

# Weekly Wet Season Situation Report in the Lower Mekong River Basin 15–21 June 2021

Prepared by The Regional Flood and Drought Management Centre 22 June 2021

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### **Key Messages**

Key messages for this weekly report are presented below.

### **Rainfall and its forecast**

- Rainfall took place from Chiang Sean in Thailand to Chaktomuk in Cambodia, and at Tan Chau and Chau Doc in Viet Nam of the LMB, ranging from 1.20 mm to 42.50 mm.
- No significant rainfall is projected for the Mekong region from 22 to 28 June 2021.

### Water level and its forecast

- The outflows at Jinghong hydrological station slightly increased over the monitoring period from 15 to 21 June 2021. It rose from 536.99 metres (m) on June 15 to 537.75 m on June 21.
- At Chiang Saen in Thailand, the closest station to the Jinghong hydrological station, the water level decreased by about 0.80 m during the same period.
- The water levels across most monitoring stations were close to their long-term average.
- The reserve flow from the Mekong River into the Tonle Sap was observed on 17 June 2021. The water volume of the Tonle Sap Lake during this reporting period is slightly higher than that in 2020 of the same periods but is still lower than its long-term average.
- Over the next few days, the water levels across most monitoring stations are expected to decrease, putting the levels close to their long-term value.

### Drought condition and its forecast

- From 12 to 18 June 2021, all parts of the LMB were at normal condition; no threat was found during the monitoring week.
- The ensemble prediction model forecasts that in June the entire LMB is likely to receive from average to above-average rainfall; the central part of the LMB and the eastern part of Cambodia are forecasted to be the wettest areas. Moving into July, it is forecasted that Cambodia, the Central Highland of Viet Nam, and southern Lao PDR will be the driest area in the region. In August, the entire LMB region is forecasted to experience some meteorological drought, a situation when there is a prolonged period with less than average rainfall. Lastly, the lower part of the LMB covering eastern Cambodia and Viet Nam is likely to receive below average rainfall in September.

### 1 Introduction

This Weekly Wet Season Situation Report presents a preliminary analysis of the weekly hydrological and drought situation in the Lower Mekong River Basin (LMB) for the period from **15 to 21 June 2021**. The trend and outlook for water levels are also presented.

This analysis is based on the daily hydro-meteorological data provided by the Mekong River Commission (MRC) Member Countries – Cambodia, Lao PDR, Thailand, and Viet Nam – and on satellite data. All the water level indicated in this report refers to an above zero gauge of each station.

The report covers the following topics that are updated weekly:

- General weather patterns, including rainfall patterns over the LMB
- Water levels in the LMB, including in the Tonle Sap Lake
- Flash flood and drought situation in the LMB
- Weather, water level and flash flood forecast, and
- Possible implications.

Mekong River water levels are updated daily and can be accessed from: http://ffw.mrcmekong.org/bulletin\_wet.php.

Drought monitoring and forecasting information is available at: http://droughtforecast.mrcmekong.org

Flash flood information is accessible at: http://ffw.mrcmekong.org/ffg.php

### 2 General Weather Patterns

The weather outlook bulletins for three months (June, July and August) and the weather maps issued by the Thai Meteorological Department (TMD) were used to verify weather conditions in the LMB.

The TMD stated that above average rainfall will start from the second week of June and is influenced by the Southwest Monsoon of the rainy season onset. During this time, there will be more thunder rainstorms, wet-season thunderstorms, and low-pressure air mass prevailing over the Mekong region. The TMD also predicted that an influential Southwest Monsoon is likely to occur and may cause more rainfall in the Mekong region between June and August.

<u>Figure 1</u> presents the weather map of 21 June 2021, showing that a low pressure is dominating the upper part of Lao PDR and Viet Nam, including the 3S area (Sesan, Sre Pok and Sekong) in Cambodia and Viet Nam of the LMB.



Figure 1. Summary of weather conditions over the LMB.

