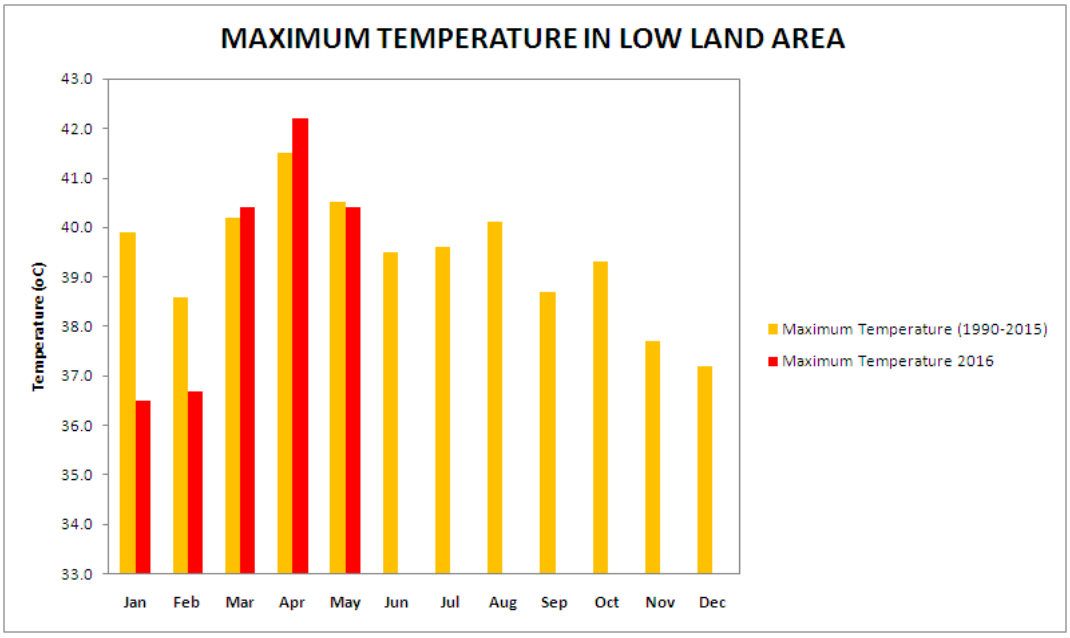
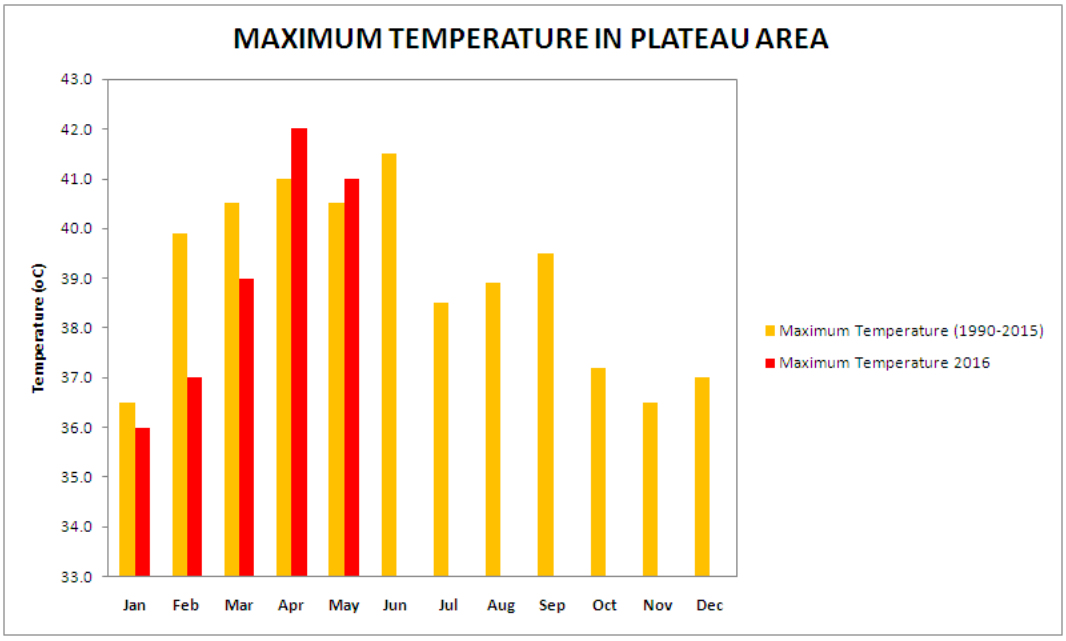


Figure 23: Maximum temperature in plateau areas in 2016 and maximum temperature of 25 years (1990-2015)



The average rainfall during the pre-southwest monsoon (March-April) in coastal areas was less than normal (31 years of average rainfall) by about 245.8 mm. Average rainfall in lowland areas is less than normal rainfall by about 100.7 mm, and for plateau areas is less than normal rainfall by about 103.9 mm (Figure 24, 25 and 26). This caused the whole country to experience severe drought that led to water shortages for both human consumption and agriculture (Figure 27). Twenty five provinces suffered extreme drought; rivers, lakes and ponds were almost completely dry and some animals died due to the warm temperature and lack of water.

