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Drought is a prolonged dry period in the natural climate cycle that can occur anywhere in the world. Drought is a natural disaster of significant concern in the Philippines. Although the Philippines receives a tropical climate with rainfall ranging from 960 – 4,000 mm per year, a modest drop in normal rainfall can trigger water shortages so it’s critical that the Filipinos be well prepared in the event of a drought. The recent droughts of 2015-2016 led to major losses of agricultural and fishery production, with 85% of provinces affected.

Drought vulnerability in the Philippines is compounded by the poor economy and the subsistence nature of agriculture, whereby cropping is small scale and may often only be sufficient to feed the farmer’s immediate household. Preparing for drought and reducing the risk and mitigating the impacts of drought are paramount given the significant vulnerabilities in the Philippines.

This National Drought Plan for the Philippines has several specific purposes. Firstly, it provides a compendium of the most up to date information on drought occurrence, impacts and risk in the Philippines. Secondly, it identifies a series of short-term immediate monitoring, communicating and response actions to address imminent drought impacts. Thirdly, it identifies longer-term actions that help prepare for future droughts by reducing drought risk. And finally, it provides a coordinated and consistent approach for government agencies and the private sector actions to reduce the impacts of drought.

The Philippines has a cluster approach to responding to natural disasters to increase coordination among Philippine Government Agencies. The National Disaster Risk Reduction and Management Council (NDRRMC) give clusters responsibilities of preparing, monitoring, communicating, responding and recovering from natural disasters as well as implementing risk reduction measures. Each cluster will have a set of responsibilities and actions for each type of natural disaster, including drought. Clusters have on-going responsibility for actions that reduce risk of future droughts, as well as responsibilities during the various phases of a drought:

1. Monitoring, observing and communicating drought as it arises
2. Response activities during drought
3. Recovery as the drought abates

The tables below summarise the various responsibilities of the NDRRMC and the clusters. The first table describes the triggers and responses that should be made during the various phases of a drought based on different levels of drought indicators (Percent Normal Rainfall Index and Standardised Precipitation Index – calculated by PAGASA). The second table summarise the many actions for reducing drought risk that should be implemented on an on-going basis. The contribution of specific clusters is highlighted in both tables.
# Table E.1: Summary of response actions under different levels of drought (per the SPI and PNRI drought indicators), and by whom.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Indicators and Impacts</th>
<th>Response actions</th>
<th>Who leads</th>
<th>Major Departments/Agencies involved</th>
</tr>
</thead>
</table>
| Drought Advisory | • D0 (Abnormally dry)  
• PNRI (< 75% for 3 months)  
• SPI (-0.5 to -0.7)  
• Short-term dryness slowing planting, growth of crops or pastures  
• Observed drops in reservoir, tank and groundwater levels | • Regular monitoring  
• Enact the drought task force to monitor situation | NDRRMC    | PAGASA                              |
| Drought watch/alert | • D1 (Moderate drought)  
• PNRI (<70% for 3 months)  
• SPI (-0.8 to -1.2)  
• Some damage to crops, pastures  
• Reservoirs, tanks and wells low  
• Some water shortages developing or imminent | • Close monitoring of conditions for persisting or rapidly worsening drought  
• Activate risk assessment committee and assess risks and impacts/needs to all potentially affected communities across the major clusters impacted by drought (Food & Non-food; Health; Education; Logistics and Telecommunications; Shelter)  
• Voluntary non-essential water-use restrictions applied  
• Intensive communication and public information campaign – implement communication with communities plan and implement communication mediums | NDRRMC    | PAGASA; DepEd; DSWD; DOH; OCD; DA |
| Drought warning  | • D2 (Severe drought)  
• PNRI (< 65% for 6 months)  
• SPI (-1.3 to -1.5)  
• Crop or pasture losses likely  
• Reservoirs, tanks and wells continue to decline  
• Water shortages common; | • Mandatory and stringent water restrictions and water conservation measures  
• Drought task force and drought monitoring committee activated  
• Potential drought emergency declared  
• Distribution of RO units and hygiene kits to worst affected communities, especially schools | NDRRMC    | PAGASA; DepEd; DSWD; DOH; OCD; DA |
<table>
<thead>
<tr>
<th>Drought emergency</th>
<th>PNRI (&lt; 60% for 6 months)</th>
<th>SPI (-1.6 to -1.9)</th>
<th>Major crop/pasture losses</th>
<th>Widespread water shortages or restrictions</th>
<th>NDRRMC</th>
<th>PAGASA; DepEd; DSWD; DOH; OCD; DA</th>
</tr>
</thead>
<tbody>
<tr>
<td>D3 (Extreme drought)</td>
<td>PNRI (&lt; 65% for 12 months)</td>
<td>SPI (-2.0 or less)</td>
<td>Exceptional and widespread crop/pasture losses</td>
<td>Shortages of water in reservoirs, tanks and wells threatening life</td>
<td>NDRRMC</td>
<td>PAGASA; DepEd; DSWD; DOH; OCD; DA</td>
</tr>
<tr>
<td>D4 (Exceptional drought)</td>
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<td></td>
<td>Distribution of emergency food and water supplies</td>
<td>NDRRMC</td>
</tr>
</tbody>
</table>

NDRRMC: National Disaster Risk Reduction and Management Council
PAGASA: Philippine Atmospheric, Geophysical and Astronomical Services Administration
DepEd: Department of Education
DSWD: Department of Social Welfare and Development
DOH: Department of Health
OCD: Office of Civil Defence
DA: Department of Agriculture
Table E.2: Summary of actions to reduce risk, better prepare and respond to drought in the Philippines. Green = lead responsibility; blue = important contributor.

<table>
<thead>
<tr>
<th>Theme or Challenge</th>
<th>Action</th>
<th>NDRRMC</th>
<th>PDRRMC and MDRRMC*</th>
<th>PAGASA</th>
<th>Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Food and Non-food (Agriculture &amp; Environment)</td>
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<tr>
<td>Better assessment of risk and vulnerabilities</td>
<td>Drought risk assessment and mapping</td>
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<tr>
<td></td>
<td>Climate change vulnerability assessment</td>
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<tr>
<td></td>
<td>Build GIS databases and capacity</td>
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<tr>
<td>Preparedness</td>
<td>Maintain current drought-rainfall forecasting and early-warning systems (3-month rainfall probabilities - PNRI)</td>
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<tr>
<td></td>
<td>Maintain current drought monitoring systems (SPI and NDVI)</td>
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<td></td>
<td>Maintain and build community networks for decentralised community-run early warning systems</td>
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<td></td>
<td>Improve monitoring and early warning systems:</td>
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<tr>
<td></td>
<td>• Increase uptake of remote sensing</td>
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<tr>
<td></td>
<td>• Better understanding of climate-drought-agriculture-biodiversity-water impacts, risks and thresholds</td>
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<td></td>
<td>• Better drought forecasting mathematical or statistical stochastic models</td>
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<td></td>
<td>Develop water supply monitoring systems</td>
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<tr>
<td></td>
<td>• Groundwater abstraction and recharge of renewable and non-renewable sources</td>
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<tr>
<td></td>
<td>• Application of GIS tools for surface waters</td>
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<tr>
<td>Theme or Challenge</td>
<td>Action</td>
<td>NDRRMC</td>
<td>PDRRMC and MDRRMC*</td>
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<tr>
<td></td>
<td>• Waste generation, treatment and reuse data</td>
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<td></td>
<td>Food and Non-food (Agriculture &amp; Environment)</td>
</tr>
<tr>
<td></td>
<td>Install new automated agro-meteorological stations in highly vulnerable agricultural areas</td>
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<td></td>
<td>Install communication equipment for more remote areas and establish multi-media information campaigns</td>
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<tr>
<td></td>
<td>Conducting cloud seeding operations when there is threat of dry spell or drought that may affect standing crops and critical reservoir level;</td>
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<tr>
<td>Response activities during drought</td>
<td>Implement communication with communities protocols as per Table 5</td>
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<tr>
<td></td>
<td>Implement drought response actions as drought unfolds, as per Table 7</td>
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<tr>
<td></td>
<td>Communicate drought management plans nationally</td>
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<tr>
<td></td>
<td>Use social media to receive real-time updates on community-level drought impacts</td>
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<tr>
<td>Recovery as drought conditions abate</td>
<td>Implement and improve systematic damage assessments</td>
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<tr>
<td>Theme or Challenge</td>
<td>Action</td>
<td>NDRRMC</td>
<td>PDRRMC and MDRRMC*</td>
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<tr>
<td></td>
<td>Review functions of NDRRMC; Emergency Operations Centre; Clusters; PAGASA; and drought response procedures and coordination</td>
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</tbody>
</table>
| Risk reduction measures for future droughts | Increase supply of freshwater:  
• New guttering and new/larger domestic rainwater tanks in remote areas  
• New small rainwater harvesting structures water impounding structures and farm reservoirs  
• Rehabilitation of upland small-scale irrigation systems for upland productivity and natural resources sustainability  
• Distribution of pump and engine sets to lowland areas with shallow ground water and surface water  
• Community-based watershed management for sustainable water resources and livelihood development in critical watersheds of selected irrigation systems |        |                |        |         |
|                    | Implement water demand management:  
• Strong water conservation campaigns  
• Incentives for water efficient appliances  
• Promotion of water-saving technologies in irrigated rice production systems |        |                |        |         |
<table>
<thead>
<tr>
<th>Theme or Challenge</th>
<th>Action</th>
<th>NDRRMC</th>
<th>PDRRMC and MDRRMC*</th>
<th>PAGASA</th>
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<td></td>
<td>Food and Non-food (Agriculture &amp; Environment)</td>
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<tr>
<td>• Introduce water pricing mechanisms to promote efficient use of water</td>
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<tr>
<td>Investigate new and novel risk financing options such as insurance, Public-Private-Partnerships</td>
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<tr>
<td>Increase resilience in agriculture:</td>
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<tr>
<td>• Support promotion of indigenous knowledge and innovative ideas for resilient agriculture techniques (intercropping, fruit tree planting, integrated farming systems using permaculture technique, food preservation)</td>
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<tr>
<td>• Distribution of drought-tolerant crop varieties</td>
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<td>• Encourage income diversification and gender-balanced approaches in traditional farming</td>
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<tr>
<td>• Promotion of farm wastes recycling and re-use for organic-based agriculture development in vulnerable upland and lowland areas</td>
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<td>• Promotion of crop insurance</td>
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<tr>
<td>• Apply new cropping calendars the use optimal planting schedules based on climate risks</td>
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<tr>
<td>• Employ agroforestry, organic farming, farm diversification, and Sloping Agricultural Land Technology (SALT).</td>
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<td>Education:</td>
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<tr>
<td>• Promotion of school gardening and kitchen gardens to improve diet diversification, dissemination and</td>
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<tr>
<td>Theme or Challenge</td>
<td>Action</td>
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<td>Knowledge of compost-making techniques and resilience techniques against drought (including water conservation techniques – drip irrigation – and traditional storage techniques)</td>
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<td>Food and Non-food (Agriculture &amp; Environment)</td>
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<td></td>
<td>• Increase water supply to schools</td>
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<td>Health</td>
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<td>• New radio communication technologies in schools for rapid communication</td>
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<td>Education</td>
</tr>
<tr>
<td></td>
<td>• Target women, schools for education campaigns and awareness raising</td>
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<td>Logistics, Infrastructure and Telecoms</td>
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<td>Health:</td>
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<tr>
<td></td>
<td>• Awareness programs about risks of consuming poor quality water from heavily depleted water supplies and/or groundwater</td>
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<td></td>
<td>• Improved health sector communication systems</td>
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<td>• Capacity building among health professionals for communication, data collection and early warning systems</td>
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</tbody>
</table>

*PDRRMC = Provincial Disaster Risk Reduction Management Council; MDRRMC = Municipal Disaster Risk Reduction Management Council
1 Introduction

Drought is a prolonged dry period in the natural climate cycle that can occur anywhere in the world\(^1\). Drought is a normal, recurring feature of climate and can occur in high and low rainfall areas (Wilhite 2000). The impacts of drought are many, but usually include damage to crops and reductions in crop yields, death of livestock and wildlife, increased fire hazard, reduced freshwater availability, and damage to wildlife and fish habitats. These impacts will have many economic and social consequences including reduced income for the agriculture and broader economic sectors, higher food prices, unemployment and migration, and in the worst cases loss of life through starvation and armed conflict.

Drought can be categorised into five main types (Wilhite 2000, Crausbay et al. 2017):

1. **Meteorological drought**: occurs when there is a period of below average precipitation.
2. **Hydrological drought**: occurs when there are deficiencies in surface and subsurface water supplies. It is generally measured as streamflow, lake, reservoir, and groundwater levels.
3. **Agricultural drought**: occurs when there is an inadequate water supply to meet the needs of crops and other agricultural operations such as livestock.
4. **Socio-economic drought**: occurs when a drought impacts health, well-being, and quality of life, or when a drought starts to have an adverse economic impact on a region.
5. **Ecological drought**: occurs when deficiencies in surface water supplies create multiple distresses across ecosystems, impacting the flow of ecosystem services.

Unlike other natural disasters such as floods, hurricanes, forest fires and earthquakes, drought onset is slow, occurs over an extended period (many months to multiple years), and the impacts can be felt well beyond the location of occurrence. Quantifying the beginning and ending of drought is often very difficult. The sequencing and the timing of the main types of drought are shown in Figure 1.

Drought is a natural disaster of significant concern in the Philippines. Although the Philippines is a warm tropical climate country receiving up to 950 – 4,000 mm of average annual rainfall, El Nino events have triggered extended periods of well below average rainfall leading to major water shortages and crop losses. Other impacts from drought in the Philippines include grass and forest fires, food shortages, reduced hydropower generation, loss of income and increased crime rates. The high incidence of poverty (around a quarter of the population) and malnutrition in the Philippines compounds the impacts of drought.

---

\(^1\) [https://public.wmo.int/en/our-mandate/water/drought](https://public.wmo.int/en/our-mandate/water/drought)
1.1 Purpose

Drought planning, including preparedness and risk mitigation measures, will help to reduce the impacts and enhance human well-being and security during and after drought. Preparing for drought and reducing the risk and mitigating the impacts of drought are paramount given the high incidence of land degradation and human poverty and malnutrition in the Philippines. This National Drought Plan for the Philippines aims to document the risk of drought and outline a series of approaches and actions the Philippines can take to prepare for and increase resilience to drought. This National Drought Plan brings together the key government agencies and private sector organisations to take a proactive approach to drought management and develop appropriate response actions when drought occurs.