According to the ASEAN Specialised Meteorological Centre (ASMC), a highest probability of warm and dry conditions is predicted over of the Mekong region covering northern Lao PDR, Thailand, Cambodia, and Viet Nam during 14–27 June 2021. Nonetheless, the southwest Monsoon weather may be in transition in the region, causing average rainfall.

Figure 2 shows the outlook of comparative warm conditions from 14 to 27 June 2021 in Southeast Asia based on results from the NCEP model (National Centres for Environmental Prediction).



Figure 2. Outlook of wet and dry conditions over the Asian countries by ASMC.

#### 2.1 Tropical depressions (TD), tropical storms (TS) and typhoons (TY)

There were low-pressure lines taking place in the lower part of the LMB during 22 June 2021, as shown in Figure 1, which would bring rain to some areas of the LMB. But based on a Tropical Strom Risk (TSR), as displayed in Figure 3, there was no sign of tropical depression (TD), tropic storm (TS), or typhoon (TY) in the Mekong region up to 22 June 2021.



Active system as of 22 June 2021 5:03 GMT

Figure 3. A tropical depression risk observed on 22 June 2021.

### 2.2 Rainfall patterns over the LMB

This week, rainfall focused in the areas from Chiang Saen in Thailand to Pakse in Lao PDR including the lower part in Cambodia and Viet Nam, varying from 1.20 millimetres (mm) to 42.50 mm. The weekly total rainfall in this reporting week is considered very low, compared with last week rainfall in the LMB (see Figure 4).



Figure 4. Weekly total rainfall at key stations in the LMB during 15–21 Jun 2021.

To verify area rainfall distribution, <u>Figure 5</u> shows a map of the weekly accumulated rainfall based on observed data provided by the MRC Member Countries – Cambodia, Lao PDR, Thailand, and Viet Nam – from 15 to 21 May 2021.



Figure 5. Weekly rainfall distribution over the LMB during 15-21 June 2021.

### 3 Water Levels in the Lower Mekong River

The hydrological regimes of the Mekong mainstream are illustrated by recorded water levels and flows at key mainstream stations: at Chiang Saen in Thailand to capture mainstream flows entering from the Upper Mekong Basin (UMB); at Vientiane in Lao PDR to present flows generated by climate conditions in the upper part of the LMB; at Pakse in Lao PDR to investigate flows influenced by inflows from the larger Mekong tributaries; at Kratie in Cambodia to capture overall flows of the Mekong Basin; and at Viet Nam's Tan Chau and Chau Doc to monitor flows to the Delta.

The key stations along the LMB and their respective model application for River Flood Forecasting during the wet season from June to October and River Monitoring during the dry season from November to May are presented in Figure 6. The hydrograph for each key station is available from the MRC's River Flood Forecasting: <u>http://ffw.mrcmekong.org/overview.php</u>. The weekly water levels and rainfall at each key station are summarised in <u>Annex A</u>.



Figure 6. Key stations and model application for River Monitoring and Flood Forecasting.

According to MRC's observed water level data, the outflows at Jinghong hydrological station showed slightly increase over the monitoring period from 15 to 21 June 2021. It rose about 0.19 m from 536.99 metres (m) on June 14 to 537.75 m on June 21. The outflows increased from 2,124 cubic metres per second (m<sup>3</sup>/s) on June 15 to 2,782 m<sup>3</sup>/s on June 21.

Figure 7 below presents water level fluctuations at the Jinghong hydrological station<sup>1</sup> during 1 June – 21 June 2021.



**Figure 7.** Water level at the Jinghong hydrological station during 1 May – 14 June 2021.

Due to below average rainfall from 15 to 21 June, water levels across most monitoring stations from Chiang Saen in Thailand to Thakhek in Lao PDR were decreasing, and from the stretches of the river between Stung Treng, Kratie and Kompong Cham in Cambodia were repeatedly increasing and staying close to their LTA.

Based on a hydrological phenomenon, the contribution of inflow water from the upstream of Lancang-Mekong in China to the Mekong mainstream is about 16% in total during the wet season from June to October. The whole inflow of water into the LMB is influenced by rainfall at the Mekong mainstream and its tributaries during the wet season.