Figure 24: Rainfall in coastal areas in 2015-2016 and average rainfall of 31 years

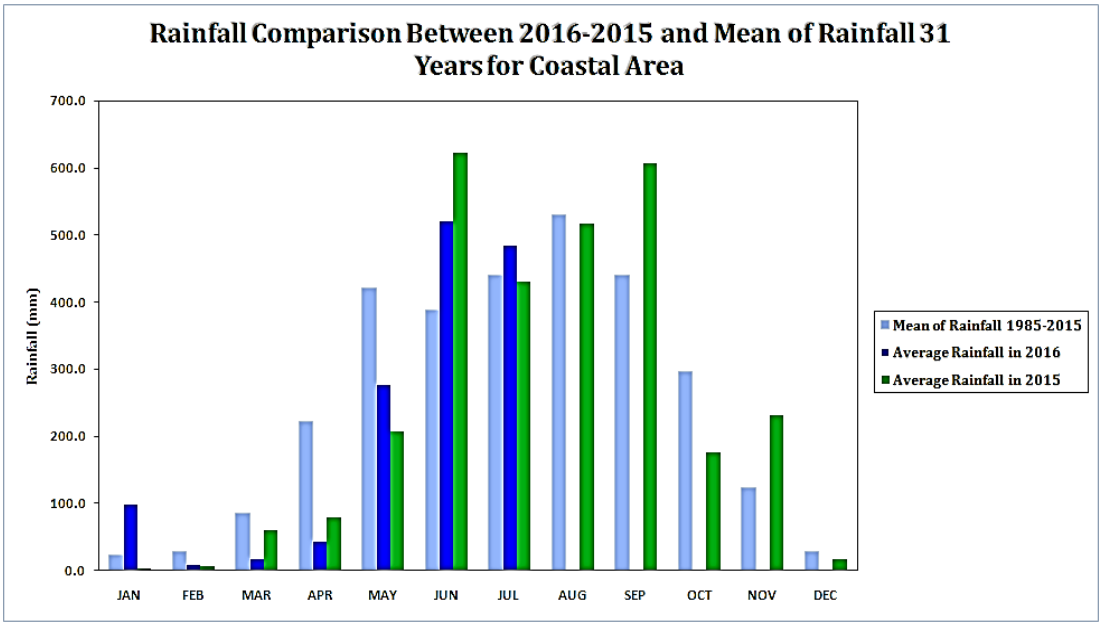


Figure 25: Rainfall in the lowland areas in 2015-2016 and average rainfall of 31 years