The National Drought Plan for the Philippines has several specific purposes. Firstly, it provides a compendium of the most up to date information on drought occurrence, impacts and risk in the Philippines. Secondly, it identifies a series of short-term immediate response actions to address
imminent drought impacts. Thirdly, it identifies longer-term actions that help prepare for future droughts. And finally, it provides a coordinated and consistent approach for government agencies and the private sector to take action to reduce the impacts of drought.

1.2 Scope

The scope of the National Drought Plan for the Philippines incorporates as much as is practical the three key pillars of drought risk reduction (‘3 key pillars’). The ‘3 key pillars’ offer a very sensible way to organise the many actions and activities a country should do to better prepare and respond to drought.

The ‘3 key pillars’ of evolved from the principles of disaster risk reduction (UNISDR 2015), and are designed to guide practical actions for implementing national drought policy and management plans. The ‘3 key pillars’ were developed during the UN-Water Decade Programme on Capacity Development regional drought management policy workshops, held in Eastern Europe, Latin America and the Caribbean, Asia-Pacific, and Africa in 2013-15. The ‘3 key pillars’ are (Tsegai et al. 2015):

1. Implement drought monitoring and early warning systems:
   a. Monitor key indicators and indices of precipitation, temperature, soil moisture, vegetation condition, stream flow and ground water.
   b. Develop reliable seasonal forecasts and develop of appropriate decision-support tools for impacted sectors.
   c. Monitor the consequences of drought especially the impacts to vulnerable sectors such as agriculture.
   d. Communicate reliable warning messages and respond to the risks in measured and timely fashion.

2. Assess drought vulnerability and risk:
   a. Identify drought impacts on vulnerable economic sectors including food and agriculture (cropping and livestock), biodiversity and ecosystem, energy, tourism, health sectors.
   b. Assess the physical, social, economic and environmental pressures on communities to identify who and what is at risk and why, before, during and shortly after drought.
   c. Assess conditions or situations that increase the resistance or susceptibility to drought and the coping capacity of communities affected by drought.
   d. Assess the extent of potential damage or loss in the event of a drought.

3. Implement measures to limit impacts of drought and better respond to drought:
   a. Implement structural, or physical measures, and non-structural measures to limit the adverse impacts of drought, prioritised based on level of vulnerability assessed in key pillar #2.
   b. Response includes all efforts, such as the provision of assistance or intervention during or immediately after a drought disaster to meet the life preservation and basic subsistence needs of those communities and sectors most vulnerable and impacted.
   c. Relevant to sectors affected by drought, based on their vulnerabilities, particularly agriculture, water and the environment, but also health, transport, tourism.
d. Measures can be long-term, medium-term or short-term, depending on their implementation time.
e. Biodiversity, land and ecosystem services play a vital role in reducing vulnerability and mitigating impacts of drought.
2 Related Plans, Policies and Programs

The Philippines has a number of existing plans and policies aimed to enhance water security, reduce risks associated with natural disasters, conserve natural resources, increase national wealth, and increase the nation’s resilience to climate change – all of which are directly relevant to national drought planning and risk reduction. It’s important to identify within these plans and policies the parts that will directly or indirectly better prepare for and reduce the risk of drought. This chapter assess the relevant plans and polices for their contribution to drought preparation and risk reduction.

2.1 Philippine Development Plan 2017-2022

The Philippine Development Plan 2017-2022 is the first medium term plan aiming to implement the Ambisyon Natin 2040, the long-term Filipino vision for the Philippines. The plan aims to lay a stronger foundation for inclusive growth, a high-trust society, and a globally-competitive economy toward realizing the 2040 vision. Risk mitigation is central to the plan: *individuals and communities will be made more resilient by reducing their exposure to risks, mitigating the impact of risks, and accelerating recovery when the risk materializes.* The plan contains many strategies, with actions within each strategy, several of which are relevant to drought risk mitigation. They are:

1. To improve AFF productivity within the ecological limit
   a. Develop an integrated color-coded agricultural map to identify the comparative advantage of specific areas.
   b. Accelerate construction of disaster- and climate-resilient small-scale irrigation systems and improve existing ones.
   c. Facilitate the use of appropriate farm and fishery machinery and equipment.
   d. Strengthen the extension system (the process of linking AFF stakeholders to extension workers) that can provide the stakeholders with technical assistance and capacity building activities.
   e. Pursue an ecosystems approach to fisheries management.

2. To increase and protect the access of small farmers and fisherfolk to land and water resources

3. To increase farmers’ and fisherfolk’s access to innovative financing
   a. Increase the number of small farmers and fisherfolk that are provided with agricultural insurance.
   b. Provide small farmers and fisherfolk easy access to affordable formal credit.

4. To deal with natural hazards:
   a. Roll out of climate and disaster vulnerability and risk assessment nationwide.
   b. Develop facilities for adaptation in local communities including risk transfer mechanisms.
   c. Provide adequate transition houses and livelihood opportunities for disaster victims during early rehabilitation and recovery period.
   d. Provide adequate mental health and psychosocial support services.

5. To implement strategic infrastructure programs and projects (Water Resources)
   a. Pursue institutional reforms such as streamlining processes in involved agencies to encourage and guide investments in water supply, sewerage, and sanitation.
b. Formulate an irrigation master plan to set the direction for irrigation development and a framework for capital and operations and maintenance financing of irrigation projects.

c. Continue flood management initiatives.

d. Create an apex body that will a) address the fragmented structure of water resources and b) formulate masterplans that will foster coordinated efforts in the country.

6. To sustain biodiversity and functioning of ecosystem services

7. To increase adaptive capacities and resilience of ecosystems

2.2 Water management


The overarching water law is the Water Code (1976) that governs the access, allocation and use of water and establishes the National Water Resources Board (NWRB) as the key regulator of water resources (Rola et al. 2016). The Water Code established the rules on the extraction and use of all waters: the control, conservation and protection of waters, the watershed and related land resources; and the administrative and enforcement of these rules (Rola et al. 2016). During periods of drought or water scarcity, the Water Code prioritizes the use of water for domestic use, followed by irrigation and other uses.

Hall et al. (2018) recently summarised the roles of the key agencies who have responsibility for water resource management, which are important to highlight here because each will have a function during periods of water shortage. The roles of the key agencies are (from Hall et al. (2018)):

- **National Economic and Development Authority** (NEDA): formulates the national development plans, sector policies and strategies, and reviews implementation;
- **Metropolitan Waterworks and Sewerage System** (MWSS): responsible for providing water supply and sewerage services to Metro Manila through their two private concessionaires, Manila Water (MWCI) and Maynilad (MWSI);
- **Local Water Utilities Administration** (LWUA): specialized lending institution that promotes and oversees the development of provincial water districts. It also establishes design and operating standards for utilities and acts as the economic regulator of water districts;
- **National Water Resources Board** (NWRB): coordinating and regulating agency for all water resource management development activities. It is tasked with the formulation and development of policies on water utilization and appropriation and economic regulation of private water utilities and franchises;
• **Department of Interior and Local Government (DILG):** provides capacity building training programs to local government units (LGUs) and provides information on available sector programs and financing;

• **Local government units (LGUs):** bear multiple mandates in the sector such as water supply and sanitation provision and economic regulation of their utilities;

• **Department of Public Works and Highways (DPWH):** in charge of major infrastructure projects of the government. Both MWSS and LWUA are currently under its policy supervision;

• **Department of Environment and Natural Resources (DENR):** promulgates rules and regulations for the control of water, air, and land pollution and ambient and effluent standards for water and air quality;

• **Department of Health (DOH):** sets drinking water standards and monitors compliance;

• **Department of Finance (DOF):** oversees the performance of government financing institutions that provide commercial funds to the sector;

• **National Irrigation Administration (NIA):** tasked with the development and management of irrigation systems all over the country; its management functions cover operations, repair and maintenance, fund management for organization and management, enforcement of procedures and resolution of water-related conflicts, and agricultural support services;

• **National Power Corporation (NAPOCOR):** in charge with hydroelectric generation of power, including small power utilities group for electrification of areas outside of the main grid;

• **Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), key agency providing scientific observation and forecasting of weather, floods, and other climatological conditions;**

• **Department of Energy (DOE):** tasked to prepare and supervise the implementation of plans and programs relative to hydroelectric energy exploration, development, utilization, distribution, and conservation;

• **Metropolitan Manila Development Authority (MMDA):** tasked with formulation and implementation of policies, standards, programs, and projects for an integrated flood control, drainage and sewerage system for Metro Manila;

• **Laguna Lake Development Authority (LLDA):** a quasi-government agency with regulatory functions covering environmental protection and jurisdiction over the Laguna Lake basin’s surface water; currently under the policy supervision of DENR.

### 2.3 Climate change and disaster risk reduction

The Philippines is taking a proactive approach to climate change adaptation and disaster risk reduction. This section summarises the key plans and policies in The Philippines.

#### 2.3.1 National Climate Change Action Plan 2011-2028

The Government of The Philippines has enacted the Climate Change Act (Republic Act 9729) that provides the policy framework with which to systematically address the growing threats of climate change on community life and the environment. The Climate Change Act establishes an organizational structure, the Climate Change Commission, and allocates budgetary resources for it.
to develop the National Climate Change Action Plan (NCCAP)² and framework, among other things (Climate Change Commission 2011). The NCCAP identifies seven priority areas and for each describes several actions to support adaptation and mitigation of climate change impacts in The Philippines. The NCCAP priority areas are shown in Figure 2. Of high relevance to drought is the priority of increased water security and sufficiency, and the NCCAP sets out a number of activities to enhance water supply, including:

- Activity 2.1.2.d: Identify alternative water sources (surface water) and demand management especially for urbanized areas that rely on reservoirs and are prone to recurrent and severe drought events.
- Activity 2.3.1. Increase safe water supply coverage for waterless communities.
- Activity 2.3.2. Implement time-limited groundwater abstraction licenses to provide flexibility to respond to changing climate conditions, e.g., prolonged drought and El Niño, as it happens.

![Figure 2. Seven priorities of the National Climate Change Action Plan 2011-2028. Source: Climate Change Commission (2011)](http://www.climate.gov.ph/knowledge-bank/knowledge-products/national-manuals)

2.3.2 National Disaster Risk Reduction and Management Plan 2011-2028

The National Disaster Risk Reduction and Management Plan (NDRRMP) was produced under the Philippine Disaster Risk Reduction and Management Act of 2010, which provides the legal basis for policies, plans and programs to deal with disasters. The NDRRMP covers four thematic areas: i) Disaster Prevention and Mitigation; ii) Disaster Preparedness; iii) Disaster Response, and; iv) Disaster Rehabilitation and Recovery. The Philippine Disaster Risk Reduction and Management Act of 2010 also established the National Disaster Risk Reduction and Management Council (NDRRMC) which is also formed around the four thematic areas.

The NDRRMP is consistent with the National Disaster Risk Reduction and Management Framework (NDRRMF), which serves as “the principal guide to disaster risk reduction and management (DRRM) efforts to the country....” The Framework envisions a country of “safer, adaptive and disaster resilient Filipino communities toward sustainable development.” It conveys a paradigm shift from reactive to proactive disaster risk management, as is consistent with the UN Hyogo Framework for Action on Disaster Risk Reduction.

The plan highlights, among others, the importance of mainstream disaster risk reduction and management (DRRM) and climate change adaptation (CCA) in the development processes such as policy formulation, socio-economic development planning, budgeting and governance particularly in the area of environment, agriculture, water, energy, health, education, poverty reduction, land-use and urban planning and public infrastructure and housing among others. It also highlights the need for institutionalizing DRRM policies, structures, coordination mechanisms and programs with continuing budget appropriation on DRR from national down to local levels. The broad goals of each thematic area in the NDRRMP are shown in Figure 3. The NDDRMP goals are to be achieved through 14 objectives, 24 outcomes, 56 outputs, and 93 activities, spread across the four thematic areas.

The natural disaster considered in the NDRRMP are typhoon-related floods and landslides, volcanic eruptions, and tsunamis, earthquakes, and earthquake-related landslides. Although droughts are not mentioned in the NDRRMP, drought is estimated to have caused about 18% of all the costs to agriculture from natural disasters (Climate Change Commission 2011). Therefore, the goals of the NDRRMP equally apply to the natural disaster of drought.

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2.3.3 National Disaster Response Plan for hydro-meteorological hazards

The Philippine National Disaster Response Plan (NDRP) for hydro-meteorological hazards\(^4\) is a detailed plan that establishes protocols for responding to natural hazards caused by severe wet weather. The hazard are floods, typhoons, storm surges, tornadoes, and land slides due to heavy rain. The primary aim of the NDRP is to ensure the timely effective and coordinated response to hazard causing disasters or calamities by the Government of The Philippines at all levels by providing support assistance to the affected areas or local government units. The detailed NDRP for hydro-meteorological hazards the cluster-based approach to disaster response, organised the following clusters:

1. Food and non-food items
2. HEALTH (Water and Sanitation, Health, Nutrition and Psychological Services)
3. Protection Camp Coordination and Management
4. Logistics
5. Emergency Telecommunications
6. Education
7. Search, Rescue and Retrieval

8. Management of the Dead and Missing

Droughts are not considered in the NDRP for hydro-meteorological hazards, but a NDRP for drought is identified as important for The Philippines. A NDRP for drought could use a similar cluster model, but some of the clusters would not be necessary because of the slow onset and impact characteristics of drought disasters. For example, it is highly unlikely the clusters of Search, Rescue and Retrieval and Management of the Dead and Missing would be needed during drought. The Food, Health, Protection Camp Coordination and Management, Logistics, Telecommunications and Education clusters are critical for providing emergency relief and response during drought disasters.

2.4 Land Use Planning

Land use planning is the process of regulating the use of land to promote more desirable social and environmental outcomes as well as a more efficient use of resources and restrict undesirable outcomes. Goals of land-use planning include conservation, limiting urban sprawl, reducing transport costs, preventing land-use conflicts, and reducing exposure to pollutants. Land use plans usually provide maps that identify locations of appropriate land uses. Land use planning also aims to restrict inappropriate land uses according to the capability of land. Capability of land can is usually broadly defined to consider such aspects as terrain, soil, and climate. Land use planning can support drought risk reduction by limiting agriculture in areas that are high drought risk or prescribing the types of climate-suitable agriculture that can take place given the risk of drought.