### Chiang Saen and Luang Prabang

The water level from 15 to 21 June 2021 at Thailand's Chiang Saen decreased from 4.59 m to 3.79 metres (m), showing a 0.80 m drop over the week. The level was about 0.31 m higher than its LTA and was significantly lower than last week's level.

<sup>&</sup>lt;sup>1</sup> Near-real time data of hydro-meteorological monitoring at the Jinghong hydrological station is available at <u>https://portal.mrcmekong.org/monitoring/river-monitoring-telemetry</u>.

The water level at Luang Prabang station in Lao PDR also saw a significant decrease, dropping from 10.14 m to 10.06 m during the reporting period. This level shows 1.52 m below its historical maximum value. The trend – of sometimes higher, or closer to its historical maximum value – has been observed since late 2020. The phenomenon was potentially caused by upstream dam operations, downstream Xayaburi dam, and heavy rainfall in the surrounding areas. The water levels at Chiang Saen and Luang Prabang are shown in Figure 8 below.

Being situated between the upstream (Nam Beng, Nam Ou, Nam Suong, and Nam Khan) and downstream (Xayaburi) hydropower dams, the Luang Prabang station has a unique characteristic as it is influenced by the operations of all its surrounding dams. **Thus, the water level at this station can possibly change very rapidly during the early of wet and dry season**.



Figure 8. Water levels at Chiang Saen in Thailand and Luang Prabang in Lao PDR.

### Chiang Khan, Vientiane-Nong Khai and Paksane

The water level at Chiang Khan in Thailand (downstream of the Xayaburi dam) also rapidly decreased from 9.35 m to 8.00 m, but still showing 1.37 m higher than its Long-Term- Average (LTA).

The water level downstream at Vientiane in Lao PDR followed the upstream trend. It dropped from 6.88 m to 5.65 m and was about 0.98 m higher than its LTA. At Nong Khai station in Thailand, the water level also decreased. It dropped about 0.82 m but was still 0.27 m higher than its LTA, decreasing from 4.30 m to 5.12 m. The water level at Paksane in Lao PDR decreased by about 0.97 m, dropping from 7.52 m to 6.55 m. The decreased level was probably due to less rainfall and together with the effect by the Nam Ngum dam operation located upstream.

The water levels at Vientiane and Paksane are shown in Figure 9 below.



Figure 9. Water levels at Veintiane and Paksane in Lao PDR.

### Nakhon Phanom to Pakse

The water levels from Nakhon Phanom in Thailand to Pakse in Lao PDR significantly decreased by about 0.50 m and were about 0.20 m above their LTA (see Figure 10).



Figure 10. Weekly water levels at Nakhon Phanom in Thailand and Pakse in Lao PDR

### Stung Treng to Kampong Cham/Phnom Penh to Koh Khel/Neak Luong

Through a contribution of flows and rainfall from the upstream part of the Mekong River and the 3S river (Sekong, Se San and Sre Pok), the water levels from Stung Treng to Kratie in Cambodia increased from 15 to 21 June 2021. This week water level at Stung Treng was about 0.40 m and at Kratie was about 0.84 m higher than their LTA (see <u>Figure 11</u>). The water level at Kompong Cham increased about 1.90 m and stayed 0.14 m higher than its LTA.



Figure 11. Water levels at Stung Treng and Kratie on the Mekong River.

At Chaktomuk on the Bassac River, the water level increased by about 0.80 m and stayed 0.43 m below its LTA, while at Koh Khel increased 0.88 m and stayed 0.13 m below its LTA. The water level at Prek Kdam on the Tonle Sap Lake increased about 1.17 m but was still about 0.37 m below its LTA. The water level at the Tonle Sap Lake (observed at Kompong Luong) was similar to Prek Kdam station's water level. The increased water level was likely due to high inflow and rainfall contribution from upstream of the Tonle Sap Lake area. The water level at the Tonle Sap Lake (observed at Kompong Luong) followed the same trend of Prek Kdam station's water level.

