Drought Initiative-Cambodia

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ACRONYM

ADPC	: Asian Disaster Preparedness Center
CCSP	: Climate Change Strategic Plan
CCCSP	: Cambodia Climate Change Strategic Plan
CEDMHA	: Center for excellence in disaster management & humanitarian assistance
CRC	: Cambodian Red Cross
GNDR	: Global network of civil society organization for disaster reduction
RGC	: Royal Government of Cambodia
MAFF	: Ministry of Agriculture, Forestry, and Fisheries
MoE	: Ministry of Environment
MoWRAM	: Ministry of Water Resources and Meteorology
NCDM	: National Committee for Disaster Management
NDMC	: National Drought Mitigation Center
UNDP	: United Nations Development Programme

I. BACKGROUND

Cambodia is prone to natural and human-induce disaster, especially in the 21st century, as seen by drought in 2012 and 2014 (RGC. 2014). Throughout the history, drought has been one among many others challenges for human wellbeing and food security in Cambodia. It was projected by MoE in 2016 that weather pattern shows greater uncertainty and intensive extreme weather events such as floods and droughts (MoE. 2016). Bruneau (2012) defined drought as an extended period of below-normal precipitation resulting in decreased soil and subsoil moisture levels and diminished surface water supplies. Wilhite & Glantz in 1985 reviewed more than 150 published definition of drought and clustered drought into four types, namely: meteorological, hydrological, agricultural, and socioeconomic droughts. According to NDMC of University of Nebraska, the first three drought types deal with ways to measure drought as a physical phenomenon while the last deals with drought in terms of supply and demand which track the effects of water shortage on the socioeconomic systems. In Cambodia, drought is characterized by loss of water sources caused by the early end or delays in expected seasonal rainfall (Leng. 2014). Drought in Cambodia causes damage to paddy fields and farming crops, and also deficit water use for humans (NCDM&UNDP. 2014). Center for Excellent in Disaster Management and Humanitarian Assistant (CEDMHA) reported in 2017 that, in Cambodia, drought severely affects farming productivity especially among rice growing communities who rely solely on rain. Low agricultural yield due to extended drought has increased indebtedness of families and contributed to widespread food shortages. Not so many research on drought have been conducted or reported. However, NCDM estimated that at least 50 percent of districts were affected by the drought and in 2017 due to El Nino in 2015-2016, 18 provinces out of 25 provinces in Cambodia were severely affected by drought and 2.5 million people were affected (CEDMHA. 2017). The drought has had a significant impact on communities with crop damage and loss of livelihoods negatively affecting poor subsistent farmers and small land holders (Sharon. 2016). Agriculture would be one main sector which has strong relationship with drought. In 2009, 13 out of 24 provinces were affected by severe droughts. There were 57,965 hectares of rice crops affected and 2,621 hectares were destroyed. In 2010, 12 provinces out of 24 were affected by severe drought, as well as 14,103 hectares of transplanted rice. In 2011, drought affected 3804 hectares of rice fields while in 2012, drought affected 14,190 hectare of rice fields and destroyed 3151 hectares (CEDMHA. 2017).

In Cambodia, short-term drought adaptation mechanisms have improved, but extended periods of drought are now the main concern for human welfare and food security (MAFF. 2018). Therefore, it is important to have a comprehensive drought plan for minimizing or coping with drought risk. Moreover, Cambodia as a UNCCD member country has committed to implement drought plan for minimizing and reducing drought risk. In order to reduce the risk from drought, national drought plan have to be prepared.

1.1 Purpose, scope, goal and objectives

The objective of national drought plan is based on the principle of risk reduction which include i) early warning and prediction, ii) Preparedness and mitigation iii) response and iv) communication for drought. Specifically, this plan is developed based on review of existing documents and policies all together and identify gaps in the national drought preparedness and planning. Unlike many other natural disaster, many document in Cambodia reported of negative effect from drought are mainly agricultural related activities such as damage of rice cultivation. ADPC in 2008 reported that while drought is not as severe as floods in terms of impact, drought severely affects farming productivity especially among rice growing communities who rely solely on rain. Low agricultural yield due to extended drought has increased indebtedness of families and contributed to widespread food shortages (ADPC. 2008). Therefore, the review of this plan is mainly focused on agricultural sector that is known as the most vulnerable sector to drought so that negative impact to livelihood of local people can be minimized/reduced.

1.2 Plan development

Unlike many other natural hazards, drought affects to large area and sometime covers a long period of time, event years. However, it is like other hazard, drought can negatively impact to social, environmental, and economic sectors. It's impact can be reduced through a better plan. The 10-steps process was first introduced in 1991 by Wilhite based on interaction with many states in the United State. Since then, it was revised and updated many times in order to adapt it to greater state, national and international experience in drought planning. Over the past decade, this planning process has been the basis for discussion at the regional training workshop and seminars on drought management and preparedness held throughout the world. With the increase interest in drought mitigation planning in recent years, this planning process has evolved to incorporate more emphasis on risk assessment and mitigation tools (Wilhite et al., 1999). The 10-steps planning process is one approach to assist the country with national drought planning. The 10 steps for drought planning process are summarized as followings:

1. Appoint a drought task force: The key decision makers initiate the drought planning process through appointment of drought task force. This task force has two purposes. i) this task force supervise and coordinate to develop the plan and ii) after the plan development and activation, and when the drought happen, the task force coordinates action, implement mitigation and response programs, and make policy recommendation to the appropriate political leader.

2. State the purpose and objectives of the drought plan: As shown in the title of this step, the task force has to clearly set the objectives of the plan. To better set the objective of plan, there are many questions to be considered including i) what is the purpose of government in drought mitigation and response effort? ii) what is the scope of plan iii) where is the most vulnerable area and its impact as well as legal

and social implication of the plan. Drought plan may be developed differently, however, it has the same goal is to reduce impact from drought.

3. Seek stakeholder participation and resolve conflict: Different stakeholder may have their own interest in sharing the scarce water resources. It is, therefore, important for the task force to identify the groups who are benefiting from drought plan. These groups consist of famers, the poor, rural residents, marginalized people, practitioners, women or female-headed households, youth and decision maker. The groups must be involved from the beginning and continuously for fair representation and effective drought management planning. This group has a chance to discuss among other to better understand each other for coming collaborative solution.

4. Inventory resources and identify group at risk: The task force need to do inventory of resources which includes natural, biological and human resources. Natural resource refers mainly to water resource in term of its quality and quantity as well its location and accessibility. The biological resource refer to type of land uses such as grassland or forest land in term of their quality and quantity while the human resource refers to labour that need for water resource development, technical assistant, etc. Beside, resource inventory, the information on cost of plan against losses should be weighed while the areas of high risk should be identified.

5. Develop organizational structure and prepare drought plan: An important activity of this step is to describe the process of relevant committee development which would consists of three main component such as monitoring, assessment, and mitigation and response component. The first two components may lead by two committees while the third component would lead by the task force. The task force and the two committee work together. The task force provides policy direction to assessment and monitoring committees while assessment and monitoring committees provides the task force with assessment and situation reports, respectively.

6. Integrate science and policy and close institutional gaps: Decision maker would have limited knowledge or understanding about scientific and technology constrain on drought while scientist is generally have poor understanding the existing policies to address and responding to the impact from drought. Therefore, enhancing communication between policy maker and scientist have to be taken into account if the planning process is to be successful. Furthermore, integrating policy and science during the planning process would be also useful. It is the role of task force in bringing them to work together as well as maintaining the strong working relationship with each other.

7. Publicize the proposed plan, solicit reaction: The task force should communicate constantly with public focusing on the issue like how the drought plan is expected to

reduce drought impact, in both short and long term impacts. If there has been good communication with the public throughout the process of drought plan establishment, people will better understand when the task force recommends different mitigation and response options.