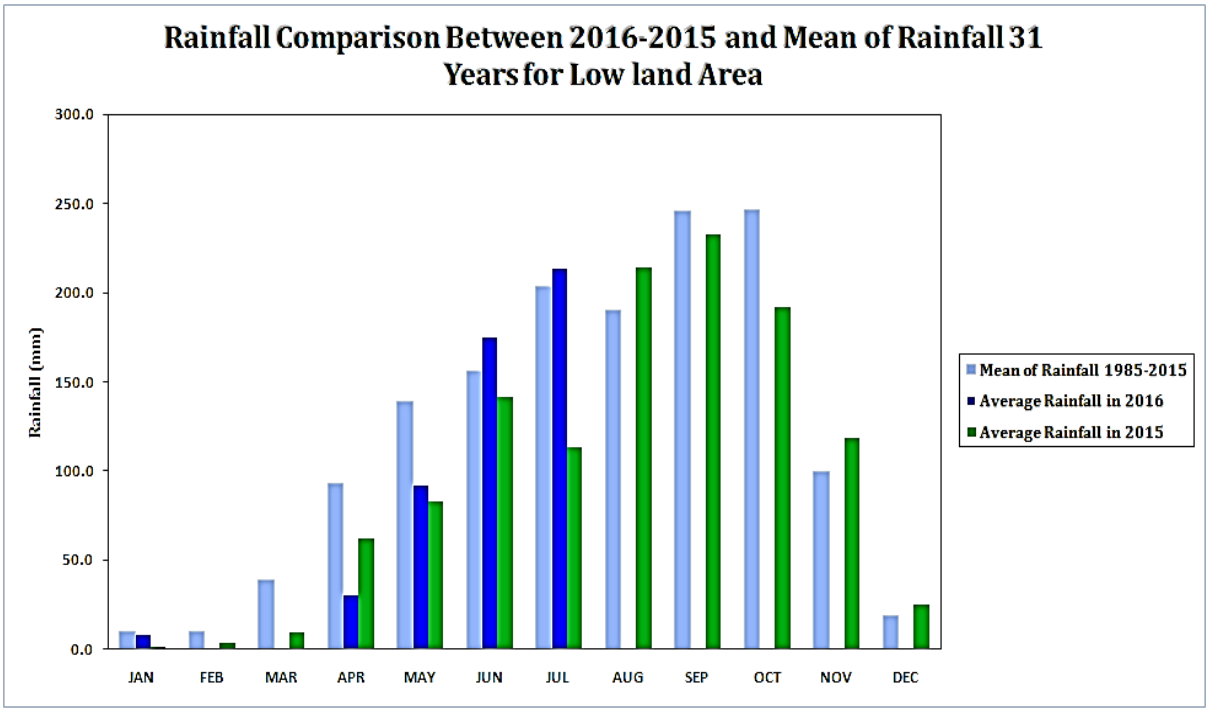


Figure 26: Rainfall in plateau areas in 2015-2016 and average rainfall of 31 years