### Tidal stations at Tan Chau and Chau Doc

Like last week, the water levels from 15 to 21 June 2021 at Viet Nam's Tan Chau and Chau Doc fluctuated due to daily tidal effects from the sea. The fluctuation levels were between -0.30 m and 1.16 m. This fluctuation levels have been out of the historical range between maximum and minimum levels for almost six months and **considered critical**.

### The Tonle Sap Flow

At the end of the dry season, when water levels along the Mekong River increase, flows of the Mekong River reverse into the Tonle Sap Lake and then to the Delta. This phenomenon normally takes place from June to early August.

Figure 12 shows the seasonal changes of the outflow of the Tonle Sap Lake at Prek Kdam in comparison with the flows of 2018 and 2019, and their LTA levels (1997–2019). Up to 21 June of this reporting period, it was observed that **the main inflow/reverse flow to the Tonle Sap Lake has started since 17 June 2021**. The inflow condition in 2021 was lower than its average flow but was similar to the 2020 flow condition. Since the water level at Prek Kdam on the Tonle Sap River rapidly increased and moved closer to its LTA value, it could be inferred that the flows at the Tonle Sap Lake also increased during this reporting period. However, the inflow of the Tonle Sap Lake is expected to slightly increase starting from next week due to some predicted rainfall from inflow catchments.



Inflow and Outflow of the Tonle Sap Lake

Figure 12. Seasonal change of inflows and outflows of Tonle Sap Lake.

The water volume of the Tonle Sap Lake up to this point has been considered low in comparison with its LTA level. Figure 13 shows seasonal changes in monthly flow volumes up to June 21 for the Lake compared with the volumes in 2018 and 2019, their LTA, and the fluctuation levels (1997–2019). It shows that up to June 21, the water volumes of the Tonle Sap Lake remained stable and were higher than the level in 2020 and close to that of 2019 during the same period. This is displayed in Table 1, which indicates that the Tonle Sap Lake has been affected by water levels from the Mekong River, the tributaries, and rainfall in the surrounding sub-catchments.



Month	Average Volume (97-19) [MCM]	Max Volume [MCM]	Min Volume [MCM]	Volume 2018 [MCM]	Volume 2019 [MCM]	Volume 2020 [MCM]	Volume 2021 [MCM]	Percentage of Volume in 2021 [%]
Jan	16452.95	26357.53	6272.01	13633.41	10285.31	5906.80	9923.80	60.32
Feb	9312.36	15596.22	4281.41	7729.72	6019.30	4264.19	5832.97	62.64
Mar	5868.92	9438.24	3350.92	5037.06	4354.62	3553.99	4264.88	72.67
Apr	4474.98	8009.14	2875.42	3956.47	3667.47	2992.61	3556.68	79.48
Мау	4166.07	9176.93	2417.81	3864.00	3266.43	2594.92	3240.78	77.79
Jun	6034.10	13635.01	2470.54	5919.18	3517.06	2641.88	3594.59	59.57
Jul	12502.58	28599.56	3832.51	12024.96	4001.99	2925.86		
Aug	26934.35	39015.12	7554.93	22399.65	7622.71	5941.07		
Sep	42644.05	65632.35	22180.73	53639.54	24194.19	12105.31		
Oct	49698.19	73757.23	24276.79	48193.08	30358.38	20799.13		
Nov	39542.58	60367.33	18576.01	31036.07	19112.65	27546.80		
Dec	26325.13	38888.95	10869.43	18469.21	10577.29	18251.65		
	Critical situation, co	mapred with his	storical Min val	ues				
	Normal condition, co	ompared with L	TA (Long term	average)				
	Low volume situatio	n, comapred w	ith LTA values					
Unit: Million C	Cubic Meter (1 MCM=	= 0.001 Km <sup>3</sup> )						

Table 1. The monthly change in the flow volume of Tonle Sap Lake.