The Philippines has a number of plans and processes that support land use planning. The Philippine Government has the Housing and Land Use Regulatory Board which prepares and implements Comprehensive Land Use Plans (CLUPs) of Local Government Units pursuant to the Local Government Code, 1991. The Local Government Code of 1991 also authorises cities and municipalities to reclassify agricultural lands into non-agricultural uses. Under the 1991 Code, agricultural land can be reclassified when land ceases to be economically feasible and sound for agricultural purposes as determined by the Department of Agriculture. Agricultural land that is at high risk of drought may not be economically viable and not sound for agriculture and could therefore be reclassified to other uses to reduce future drought impacts to agriculture.

Other land uses planning in the Philippines include Forest Land Use Plans which allocate forests and forest lands as natural resource assets and place them under appropriate management and tenure arrangements to protect them for future generations to enjoy. At local government level are the Comprehensive Development Plans which describe ambitions for economic and social development across the main sectors in a municipality.

2.5 Agricultural development

There are a number of plans and policies supporting agricultural development in The Philippines that increase resilience of agriculture to climate change and increase the productivity of agriculture in the country. For example, the Agriculture and Fisheries Management Plan 2018-2023, expected to be released very soon (early 2019), aims to lift productivity, gross value added (GVA) and income of agri-based households, enhance food security, and increase climate change resilience. The
Department of Agriculture’s National Color-coded Agriculture Guide Map⁵ uses the latest scientific data on soil, climate impacts, geographical hazards and weather prediction to determine the crop types most suitable across the Philippines. The online interactive tool allows farmers to determine what crops can ideally be grown in their area. At the provincial scale, the Department of Agriculture is supporting the Priority Commodity Investment Plans (PCIPs) that identify the priority commodity value chains as well as the rural infrastructure and enterprise subprojects for priority commodities.

The National Irrigation Administration has taken a proactive approach to increased risk of drought caused by more intense El Nino cycles by adopting various water saving measures. For example, during the 2015 El Nino, the NIA encouraged farmers to plant early-maturing rice varieties and drought tolerant rice varieties to save water, and they implemented the Quick Turnaround Scheme which promoted planting of the 2015 first crop immediately after the harvest of 2014 second crop. The NIA also encouraged irrigators to adopt water saving technologies and increase rainwater harvesting.

As a signatory to the UNCCD, the Philippines has a national action plan to combat desertification and land degradation and mitigate impacts of drought. The Aligned Philippines National Action Plan to combat Desertification, Land Degradation, and Drought 2015-2025 sets out a number of strategic objectives: i) to improve the productivity and livelihood of landscapes affected by degradation; ii) to regenerate and rehabilitate watershed landscapes and their resources to enhance ecosystem services; iii) to develop synergies with the other Rio Conventions, and; iv) to develop effective resource mobilisation mechanisms and strategies through partnership and collaboration. Reducing land degradation will be achieved through five major programs: i) agro-ecosystem management through improved soil health and vegetative cover and efficient water management; ii) SLM for climate-smart agriculture; iii) watershed landscape management and rehabilitation; iv) scaling-up best-bet SLM through a landscape approach, and; v) mainstreaming SLM in local agricultural landscapes.

2.6 Environment and conservation

Protecting and restoring ecosystems reduces risks and increases resilience to drought. The Department of Environment and Natural Resources implements the National Greening Program, launched in 2011 with the aim of reducing poverty, mitigating and adapting to climate change, and increasing food security, environmental stability and biodiversity conservation. The Program aims to plant 1.5 billion trees in 1.5 million hectares of public land across The Philippines during the period 2011-2016. The Program will improve water quality in rivers and irrigation water, reduce flood risk, sequester carbon, and in the longer term prove for economic opportunities with wood products. The Program was expanded in 2016 and as of end of 2018 nearly 1.7 billion seedlings had been planted across 2 million hectares. The Philippines also has the national Biodiversity Strategy and Action Plan 2015-2028, which aims to protect and restore biodiversity and ecosystem functions in line with the International Convention on Biological Diversity.

⁵ http://www.farmersguidemap.gov.ph
3 Overview of Drought in The Philippines

3.1 Description of The Philippines

The Philippines (Figure 4), located in Southeast Asia, is an archipelago over 7,000 islands with a total land area of approximately 300,000 km$^2$ (Villarin et al. 2016). Only about 2,000 islands are inhabited. The largest islands are Luzon in the north (110,000 km$^2$) and Mindanao in the south (97,000 km$^2$), with the 11 largest islands containing 94% of the total land area (Rola et al. 2018). Topography in the Philippines consists of hills, plains, valleys and high mountains up to 3,000 m above sea level.

The Philippines has a tropical and maritime climate with high temperatures and humidity. The mean annual temperature of the Philippines is 26.6 °C, seasonally varying from 25.5 °C in January (coolest month) to 28.3 °C in May (warmest month) (Villarin et al. 2016). The coolest season is December – February and warmest is March – May. Mean annual rainfall ranges from 960 mm (in southeast Mindanao) to over 4,000 mm (in central Luzon) with a national average of 2,400 mm. The high variation is caused by seasonality, direction and location of monsoons and tropical cyclones, the El Nino-Southern Oscillation (ENSO) and the location of the Intertropical Convergence Zone (ITCZ) (Villarin et al. 2016). Although much of the Philippines receives rainfall consistently throughout the year, the drier months are generally March to early-May, and the wet season is from mid-May to September. The variable climate of the Philippines has been classified into four climate types using a modified Coronas Classification (Kintanar 1984), with each type defined by the seasonality (or not) of rainfall (Figure 5).

Land use in the Philippines is dominated by agriculture, making up about 41% of the country, of which about 44% is annual crops and 44% is permanent crops, with the remaining 12% under permanent pasture$^6$. The major agricultural crops are rice, corn, coconuts, sugarcane and bananas. Around 26% of the Philippines is under forest, and the remaining 33% is artificial surfaces and bare land.

The population of the Philippines is just over 100 million (2015 census) with an annual growth rate of 1.7%. The proportion of the total population living in urban areas is about 47%, with the most populous metropolitan area of Manila holding an estimated 12.9 million (2015 census). The Philippine economy is the 34th largest in the world with 2015 GDP estimated at USD 330 billion, growing at 6-7% per annum$^7$. But the nominal GDP per capita is only about USD 3,000, putting it in the bottom third of all countries. Approximately 21% of the total population is below the poverty line (in 2015)$^8$, with poverty in rural areas at over 40% (Rola et al. 2018). Unemployment sits at around 5.3% in January 2018$^9$. The major sectors of the economy are services (59% GDP), industry (31% GDP) and agriculture (10% GDP).

$^7$ See [https://www.adb.org/countries/philippines/economy](https://www.adb.org/countries/philippines/economy)
Figure 4. Map of the Philippines. Source: https://en.wikipedia.org/wiki/File:Ph_physical_map.png#file
3.2 Water supply and demand

The Philippines has 18 major river basins and 421 smaller river basins (Almaden 2014). Water supply comes from rainfall, surface water resources (rivers, lakes, reservoirs) and groundwater. An
estimated 50% of rainfall is collected as water runoff. Freshwater storages are estimated to have a dependable supply of 125.8 billion m³ per year for surface water, and 20 billion m³ per year for groundwater, making a total supply of around 145.8 billion m³ (Pulhin and Tapia 2016). Total dam capacity is about 6.3 billion m³ in 2006\textsuperscript{10}. There are about 500 water districts that mainly serve urban areas outside of Metro Manila, and about 1,200 piped water systems operated by municipal governments (De Vera and Hall 2018). Most water supply utilities use groundwater and only those utilities with more than 20,000 connections use surface water (De Vera and Hall 2018). The Philippines is perceived to have an excess of water. However, geographical and seasonal variations in rainfall, and weather and climate-related extreme events can lead to water shortages, particularly in highly populated areas (Climate Change Commission 2011).

Per capita water availability in the Philippines was about 1,900 m³ in 2000 (just under a third of the global average) (Rola et al. 2018), and 91% of the population had access to improved water in 2009\textsuperscript{10}. Water stress is experienced when per capita availability drops below 1,700 m³ per year and water scarcity occurs when availability drops below 1,000 m³ per year, suggesting the Philippines is already close to experiencing water stress. But the per capita water availability is on a downward trend due to increased water demand as the population and the economy grow, and the decrease in supply from declines in runoff and significant degradation of watersheds including deforestation and pollution (Rola et al. 2018). Many of the major rivers and lakes are heavily polluted: of the 688 classified water bodies in the Philippines, only about 27% have potable water, and of the 40 waterbodies monitored for drinking water supply, only 28% are below the acceptable threshold of total suspended solids (Rola et al. 2018).

The management of water resources in the Philippines is complex, fragmented and uncoordinated, with more than 30 agencies (national, catchment-based, private and local) involved either in water resource management or regulation (Almaden 2014, Rola et al. 2018), and at least seven legal frameworks governing the water sector (Rola et al. 2016).

A permit system administered by the National Water Resources Board controls the allocation of all water resources to the major uses – 201 billion m³ was allocated in 2016, 98% of which was surface water\textsuperscript{11}. The greatest allocations were to power generation (57%), irrigated agriculture (33%), industrial (5%) and municipal (3%)\textsuperscript{11}. Rice is a major user of irrigation water – the area of rice under irrigation is about 90% of all the irrigated crop area, with about 68% (3.24 M ha) of all rice produced in the Philippines irrigated and the remaining rainfed (Pulhin and Tapia 2016). The capacity of dams supplying irrigation is about 6.2 billion m³, all managed by the National Irrigation Administration\textsuperscript{10}. Water is also very important to the hydropower sector, generating 20% of the Philippines energy supply, and 55% in Mindanao (Pulhin and Tapia 2016). Total water demand from municipal, industrial and irrigated agriculture sectors is estimated at 134 billion m³, which is not much less than total supply.

Forecasts to 2025 suggest there will not be enough water to meet demand in some parts of the Philippines under a high economic growth scenario (Rola et al. 2018). By 2040, the World Resources

\textsuperscript{10} FAO AQUASTAT [http://www.fao.org/nr/water/aquastat/countries_regions/PHL/]

\textsuperscript{11} From Department of Environment and Natural Resources statistics [https://www.denr.gov.ph/e-library/compendium-enr-statistic-2016.html]
Institute (WRI) predicts that Philippines will experience a ‘high’ degree of water shortage, with agriculture the most stressed sector, and Mindanao the most stressed region (Rola et al. 2018).

### 3.3 Historical Drought Occurrences and Impacts

The occurrence of drought is heavily influenced by the El Nino Southern Oscillation (ENSO) and its warm and dry phase, El Nino (Villafuerte et al. 2014). During an El Nino phase the sea surface temperatures are warmer than normal over the eastern equatorial Pacific, leading to above average rainfall in the eastern pacific and below average rainfall over the western Pacific including the Philippines (Salinger et al. 2014). In the Philippines the El Nino events are associated with the late onset and early finish of the rainy season, weak monsoons and less tropical cyclone activity (Lansigan et al. 2000), and drier than normal conditions between October to December (Figure 6) which can sometimes carry through to June. These El Nino-driven drier than normal conditions have occurred throughout the Philippines (Figure 6), but the southern parts of the country (Mindanao) are particularly affected (Figure 7). The year-to-year variability of the ENSO can be modulated by the Pacific Decadal Oscillation (PDO) characterised by decade-long anomalies in sea surface temperature in the northern Pacific. Although climate anomalies caused by ENSO can potentially be enhanced (or weakened) when the ENSO and PDO are in phase (or out of phase), further research is needed to better understand these relationships (Villarin et al. 2016).

Recent analysis of climate data across the Philippines has shown an increase in annual mean temperatures of 0.65 °C over the period 1951-2010, with the rate of increase growing in the last 30 years (Villarin et al. 2016). Over the same period there is also an increasing significant trend in the number of hot days (maximum temperature above 99th percentile) and a decreasing significant trend in the number of cold nights relative to normal values for 1971-2000 (Villarin et al. 2016). The recent trends in daily rainfall suggest a drying for the dry season (January–March), as indicated by statistically significant decreasing trends in wet days total rainfall and increasing trends in maximum length of dry spell (Villafuerte et al. 2014).
Figure 6. Station locations with a statistically significant occurrence of above- and below-median seasonal rainfall during El Nino events are represented by filled and open circles, respectively for: a) July-September (JAS), and; b) October-December (OND). Source: (Lyon et al. 2006)

Figure 7. Impacts of ENSO on Philippine rainfall, 1977 – 1999. Source: PAGASA
3.3.1 Historical drought occurrences

There have been 11 droughts recorded since 1968 (Table 1) meaning drought has impacted the Philippines about every 4-5 years. The drought events of 1982–1983, 1986–1987, and 1997–1998 were particularly severe and were associated with El Nino events, but the drought in 1989–1990 occurred during a neutral condition (Hilario et al. 2009). The recent 2015-2016 drought, which caused damage across 16 of the Philippines 18 regions (85% of the country), was driven by the most severe El Nino event ever recorded (World Food Program 2016). This El Nino event lasted for 18 months in the Philippines, beginning in February 2015 and ending in July 2016. The previously most severe El Nino was the 1997-1998 event.

A drought is declared in a province by PAGASA when there are 3 consecutive months of more than 60% reduction of average rainfall. A ‘dry spell’ will be officially declared in a province if there are three consecutive months of a 21-60% reduction of average rainfall – for example Luzon was hit by a dry spell in June-July 2007 where rainfall was 40% below normal, and agriculture, water and hydropower was affected (Yumul et al. 2010), but this was not identified as a drought.