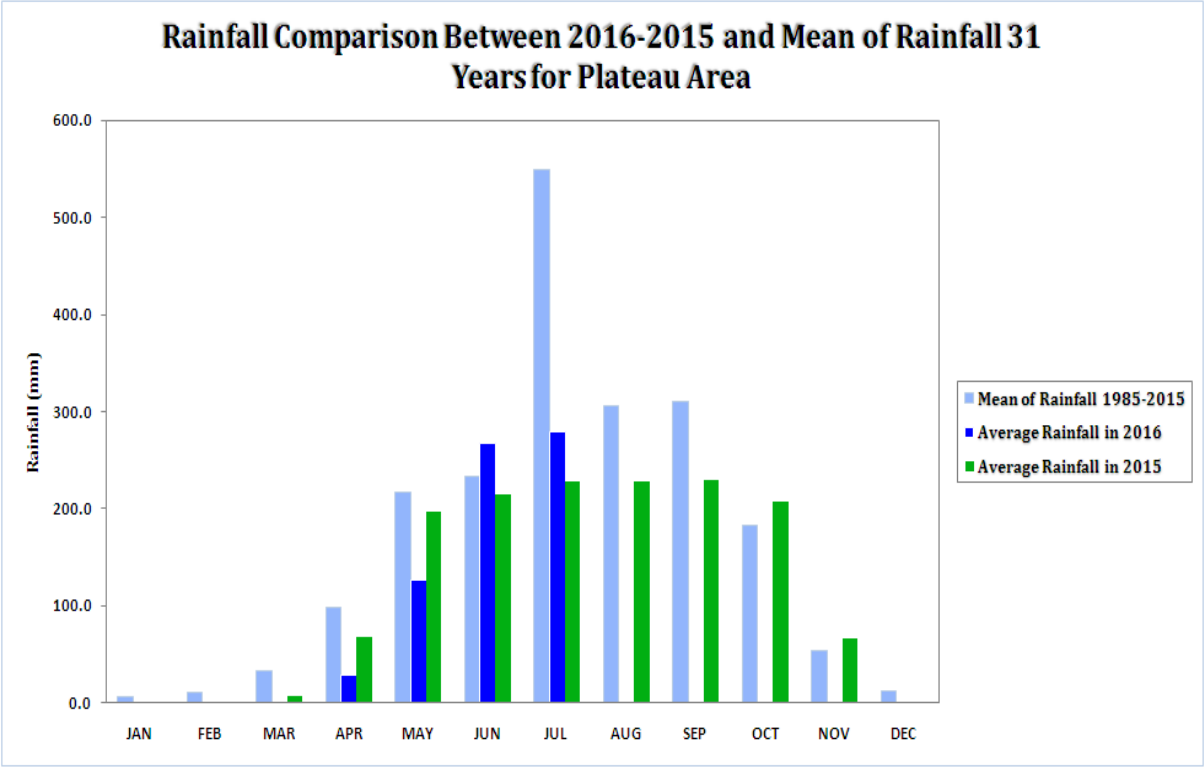
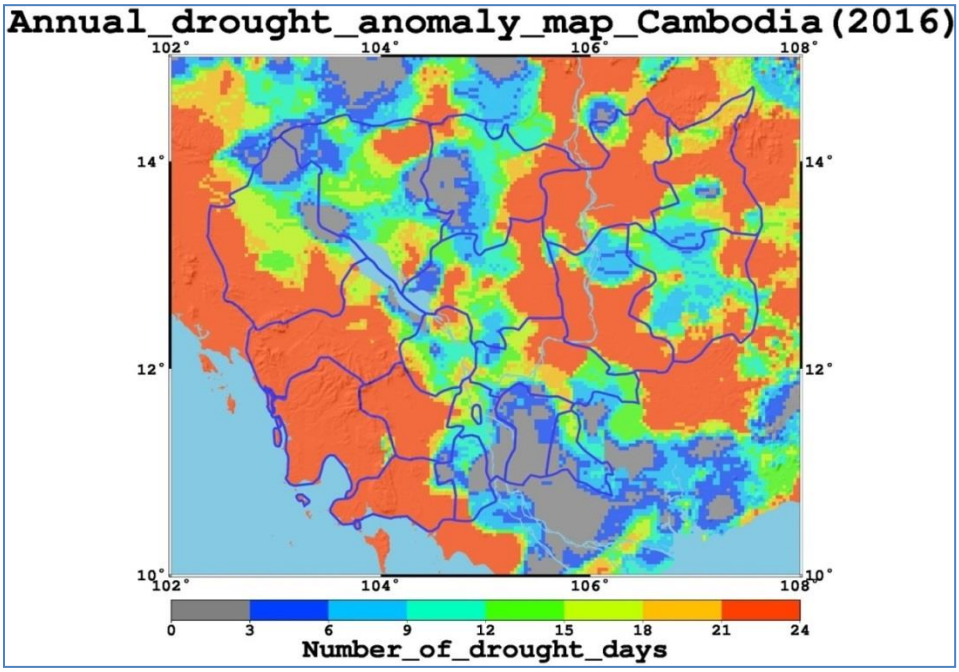
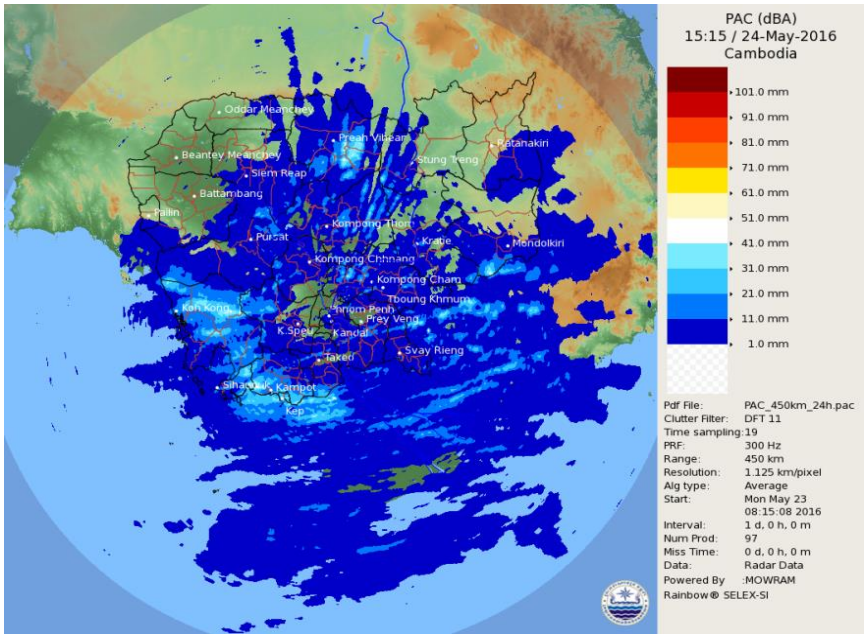


Figure 27: Map of the annual drought anomaly in 2016 (Source: Drought monitoring by ESCAP/WMO)



The National Committee for Disaster Management (NCDM) estimated that about 2.5 million people in Cambodia have been affected by drought across all provinces of the country. Around 18 provinces in the country were severely affected, causing acute water shortage and drying out of soil. The southwest monsoon onset was delayed until 24 May 2016, after which coastal areas and some provinces in Cambodia started to receive rainfall (Figure 28).

Figure 28: Accumulative rainfall over Cambodia (24 hours)



8.4 Key meteorological challenges

- Requirement and development of specialized human resources: Both technically and also the requirement for resource persons to impart new skills.
- Capacity development for drought-mapping techniques: The Department of Meteorology needs to develop capacity to create drought mapping for providing these maps to users.
- Availability of new tools: In terms of software and hardware.
- Need for a more enhanced data flow: More information-sharing among relevant agencies.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