The increased inflows from the Mekong River and tributaries of the Tonle Sap Lake from early June (1-20) 2021 have resulted in a reverse flow into the Tonle Sap Lake in the middle of wet season of 2021. This demonstrates the influence of the relationships between the reverse flows, water levels of the Mekong River, inflows from tributaries, and the flow direction in the complex hydraulic environment of the Tonle Sap Lake during the wet and dry seasons. The data show that about half of the annual inflow volume into the Tonle Sap Lake has originated from the Mekong mainstream. Thus, flow alterations in the mainstream could have direct impact on the Tonle Sap Lake water levels and on its hydrology.

### 4 Flash Flood in the Lower Mekong Basin

From June 15 to 21, the LMB was affected by two weather factors including (i) The lowpressure cell which downgraded from the tropical storm *Koguma* covered the upper portion of the northern part on the first day of the week, and (ii) the moderate Southwest Monsoon which prevailed over the LMB. These conditions caused small and moderate rainfall in some areas of the LMB during the beginning of the week and the weekend.

According to the MRC-Flash Flood Guidance System (MRC- FFGS) and analysis, flash flood events were detected during the reporting period in several areas of member countries with the impacts ranging from low to moderate level as shown in Figure 14 and Table 2.

Date of FFG produ	cts 15/06/2021 00:0	00 UTC time												
	01-Hour Flash Fl	ood Risk and Locati	on			03-1	Hour Flash I	Flood Risk and Location		0	6-Hour Fla	ash Flood Risk an	l Locatio	n
Provinces	Districts	Villages	Region	Level Risk	Provinces	Districts	Villages	Region	Level Risk	Provinces	Districts	Villages	Region	Level Risk
Xaysomboun	Hom	VIENGKEO	province is r	Low-Risk	Vientiane	Thoulakho	NAM ANG	Northwest	Low-Risk	Xaysomboun	Thathom	NAMPHAI	province is	Low-Risk
Xaysomboun	Hom	KORMI	province is r	Low-Risk	Xaysomboun	Phoun	PHADAENG N	Eprovince is mountainous Northeast	Low-Risk	Xiengkhuang	Morkmay	KHANGVIENG	Northeast	Low-Risk
Xaysomboun	Hom	MUANGSOUM	province is r	Low-Risk	Vientiane	Vangvieng	NABUA	Northwest	Low-Risk	Bolikhamxay	Khamkheut	NAMSANGIN	Central La	Low-Risk
Vientiane	Thoulakho	NAM ANG	Northwest	Low-Risk	Vientiane	Vangvieng	KEOKUANG	Northwest	Low-Risk	Bolikhamxay	Khamkheut	NAPHOUANG	Central La	Low-Risk
Kaysomboun	Phoun	PHADAENG NEUA	province is r	Low-Risk	Vientiane	Vangvieng	NAMPAT NEU	// Northwest	Low-Risk	Xaysomboun	Hom	VIENGKEO	province is	Low-Risk
Vientiane	Vangvieng	NABUA	Northwest	Low-Risk	Vientiane	Kasy	HUAYPHANLA	Northwest	Low-Risk	Xiengkhuang	Khoune	POUNG	Northeast	Low-Risk
/ientiane	Vangvieng	KEOKUANG	Northwest	Low-Risk	Xayaboury	Phieng	NAM PHONE	Northwest	Low-Risk	Xaysomboun	Thathom	NAMKAI OR NAMPAT	province is	Low-Risk
Vientiane	Vangvieng	NAMPAT NEUA	Northwest	Low-Risk	Luangprabang	Nan	PHONXAY	North	Low-Risk	Bolikhamxay	Pakxanh	XAYSAVANG	Central La	Low-Risk
Vientiane	Kasy	HUAYPHANLA	Northwest	Moderate-Risk	Khammuane	Hinboon	MOUANG NAM	VI Center of Laos	Low-Risk	Xaysomboun	Hom	KORMI	province is	Low-Risk
Xayaboury	Phieng	VANG KHAM	Northwest	Low-Risk						Xaysomboun	Hom	MUANGSOUM	province is	Low-Risk
Xayaboury	Phieng	NAM PHONE	Northwest	Low-Risk						Vientiane	Thoulakho	NAM ANG	Northwest	Low-Risk
Xayaboury	Phieng	SOM SA VAT	Northwest	Low-Risk						Xaysomboun	Phoun	PHADAENG NEUA	province is	Low-Risk
Xayaboury	Phieng	HOUY NGOU	Northwest	Low-Risk						Vientiane	Vangvieng	NABUA	Northwest	Low-Risk
Xayaboury	Phieng	NAM LIAB	Northwest	Low-Risk						Vientiane	Vangvieng	KEOKUANG	Northwest	Low-Risk
Luangprabang	Nan	PHONXAY	North	Moderate-Risk						Vientiane	Vangvieng	NAMPAT NEUA	Northwest	Low-Risk
Khammuane	Hinboon	MOUANG NAM SANG	Center of La	Low-Risk						Vientiane	Kasy	HUAYPHANLA	Northwest	Moderate-Ris
										Vientiane	Kasy	NAXAIKHAM	Northwest	Low-Risk
										Vientiane	Kasy	PHONENGAM	Northwest	Low-Risk
										Vientiane	Feuang	MOUANGFOUANG	Northwest	Low-Risk
										Vientiane	Feuang	NAMOUANG	Northwest	Low-Risk
										Xayaboury	Phieng	VANG KHAM	Northwest	Low-Risk
										Xayaboury	Phieng	NAM PHONE	Northwest	Low-Risk
										Xayaboury	Phieng	SOM SA VAT	Northwest	Low-Risk
										Xavahoury	Phiena	HOUY NGOU	Northwest	Low-Risk