3.3.2 Historical drought impacts

Droughts have had severe economic consequences on the Philippines economy (Table 1), particularly to the agricultural sector which accounts for 10% of GDP. The crop most vulnerable and most impacted is rice. Other sectors, especially water, energy and human health have been heavily impacted by past droughts. This section provides examples of the impacts of past droughts to each of these sectors.
<table>
<thead>
<tr>
<th>Year of drought</th>
<th>Areas affected</th>
<th>Major impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968 – 1969</td>
<td>Moderate to severe drought over most of the Philippines with Bicol region as most severely affected</td>
<td>Total loss of 5x10^5 Mt of rice and corn production</td>
</tr>
<tr>
<td>1972 – 1973</td>
<td>Central Luzon, Palawan, Visayas, and Mindanao</td>
<td>Total loss of 6.3x10^5 Mt of rice and corn production</td>
</tr>
<tr>
<td>1977 – 1978</td>
<td>All of Mindanao except Davao</td>
<td>Total loss of 7.5x10^5 Mt of rice and corn production</td>
</tr>
<tr>
<td>October 1982 – September 1983</td>
<td>Western and Central Luzon, Southern Tagalog provinces, Northern Visayas, Bohol, and Western Mindanao; Moderate to severe drought affected most of Luzon, Negros Occidental, and Iloilo</td>
<td>Total loss of 6.4x10^5 Mt of rice and corn; Insurance claims mounted to PhP 38 million; Hydropower generation loss was PhP 316 million</td>
</tr>
<tr>
<td>October 1986 – September 1987</td>
<td>Severe drought affected Bicol region, Southern Negros, Cebu, and Western Mindanao; Severe drought affected mainland Luzon, Central Visayas, and Western Mindanao</td>
<td>Estimated agricultural damages of PhP 47 million; Hydropower generation loss was PhP 671 million</td>
</tr>
<tr>
<td>October 1989 – March 1990</td>
<td>Drought affected Cagayan Valley, Panay Island, Guimaras, Palawan, and Southern Mindanao; Affected rice and corn area: 283,562 hectares; Major multipurpose water reservoirs reduced inflow</td>
<td>Estimated 5x10^5 Mt of rice and corn production losses; hydropower generation loss of PhP 348 million; 10% cutback in water production in Metro Manila</td>
</tr>
<tr>
<td>1991 – 1992</td>
<td>Severe drought affected Manila, Central and Western Visayas, and Cagayan Valley; Affected agricultural area: 461,800 hectares;</td>
<td>PhP 4.09 billion in agricultural losses; 20% shortfall in Metro Manila’s water supply</td>
</tr>
<tr>
<td>1997 – 1998</td>
<td>About 70% of the Philippines experienced severe drought; About 292,000 hectares of rice and corn area completely damaged</td>
<td>6.2x10^5 Mt of rice production loss and 5.7x10^5 Mt of corn amounting to PhP 3 billion; water shortages; forest fires and human health impacts; PhP 6.2 million estimated losses to aquaculture</td>
</tr>
<tr>
<td>May 2002 – March 2003</td>
<td>Severe drought affected Western Mindanao. Central Mindanao, Bicol, Eastern Visayas, Southern Tagalog and Northern Luzon moderately affected.</td>
<td>0.8% reduction in palaya production in first quarter of 2003</td>
</tr>
<tr>
<td>Period</td>
<td>Details</td>
<td>Damage</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2009 – 2010</td>
<td>USD 240 million in damages</td>
<td>PhP 10 billion in crop damages; $1.48 \times 10^6$ Mt of crops lost including rice, corn, cassava, banana and rubber; over 400,000 farming households and 556,000 ha affected; 23% decline in fish catch &amp; PhP 600 million defensive expenditures</td>
</tr>
<tr>
<td>February 2015 – July 2016</td>
<td>85% of provinces experienced drought. Iloilo, Guimaras, General Santos City, Isabela, Quirino, Bukidnon, Davao del Sur, Basilan, Bohol, and Cebu declared a state of calamity.</td>
<td></td>
</tr>
</tbody>
</table>
3.3.2.1 Agriculture

Agriculture, and especially rice due to its high water requirement and the timing of sowing, is the most impacted sector when drought hits the Philippines. Corn is also impacted. The sowing and growth of the second rice and corn crops traditionally occurs in the months when El Niño rainfall shortages are the largest (October-March) (Figure 8). Every past drought has impacted agriculture but at varying levels of intensity and different locations (Table 1). An estimated USD 370 million in agricultural damages have been estimated for all the ENSO events between 1990 and 2003 (Department of Agriculture 2010). The worst two droughts were those of 1997-1998 and 2015-2016 so these can be used as benchmarks for extreme severity of impact from past droughts.

![Figure 8. Rice and corn crop calendar and timing of El Niño-induced driest drought months. Source: (World Food Program 2016)](image)

3.3.2.1.1 The 1997-1998 drought

About 70% of the country was affected, with rice and corn losses of about PhP 3 billion and contraction of all agricultural production of over PhP 5 billion, or 6.4% (World Food Program 2016). The losses per crop were: i) rainfed rice – 32.4% decline; ii) irrigated rice – 21.2% decline; iii) corn – 11.7% decline, and; iv) coconut – 11.9% decline. About 620,000 tonnes of rice and 565,000 tonnes of corn were lost compared to production in the previous year (World Food Program 2016). Around 314,000 ha of rice and 646,000 ha of corn crops were affected (Department of Agriculture 2010).

Livestock and poultry production were also affected by the 1997-1998 drought, with estimates of a decline in pork and poultry populations of 79% and 67% respectively, with an average decline across all livestock of 45% compared to previous year’s production (Department of Agriculture 2010). Swine were disposed of to generate income as compensation for losses in rice and corn farming.
3.3.2.1.2 The 2015-2016 drought

PhP 10 billion in crop damages; 1.48x10^6 Mt of crops lost including rice, corn, cassava, banana and rubber; over 400,000 farming households and 556,000 ha affected; 23% decline in fish catch & PhP 600 million defensive expenditures.

3.3.2.2 Fisheries

The 1997-1998 drought caused an estimated PhP 6.2 million in losses to the aquaculture industry (Department of Agriculture 2010). During the 2015-2016 drought fisheries were also negatively affected by the extreme heat and prolonged drought. The Bureau of Fisheries and Aquatic Resources (BFAR) reported a 23 per cent (279,000 ton) decline in fish catch due to warmer waters, suggesting at least 100,000 fisherfolk would need to look for alternative sources of income. The BFAR spent PhP 380 million supporting the fishing industry with restocking and capacity building for alternative marine income sources, and a further PhP 225 million to prevent illegal fishing as fishers sought catch in protected areas.

3.3.2.3 Water

Drought can impact the major reservoirs in the Philippines because inflows reduce during periods of abnormally low rainfall. This causes shortages in domestic water and irrigation supply. The 1997–1998 drought led to a major reduction in the water supply capacity of Angat Dam (from 37 to 22 m^3 per second), which supplies more than 90 % of domestic water in Metro Manila (Pulhin and Tapia 2016). The Metropolitan Waterworks and Sewerage System in Manila had to resort to water rationing, restricting supply to four hours per day (Pulhin and Tapia 2016), and cutting off irrigation water to 27,000 ha of agricultural land in Bulacan and Pampanga. Other impacts included groundwater depletion as people resorted to water wells for water supply, and expensive cloud seeding operations with the Bureau of Soils and Water Management spending PhP 36.7 million (Pulhin and Tapia 2016).

During the 2015-2016 drought a state of calamity was declared in Zamboanga City (Mindanao) in January 2016 because of low dam water levels – 9 out of 25 dams has dried up, 6 were at critical levels and 10 were below normal water levels.

3.3.2.4 Energy

With a substantial portion of the Philippines energy coming from hydropower, droughts can have a large impact on the country’s energy supply. For example, the 1989–1990 drought incurred a hydropower generation loss of PhP 348 million. In 1991–1992, the major multi-purpose dams in Luzon (Angat, Magat and Pantabangan) experienced power generation losses of about 31 %. In the 1997-1998 drought the Angat dam had a hydropower generation deficit of 333 Gwh equating to a drop in power generation of up to 58.9 % during some periods (Pulhin and Tapia 2016).

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12 See https://www.philstar.com/nation/2016/02/13/1552791/sthash.2FwK0rYZ.dpuf
3.3.2.5 Human health

Reports during the 2015-2016 drought noted the prevalence of disease due to malnutrition and reduced access to potable water14. A March 2016 survey in Mindanao found that approximately 25% of households reported poor food consumption, resorting to eating less preferred food items, limiting meal portions and reducing the number of meals (World Food Program 2016). Rice farmers were the most affected.

3.3.2.6 Environment

Drought has substantial impacts on the well-being of biodiversity leading to the death of plants and animals, potentially including those on the endangered list. The ENSO-driven droughts cause sea temperatures to increase which causes coral bleaching. Estimates for the 1997-1998 drought report that coral bleaching was widespread, reaching as high as 80% of coral cover in Bolinao (Burke et al. 2002). Red tide outbreaks and fish kills were reported during the 1982-1983, 1991-1992, and 1997-1998 El Nino periods.

Forest fires are also regular in the Philippines during droughts, leading to species loss, increased erosion and dam sedimentation, river siltation, and air pollution.

3.4 Climate Change and Drought

Climate change would likely have a direct impact on the occurrence of drought with subsequent indirect impacts felt in the Philippines. The direct impacts will be on the changes to rainfall dynamics and increase in average temperatures which will increase the severity of drought. By 2050, much of the Philippines could experience temperature increases of more than 2 °C and rainfall declines of more than 30% through the dry season months of March to May (Figure 9, Figure 10). Extreme events such as the number of dry days are also predicted to increase under climate change (Villarin et al. 2016).

Figure 9. Projected season temperature increases (°C) in the Philippines in 2020 and 2050. Source: (PAGASA 2011)

Figure 10. Projected season rainfall change (%) in the Philippines in 2020 and 2050. Source: (PAGASA 2011)
There may also be changes to the monsoon dynamics that are relied on for much of the rainfall in the Philippines. While climate change impacts to the East Asian Summer Monsoon which has a significant bearing on the Philippines rainfall are not well studied, regional downscaling of climate change projections suggests a suppression of the south Asian summer monsoon, along with a delay of monsoon onset and increase of monsoon break periods (Salinger et al. 2014).

The indirect impacts from climate change and climate variability are expected to include a shift in the hydrologic processes in watersheds that would affect the spatial and temporal distribution of water resources (Comiso et al. 2014, Pulhin and Tapia 2016). Climate scenarios that project a drier dry season (see for instance the study of Tapia et al. 2014) would have large effects on streamflow, dam operation and water allocation, domestic water supply, irrigation, hydropower generation, depth and recharge of aquifers and water quality. These would have detrimental consequences on environmental integrity, food and human security, and the economy (Villarin et al. 2016)
4 Organisation and Responsibilities for Drought

The Philippine Disaster Risk Reduction and Management Act of 2010 (Republic Act 10121) provides the legal basis for policies, plans and programs to deal with natural disasters, including drought. The National Disaster Risk Reduction and Management Council (NDRRMC) was formed under this 2010 Act. By being bottom-up and participatory, recognising vulnerability as a key part of disaster impact, and integrating across government and society, the 2010 Act and the NDRRMC take a proactive approach to natural disasters. The NDRRMC is the highest organised and authorised body for disaster risk reduction in The Philippines, and its composition is shown in Figure 11. The next section details the roles of the leading government agencies in the NDRRMC.

**NDRRMC Composition**

**Chairperson:**
Secretary, DND

**Vice-Chairpersons:**
Sec, DOST – Prevention & Mitigation
Sec, DILG – Preparedness
Sec, DSWD – Disaster Response
DG, NEDA – Rehab & Recovery

**Executive Director:**
OCD Administrator

**Members:**
- 15 depts: DOH, DENR, DA, DepEd, DOE, DOF, DTI, DOT, DBM, DPWH, DFA, DOJ, DOLE, DOTr & DICT
- 12 govt agencies: OES, OPAPP, CHED, AFP, PNP, OPS, NAPC, PCW, HUDCC, CCC, & PHILHEALTH
- 2 govt financial institutions: GSIS & SSS
- 1 quasi-government agency: PRC
- 5 LGU Leagues
- 4 Civil Society Organizations
- 1 Private Sector Organization

Figure 11. Organisation, leadership and composition of the Philippine National Disaster Risk Reduction and Management Council.

4.1 Roles and responsibilities of key NDRRMC agencies

4.1.1 Chair and implementing agency

Office of the Civil Defence (OCD) under the Department of National Defence (DND) is the implementing arm of the NDRRMC with the primary mission of administering a comprehensive national civil defence and Disaster Risk Reduction and Management (DRRM) program by providing leadership in the continuous development of strategic and systematic approaches as well as
measures to reduce the vulnerabilities and risks to hazards and manage the consequences of disasters. It also ensures the implementation and monitoring of NDRRMP.

4.1.2 Disaster prevention and mitigation

The Department of Science and Technology (DOST) is mandated to “provide central direction, leadership and coordination of scientific and technological efforts and ensure that the results therefrom are geared and utilized in areas of maximum economic and social benefits for the people”. As the overall responsible agency in implementing the Prevention and Mitigation aspects of NDRRMP, DOST’s objectives are to reduce vulnerability and exposure of communities of all hazards and enhance capacities of communities to reduce their own risks and cope with the impacts of all hazards. The activities of DOST include establishing and maintaining systems of early warning, forecasting and monitoring, and hazard and risk mapping. They also undertake structural and non-structural interventions.

4.1.3 Disaster preparedness

The Department of Interior and Local Government (DILG), in coordination with OCD and other DRRM agencies develop IEC materials, conduct campaigns and develop awareness of target population; train communities, teams, DRRM managers and key decision makers; establish training institutions at various levels; and develop and implement comprehensive national and local preparedness and response policies, plans and systems.

4.1.4 Disaster response

The Department of Social Welfare and Development (DSWD) is mandated to provide a comprehensive program of social welfare services designed to ameliorate the living conditions of distressed Filipinos, particularly those who are handicapped by reason of poverty, youth, physical and mental disability, illness and old age, or who are victims of natural calamities including assistance to members of the cultural minorities. During or immediately after a disaster the DSWD is responsible for damage assessment, evacuation, issuance of advisories, search, rescue and retrieval, relief distribution, and management of evacuation centres.

4.1.5 Disaster rehabilitation and recovery

The National Economic and Development Authority (NEDA) is responsible for leading the post-disaster recovery programs, including completing post-disaster needs assessments (PDNA), resettling of displaced people and communities, and provision of new livelihoods.

4.1.6 Other key agencies

4.1.6.1 Department of Education (DepEd)

The DepEd constituted the DRRM Core Group to provide a venue to discuss issues on DRRM and Education in Emergencies (EiE), to recommend policy actions, and propose programs/projects which will mitigate and reduce the impact of disasters to DepEd teaching/non-teaching personnel/staff, learners and properties.
4.1.6.2 Department of Health (DOH)

The DOH is the principal health agency responsible for ensuring access to basic public health services for all Filipinos through the provision of quality health care and regulation of providers of health goods and services.

4.1.6.3 Department of Environment and Natural Resources (DENR)

The DENR is the primary government agency responsible for the conservation, management, development, and proper use of the country’s environment and natural resources, specifically forest and grazing lands, mineral resources, including those in reservations and watershed areas, and lands of the public domain. It is also tasked to ensure DRRM and CCA-sensitive and environmental management by formulating and implementing policies and plans, including for land use and natural resource management.