8. Implement the plan: After the plan is agreed, the task force and its representative start oversee implementation, both long term and short term aspect. During the implementation, testing, evaluating and updating drought plan would be essential for the responding to the real situation and need of people.
9. Develop education programs: Responding to drought for short and long term, education people is important so that people will know how to response to drought when it occurs.
10. Post-drought evaluation: It is also important steps where recommendation can be provided to the government, nongovernment institution, and other responding to their action to address drought so that the improvement for event can be achieved. Without post evaluation, it is difficult to learn the success and mistake that have been occurred during previous drought event.

II. RELATIONSHIP TO OTHER PLANS AND POLICIES

Based on the review of existing available document during this study, there is no specific stand-alone document on drought. However, drought intervention and some specific activities have been documented in different existing law, policies, national strategies and plans as summarized in Table 1 below.

Table 1. Summary of existing plans and policies

No.	Existing plans and policies related to drought	Objectives	Description
1	Law on disaster management	To regulate disaster management in Cambodia before, during, and after drought happening.	This law provides mandate to NCDM to lead, administer, and coordinate of all management activities related to drought. The law also allows the ministries-institutions to establish a disaster management mechanism in their respective ministries-institutions and assign a focal point for regular coordination and communication with NCDM.

No.	Existing plans and policies related to drought	Objectives	Description
2	Law on water management	To foster effective and sustainable management of the water resources for attaining socio-economic benefit.	This Law determines i) the rights and obligations of water users, ii) the fundamental principles of water resources management, and iii) the participation of water user communities in sustainable water resources development. The law provides the mandate to MOWRAM to serve as headquarter in the execution of the required action in close collaboration with the concerned ministries and local authority in the event of flood and drought.
3	Rectangular strategy phase IV	To laid out concrete strategic policy measures for implementing the political platform of the Royal Government of the Sixth Legislature of the national assembly, 2018-2023, aimed at responding to the demand of people and laying foundations for the journey toward the goals of Cambodia vision 2030 and 2050.	It recognized climate change and the strategy included the promotion of development and implementation of integrated water resource management plan in order to expand water supply in response to demand, minimize the risks caused by flood and drought, as well as to ensure long-term water security is one main priority.
4	Cambodia Climate Change Strategic Plan 2014-2023	To reduce vulnerability to climate change impact of people, especially the most vulnerable and critical system.	To achieve the set objective, the plan focused on institutional capacity building for climate projection and its impact as well as adaptation and disaster risk reduction for vulnerable sectors. The plan set out a number of actions which structured into three phases of implementation,

No.	Existing plans and policies related to drought	Objectives	Description
			namely immediate, medium and long term. The immediate and medium term were already passed while the long term will be from 2019-2023. In long term implementation, the plan is focused of on research and learning, but its main objective will be to scale up success cases and to continue mainstreaming climate change into national and sub-national programs.
5	National strategic development plan 2014-2018	To ensure that the actions, programs and projects of all ministries, agencies and sub-national authorities are aligned to the implementation of the prioritized policies of the RGC outlined in the Rectangular Strategy.	The plan tries to address factors to reduce impact from climate change and to reduce vulnerability of local community. Furthermore, the plan continue reduction of disaster risk by focusing on the different aspect including i) strengthening disaster management institution, enhancing disaster risk assessment, monitoring, and early warning system, ii) knowledge and innovation development, iii) reducing risk factor, and iv) strengthening preparedness for effective emergency response.
6	National Action plan for disaster risk reduction (NAP-DRR) 2014-2018	To pursue proactive and integrated way to reduce risk to hazards through sustainable, innovative and realistic strategies with stronger with stronger partnership of all	NAP-DRR consists of five strategic components, namely: i)Consolidating and further enhancing capacity of the disaster management institution at national, sub-national and local community levels ii) Enhancing risk assessment and improving

No.	Existing plans and policies related to drought	Objectives	Description
		stakeholders.	early warning systems iii) development and use of innovation and knowledge to build resilience iv) reduction of the underlying causes of risks and v) enhancing emergency response and recovery capabilities at all levels
7	National Adaptation Programme of Action to Climate Change (NAPA)	To provide a framework to guide the coordination and implementation of adaptation initiatives through a participatory approach, and to build synergies with other relevant environmental and development programmes.	NAPA identified 20 priority projects to address urgent and immediate needs and concerns of people at the grassroots level for adaptation to the adverse effects of climate change in key sectors
8	Climate change priority action plan for Agriculture, Forestry, and Fisheries Sector	to reduce any negative impacts of CC and the vulnerability of the agricultural sectors and to counteract damages and losses through increased DRR, CCA and mitigation measures to CC and global warming, while being able to respond and recover in case of unavoidable disasters	This plan had proposed specific priority activities to response to climate change in the different agricultural sub-sectors (animal production, forestry, and fisheries, and crop sectors) and cross cutting issues. Therefore, the plan proposed 5 strategies: i) ensure food security and farmers' livelihood improvement, ii) promote sustainable natural rubber development, iii) increase sustainable livestock production, iv) enhance sustainable forest management, and v) enhance management, conservation and development of fishery resource in a sustainable manner
9	Climate change action plan for water resources	To identify priority action required to deliver the CCSP	the plan proposed four main strategic areas: i) improve hydrological planning,

No.	Existing plans and policies related to drought	Objectives	Description
	and meteorology 2014-2018	strategies and priorities, proposed activities and costing and financial mechanism.	management, and early warning, ii) improve flood and drought management, iii) capacity development for MOWRAM staff, and iv) promoting gender responsiveness in climate change planning in the water sector.
10	Climate change action plan	To promote implementation of the strategic objectives of the CCCSP 2014-2023 by setting out key priority actions for MoE.	This plan contributes to the climate change strategic plan 2014-2023 through different strategic actions including environmental protection, conservation and sustainable use of natural resources, green growth, environmental education and awareness raising, and climate change governance.
11	Climate change strategic plan for disaster management sector	To reduce people's vulnerability to climate change hazards	The strategic plan consists of 4 strategies: i) Links between climate change adaptation and disaster risk reduction, ii) Promoting the early warning system, iii) Building disaster resilience and climate change adaptation capacity at all levels through education, and iv) Developing by paying more attention to risk

III. OVERVIEW OF DROUGHT IN THE COUNTRY

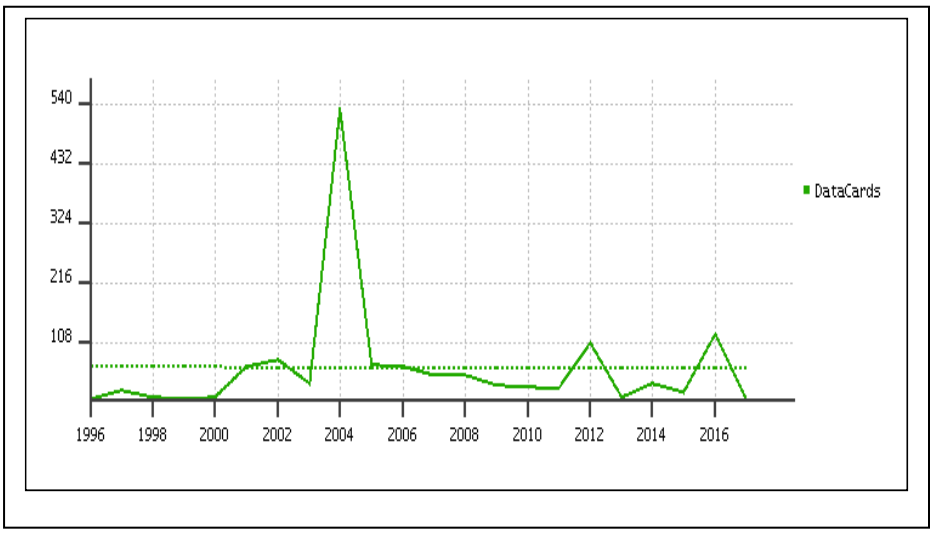
3.1 Historical occurrence

Cambodia is considered among the world's most affected by natural hazard, including drought. Drought is commonly defined "as an extended period of below-normal precipitation resulting in

decreased soil and subsoil moisture levels and diminished surface water supplies (Bruneau. 2012). In Cambodia, Drought is characterized by loss of water sources caused by the early end or delays in expected seasonal rainfall during rainy season. There is also a common occurrence of mini-drought between late July and early August.