#### Table 2. Detected flash flood in Lao PDR, Thailand, Viet Nam, and Cambodia on June 15

Date of FFG product	FG products 15/06/2021 00:00 UTC time										
01	-Hour Flash Flood F	Risk and Location		03	-Hour Flash Fl	ood Risk and Loca	tion	0	6-Hour Flash Flood F	tisk and Locati	on
Provinces	Districts	Region	Level Risk	Provinces	Districts	Region	Level Risk	Provinces	Districts	Region	Level Risk
Phitsanulok	Chat Trakan	Northern	Low-Risk	Udon Thani	Na Yung	Northeastern	Low-Risk	Nan	King Amphoe Bokuai	Northern	Low-Risk
Udon Thani	Na Yung	Northeastern	Low-Risk	Tak	Mae Sot	Northern	Low-Risk	Nan	Mae Charim	Northern	Low-Risk
Tak	Mae Sot	Northern	Low-Risk	Nan	Song Kwae	Northern	Low-Risk	Loei	Phu Rua	Northeastern	Low-Risk
Nan	Song Kwae	Northern	Low-Risk	Phitsanulok	Chat Trakan	Northern	Low-Risk	Phitsanulok	Chat Trakan	Northern	Low-Risk
Loei	Nahaeo	Northeastern	Low-Risk	Loei Nahaeo		Northeastern	Low-Risk	Loei	Nahaeo	Northeastern	Low-Risk
								Nan	King Amphoe Song Khae	Northern	Low-Risk
								Nan	Song Kwae	Northern	Low-Risk
								Udon Thani	Na Yung	Northeastern	Low-Risk
								Phayao	Chiang Kham	Northern	Low-Risk
								Tak	Mae Sot	Northern	Low-Risk
								Chiang Mai	King Amphoe Maeon	Northern	Low-Risk
								Lampang	Mae Mo	Northern	Low-Risk
								Phayao	Pong	Northern	Low-Risk
								Nan	Tha Wang Pha	Northern	Low-Risk
								Uttaradit	Tha Pla	Northern	Low-Risk
								Nan	Song Kwae	Northern	Low-Risk
								Phayao	Pong	Northern	Low-Risk
								Nan	Muang Nan	Northern	Low-Risk
								Nan	King Amphoe Santisuk	Northern	Low-Risk
								Nan	Mae Charim	Northern	Low-Risk
								Nan	Wiang Sa	Northern	Low-Risk
								Loei	Nahaeo	Northeastern	Low-Risk
								Phetchabun	Khao Kho	Northern	Low-Risk