4.1.6.4 National Water Resources Board (NWRB)

NWRB is an attached agency of the Department of Environment and Natural Resources responsible for ensuring the optimum utilization, exploitation, development, conservation, and protection of the country’s water resources consistent with the principles of Integrated Water Resources Management (IWRM).

4.1.6.5 Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA)

PAGASA is the Philippine national institution dedicated to providing flood and typhoon warnings, public weather forecasts and advisories, meteorological, astronomical, climatological, and other specialized information and services primarily for the protection of life and property and in support of economic, productivity and sustainable development.

4.1.6.6 Department of Agriculture (DA)

The DA is the executive department of the Philippine government responsible for the promotion of agricultural and fisheries development and growth. At times of drought, the agency monitors the sector in terms of areas affected and prepares action plan that focuses on production support (including cloud seeding operation), water management, and information dissemination.

4.1.6.7 Bureau of Soils and Water Management (BSWM)

The BSWM is the nationally mandated agency on sustainable management of soil and water resources for agriculture. It formulates measures and guidelines to effectively utilize and sustain productivity of soil and water resources to help attain food and nutrition security. At times of drought and El Nino, in coordination with appropriate agencies and local government units, facilitates the conduct of cloud seeding operation in affected areas.

4.1.6.8 Bureau of Fisheries and Aquatic Resources (BFAR)

The BFAR is an agency under the DA, responsible for the development, improvement, management and conservations of the country’s aquatic resource. The bureau, in fulfilling its mandate of
management, conservation and development of country’s aquatic resources, may allocate funds for recovery and rehabilitation.

4.1.6.9 National Irrigation Administration (NIA)

The NIA is a government-owned and controlled corporation responsible for irrigation development and management.

4.1.6.10 Local Water Utilities Administration (LWUA)

The LWUA is a government-owned and controlled corporation with specialized lending function mandated by law to promote and oversee the development of water supply systems in the provincial cities and municipalities outside of Metropolitan Manila.

4.1.6.11 Metropolitan Waterworks and Sewerage System (MWSS)

The MWSS is the government agency that is in charge of water privatization in Metro Manila in the Philippines. It split the water concession into an east and a west concession with Manila Water being award one contract and Maynilad Water Services being awarded the other.

4.1.6.12 Climate Change Commission (CCC)

The CCC is an independent and autonomous body that has the same status as the national government agency. It is the sole policy-making body of the government which is tasked to coordinate, monitor and evaluate programs and action plans relating to climate change.

4.2 Activities during past droughts

Philippine Government responses in previous droughts have seen several activities designed to monitor the onset and impacts of El Nino and understand the impacts to the water and agriculture sectors. The previous responses have been (de Guzman 2009):

1. 1985 – First issuance of monthly climate assessment bulletins
2. 1986 – Creation of the Drought Early Warning and Monitoring System (DEWMS)
5. Establishment of the Inter-Agency Committee on Rice and Cereals

4.2.1 El Nino Task Force

The El Nino Task Force was established to formulate action plans and develop strategic programs to help affected population cope with the phenomenon and to minimize its adverse effects. The membership of the El Nino Task Force is (de Guzman 2009):

Chairman: Secretary, Department of Agriculture
Co-Chairman: Secretary, Department of National Defence
Members: Secretary, Department of Interior and Local Government
          Secretary, Department of Environment and Natural Resources
4.2.2 The Inter-Agency Committee on Water Crisis Management

The Inter-Agency Committee on Water Crisis Management was established for the 1986-1987 El Nino event. This committee is responsible for water management during a drought including establishing priorities on water use. The committee meets regularly during periods of water crisis to monitor water supply and identify priorities (Tejada et al. 2015). Reports are issued routinely on water supply or forecasts by existing government agencies such as PAGASA, which are forwarded to Inter-Agency Committee on Water Crisis Management for review and consideration. Recommendations are then transmitted to NDRRMC for future action. The media is a major partner of the government in the information and awareness campaign (Tejada et al. 2015). The representatives are (de Guzman 2009):

- National Water Resource Board (NWRB) – Leadership and coordination
- National Power Corporation (NPC) – Hydropower and status of dams
- National Irrigation Administration (NIA) – Assessing status of irrigation
- Metropolitan Waterworks and Sewerage System (MWSS) – Water supply for Metro Manila
- Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) – Weather, flood and climate advisories and information
- Bureau of Soils and Water Management (BSWM) – Cloud seeding operations
- Department of Public Works and Highways (DPWH)
- Local Water Utilities Administration (LWUA)
5 Drought Monitoring, Forecasting and Impact Assessment

A proactive approach to drought management requires monitoring drought using a consistent set of indicators to identify when drought is occurring, its extent, and when it is ending. Monitoring reduces the chance of surprises and gives time for planning and implementing drought mitigation strategies. Monitoring also provides continuous feedback to government decision makers to determine when and where to implement preparation and response actions.

Being able to forecast droughts allows for advance warnings that help sectors and organisations prepare for the adverse effects of drought. An impact assessment methodology is important for the Philippines Government to identify the sectors of the economy and society more likely to be adversely affected by drought. This chapter describes some of the tools and systems available to the Philippines Government for monitoring, forecasting and assessing impacts of drought.

5.1 Drought monitoring indicators

Many indicators are available for monitoring the main types of drought – meteorological, agricultural, hydrological. The UNCCD Technical Guidelines to support its Drought Resilience, Adaptation and Management Policy (DRAMP) Framework (Crossman 2017) identify ten indicators for meteorological drought, one indicator for hydrological drought and three indicators for agricultural drought. Data inputs required for these 14 indicators include a mix of rainfall, temperature, evapotranspiration, soil available water holding capacity and stream flow. The DRAMP Technical Guidelines also list nine remotely sensed indicators (mostly related to vegetation stress) and five modelled/composite indicators that use multiple data inputs. Choosing an indicator is determined by specific national circumstances, such as availability of spatio-temporal data, technical capacity and the nuances of the climatic, social, economic and environmental conditions.

Ideally a drought monitoring indicator would include spatial data on evapotranspiration and soil attributes to get a more complete picture of circumstances within agriculture in the Philippines. However real time and/or regular collection of this information is expensive especially over a large country characterised by complex topography and low levels of development. Rainfall-based indicators are a good basis for monitoring drought given that drought is an exceptional lack of water as compared to the expected normal (Carrão et al. 2016, Van Loon et al. 2016) and extended rainfall deficits cause agricultural, hydrological and/or socioeconomic disasters. Therefore rainfall indicators can be used as proxies for agricultural and hydrological drought (Vicente-Serrano et al. 2012).

There are 35 meteorological stations geographically dispersed across the Philippines, with daily rainfall data extending back to 1951. Four of those stations have daily rainfall data going back to 1911 (Villafuerte et al. 2014). Two common and accessible rainfall-based drought indicators are described below. A third index is also described which assesses vegetation health – the common Normalised Difference Vegetation Index (NDVI). A state-of-the-art index that integrates multiple indicators is also described to demonstrate the potential of a multi-attribute index.
5.1.1 Percentage of Normal Rainfall Index (PNRI)

Past droughts in the Philippines have been indicated by the Percentage of Normal Rainfall Index (PNRI). It is calculated by dividing the actual rainfall received by the rainfall normally received – typically a 30-year mean - and multiplying by 100. The index can be calculated for a variety of time scales (e.g. a month, a 3-month season). PNRI, although very simple and easy to understand, is limited and crude because it cannot be applied uniformly across a diverse area with different rainfall averages. A high rainfall area and low rainfall area can have the same percentage of normal rainfall for two very different amounts of actual rainfall.

5.1.2 Standardised Precipitation Index (SPI)

A better indicator is the Standardised Precipitation Index (SPI) which expresses actual rainfall as a standardised departure from the long-term median rainfall. The values of SPI are expressed in standard deviations, with positive indicating greater than median rainfall and negative values indicating less than median rainfall. SPI can be applied over different timescales (1, 3, 6, 12, 24 and 48 months) and is normalised so it is applicable to different climates (Crossman 2017). The drought categories of SPI in Table 2 can be used as triggers for implementing various levels of planning and management actions. Drought starts when the SPI value is equal or below -1.0 and ends when the SPI value becomes positive (World Meteorological Organization 2012).

<table>
<thead>
<tr>
<th>SPI</th>
<th>Category</th>
<th>Number of times in 100 years</th>
<th>Severity of event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to -0.99</td>
<td>Mild dryness</td>
<td>33</td>
<td>1 in 3 years</td>
</tr>
<tr>
<td>-1.0 to -1.49</td>
<td>Moderate dryness</td>
<td>10</td>
<td>1 in 10 years</td>
</tr>
<tr>
<td>-1.5 to -1.99</td>
<td>Severe dryness</td>
<td>5</td>
<td>1 in 20 years</td>
</tr>
<tr>
<td>-2.0 or less</td>
<td>Extreme dryness</td>
<td>2.5</td>
<td>1 in 50 years</td>
</tr>
</tbody>
</table>

5.1.3 Normalised Difference Vegetation Index (NDVI) and Land Surface Temperature (LST)

The Normalised Difference Vegetation Index (NDVI) is the ratio of red to near infra-red light and can identify whether vegetation is present and is stressed (Tucker 1979, Sellers 1985). Many studies have found that there is a strong negative correlation between temperature (e.g. Land Surface Temperature, LST) and NDVI during drought periods, and that a time series of LST/NDVI is a rapid indicator of drought at country and province level in tropical areas (McVicar and Bierwirth 2001).

5.1.4 US Drought Monitor

The state of the art in composite indicators for drought monitoring is the US Drought Monitor (USDM) (Svoboda et al. 2002). The full USDM combines six indicators of drought (Palmer Drought Severity Index, soil moisture, daily stream flow, rainfall deciles, SPI and Vegetation Health Index) that
describe the major types of drought (meteorological, agricultural, hydrological). The USDM uses weighted averages of the inputs to produce a weekly real-time assessment of current drought conditions in the USA. The drought categories used by the USDM (Table 3) are potential triggers for different levels of planning and drought management response. The thresholds of each indicator are a useful guide for identifying triggers under each indicator in the USDM.

Table 3. The USDM drought categories, possible impacts and association with input indicators. Source: adapted from Svoboda et al. (2002)

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Possible Impacts</th>
<th>Palmer Drought Severity Index (PDSI)</th>
<th>CPC Soil Moisture Model (Percentiles)</th>
<th>USGS Weekly Streamflow (Percentiles)</th>
<th>Standardized Precipitation Index (SPI)</th>
<th>Objective Drought Indicator Bolds (Percentiles)</th>
</tr>
</thead>
</table>
| D0       | Abnormally Dry | Going into drought:  
- short-term dryness  
- slowing planting, growth of crops or pastures  
- Coming out of drought:  
- some lingering water deficits  
- pastures or crops not fully recovered | -1.0 to -1.9 | 21 to 30 | 21 to 30 | -0.5 to -0.7 | 21 to 30 |
| D1       | Moderate Drought |  
- Some damage to crops, pastures  
- streams, reservoirs, or wells low, some water shortages developing or imminent  
- Voluntary water-use restrictions requested | -2.0 to -2.9 | 11 to 20 | 11 to 20 | -0.8 to -1.2 | 11 to 20 |
| D2       | Severe Drought |  
- Crop or pasture losses likely  
- Water shortages common  
- Water restrictions imposed | -3.0 to -3.9 | 6 to 10 | 6 to 10 | -1.3 to -1.5 | 6 to 10 |
| D3       | Extreme Drought |  
- Major crop/pasture losses  
- Widespread water shortages or restrictions | -4.0 to -4.9 | 3 to 5 | 3 to 5 | -1.6 to -1.9 | 3 to 5 |
| D4       | Exceptional Drought |  
- Exceptional and widespread crop/pasture losses  
- Shortages of water in reservoirs, streams, and wells creating water emergencies | -5.0 or less | 0 to 2 | 0 to 2 | -2.0 or less | 0 to 2 |

5.1.5 Current drought monitoring for The Philippines

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is the Philippine’s national meteorological and hydrological services agency. It is mandated to provide weather, flood, climate and astronomical products and services to promote people’s safety and well-being and contribute to national development. It was created in 1972 by reorganizing the Weather Bureau and is an agency of the national Department of Science and Technology.
5.1.5.1 Meteorological drought

PAGASA provides three main products that monitor and forecast drought which all use the Percentage of Normal Rainfall Index (PNRI) at provincial scale:

1. **Monthly climate assessment and outlook** – monthly summary of the temperature and rainfall for the past month and a forecast of temperature and rainfall for the next month, including the weather systems and ENSO conditions underpinning the assessment and outlook;
2. **Season climate outlook** – twice-yearly forecast of the temperature and rainfall for the coming two seasons (six months), including the weather systems and ENSO conditions underpinning the outlook;
3. **Monthly drought and dry spell assessments** – monthly summary of drought conditions for the previous month, issued during periods of drought. An example of a monthly drought assessment issued by PAGASA during the height of the 2015-2016 drought is provided in Figure 12.

PAGASA uses three categories of drought and dry spell, defined as:

1. **Drought:**
   a. Three consecutive months of way below normal rainfall (>60% reduction from average rainfall), or
   b. Five consecutive months of below normal rainfall (21-60% reduction from average rainfall)
2. **Dry spell:**
   a. Three consecutive months of below normal rainfall (21-60% reduction from average rainfall), or
   b. Two consecutive months of way below normal rainfall (>60% reduction from average rainfall)
3. **Dry condition** – two consecutive months of below normal rainfall (21-60% reduction from average rainfall).

PAGASA recently adopted the Standardised Precipitation Index (SPI) and Normalised Difference Vegetation Index (NDVI) for improved drought monitoring.
5.1.5.2 Agricultural drought

Although PAGASA has the official responsibility of monitoring and forecasting [meteorological] drought, researchers in the Philippines are developing new models and techniques for assessing other types of drought such as agricultural drought. It’s possible that meteorological droughts do not always coincide with agricultural droughts because the return of rainfall after a long period of dryness will bring an end to the meteorological drought but the rainfall may not be sufficient to meet crop water demand so the agricultural drought continues (Wilhite and Glantz 1985). A meteorological drought may not signal an agricultural drought if alternative water sources are available such as irrigation water.