Drought is one among 8 disasters (flood, storm, fire, lightening, drought, pest outbreak, epidemic, and river bank collapse) in Cambodia which is not as severe as floods and some other disaster that lead to the death of people's life. However, drought severely affects farming productivity especially among rice growing communities who rely solely on rain (NCDM. 2008). NCDM & UNDP in 2014 reported that drought does not cause human life loss like other disaster, but it impacts significantly on livelihood, especially on agriculture, livestock, and water. As shown in Figure 1, the annual distribution of drought data card (record) that have been entered and recorded from 1996 to 2016 by NCDM (http://www.ncdm.gov.kh) shows that the largest drought record was in 2004. It follows by 20012 and 2016. In 2016, due to El Niño weather phenomenon, it has resulted in significantly less rainfall patterns, warmer weather and delayed or shorter monsoon rains in Cambodia in which the Royal Government of Cambodia declared that 18 of Cambodia's 25 provinces have been severely affected by drought. It is the worst drought record in fifty years (Salman & Mary. 2017).

Figure 1. Drought record from 1996 to 2016 in Cambodia (Source: http://camdi.ncdm.gov.kh)

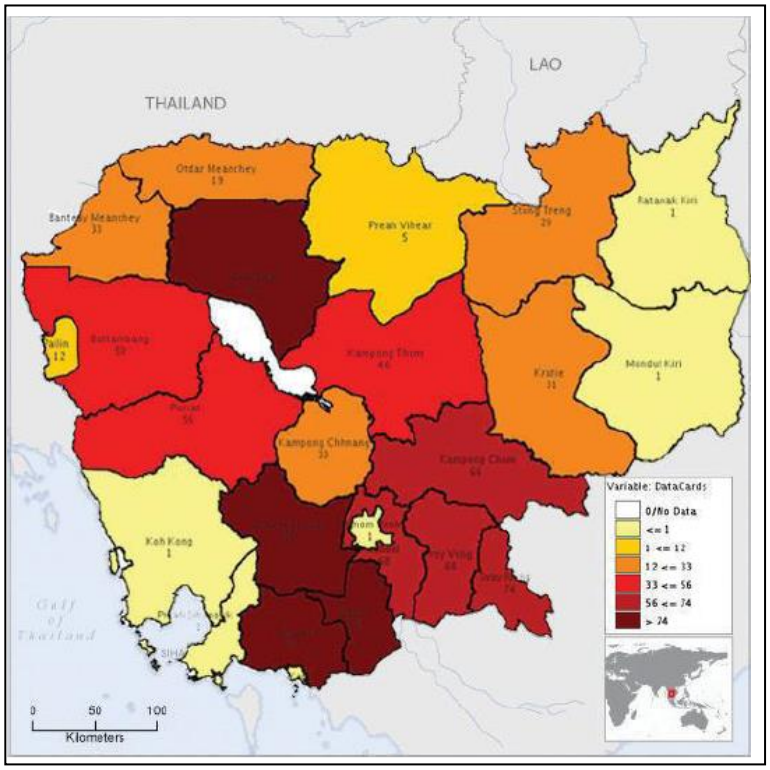


According to NCDM and UNDP in 2014, drought has been reported from all provinces from 1996 to 2013. NCDM and UNDP in 2014 produced the thematic drought map based on data card reported from each province from 1996 to 2013 as shown in Figure 2. This figure shows that Kampong Spoeu province had the largest number of drought report (197 reports) while it is followed by Kampot (153 reports), Takeo (124 reports) and Siem Reap (102 reports) provinces.

Drought has had a significant impact on communities with crop damage and loss of livelihoods negatively and, thus, affecting poor subsistent farmers and small land holders. Low agricultural

yield due to extended drought has increased indebtedness of families and contributed to widespread food shortages (Leng. 2014). Low water supplies have exacerbated poverty for many poor communities who depend on rivers and ponds for irrigation (Sharon. 2016).

Figure 2: Thematic map of drought from 1996 to 2013 (Source: NCDM & UNDP. 2014)



Under a normal year, typical rainfall distribution from May to October and the heavy rainfall from August till mid-October with a dry spell for about 2 to 3 weeks in between July and August. In a year when this dry period is extended too long, an agricultural drought could occur in addition to the late rain and early end of rainy season. There are four characteristics of agricultural drought in Cambodia (RGC. 2008):

1. Unpredictable delays in starting rainfall in early wet season
2. Erratic variations in wet season rainfall onset, amount, and duration across different areas
3. Early ending of rains during the wet season
4. Common occurrence of mini-droughts of three weeks or more during the wet season, which can damage or destroy rice crops without irrigation

3.2 drought impacts: by sectors

Since drought severely affects farming productivity especially among rice growing communities who rely solely on rain, the impact of drought is significant on agriculture. NCDM and UNDP recorded the impact from drought from 1996 to 2013. It was reported that drought did not

cause human life loss like other disasters, but it impacted significantly on livelihood, especially agriculture. From 1996 to 2013, drought had the second highest impact after flood on paddy rice field which damaged 775,519 hectares or 31 % of total loss. Furthermore, Vathana in 2018 ported the drought affect to agriculture from 2010 to 2016 as shown in Table 2. It shows that in 2015 drought affected 252,189 ha of rice field accounted to 9.84% of the total production area and damage 41,469 ha accounted to 1.62% of total rice production area.

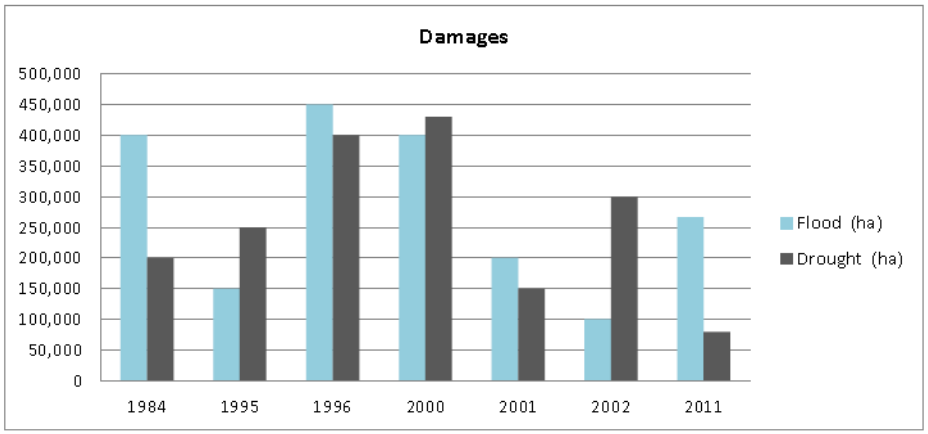
Table 2. Impact of drought on rice field

Year	Affected area		Damage area	
	Area (ha)	Percentage of total area	Area (ha)	Percentage of total area
2010	14,103	0.59	2,934	0.12
2011	3,659	0.15	53	0.00
2012	167,819	6.68	19,420	0.77
2013	9,542	0.37	178	0.01
2014	116,129	4.53	20,289	0.79
2015	252,189	9.84	41,469	1.62
2016	173,613	6.68	16,751	0.64

Paddy rice fields in Prey Veng and Takeo were two top provinces recorded the rice field damage while Kandal, Battambang, Kampong Cham, and Pailin were four main provinces in term of subsidiary crop damage. Natural disasters have severly affected agriculture. Flood is the main factor which damaged 67% of the total damage paddy rice fields while drought was the second main cause at 31% (NCDM & UNDP. 2014)

In addition to the above mention impact, MAFF also recorded the damage caused by flood and drought from 1984 to 2011 as shown in Figure 3. It is shown that damage caused by drought in 2000 was more than 400,000 hectares which was the highest drought damage from 1984 to 2011.