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Rate-risk and location of the flash flood may occur in the next 1, 3, and 6 hours in Cambodia

Date of FFG products	15/06/2021 00:00	UTC time												
0	1-Hour Flash Flood 1	Risk and Loc	ation			03-Hour Flas	h Flood Risk	and Location	ı		06-Hour Fla	sh Flood Risk a	and Location	
Provinces	Villages	Region	Level Risk	Provinces	Districts	Villages	Region	Level Risk	Provinces	Districts	Villages	Region	Level Risk	
NO ANY DETECTION OF F	LASH FLOOD WITHIN N	EXT 01-HOUR			NO ANY DETER	CTION OF FLAS	H FLOOD WITH	IN NEXT 03-HC	UR	Sihanouk Ville	Prey Nob	Chumpu Khmau	Southwest	Low-Risk



Figure 14. Flash Flood Guidance for the next 1 hour, 3 hours and 6 hours on June 15.

### 5 Drought Monitoring in the Lower Mekong Basin

#### Weekly drought monitoring from 12 to 18 June 2021

Drought monitoring data for 2021 are available from Saturday to Friday every week; thus, the reporting period is normally delayed by three days compared to Flood and Flash Flood reports. We adopt the Index of Soil Water Fraction (ISWF) data obtained from FFGS to represent soil moisture of agricultural indicator for both dry and wet seasons.

#### Weekly Standardised Precipitation Index (SPI1)

Like the conditions last week (June 5 to 11), meteorological drought conditions from 12 to 18 June 2021, as shown in Figure 13, were normal and wet in most parts of the LMB except in Thailand's Nakhon Ratchasima, and Chaiyaphum, Burirum, Roi Et, Si Saket, Ubon Ratchathani, Cambodia's Oddar Meanchey, Preah Vihea, Kampot, Svay Rieng, and Viet Nam's Tay Ninh, Long An, and Tien Giang where moderate and severe droughts occurred. In general, the region received from average to above average rainfall during the reporting week.



Figure 15. Weekly standardized precipitation index from 12 to 18 June 2021.

• Weekly Index of Soil Water Fraction (ISWF)

Like last week, soil moisture conditions from 12 to 18 June 2021, as shown in Figure 14, shows that half of the upper part of the region was relatively wet while half of the lower part was mostly normal. This indicates that the region did not experience any agricultural drought.



Figure 16. Weekly Soil Moisture Anomaly from 12 to 18 June 2021.

### • Weekly Combined Drought Index (CDI)

The overall drought conditions through combined drought index from 12 to 18 June 2021, as displayed in Figure 15, indicates a normal condition over the entire LMB region. No thread was found for the LMB during the reporting week.



Figure 17. Weekly Combined Drought Index from 12 to 18 June 2021.

More information on Drought Forecasting and Early Warning (DFEW) as well as the explanation is available here: <u>http://droughtforecast.mrcmekong.org/templates/view/our-product</u>. DFEW provides not only weekly monitoring and forecasting information but also a three-month forecast of drought indicators with seasonal outlook which are updated every month based on international weather forecast models. Details on drought forecast are described in section <u>6.4</u> of this report.

### 6 Weather and Water Level Forecast and Flash Flood Information

### 6.1 Weather and rainfall forecast

Based on the analysis of the synoptic meteorological information and result from the Global Forecast System (GFS) model, in the coming week, the moderate Southwest Monsoon will continue prevailing over the LMB.

From June 22 to 28, small rainfall (5–10 mm/24 h) will likely occur in some parts of the LMB.

Figure 18 shows accumulated rainfall forecast (24 h) of the GFS model from 22 to 28 June 2021.





Figure 18. Accumulated rainfall forecast (24 h) based on a GFS model.