Researchers at the University of The Philippines Diliman, in partnership with PAGASA, have developed the Drought and Crop Assessment and Forecasting (DCAF) model to assess agricultural drought. Central to the DCAF model is the Standardised Vegetation-Temperature Ratio (SVTR) (Perez et al. 2016). The SVTR uses the ratio of NDVI to Land Surface Temperature (LST) as a reliable proxy indicator of soil moisture and therefore agricultural drought (Son et al. 2012, Perez et al. 2016). Both the NDVI and the LST are computable from MODIS satellite sensor data which has been collecting daily observation data at 5.6km resolution across the Philippines since 2000. Values of SVTR range from -3 to 3 for a month, but these are classified into drought severity (Figure 13). An accuracy assessment that compared SVTR index values to actual on ground drought events concluded that the SVTR could correctly identify droughts 74% of the time when SVTR < -0.5 was defined as a drought occurrence (Perez et al. 2016).

![Figure 13. Agricultural drought severity estimated from SVTR at the height of the 2015-2016 drought in the Philippines. Source: (Perez et al. 2016)]
5.1.5.3 Other drought monitoring systems

Researchers at the University of Tokyo, Japan (Takeuchi et al. 2015), have produce a near real time meteorological drought monitoring and early warning system for crop land uses (specifically rice) in Asia. They calculate daily values of the Keetch-Bryam Drought Index (KBDI) using freely available rainfall data (from Global Satellite Map of Precipitation, GSMaP), land surface temperature (from MTSAT) and NDVI (from MODIS). The KBDI summarise the balance between precipitation and evapotranspiration and ranges from 0-100 with 0 being no moisture deficit. The system provides an alert for drought in a province if the value of the KBDI is 40% above the normal index value at a point in time. The system is operational and data for the Philippines is available online15.

The UN Food and Agricultural Organisation (FAO) produces a 10-day Agricultural Stress Index (ASI) for the world as part of its Global Information and Early Warning System (GIEWS). Every 10 days FAO publishes a map of the world showing the ASI describing the intensity, duration and spatial extent of agricultural drought for the previous 10 days. The analysis is only conducted in cropping land uses and is only performed during the start and end of the crop growing season. The input data is 1km resolution satellite data of vegetation (NDVI) and land surface temperature captured by the AVHRR sensor, and the data is freely available for the Philippines online16 at country and provincial level.

5.2 Drought forecasting

Rainfall in the Philippines is associated with the El Niño Southern Oscillation (ENSO) phenomenon. The ENSO El Nino dry episodes that occurred in 1982–1983, 1986-1987, 1997–1998 and 2015–2016 were some of the most intense events, and they gave rise to the droughts that affected the Philippines at those times. Droughts generally occur during the dry season and following couple of months either in the middle or towards the end of an El Nino, making the presence of an El Nino dry event a good predictor of drought.

5.2.1 ENSO Monitoring

PAGASA currently uses ENSO outlooks to inform its monthly and seasonal climate outlooks. El Nino is a periodic large scale oceanic/atmospheric phenomenon characterised by unusually warm sea surface temperatures and weakened surface westerly winds in the equatorial Pacific. They occur about every 2-7 years and can last from 14-22 months. A La Nina event is said to occur when the opposite cooler than normal sea surface temperatures give rise to wetter than normal conditions. The presence of an El Nino can be detected with monitoring of sea surface temperatures in the equatorial Pacific. The strong link between an ENSO El Nino dry event and drought means watching the El Nino event unfold via an ENSO tracker is a good way to monitor and forecast drought. For example, every month the Australian Bureau of Meteorology produces an ENSO Outlook (Figure 14) which can be used to assess the likelihood of drought occurring in the near future. It can be seen in Figure 14 that the severe droughts of 1982–1983, 1986-1987, 1997–1998 and 2015–2016 in Philippines were preceded by an El Nino of at least several months. The emergence of an El Nino in

15 http://wtlab.iis.u-tokyo.ac.jp/DMEWS/Philippines/
June-August may indicate imminent drought during the next dry season and/or during the sowing and growth of second rice crops from December to March.

5.2.2 Rainfall season (6-month) forecasts

PAGASA uses a model consensus approach to produce official monthly rainfall forecasts for the coming 6-month season. The consensus method involves taking statistically downscaled climate models (GCMs) and applying a mixture of expert knowledge, best model fit, antecedent conditions and past model performance to produce a probability/anomaly/absolute value forecast of rainfall per month for the next six months. The rainfall outlook for the September 2018 to February 2019 period is shown in Figure 15, predicting a number of locations and times when rainfall in the Philippines will be below normal.
5.2.3 Forecasting agricultural drought

In addition to demonstrating the potential for SVTR to monitor agricultural drought, researchers at the University of Philippines Diliman have also piloted the development of a model to forecast SVTR for a 6 month period (Perez et al. 2016). The model uses historical NDVI and LST data and historic and forecast values of the Oceanic Nino Index (ONI). Ensemble predictions are made using five different statistical models, with the final product forecasting SVTR at the province scale (Figure 16).
5.3 Drought Impact Assessment

Drought can have many different effects on different sectors. Impact assessments attempt to quantify the consequences of a drought on the different sectors of society and the economy. The potential impacts to the major sectors in the Philippines are listed in Table 4. This section summarises the importance of each of these major sectors to the Philippine economy and society, and how they have been impacted in the past by drought.

Table 4. Potential drought impacts for the major sectors in the Philippines. Source: adapted from One World One Water (2017).

<table>
<thead>
<tr>
<th>Agriculture and commerce</th>
<th>Water supply</th>
<th>Public health, environment and safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss from crop production</td>
<td>Groundwater depletion</td>
<td>Mental and physical stress</td>
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<tr>
<td>Loss from livestock and dairy production</td>
<td>Reservoir draw down</td>
<td>Health-related water shortage problems (water contamination, diminished sewage flows)</td>
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<tr>
<td>Loss from fishery production</td>
<td>Water quality declines (increased salinity)</td>
<td>Increased conflicts</td>
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<tr>
<td>Income loss for farmers</td>
<td>Disruption of water supplies</td>
<td>Increased wildfire risk and severity</td>
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<tr>
<td>Unemployment from drought-related production declines</td>
<td>Increased surface water depletion</td>
<td>Disruption to cultural belief systems</td>
</tr>
<tr>
<td>Loss to tourism industry</td>
<td>Increased conflicts over water use</td>
<td>Loss of aesthetic values</td>
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<tr>
<td>Declines in food production</td>
<td>Mental and physical stress</td>
<td>Reduction in recreational activities</td>
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<tr>
<td>Cost of water transport</td>
<td>Reduced quality of life and changes in lifestyle</td>
<td>Reduced quality of life and changes in lifestyle</td>
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<tr>
<td>Reduced economic development</td>
<td>Depleted rainwater catchment and storage for residents without water service</td>
<td>Population migration</td>
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<tr>
<td>Mental and physical stress</td>
<td>Increased costs for water hauling for residents without water service</td>
<td>Damage to biodiversity and ecosystem degradation</td>
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<tr>
<td>Reduced quality of life and changes in lifestyle</td>
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<td>Loss of wetlands</td>
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<tr>
<td>Population migration</td>
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<td>Coral bleaching and marine habitat degradation</td>
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</tbody>
</table>
5.3.1 Agriculture and commerce

Agriculture is one of the largest and most important sectors in the Philippines economy. In 2017 the sector accounted for about 8.5% of GDP and 25% of employment. The major crops grown are rice, coconuts and corn, which in 2017 accounted for about 36%, 27% and 19%, respectively, of the total area of cropping in The Philippines. The value of all crops grown in The Philippines in 2017 was about PhP 964 billion, with rice worth about PhP 350 billion (36%) and bananas about PhP 148 billion (15%). Around 60% of all rice produce in The Philippines is grown in Luzon (with 18% in Central Luzon), and 22% in Mindanao. For corn, about 50% is grown in Mindanao and 43% in Luzon. Mindanao is the major producer of bananas (85% of all production) and coconuts (60% of all production). The impacts of drought on cropping will be particularly severe in Mindanao given the importance of cropping in that region.

Livestock in The Philippines was worth about PhP 292 billion in 2017, with hogs accounting for about 83% of the total value. Poultry was worth around PhP 215 billion, with chickens accounting for about 73%. Luzon produced about 54% of all hogs and 66% of chickens. Impacts of drought on livestock and poultry production would be especially severe in Luzon.

Figure 17 shows the impacts to agriculture from the 2015-16 El Nino drought event, with parts of Luzon and Mindanao having the largest extent of damages.

Drought also can have a significant impact on the fishery sector. For example, the Bureau of Fisheries and Aquatic Resources (BFAR), reported a 20 per cent decline in fish catch due to warmer waters during drought, citing that at least 100,000 fisherfolk would need to look for alternative sources of income during drought.

---

5.3.2 Water supply

The Philippines has total annual renewable water resources of 479 billion m³ from its surface water and groundwater sources. This translates into an annual per capita availability of about 6,100 m³, which is twice that of the rest of Asia, and 6 times the global scarcity threshold of 1,000 m³ (Asian Development Bank 2013). However, only about half of this is available annually as a dependable supply of surface and ground water – agricultural use accounts for up to 85% of this. Growing urban populations, together with water pollution, reservoir sedimentation, wasteful and inefficient use, continued denudation of forest cover (particularly in watersheds), and saltwater intrusion caused by excessive withdrawal of groundwater (particularly in the metropolitan area of Cebu, Davao City, and parts of Metro Manila), are the major challenges facing the country’s water resources (Asian Development Bank 2013).

Past El Niño events in the Philippines have applied significant stress on water resources from reduced water inflows into major watersheds, reservoirs and other impoundments. As a result,
water for households and irrigated agriculture have been reduced substantially during droughts, especially in Metro Manila. During the most severe El Nino-driven droughts, water for agriculture was sacrificed in favour of domestic and industrial water supply, seriously impairing agricultural land productivity during the period (Moya and Malayang 2004).

Climate change was found by (Jose and Cruz 1999) to have significant impacts on future inflow in two major reservoirs, Angat (supplying Metro Manila) and Lake Lanao; with rainfall variability having a greater impact than temperature variability. In both locations, runoff is likely to decrease in the future and be insufficient to meet future water demands.

5.3.3 Public health, environment and safety

Water shortages during drought can lead to increased rates of diarrhoea, conjunctivitis, scabies and influenza-like-illness, and food shortages can lead to declines in nutrition and subsequent increases in malnutrition, morbidity and mortality. Increased occurrences of wildfire during droughts can cause significant air pollution from increased smoke which can lift the rates of respiratory diseases. Heightened rates of heat stress also occur during drought. El Nino-related warmer temperatures may result in vector-borne disease epidemics in highland areas, which are too cold for vector survival and disease transmission at other times, which could impact the mountainous areas in the Philippines.

5.3.4 Drought impact reporting

Detecting drought impacts early can help to prevent the drought turning into a humanitarian crisis because drought response actions can be implemented swiftly before the situation deteriorates. Collection of anecdotal data on drought impacts provides an early and, when complemented with technical information such as drought indices and forecasting, can create a comprehensive understanding of losses caused by drought. Anecdotal information can include word of mouth, media reports, photographs, food and water market activity and citizen science.
6 Drought Risk and Vulnerability

A drought risk assessment is a core activity for establishing an effective drought monitoring and early warning system. A risk assessment provides important information for setting priorities and developing actions that prevent drought and mitigate drought impacts. The drought risk assessment can be used by authorities to target drought preparedness, mitigation and crises response actions to those communities and sectors most vulnerable to drought, and in locations where the impacts of drought are currently or forecast to be most severe. Outputs from a drought risk assessment should be incorporated into land use and rural development planning, health care systems, environmental and natural resource management approaches, supply chains and business models, and non-agricultural sectors.

Thus, understanding and assessing drought risk is essential, as some sectors, population groups or regions can be more vulnerable than others or vulnerable in different ways. Accordingly, risk assessments should be carried out in a consistent and coordinated manner.

This chapter introduces the concepts of risk and vulnerability and compiles information for assessing risk and vulnerability to drought in the Philippines. Risk assessment outputs are provided from a global study completed by the European Commission’s Joint Research Centre (Carrão et al. 2016). These are complemented by several studies completed by national organisations that have assessed components of risk in the Philippines.

6.1 Definitions

Drought risk and vulnerability assessments are inextricably linked, with the latter being a subset of the former. A drought risk assessment extends the vulnerability assessment by including information about the drought hazard independent of the sectors and communities potentially impacted by drought.

Drought risk can be calculated as:

\[
\text{Drought risk} = \text{Vulnerability} (V) \times \text{Hazard} (H)
\]

Where vulnerability (V) is calculated as described below, and hazard (H) is the likelihood of drought occurrence calculated using the indicators and indices developed for the drought monitoring and early warning system (see Chapter 5).

Vulnerability can be calculated as:

\[
\text{Vulnerability} (V) = \text{Exposure} (E) + \text{Sensitivity} (S) - \text{Adaptive Capacity} (\text{AC})
\]

Where exposure (E) is the degree to which communities and ecosystems experience stress from drought (Adger 2006), sensitivity (S) is the degree to which communities and ecosystems are modified or affected by perturbations (Adger 2006), such as a change in climatic conditions brought about by the onset of drought, and adaptive capacity (AC) is the ability of communities and ecosystems to evolve in order to accommodate environmental hazards or policy change and to expand the range of variability with which it can cope (Adger 2006), including the ability to take advantage of opportunities, or to cope with the consequences (Füssel and Klein 2006).
Completing a drought risk and vulnerability assessment is important for several reasons (Crossman 2017):

1. Identifies the communities and sectors that are at risk from a drought. Drought management plans, policies and risk mitigation measures can then be effectively designed, tailored and prioritised toward those at greatest risk;
2. Identifying vulnerable communities and sectors is a pre-cursor to developing drought preparedness, monitoring, early warning response systems.
3. Is an important learning and knowledge gathering exercise by improving the understanding of human and natural processes that add to drought vulnerability and community resilience.
4. Provides important insights into community groups that may be marginalised such as women, children, the elderly and sick, the landless, and indigenous communities.

6.2 Assessing drought vulnerability

Vulnerability assessments should be integrative and comprehensive and incorporate different dimensions (social, economic, physical, environmental, and institutional). An elegant framework for calculating vulnerability of a system (e.g. people, communities, sectors) to drought is presented in Figure 18. Variables describing drought, such as spatial extent, probability of occurrence (from historic drought events), projected frequencies under climate change, and intensity are often used to estimate exposure. For estimating sensitivity, variables describing the system of interest (e.g. agriculture) are needed, such as dependency on water resources, extent of land degradation, population densities, and diversification of income sources. For estimating adaptive capacity, variables describing the five capitals (natural, social, human, financial, manufactured) are needed.
The variables used to describe exposure, sensitivity and the adaptive capacity of the Philippine’s social, human, financial, manufactured and natural capital would ideally be spatially explicit and high resolution.