Figure 3. Damage caused by extreme whether (Source: MAFF. 2016)



The drought that took place in 2002 affected some 420 communes in 76 districts located in 10 provinces. This drought had affected 2,047,340 people or 442,419 families (RGC. 2008). This drought incident incurred a total damage of USD 38 million (NCDM. 2008).

Even there is no record in Figure 3 shown above, NCDM recorded that the impact of drought on agriculture in 2004 was around 12,000 hectares of transplant rice fields and 790,000 hectares of farming crops (NCDM: www.ncdm.gov.kh). It has been estimated that up to 2013, approximately 7.8 million people had been affected by droughts, with an estimated damage of US$165 million (Salman & Mary. 2017). Furthermore, It was estimated in 2016 that there were around 2.5 million people in Cambodia were affected by drought (Sharon. 2016).

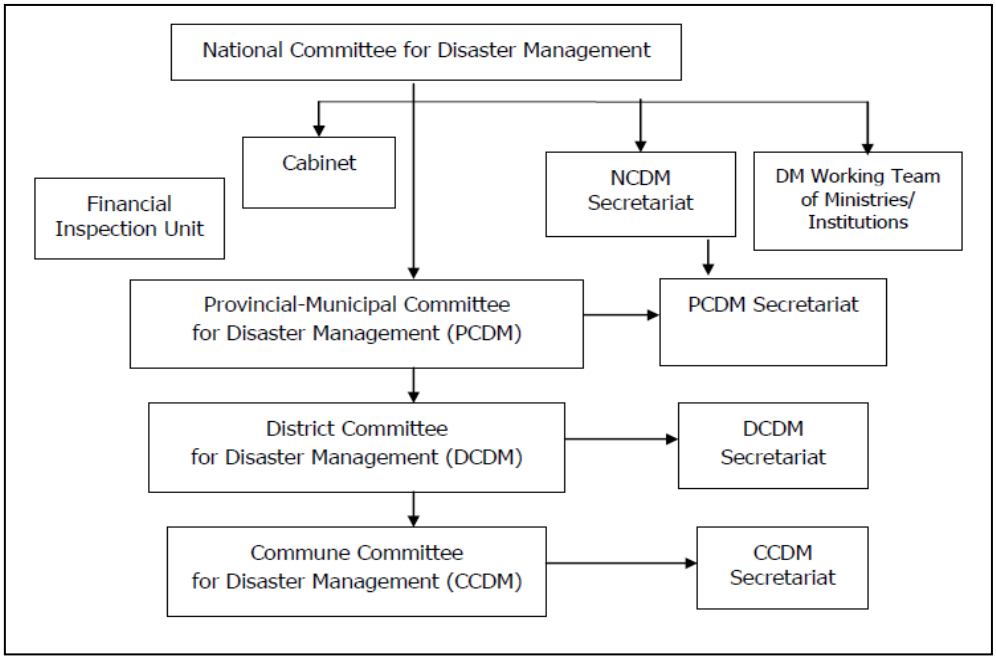
Furthermore, UNICEF in 2016 reported that Cambodia witnessed drying up of surface water reservoirs in 2015 thereby reducing water for irrigation, domestic and livestock use. The assessment conducted in 25 provinces found that 30,044 wells and 2,024 ponds had dried out.

IV. ORGANIZATION AND ASSIGNMENT OF RESPONSIBILITIES

4.1 Organizational overview

The National Committee for Disaster Management (NCDM) was established in 1995 to serve as the coordinating body for disaster management-related activities in Cambodia. The NCDM Secretariat, which is the locus of disaster management for the country, was set up to lead and coordinate disaster management affairs and to provide support to NCDM (Leng. 2014). As part of the decentralization process, disaster management institutions such as Provincial Committee for Disaster Management (PCDM), District Committee for Disaster Management (DCDM) and Commune Committee for Disaster Management (CCDM) have been set up to lead disaster management at their respective levels (Figure 4).

Figure 4. Disaster risk management coordination mechanism (Source: RGC. 2008)



Headed by Prime Minister, NCDM consists of 22 members from different Ministries, Cambodian Armed Forces, and Civil Aviation Authority as well as representatives of Cambodian Red Cross (Leng. 2014).

4.2 Assignment of responsibility

Cambodia developed a National Action Plan for Disaster Risk Reduction in Cambodia. Due to the overarching nature of disaster that involve contribution from all stakeholder, including governmental institutions from national, provincial, and district level, private sector, donor, ad NGOs to address, the following are the general implementation roles and responsibilities for disaster risk reduction (RGC. 2013):

- NCDM Secretariat will provide the overall leadership to coordinate the implementation of national disaster risk reduction. This includes supporting the Ministries to integrate the activities into their annual plan through management of technical advice, and production of guidelines. The NCDM Secretariat also support the Ministries to mobilize necessary financial, technical and technological resources.
- Ministries will first form the Disaster Management Working Group, and unpack the plan and activities for their respective sectors. The Ministries will also establish national and international partnerships for technical cooperation and resource mobilization.
- Provincial Committee for Disaster Management (PCDM) and District Committee for Disaster Management (DCDM) will be responsible for integrating the NAP-DRR into their annual development and investment plans.
- Private Sector Private sector will become an active partner of the implementation of the disaster rick reduction plan.
- UN Agencies will gradually integrate the DRR issues into the United Nations Development Assistance Framework (UNDAF). During the NAP-DRR period, the technical, financial and operational cooperation between the RGC and the UN will continue to grow.
- National and International NGOs play as important roles in the implementation of the community based DRR activities. They will work with the NCDM Secretariat to develop outreach strategies to cover the locations that are vulnerable to current and future disasters. They will also play important roles with the NCDM Secretariat in the advocacy for resource mobilization, facilitate knowledge management and take part in the monitoring and evaluation of the NAP-DRR.
- Donor agencies and International Financial Institutions are the key partners for the implementation of disaster risk reduction plan.
- Academic Institutions and universities will take over the research, knowledge development, technical innovation and academic programme.
- Media will support the implementation of the plans through supporting public awareness raising and facilitating exchange of information, dissemination of early warning.

According to Royal Decree on the Organization and Functioning of the NCDM, The Royal Decree defines the organization and functioning of NCDM as the headquarters of the Royal Government to lead, administer and coordinate all disaster management activities induced by either natural or human made disasters in the Kingdom of Cambodia (IFRC and UNDP. 2017). The NCDM has the following tasks and responsibilities:

- Issue the policies, strategic plans, plans of action, regulations, programmes and projects for disaster management;
- Issue guidelines for implementation of disaster management, promote public awareness, prevention, mitigation, preparedness, emergency response and recovery for safety and resilience;
- Recommend the Royal Government to take action on every case that will cause disaster and disaster occurrence;
- Coordinate the implementation of disaster risk reduction, mainstreaming of climate change, sustainable development, and gender issues by collaboration with line ministries in developing and strengthening the institutions, mechanisms and disaster management at all levels, in particular, at local community level to ensure better response during emergencies;
- Mobilize resources for implementation of policies, strategic plans, plans of action, relevant programmes and projects of disaster risk reduction;
- Strengthen collaboration and cooperation with development partners, public sector, private sector and civil society for the benefits of disaster reduction;
- Strengthen and expand collaboration at the regional and international levels in disaster reduction;
- Manage the information and communication associated with disaster risk reduction activities;
- Raise proposal to the Royal Government on the requirement, reserve, budget, resource and assistance for emergency response and recovery;
- Implement other tasks assigned by the Royal Government.
- Convene a meeting at least once a year upon the invitation of the President; and
- Invite the representatives of ministries, institutions, public sector, private sector, development partners, and civil society to participate in the consultation meeting and conduct the research on every issue associated with the disaster management framework.

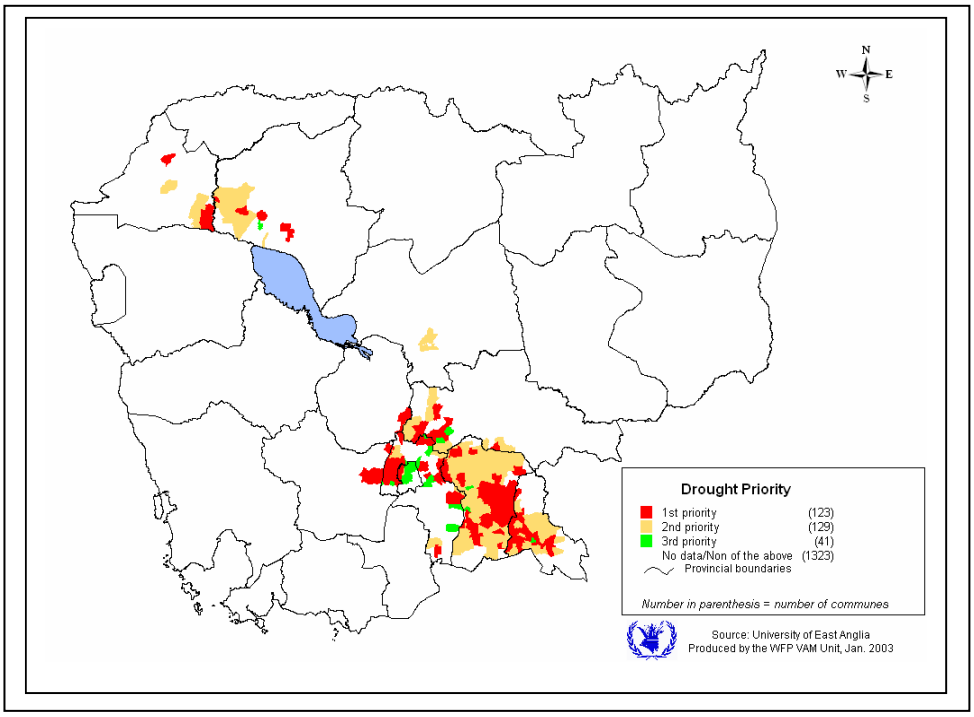
V. DROUGHT MONITORING, FORECASTING, AND IMPACT ASSESSMENT

5.1 Drought indices

Drought severity has been quantified in different ways. Some authors have used meteorological data and some have used human perception while others have measured productivity losses using indices such as the Normalized Difference Vegetation Index (NDVI) from remotely sensed data (Chhin. 2015). In Cambodia, NCDM with WFP in 2003 generated drought prone area map

by measuring productivity using Normalized Different Vegetation Indices (NDVI). By combining three indicators, drought affected areas, rice dependency, and food security situation, NCDM and WFP in 2003 prioritized and classified areas for assisting vulnerable populations in drought prone areas into three groups as shown in Figure 5.

Figure 5: Drought prone area for drought intervention (Source: NCDM&WFP. 2003)



Drought prone area was analyzed using 4 main criteria, namely: i) 30 year average precipitation ii) 20 year average NDVI iii) high rice dependency and iv) rice deficit in 1998. The first priority area is the area where average precipitation is less than 470 mm and NDVI was less than 0.40. This area was given as a top priority for any drought related intervention programs. The second priority area is the same with the first priority areas, except that these areas did not face food shortages as severe as those in the first priority areas while the third priority area is the area where precipitation and NDVI are low, but the population is not highly rice dependent or food insecure. These third priority areas are likely to face with drought, but should be given a lower priority because the effects of droughts are not severe like in the first and second priority areas.

Even the map shown above has been produced in 2003 by WFP and NCDM. 2003, this map is still being used until now in different national action plan document including Strategic National Action Plan for Disaster Risk Reduction 2008-2013 and Plan of Action for Disaster Risk Reduction in Agriculture 2014-2018 as well as NCDM in 2014 and GNDR in 2016.

Ministry of Water Resources and Meteorology is currently testing 'www.mowran-nffc.org' web portal in disseminating drought forecasting using standardize precipitation index.

5.2 Current monitoring, forcasting and data collection

Farmers have been regularly reported and observed direct impact from drought. The information on climate forecasts is very important for farmer for making important decisions regarding the management of their crops, livestock, soil, harvest, and equipment. The Department of Meteorology which is under the Ministry of Water Resources and Meteorology (MOWRAM) is mandated to provide weather services for Cambodia. It is responsible for the operation and maintenance of all the meteorological observation and measurements, issuance of weather forecasts and severe weather warnings all over the country (MoWRAM. Undated).

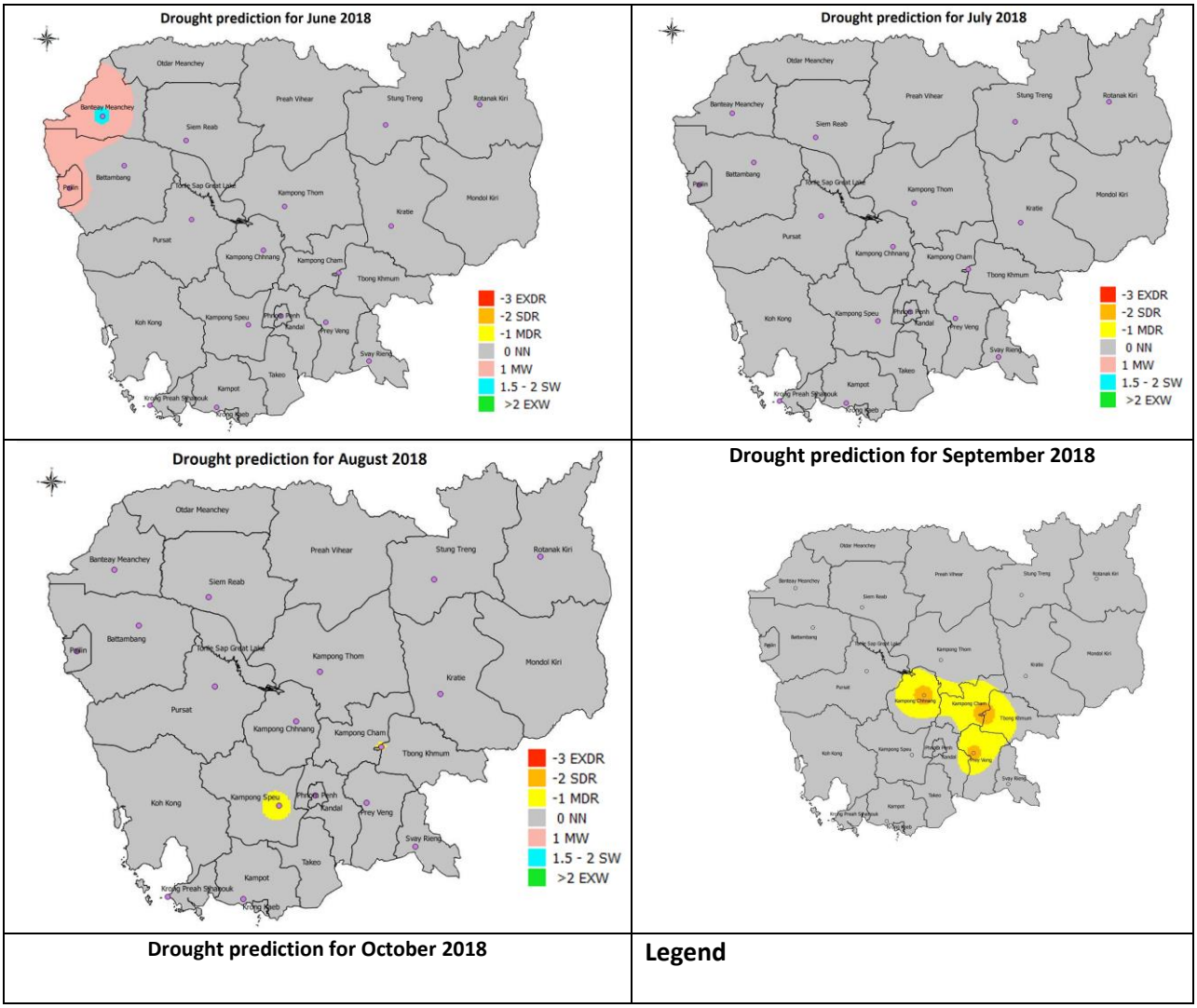
Weather Observation Network in Cambodia in 2010 consists of synoptic stations with manned observational equipment and manual rainfall stations. Cambodia conducted operational weather observation for 4 times per day in the main standard time. The data is transfer to the Head office of Research and Weather Forecast for using in forecasting before it is transmitted to the Head office of Climate for climatologically use (Peou. 2010). However, it was reported in 2016 that Weather observation network and forecast tool in Cambodia consist of 35 Automatic Weather Stations (AWS), manual weather stations, rain gauges, one S-Band weather RADAR, GTS connection, high performance servers, and a HIMAWARI weather satellite data reception and visualization station; while the hydrological observation network consists of 12 stations. MoWRAM provides climate data and information; Nowcasting; three-day, one-week, and seasonal forecasts; and severe weather warnings as a public weather service (Oum. 2016). Furthermore, It was also reported MoWRAM got the various meteorological data /information as well as early warning for any extreme event that occurred in the region via the regional Global Telecommunication System (GTS) that linked from Bang Kok. The early warning is provided to many users such as local authorities, NCDM, MoI, Ministry of Defense, Cambodia Red-Cross, Media (TV, Radio, newspaper, through fax, telephone, email, and website (Oum. 2016).