**6.3 Drought Risk Mapping by the European Commission Joint Research Centre**

A drought risk assessment was completed by the Joint Research Centre of the European Commission for the period 2000-2014. It uses a global-scale top-down data driven approach that is consistent and applicable to all regions in the world. Drought risk is calculated as the probability of harmful consequences or likelihood of losses resulting from interactions between drought hazard (i.e. the possible future occurrence of drought events), drought exposure (i.e. the total population, its livelihoods and assets in an area in which drought events may occur), and drought vulnerability (i.e. the propensity of exposed elements to suffer adverse effects when impacted by a drought event) (Carrão et al. 2016). Specifically, drought risk was calculated as:

\[
\text{Drought risk} = \text{Vulnerability} \times \text{Hazard} \times \text{Exposure}
\]

Each component of drought risk was calculated independently of each other and based on global-scale indicators of different spatial resolutions. Hazard was using historical sequences of monthly precipitation deficits for the period between 1901 and 2010. Exposure was computed at the sub-
national level using high spatial resolution gridded indicators of population and livestock density, crop cover and baseline water stress. Vulnerability was derived from a combination of factors of social, economic and infrastructural indicators.

The individual components of drought risk for the Philippines are shown in Figure 19 (vulnerability), Figure 20 (hazard) and Figure 21 (exposure). The final drought risk assessment is shown in Figure 22. The maps are a first screening analysis and its recommended that local assessments of risk should be carried out to improve the outputs for targeting of drought preparedness and appropriate drought mitigation solutions – this is the focus of the next section. The outputs of the drought risk assessment provide a relative measure of drought risk globally – that is, the scale of risk is not a measure of absolute losses or actual damage to human health or the environment, but a ranking and comparison of input geographic regions. Carrão et al. (2016) should be consulted for detailed information on the methodology.

Figure 19. European Commission Joint Research Centre mapping of drought vulnerability in the Philippines. Source: Carrão et al. (2016).
Figure 20. European Commission Joint Research Centre mapping of drought hazard in the Philippines. Source: Carrão et al. (2016).
Figure 21. European Commission Joint Research Centre mapping of drought exposure in the Philippines. Source: Carrão et al. (2016).
6.4 National drought risk mapping in the Philippines

Various aspects of drought risk have been studied and mapped by different organisations within the Philippines. The World Food Program (2016) mapped areas at risk of rainfall reductions from El Nino (Figure 23). Under El Nino conditions, there are significant reductions in rainfall in large parts of country, particularly in the southern and western parts of the country: Mindanao, the Central Visayas, and Palawan. These are areas where peak rice harvesting occurs between December and February, and yields may be affected by high temperatures and lower rainfall during the end of the growing season. This can have serious effects on food security. These regions also produce other important cash crops including bananas, coconuts and pineapple. Drought conditions could reduce productivity of these crops with widespread economic losses and food security consequences.

de Guzman (2009) has mapped the vulnerability of rice and corn, the two most important crops in the Philippines, to the reduction in rainfall occurring during El Nino events (Figure 24).
Figure 23. Areas at risk of rainfall reductions in the Philippines due to El Nino. Source: World Food Program (2016)

Figure 24. Vulnerability in the Philippines of rice and corn to reduced rainfall typically experienced during El Nino events. Source: de Guzman (2009)
Perez et al. (2016) and Macapagal et al. (2015) have assessed the vulnerability of rainfed agriculture to drought in the Philippines. Their vulnerability included four indicators: i) access to irrigation; ii) available soil-water holding capacity (mm water per metre of soil); iii) average evapotranspiration 2000-2014 (mm/month), and; iv) average precipitation (mm/hour). These four indicators were standardised and combined in a weighted linear combination function. The most vulnerable areas are croplands that rely exclusively on rainfall and are not serviced by any irrigation systems and water reservoirs. The most vulnerable croplands are found in some parts of Central Luzon and some parts of Central Mindanao (Perez et al. 2016). An assessment of drought hazard, using time series evapotranspiration data for 2000-2014, was also completed by Perez et al. (2016), identifying the areas in the Philippines that are most likely to have a drought (Figure 26). Drought of varying severity are more likely to occur in Mindanao, Western and Central Visayas and Cagayan Valley in Luzon (Figure 26).

![Agricultural drought vulnerability map](image)

Figure 25. Agricultural drought vulnerability in some parts of Cagayan Valley and Central Luzon (left) and Bohol and Mindanao (right). Source: Perez et al. (2016).
Figure 26. Drought probabilities for (a) near-normal, (b) moderate, (c) severe and (d) all kinds of drought events. Source: Perez et al. (2016).
7 Drought Communication and Response Actions

Effective communication of the onset of drought and the actions required to respond to drought across all stakeholders is essential for reducing impacts. Clear protocols are needed about who and where drought messages are made, when they are made (in response to different drought conditions), and how to respond in the event of a drought. All stakeholders, whether they be government agencies, private sector or the general population in the Philippines, have a responsibility to communicate and respond appropriately as a drought unfolds and conditions worsen. This chapter presents specific details and actions for communicating and responding to drought in the Philippines.

7.1 Drought Communication Protocol

Information and communication are critical to ensuring that drought-affected people are at the centre of humanitarian action during drought. It’s now recognised that information and communication are important forms of aid, in addition to traditional humanitarian aid such as food, water and shelter. Without information and communication, affected people cannot access services or make the best decisions for themselves and their communities. When people are given the opportunity to voice their opinions and provide feedback this enhances their sense of well-being, helps them adapt to the challenges they face, and better enables them to take an active role in their own recovery.

Traditionally, drought communication has been a one-way process of alerting communities to evolving drought circumstances, providing advice on what they should do, and clarifying and coordinating the roles of each of the relevant government agencies as drought evolves. This is still very important to ensure coordination for effective response. Therefore, the communication protocol presented here is multi-dimensional - it presents actions for opening up effective lines of communication with communities during drought, and actions that the Government of the Philippines and communities take during and after drought. The actions for the Government for establishing two-way communication during the phases of drought are presented in Table 5. The process of communicating actions as a drought conditions evolve is presented in the remainder of this chapter and is linked to different levels of the key indicators used to monitor drought (see Chapter 5).
Table 5. The actions for communicating with communities during various phases of drought onset and recovery. 
Adapted from: CDAC Network (2014)

<table>
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<tr>
<th></th>
<th>Phase 1: First 72 hours</th>
<th>Phase 2: First 1-2 weeks</th>
<th>Phase 3: Weeks 3-4</th>
<th>Phase 4: Weeks 5-6</th>
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<tbody>
<tr>
<td><strong>Speaking with and listening to communities</strong></td>
<td>Rapidly reestablish</td>
<td>Strengthen multiple</td>
<td>Establish (or</td>
<td>Ensure information</td>
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<td>information and</td>
<td>channels for dialogue</td>
<td>strengthen</td>
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<td>communication channels</td>
<td>with communities</td>
<td>partnerships with</td>
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<td>Disseminate relevant</td>
<td>Work with local media</td>
<td>local ICT</td>
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<td>lifesaving information</td>
<td>to ensure the</td>
<td>providers and</td>
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<td>through existing</td>
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<td>and useful information</td>
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<td>Establish common service</td>
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<td>mechanisms for</td>
<td>service complaints</td>
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<td>community feedback</td>
<td>handling mechanism</td>
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<td><strong>Assessment and evaluation</strong></td>
<td>Conduct a rapid</td>
<td>Conduct a mapping of</td>
<td>Conduct ongoing</td>
<td>Conduct a real-time</td>
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<td>assessment of the</td>
<td>Government and local</td>
<td>community</td>
<td>review of CwC</td>
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<td>agencies capacity re:CwC</td>
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<td>Conduct a secondary</td>
<td>Comprehensive multi-</td>
<td>Establish a</td>
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<td>data review to gain a</td>
<td>stakeholder information</td>
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<td>better understanding</td>
<td>and communications</td>
<td>monitor the ‘local’</td>
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<td>of the pre-existing</td>
<td>needs assessment</td>
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<td>information and</td>
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<td>communication eco-system</td>
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<td>Ensure that key CwC</td>
<td>Document CwC challenges,</td>
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<td>questions are integrated</td>
<td>successes lessons learnt</td>
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<td>into multi-sector</td>
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<td>inter-agency assessments</td>
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<td>Ensure that CwC learning</td>
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<td>informs planning and</td>
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<td>response</td>
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<td><strong>Technical Support</strong></td>
<td>Map existing preparedness</td>
<td>Develop context specific</td>
<td>Conduct training</td>
<td>Continue identifying</td>
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<td>materials and draw on</td>
<td>and effectively targeted</td>
<td>on CwC with</td>
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<td>resources for</td>
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<td>appropriate/prepared</td>
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<td>messages</td>
<td>cross-cutting issues</td>
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<td>training on CwC</td>
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<td><strong>Coordination of CwC</strong></td>
<td>Circulate 4Ws for CwC</td>
<td>Establish a ‘scope of’</td>
<td>Continue to actively</td>
<td>Review (and if</td>
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<td>work for CwC ‘platform’</td>
<td>support coordination</td>
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<td>Conduct a mapping of</td>
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<td>Establish a common</td>
<td>Link with cross-cutting</td>
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<td>CwC ‘platform’</td>
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<td>Map intra/inter agency</td>
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<td><strong>Advocacy and representation</strong></td>
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<td>Ensure CwC is represented</td>
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<td>information beyond</td>
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<td>humanitarian agency</td>
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<td>Identify CwC funding</td>
<td>Link CwC approaches</td>
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<td></td>
<td>opportunities/mechanisms</td>
<td>with other cross-cutting</td>
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<td>initiatives to</td>
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<td>establish common</td>
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<td>themes/advocacy</td>
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<td>messages</td>
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<td>Liaison with global</td>
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<td>level regarding</td>
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<td>advocacy asks</td>
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</table>

7.2 Declaration of Drought Conditions

Drought conditions in The Philippines are monitored by PAGASA. PAGASA currently provides three main products that monitor and forecast drought which all use the Percentage of Normal Rainfall Index (PNRI) at provincial scale:
1. **Monthly climate assessment and outlook** – monthly summary of the temperature and rainfall for the past month and a forecast of temperature and rainfall for the next month, including the weather systems and ENSO conditions underpinning the assessment and outlook;

2. **Season climate outlook** – twice-yearly forecast of the temperature and rainfall for the coming two seasons (six months), including the weather systems and ENSO conditions underpinning the outlook;

3. **Monthly drought and dry spell assessments** – monthly summary of drought conditions for the previous month, issued during periods of drought.

PAGASA uses three categories of drought and dry spell, defined as:

1. **Drought**:
   a. Three consecutive months of way below normal rainfall (>60% reduction from average rainfall), or
   b. Five consecutive months of below normal rainfall (21-60% reduction from average rainfall)

2. **Dry spell**:
   a. three consecutive months of below normal rainfall (21-60% reduction from average rainfall), or
   b. two consecutive months of way below normal rainfall (>60% reduction from average rainfall)

3. **Dry condition** – two consecutive months of below normal rainfall (21-60% reduction from average rainfall).

PAGASA recently adopted the Standardised Precipitation Index (SPI) and Normalised Difference Vegetation Index (NDVI) for improved drought monitoring. The next section summarises monitoring, declaration and responses actions as the drought worsens and the values of the SPI indicator decreases beyond certain thresholds.

### 7.3 Communication and Coordination Guidelines and Response Actions

#### 7.3.1 Communication during drought

Various communication channels and tools will be used to disseminate information about drought management in the country, which will include the following:

- **Print media**: Newspapers, magazines, newsletters, leaflets, brochures, pamphlets, road banners, roll-up banners, posters, bill boards;
- **Electronic media/broadcast**: Radio, television, documentary, interactive website, social media.
- **Direct stakeholder engagement**: Interactive engagements such as meetings, workshops, symposia, exhibits/displays, road shows, school clubs
- **Social marketing and advertising**: Newspapers, radio, TV.

The approaches for communicating with different types of Filipino audiences and their advantages and disadvantages are listed in Table 6. Its important that consideration be given to local dialects.
and clear and simple communication protocols in any products distributed to people vulnerable to drought.

Table 6. Approaches for communicating with Filipinos and their advantages and disadvantages. Source: modified from Government of Malawi (2014)

<table>
<thead>
<tr>
<th>Target audience</th>
<th>Communication approaches</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural communities</td>
<td>Radios; mobile phones; posters; TV; leaflets; brochures; meetings; school clubs; helpline; community radio stations</td>
<td>Radio – reaches mass audience</td>
<td>Not everyone has access to radios</td>
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<tr>
<td></td>
<td></td>
<td>Mobile phones - fast</td>
<td>Mobile phones – not everyone has access and coverage; require electricity to charge</td>
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<td></td>
<td></td>
<td>Posters – easy to distribute</td>
<td>Posters – prone to vandalism</td>
</tr>
<tr>
<td>Urban communities</td>
<td>Radios; mobile phones; posters; TV; leaflets; brochures; meetings; school &amp; sport clubs; social media and advertising (newspapers; radio; TV)</td>
<td>Radio &amp; TV – wide coverage</td>
<td>Radio &amp; TV – requires electricity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social media – wide coverage</td>
<td>Social media – requires modern technologies which exclude older generations</td>
</tr>
<tr>
<td>Whole of Government</td>
<td>Newspapers; television; radios; workshops/meetings; leaflets; brochures; policy briefs</td>
<td>Newspapers – easily accessed</td>
<td></td>
</tr>
<tr>
<td>International community; private sector; donors</td>
<td>Newspapers; websites &amp; social media; press conferences; meetings; reports; workshops</td>
<td>Social media – widespread among professional communities</td>
<td></td>
</tr>
</tbody>
</table>

7.3.2 Coordination and response

In response to a major drought, the Philippines Government, via the NDRRMC, will lead various actions as the drought unfolds. The responses will be coordinated under a cluster model as shown in Figure 27.
The are many actions that should be implemented in the Philippines during a drought, and the different clusters will be responsible for different actions. The actions in responding to drought include:

In general:

- Rehabilitate irrigation networks to improve irrigation efficiency
- Massive information campaign – daily media briefings
- Water rationing
- Intensification of leak repair programs
- Water quality monitoring
- Cloud seeding operation
- Hydropower generation shall be kept to their respective minimum allowable generating capacities

For agriculture:

- Ensuring water availability in production areas through irrigation (shallow tube wells) and cloud seeding. Climate risk factors should be incorporated into any new or expanded water supply projects;
- Shifting of planting calendars or early planting, especially in drought vulnerable areas;
- Planting early maturing crops that require less water and are more tolerant to drought. Focus on location-specific varieties in drought vulnerable areas;
- Emergency income assistance to compensate for farm/fishery income loss;
- Emergency food assistance;
- Provide insurance coverage to affected areas;
• Promotion of alternative crops as replacement for major staples.
• Providing seeds, planting materials and fingerlings;
• Fertilizer support (organic/inorganic); and
• Further irrigation development.