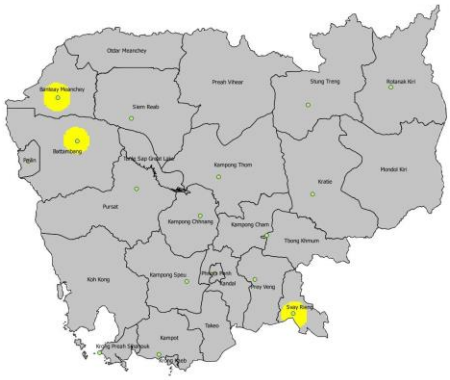
MoWRAM, Department of Hydrology and River Work, is responsible to manage and exchange hydrological information and issue forecasts and early warnings for possible floods and droughts to facilitate the timely adoption of mitigation measures. From 2010, MOWRAM engaged in the modernization of meteorological predications in Cambodia. The objective of this modernization is to enable the department to produce and broadcast weather forecasts to the relevant stakeholder. The decision has been taken to equip Cambodia with a "Doppler weather radar meteo 650C". The construction of the Radar Station TECHO SEN, located in Phnom Penh, began on 25th of March 2011. The station is operational since the 4th of April 2012 (http://www.cambodiameteo.com).

In addition, MoWRAM, with financial support from the Asian Development Bank under the Greater Mekong Sub-Region Flood and Drought Risk Management and Mitigation Project (GMS-FDRMMP), has strengthened the National Flood Forecasting Centre (NFFC) under the Department of Hydrology and River Works. The results of this initiative include better forecasts of floods and droughts with the objective of reducing the negative impact from these natural disasters, and the enhancement of Cambodia’s contribution to regional data, information, and

knowledge for the improving management of risks associated with floods and droughts. The improved dissemination of information on current hydrological conditions and forecasts is provided through 'www.mowran-nffc.org' web portal. Like the case for drought prediction from June to October 2018 using standardize precipitation presented in the web portal showed that most parts of Cambodia are in near normal situation (i.e. no drought) during this 3-months period from August to October 2018. However, the south-eastern part of the central plain (Kampong Chhnang, Kampong Cham, Tbong Khmum and Prey Veng) will probably face moderate to light severe drought in September as shown in Figure 6.

Figure 6. Drought prediction for June and October 2018 (source: http://www.mowram-nffc.org)





Abbreviation	Explanation
EXDR:	Extreme Drought
SDR:	Severe Drought
MDR:	Moderate Drought
NN:	Near Normal
MW:	Moderate Wet
SW:	Severe Wet
EXW:	Extreme Wet

5.3 Drought severity in all relevant sectors

Due to a combination of below average rainfall and extremely high temperatures in 2015 which resulted from El Nino, Cambodia witnessed drying up of surface water reservoirs thereby reducing water for irrigation, domestic and livestock use for the rural people. In extreme cases, fish and small livestock died. I was recorded that Cambodia faced with drought frequently during the past decade. The most severe droughts to have occurred in the country were in 2002, 2012, 2015 and 2016. Typically, a severe drought year is defined as a year in which the annual rainfall is greater than 20 percent of the long-term average rainfall (MRC. 2012). In 2016, the government of Cambodia declared a state emergency for the first time in its history due to severe drought that affected its population and the development of the entire country (Sithirith. 2017). That drought impact not only to agriculture which damage to crop, but also natural resources such as drying out of water sources in the forest which leads to shortage of water in the wild for wildlife.

The impact on drought to different sector has not been recorded well. Definitive data for the cost of drought in the LMB are lacking. However, it is apparent that meteorological drought will have a major impact of rainfed rice production (MRC. 2012). Most reports recorded the impact from drought to agricultural sector, especially the impact on rice field and plantation. However, the study conducted by UNICEF in 2016 reported that there were more than 2500 schools nationwide experienced varying levels of water shortages while 31 health centers in seven provinces were affected by water shortages. Furthermore, the survey jointly conducted by WFP, FAO and UNICEF with 2400 respondents in 25 provinces of Cambodia reported of water shortages, decline in paddy and cassava production, income losses, eating smaller amounts of preferred food, and diarrhea for children younger than five years (UNICEF. 2016). Drought accounted for 20% of rice production losses between 1998 and 2002, while droughts accounted for 20% of those losses (Sithirith. 2017). Impacts of the drought in 2016 is considered the worst regional drought in more than 50 years, brought on by an El Niño cycle exacerbated by climate change, water shortages have been declared in 18 of the country's 25 provinces. It was found n Banteay Meanchey, Kampot, Siem Reap and Battambang provinces that water scarcity is jeopardizing food security, health and livelihoods of many, though a few have carved out business opportunities amid the devastation (MoE. 2017). Unlike floods, there are no benefits

associated with the occurrence of droughts, and droughts have only a limited impact (if any) on public infrastructure (MRC. 2012).

5.4 Drought impact assessment methodology

Unlike flood, not so many studies have been recorded drought in Cambodia. Most recorded the impact from drought referred to mainly on agricultural crop, especially rice field. Currently, the impact from drought on agriculture has been reported from local level to the national level. This means that district agriculture reported to Provincial Department of Agriculture, Forestry, and Fisheries (PDA) and PDAs will report to Ministry of Agriculture, Forestry, and Fisheries (MAFF). While MAFF will consolidate all drought impact that reported from all PDAs in term of area affected and area damage from drought.

The National Committee for Disaster Management of the Royal Government of Cambodia in 2014 issued the guideline on implementation of the disaster reporting forms. The objective of this forms is to i) allow stakeholders at the sub-national level to record/enter assessment and evaluation data or figures already agreed upon, in order to submit to the national level in a timely and clear manner (consistency) ii) help leadership of the Royal Government/ ministries/agencies to make quick and informed decision on immediate, timely and effective measures and interventions iii) allow stakeholders/donors to consider providing appropriate humanitarian assistance to victims and rehabilitation, recovery and reconstruction assistance and iv) reduce time wastage and overlapping uses of resources, as well as the suffering of victims, and allow for timely and effective interventions and better and stronger cooperation among all stakeholders at national and international levels.

In this guideline, there are 5 forms that need to be filled. Those forms are: form for monitoring pre-disaster events, form for reporting during emergency, form for preliminary report during disaster events, total impact and damage at district level, and total impact and damage at provincial level. The form records different types of hazard including drought in the commune as well as its impact on different aspects including rice, other crops and animals for pre-disaster event and preliminary report during disaster events. Upon receiving the report from Commune Committee for Disaster Management (CCDM), the District Committee for Disaster Management (DCDM) will consolidate all the report from commune within the district through a meeting with all stakeholder to take action in affected areas. The same with DCDM, upon receiving the report from DCDM, the Provincial Committee for Disaster Management (PCDM) will evaluate the impact from disaster at provincial level by organizing a meeting with all stakeholder.

VI. DROUGHT RISK AND VULNERABILITY

6.1 Drought risk and vulnerability assessment and GIS mapping

Drought risk assessment and mapping is important for drought management since it helps identify the area most at risk of droughts which allow stakeholder to plan and prepare

necessary action to cope with the potential impact. According to MRC in 2012, drought risk for 4 countries (Cambodia, Lao, Thailand, and Vietnam) can be expressed as:

Risk = Function {P*SEI}, and
SEI = Function {N*LU*SEV}
Where **P** refers to the likelihood of a specific drought event occurring
SEI is the socio-economic impact of that drought event
N refers to the nature of drought (time of onset, duration, etc.)
LU refers t land use
SEV refers to socio-economic vulnerability of community to drought shock.

One of WFP's programs team in Cambodia illustrated nutrition, poverty and food security issues related to WFP programs in Cambodia. The team also plays a supporting role for all UN agencies in the country by generating map-based information for their individual projects. It also helped to develop the flood and drought hazard maps in 2003 used by NCDM (Paul. 2013) as shown in Figure 1 previously. According that map, there are 10 provinces, namely: Banteay Manchey, Siem Reap, Kampong Thom, Kampong Cham, Tbong Khmom, Kampong Chhnang, Kampong Spoeu, Kandal, Prey Veng, and Svay Reing Provinces, are vulnerable to drought.

In addition to the above mentioned product, Ministry of Water Resources and Meteorology is now producing a drought map based on standardize precipitation index in forecasting drought and flood in Cambodia. However, this activity is still initial stage which is being tested.

6.2 Drought risk areas in various administrative areas

As shown in Figure 1 that was developed by WFP and NCDM in 2003, drought prone area was developed based on NDVI index by using three indicators, namely: drought affected areas, rice dependency, and food security situation. Drought prone areas are mostly located in Southern and Northwest parts of Cambodia.

Based on MoWRAM on drought prediction from June to October 2018 shows that the provinces that affected by drought is almost the same with the province that was mapped by WFP and NCDM in 2003. This prediction was based on standardize precipitation index. Based on this drought maps, drought prediction from Jun to October 2018, drought occurred mostly in Kampong Chhnang, Kamong Cham, Tbong Khumkhmum, and Prey Veng provinces ranged from moderate to severe drought.

VII. DROUGHT COMMUNICATION AND RESPONSE ACTIONS

7.1 Declaration of drought conditions

Cambodia has a mandate to provide meteorological information, including drought, for the well-being of its people through the Ministry of Water Resources and Meteorology (MoWRAM). Currently MoWRAM employed meteorological drought prediction by using standardize

precipitation index. The prediction classified drought into 7 levels as i) Extreme drought ii) Severe drought iii) Moderate drought iv) Near normal v) Moderate wet vi) Severe wet and vii) extreme wet.

Based on its own meteorological observation, international and regional meteorological informational, MoWRAM will inform the public about drought condition in Cambodia through their website, media (TV, Radio, email, etc,), email, and letter. Like currently MoWRAM is testing its own webpage, http://www.mowram-nffc.org, for informing public about weather condition in Cambodia, including flood and drought condition.

In the webpage, announcement is made not only flood but also drought within three months, currently from August to October 2018, which shows the condition of drought and flood in the whole Cambodia so that all stakeholder can make use of this information. However, this webpage is still on testing process.

7.2 Communication and coordination guidelines

As shown in the guideline for implementation of the disaster data reporting forms, the communication on disaster including drought through CCDM, DCDM, and PCDM. The commune committee has to report to district about disaster in their administrative boundary based on the forms provided while district committee monitors and takes emergency response action, and then collects information for subsequent reporting purposes until the disaster ends. The report from DCDM consists of the following points:

- Type of disaster
- Time of occurrence
- Status and current state
- Location and vulnerable population
- Evaluation of safe areas
- Situation/Shortage of people In and Out of the safe areas
- Causality (Death, injure, missing)
- impacts and damage on different sub-sectors
- Emergency assistance received
- Statement on priority need
- Summary of action up to date and
- Assessment/conclusion on disaster impact.

7.3 Drought response actions

Most drought impact has been expressed in term of water shortage and crop damages. After informing by MoWRAM on drought condition prediction, government institutions and relevant stakeholder prepared material, tool and equipment for response action. When drought happens, the government institutions and relevant stakeholder carried out the following response action:

- Declaration on disaster situation and appeal all stakeholder to keep monitor situation closely and update situation for post drought activity and take necessary action.
- The NCDM worked closely with concerned government institutions and UN agencies and played a key role in coordinating the response.
- The local authorities, the Cambodian Red Cross (CRC) and NGOs have helped people distributing assistance to people in drought-affected areas.
- Helping farmer through pumping water from water sources to rice field and also helping farmer through connecting the dry up rice field to water sources by digging a temporary canal for that drought period as shown in Figure 7.

Figure 7. Government helping farmer in bringing water from different sources to farmer rice field (Source: www.mowram.gov.kh)

Source: http://www.mowram.gov.kh/index.php/en/resources/2013-06-11-03-23-59

- Helping farmer and local community in digging water well (drilling new tube wells) for supplying not only agricultural purposes but serving clean water for local community for household consumption.

- The government and relevant stakeholder help distributing water by transporting water in a truck and distribute it to local people for daily consumption and household uses.
- Since drought caused negative impact to agriculture, careful monitoring and updating drought situation is very important so that the officer can have better idea on the amount of seed required at post drought period.

VIII. DROUGHT MITIGATION AND PREPAREDNESS

8.1 National water resources monitoring and impact assessment

Cambodia is a country that is considered to have abundant of water. Its rivers and streams, aquifers and marine are an important resource for the country. The Mekong and Tonle Sap River system plays as an important role in maintaining aquatic ecosystems, and provides a basic resource for national development.

The Tonle Sap Lake, the largest freshwater lake in Southeast Asia, takes and releases millions of cubic meters of water from and to the Mekong River. About 75,000 million m^3 of surface water run off Cambodian land in the wet season each year, but only 1% of the total amount of water in the country or 750 million m^3 is actually used by humans, and 95% of this is used for agriculture (Sithirith. 2017).

The Ministry of Water Resources and Meteorology (MOWRAM) was established in 1993 to develop and govern Cambodia's water resources, and oversees irrigation development and flood control. Cambodia's water resources are managed under the 2007 Law on Water Resources Management. Hydrology and River Work is one department established in 1999 under the MoWRAM. One task of this department is about implementing and monitoring of water level, water discharge and sediment in the river basins system in Cambodia. Through hydrology station, the department developed flood bulletin that describe water level in each hydrological station, the water level compared to yesterday level and last year level, rainfall, and warning level of each station.