The response actions are summarised in Table 7. The actions are linked to various levels of drought intensity as indicated by the SPI and PNRI drought indicators. During the early phases of the drought, a drought risk, impact and needs assessment should be completed to identify the regions, LGUs and communities requiring aid. Water supply enhancing technologies and food aid should be distributed as early as practical to avoid human suffering.
Table 7. Summary of response actions under different levels of drought (per the SPI and PNRI drought indicators), and by whom.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Indicators and Impacts</th>
<th>Response actions</th>
<th>Who leads</th>
<th>Major Departments/Agencies involved</th>
</tr>
</thead>
</table>
| Drought Advisory       | • D0 (Abnormally dry)  
• PNRI (< 75% for 3 months)  
• SPI (-0.5 to -0.7)  
• Short-term dryness slowing planting, growth of crops or pastures  
• Observed drops in reservoir, tank and groundwater levels | • Regular monitoring  
• Enact the drought task force to monitor situation                                                                                                                                                    | NDRRMC       | PAGASA                             |
| Drought watch/alert    | • D1 (Moderate drought)  
• PNRI (<70% for 3 months)  
• SPI (-0.8 to -1.2)  
• Some damage to crops, pastures  
• Reservoirs, tanks and wells low  
• Some water shortages developing or imminent | • Close monitoring of conditions for persisting or rapidly worsening drought  
• Activate risk assessment committee and assess risks and impacts/needs to all potentially affected communities across the major clusters impacted by drought (Food & Non-food; Health; Education; Logistics and Telecommunications; Shelter)  
• Voluntary non-essential water-use restrictions applied  
• Intensive communication and public information campaign – implement communication with communities plan as per Table 5 and implement communication mediums as per Table 6 | NDRRMC       | PAGASA; DepEd; DSWD; DOH; OCD; DA |
| Drought warning        | • D2 (Severe drought)  
• PNRI (< 65% for 6 months)  
• SPI (-1.3 to -1.5)  
• Crop or pasture losses likely  
• Reservoirs, tanks and wells continue to decline  
• Water shortages common; | • Mandatory and stringent water restrictions and water conservation measures  
• Drought task force and drought monitoring committee activated  
• Potential drought emergency declared  
• Distribution of RO units and hygiene kits to worst affected communities, especially schools | NDRRMC       | PAGASA; DepEd; DSWD; DOH; OCD; DA |
<table>
<thead>
<tr>
<th>Drought emergency</th>
<th>PNRI (&lt; 60% for 6 months)</th>
<th>SPI (-1.6 to -1.9)</th>
<th>Major crop/pasture losses</th>
<th>Widespread water shortages or restrictions</th>
<th>Mandatory water allocations and emergency supplies</th>
<th>Maximum per capita daily water uses applied</th>
<th>President declares national State of Emergency</th>
<th>Activate Emergency Operations Centre (OpCen)</th>
<th>NDRRMC</th>
<th>PAGASA; DepEd; DSWD; DOH; OCD; DA</th>
</tr>
</thead>
<tbody>
<tr>
<td>D4 (Exceptional drought)</td>
<td>PNRI (&lt; 65% for 12 months)</td>
<td>SPI (-2.0 or less)</td>
<td>Exceptional and widespread crop/pasture losses</td>
<td>Shortages of water in reservoirs, tanks and wells threatening life</td>
<td>Distribution of emergency food and water supplies</td>
<td>Hospital disaster emergency operations implemented</td>
<td>Military engaged to dispel any potential conflicts over water and food</td>
<td>NDRC</td>
<td>PAGASA; DepEd; DSWD; DOH; OCD; DA</td>
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</tbody>
</table>

NDRRMC: National Disaster Risk Reduction and Management Council
PAGASA: Philippine Atmospheric, Geophysical and Astronomical Services Administration
DepEd: Department of Education
DSWD: Department of Social Welfare and Development
DOH: Department of Health
OCD: Office of Civil Defence
DA: Department of Agriculture
8 Drought Mitigation and Preparedness

Being better prepared for the next drought requires actions to be put in place as soon as possible to reduce drought risk and potential impacts of future droughts. There are many things that the Philippines could do to mitigate risk and be better prepared, including development of new and alternative water sources, community education and outreach to encourage water conservation practices, and improved water resource monitoring and impact assessment. This chapter presents a number of options to monitor and enhance water supply, improve water quality and educate communities about the importance of water conservation. Also in this chapter are actions that summarise material discussed in previous chapters on the drought monitoring and early warning (Chapter 5), drought risk and vulnerability assessments (Chapter 6), and drought communication and response (Chapter 7). The actions available are presented in summary tabular format (Table 8) for ease of communication and reference. They are group according to major themes or challenges, and the relevant cluster or authorities/ministries are identified.
<table>
<thead>
<tr>
<th>Theme or Challenge</th>
<th>Action</th>
<th>NDRRMC</th>
<th>PDRRMC and MDRRMC*</th>
<th>PAGASA</th>
<th>Cluster</th>
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<tbody>
<tr>
<td>Better assessment of risk and vulnerabilities</td>
<td>Drought risk assessment and mapping</td>
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<td></td>
<td>Climate change vulnerability assessment</td>
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<td></td>
<td>Build GIS databases and capacity</td>
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<tr>
<td>Preparedness</td>
<td>Maintain current drought-rainfall forecasting and early-warning systems (3-month rainfall probabilities - PNRI)</td>
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<td></td>
<td>Maintain current drought monitoring systems (SPI and NDVI)</td>
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<td></td>
<td>Maintain and build community networks for decentralised community-run early warning systems</td>
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<td></td>
<td>Improve monitoring and early warning systems:</td>
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<td>• Increase uptake of remote sensing</td>
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<td></td>
<td>• Better understanding of climate-drought-agriculture-biodiversity-water impacts, risks and thresholds</td>
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<td></td>
<td>• Better drought forecasting mathematical or statistical stochastic models</td>
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<td></td>
<td>Develop water supply monitoring systems</td>
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<td></td>
<td>• Groundwater abstraction and recharge of renewable and non-renewable sources</td>
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<tr>
<td></td>
<td>• Application of GIS tools for surface waters</td>
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<tr>
<td>Theme or Challenge</td>
<td>Action</td>
<td>NDRRMC</td>
<td>PDRRMC and MDRRMC*</td>
<td>PAGASA</td>
<td>Food and Non-food (Agriculture &amp; Environment)</td>
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<td>Waste generation, treatment and reuse data</td>
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<td></td>
<td>Install new automated agro-meteorological stations in highly vulnerable agricultural areas</td>
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<td></td>
<td>Install communication equipment for more remote areas and establish multi-media information campaigns</td>
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<td></td>
<td>Conducting cloud seeding operations when there is threat of dry spell or drought that may affect standing crops and critical reservoir level;</td>
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<tr>
<td><strong>Response activities during drought</strong></td>
<td>Implement communication with communities protocols as per Table 5</td>
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<td></td>
<td>Implement drought response actions as drought unfolds, as per Table 7</td>
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<tr>
<td></td>
<td>Communicate drought management plans nationally</td>
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<td></td>
<td>Use social media to receive real-time updates on community-level drought impacts</td>
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<td><strong>Recovery as drought conditions abate</strong></td>
<td>Implement and improve systematic damage assessments</td>
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<tr>
<td>Theme or Challenge</td>
<td>Action</td>
<td>NDRRMC</td>
<td>PDRRMC and MDRRMC*</td>
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<td></td>
<td>Review functions of NDRRMC; Emergency Operations Centre; Clusters; PAGASA; and drought response procedures and coordination</td>
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**Risk reduction measures for future droughts**

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<th>Action</th>
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<th>PDRRMC and MDRRMC*</th>
<th>PAGASA</th>
<th>Cluster</th>
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<tbody>
<tr>
<td>Increase supply of freshwater:</td>
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<tr>
<td>• New guttering and new/larger domestic rainwater tanks in remote areas</td>
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<tr>
<td>• New small rainwater harvesting structures water impounding structures and farm reservoirs</td>
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<tr>
<td>• Rehabilitation of upland small-scale irrigation systems for upland productivity and natural resources sustainability</td>
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<tr>
<td>• Distribution of pump and engine sets to lowland areas with shallow ground water and surface water</td>
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<tr>
<td>• Community-based watershed management for sustainable water resources and livelihood development in critical watersheds of selected irrigation systems</td>
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<tr>
<td>Implement water demand management:</td>
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<tr>
<td>• Strong water conservation campaigns</td>
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<tr>
<td>• Incentives for water efficient appliances</td>
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<tr>
<td>• Promotion of water-saving technologies in irrigated rice production systems</td>
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<tr>
<td>Theme or Challenge</td>
<td>Action</td>
<td>NDRRMC</td>
<td>PDRRMC and MDRRMC*</td>
<td>PAGASA</td>
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<td></td>
<td>• Introduce water pricing mechanisms to promote efficient use of water</td>
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<td>green</td>
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<td></td>
<td>Investigate new and novel risk financing options such as insurance, Public-Private-Partnerships</td>
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<tr>
<td>Increase resilience in agriculture:</td>
<td>• Support promotion of indigenous knowledge and innovative ideas for resilient agriculture techniques (intercropping, fruit tree planting, integrated farming systems using permaculture technique, food preservation)</td>
<td>blue</td>
<td>blue</td>
<td>green</td>
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<td></td>
<td>• Distribution of drought-tolerant crop varieties</td>
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<tr>
<td></td>
<td>• Encourage income diversification and gender-balanced approaches in traditional farming</td>
<td>blue</td>
<td>blue</td>
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<tr>
<td></td>
<td>• Promotion of farm wastes recycling and re-use for organic-based agriculture development in vulnerable upland and lowland areas</td>
<td>blue</td>
<td>blue</td>
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<tr>
<td></td>
<td>• Promotion of crop insurance</td>
<td>blue</td>
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<td></td>
<td>• Apply new cropping calendars the use optimal planting schedules based on climate risks</td>
<td>blue</td>
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<tr>
<td></td>
<td>• Employ agroforestry, organic farming, farm diversification, and Sloping Agricultural Land Technology (SALT).</td>
<td>blue</td>
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<tr>
<td>Education:</td>
<td>• Promotion of school gardening and kitchen gardens to improve diet diversification, dissemination and</td>
<td>blue</td>
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<td>green</td>
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</tbody>
</table>

Clusters: Food and Non-food (Agriculture & Environment), Health, Education, Logistics, Infrastructure and Telecoms.
<table>
<thead>
<tr>
<th>Theme or Challenge</th>
<th>Action</th>
<th>NDRRMC</th>
<th>PDRRMC and MDRRMC*</th>
<th>PAGASA</th>
<th>Cluster</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>knowledge of compost-making techniques and resilience techniques against drought (including water conservation techniques – drip irrigation – and traditional storage techniques) • Increase water supply to schools • New radio communication technologies in schools for rapid communication • Target women, schools for education campaigns and awareness raising</td>
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<td></td>
<td>Health: • Awareness programs about risks of consuming poor quality water from heavily depleted water supplies and/or groundwater • Improved health sector communication systems • Capacity building among health professionals for communication, data collection and early warning systems</td>
<td></td>
<td></td>
<td></td>
<td>Health, Education, Logistics, Infrastructure and Telecoms</td>
</tr>
</tbody>
</table>

*PDRRMC = Provincial Disaster Risk Reduction Management Council; MDRRMC = Municipal Disaster Risk Reduction Management Council
9 Recommendations and Implementation Actions

9.1 Priority Implementation Actions

Given the high vulnerability of the Philippines communities to drought, and the significant threat posed by drought, many actions presented in Table 8 are high priority for mitigating future drought risk. The actions listed here will reduce the likelihood of major impacts to the physical health and well-being of Filipinos. However, during drought emergencies, immediate response actions will be required, and these are listed in Table 7. The NDRRMC should have a significant role in leading or supervising all actions. To summarise by cluster, the most important drought risk mitigation actions are:

- Health (especially Water): i) Increase supply of freshwater through new water harvesting structures and pumping; ii) Strongly encourage water demand management through education campaigns, capacity building and water saving technologies; iii) Raise awareness and build capacity in the health system about the risks of consuming depleted poor-quality water resources during times of drought.
- Food and Non-food (especially Agriculture): Distribute and encourage use of drought tolerant crops, support shift to alternative cropping systems and calendars, and diversified income sources, and support use of indigenous knowledge systems and innovative water saving farming systems.
- Education: Increase water supply to schools and provide education and activities on water saving, kitchen gardens, composting.
- Logistics, Infrastructure and Telecoms: New advanced multi-media information campaigns and information dissemination during drought.

9.2 Future Updates and Revisions

The implementation of this drought plan should be done through the NDRRMC, the unit responsible for coordinating and directing the implementation of disaster risk management programs in the country. Relevant ministries and other members of the various cluster should implement interventions in their own sectors while the NDRRMC will be managing the resources mobilized for drought risk mitigation, response, and recovery actions.

A monitoring and evaluation system should be established through a consultative process with all stakeholders and sectors involved in the planning and implementation of this drought plan. Activities to be monitored are those listed in Table 8 The NDRRMC should prepare and guide standardized data collection and analysis tools and approaches and produce and share periodic progress reports with all stakeholders. These progress reports should highlight successes and challenges in the implementation of the national drought plan and assist in reviewing and updating the drought plan.

Regular updating and revising the drought plan will ensure the following: (i) increased agricultural productivity and sustainability through sustainable agricultural practices; (ii) strengthened resilience of water resource management and supply; (iii) improved food security, nutrition and delivery of health services; and (iv) ensure enhanced drought resilience and preparedness by strengthening the capacity of institutions and drought affected communities to reduce their risks and vulnerability.
10 References


CDAC Network. 2014. Practice Brief: Communicating with Communities during the First Six Weeks of an Emergency Response.