8.2 Development of new and alternative water sources

Water resources are highly vulnerable to climate change. It was projected that by 2050, the temperature is expected to increase from 0.5^0C to 1.5^oC. It was also projected that flood and droughts will occur frequently and sever. This would cause negative impact to agricultural sector in which the majority of Cambodia people depend on. To responds to this challenges, MAFF and MoWRAM develop strategy for agriculture and water in 2007 with the vision is to ensure enough, safe and accessible food and water for all people, reduce poverty, and contribute to economic growth (GDP per capita), while ensuring the sustainability of natural resources to contribute to poverty reduction, food security and economic growth through (a) enhancing agricultural productivity and diversification and (b) improving water resources development and management (MAFF & MOWRAM. 2007). In 2014, MOWRAM developed

climate change action plan for 2014-2018. The plan considered the improvement of flood and drought management through changes in design of reservoirs and irrigation and protection infrastructures, especially in vulnerable zone, as one main strategy. The plan also listed development and rehabilitation of flood protection dikes for agriculture/urban development as one main activity. In addition, the plan promoted scientific and comprehensive method on ground water study in responding to drought and climate risks.

8.3 Water conservation practices/public education awareness and outreach

To meet water the need of people in utilizing water, the government has tried to i) maintain, preserve, diversify water resources in rainy season (dam, canal, stream, drain, etc.) and ii) provide water for irrigation during the dry season in parallel to the use of agricultural diversification system (Vathana. 2014).

In addition to that the government has set in policy in trying to keep forest cover 60 percent of the total area of the country by allocating many new forest areas as protected forest. This activity contributes not only to forest protection, biological conservation, but also water conservation.

General directorate of agriculture has applied cropping system such as conservation agriculture in some provinces such as Kampong Cham, Kampong Thom and Battambang. This practice contributes not only for soil protection, but also soil moisture protection from evaporation so that crops that are planted in that area coop very well with drought condition.

8.4 Legislation and land use planning

To response to drought, the government has adopted law on water management on 29 June 2007 and the law on disaster management on 10 July 2015. The objective of the law on water management in Cambodia is to foster the effectiveness and sustainable management of the water resources of the Kingdom of Cambodia to attain socio-economic development and the welfare of the people while objective of the law on disaster management is to regulate disaster management in the Cambodia.

The Ministry of Land Management, Land Administration and Planning are now developing commune land use plan (CLUP) in some provinces. In addition to this the Royal Government of Cambodia encourage the Ministry of Agricultural, Forestry and Fisheries to develop crop zoning. This crop zoning will contribute not only suitability of crop production, but also contribute to environmental protection and sustainable resources management in order to keep providing ecosystem services to local people and other stakeholder.

8.4 Risk reduction measures

MOWRAM developed risk reduction action on 4 main sectors including flood and drought, hydrogeology and meteorology, irrigation related work, and climate change and gender while

MAFF sector developed risk reduction action on agriculture and industrial crop, livestock, fisheries, and cross cutting issues as shown in Table 3.

Table 3. Priority actions on drought from MOWRAM and MAFF sectors.

No.	Sector/Line ministries	Sub-sector	Priority action	Sources
1	MOWRAM	Flood and drought	Development and rehabilitation of flood protection dikes for agricultural/urban development	MOWRAM. 2014. Climate change action plan for water resources and meteorology 2014-2018
			Improve capacity for flood and drought forecasting and modeling for technical offices at national and subnational level	
			Establishment of national hydrology forecasting center	
			Promoting scientific and comprehensive methods on ground water study in responding to drought and climate change risks.	
		Hydrology and meteorology	Strengthening climate information and early warning system	
			Capacity building for national and provincial department of water resources for climatic data collection, recording, etc.	
			Improving institutional structure, networking with mass media for public weather and climate forecasting dissemination	
		Irrigation related works	climate risk management and rehabilitation of small, medium and large-scale irrigation infrastructure	
			Capacity building and awareness raising on climate change and DRR for FWUC	
			Capacity development for irrigation engineers on climate risk management	
			Up-scaling mobile pumping stations and permanent stations in responding to mini-droughts	
		Climate change and Gender	Promoting gender responsiveness in water management, climate change impact and adaptation	

2	Ministry of Agriculture, Forestry and Fisheries	Agriculture and agro-industry	promote and up-scaling climate smart farming system that increase resilience to cc and extreme weather events	MAFF. 2016. Climate change priority action plan for Agriculture, Forestry and Fisheries sector 2016-2020
			Developing crop variety suitable to agro-ecological zone resilient to climate change	
			promoting research work on appropriate climate smart agriculture technology/technique to increase productivity and adapt and mitigate the impacts of cc and extreme weather events	
			development of knowledge and information system on climate change	
			institutional capacity development for DRR and coordination of emergency response and recovery	
			strengthening capacities for risk prevention and reduction, effective emergency preparedness and response at all levels, enhancing early warning system and integrating DRR and CCA measure in to recovery and rehabilitation initiatives in the cropping sector	
		Livestock sector	promoting resilience in animal production and CCA	
			Enhancing animal waste management and emission reduction	
			Promoting and enhancing technology development on the improvement of animal bread, animal feed, and animal health for CCA and DRR	
			Strengthening capacities for risk prevention and reduction, effective emergency preparedness and response at all levels, enhancing livestock and disease related early warning systems, and integrating DRR and CCA measure into recovery and rehabilitation initiatives in the livestock sector.	
		Fishery	Promoting aquaculture production systems and practices that are more adaptive to CC and extreme weather events	
			Promoting community fisheries, resilient capacity and climate resilience of wild fishery resources	
			Enhancing the climate resilience in fishery sector (ECRF)	

			Enhancing fish and fisheries products in the entire supply and value chain in response to CC and disaster impacts	
			Strengthening capacities for risk prevention and reduction, effective emergency preparedness and response at all levels; enhancing fisheries related early warning systems, and integrating DRR and CCA measures into recovery and rehabilitation initiatives in the fisheries sector	
		Cross cutting issues	Institutional mainstreaming CCA and DRR by building capacity and scaling up community resilience.	
			Promoting marginalized groups and women participation to CCA and mitigation strategy.	

IX. RECOMMENDATIONS AND IMPLEMENTATION ACTIONS

9.1 Priority implementation actions

- Strengthening dependable weather forecasts and early warning systems is very important for all stakeholders to be aware of and be ready for responding to that disaster on time.
- The coverage of current irrigation system is still not large enough which needs to expanse more in to other area. Furthermore, this irrigation stem do not complete yet and, thus, need to work more on draining water from the main canal into farmer rice so that minimizing cost from pumping water into rice field.
- Rice is the main crop for Cambodia which has been planted in the low land area. However, to meet economic development, many other crops such as black pepper, banana, cassava, coffee etc. have been panted. Planting of these crop depend main on rain. Therefore, development of irrigation for upland crop would be essential.
- Join planning between MAFF and MoWRAM as well local authority and farmer in using water effectively for crop production in order to avoid shortage of water during crop growing and development stage is crucial while maximizing crop production.
- Making more available drought-resistant seeds on potential crop would minimized negative impact from drought and, thus, more benefit to farmer.
- Currently there are some best cropping system available in the country. However, those practices are still in small scale. Therefore, scaling up of those best practices would be highly needed for ground water conservation and coping strategy for drought.

- Proper land use planning, land allocation, and translating those plans into reality on the ground for sustainable natural resources management would be important to be taken into account for drought mitigation.
- Drought impact is not only on agriculture and water resources, but also on many other sectors such as health, education, energy, etc. However, the information on these sectors is still missing. The detail study or record from these sectors would be beneficial for better planning and taken intervention measure.

9.2 Future updates and revisions

- The drought risk map was produced sine 2003 till now land use and land cover have change rapidly while at the same time the development of irrigation system and livelihood activity were also changed. Thus updating drought risk map is crucial for effective drought intervention in the future.
- Accurate and timely information for decision making on severe weather forecasts is important for all stakeholder to be taken into account for their respective intervention measure.
- Currently, the impact of drought has been recorded based on the individual project site while information on this impact at the national level is still limited. The future update this information into national level would be important to see the whole image of drought impact in the country.
- Many work plans are about climate change. However, it seems that reporting the achievement again those plans is still missing. from However, Extending the study Updating information about impact Strong cooperation from all stakeholder would be essential

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