### 6.2 Water level forecast

#### **Chiang Saen and Luang Prabang**

Based on June 21's daily flood forecasting bulletin, the daily forecasted water level at Chiang Saen in Thailand is expected to decrease from 3.95 m to 3.78 m over the next five days. The trend will keep the water level at this station above its LTA.

For Luang Prabang in Lao PDR, the water level will decrease from 10.06 m to 9.96 m during the next five days. The current water level is lower than its maximum value but still higher than its LTA. Precipitation is forecasted for the areas between Chiang Saen and Luang Prabang next week.

#### Chiang Khan, Vientiane-Nong Khai and Paksane

The water level at Chiang Khan in Thailand is forecasted to decrease by about 0.40 m, and about 0.77 m at Vientiane in Lao PDR. From Nong Khai in Thailand to Paksane in Lao PDR, the water levels will decrease by about 0.80 m over the next five days. Rainfall is forecasted for the area between Chiang Khan and Paksane next week.

The water levels are expected to go down close to their LTAs at Chiang Khan, Vientiane, Nong Khai, and Paksane.

### Nakhon Phanom to Pakse

The water levels from Nakhon Phanom in Thailand to Savannakhet in Lao PDR are forecasted to decrease by about 0.80 m over the next seven days. From Khong Chiam in Thailand to Pakse in Lao PDR, the stations will likely experience 1.00 m decrease. The water levels from Nakhon Phanom in Thailand to Pakse in Lao PDR will stay close to their LTA, with some forecasted rainfall for the areas next week.

### Stung Treng to Kampong Cham/Phnom Penh to Koh Khel/Neak Luong

From Stung Treng to Kampong Cham along the Mekong River in Cambodia, the water levels will decrease by about 0.50 m over the next seven days. Precipitation is forecasted for the area between Stung Treng and Kratie during next week.

The water levels of the Tonle Sap Lake at Prek Kdam and Phnom Penh Port, as well as at Phnom Penh's Chaktomuk on the Bassac River will decrease by about 0.25 m over the next seven days.

Water levels at these stations will continue to stay lower than their LTA values, particularly from the Bassac at Phnom Penh to Koh Khel as well as from Tonle Sap at Prek Kdam to Phnom Penh Port, including the Tonle Sap Lake. Precipitation is forecasted for the low-lying area of Cambodia next week.

### Tidal stations at Tan Chau and Chau Doc

For Viet Nam's Tan Chau on the Mekong River and Chau Doc on the Bassac River, the water levels will be fluctuating below their LTA, following daily tidal effects from the sea. Rainfall is forecasted for the Delta area next week.

The performance of the weekly flood forecast, with an accuracy and data input evaluation from 15–21 June 2021, is presented in Annex 1.

<u>Table 2</u> shows the daily flood forecasting Bulletin issued on June 21. Results of the weekly river monitoring bulletin are also available at <u>http://ffw.mrcmekong.org/bulletin\_wet.php</u>.

### 6.3 Flash Flood Information

With small rainfall forecasted for next week, flash floods are not expected to take place in the LMB. Local heavy rain in a short period of time is possible with unexpected short flash floods. The information on flash flood guidance for the next one, three, and six hours is updated twice daily at: <u>http://ffw.mrcmekong.org/ffg.php</u>.

Detailed information on Flash Flood Warning Information as well as on its explanation is available for download <u>here</u>.

### 6.4 Drought forecast

There are several climate-prediction models with different scenarios on the upcoming months until September 2021. The MRC's DFEWS adopts an ensemble model called the North America Multi-Model Ensemble (NMME), which averages all scenarios.

The global scale of rainfall prediction is used to see how the rain distribution looks like for the coming months. <u>Figure 18</u> shows the ensemble mean of daily average precipitation (mm/day) each month from June to September 2021 produced by the NMME.



Figure 19. Daily average of monthly rainfall anomaly forecast from June to September 2021.

The ensemble prediction model forecasts that in June the entire LMB is likely to receive from average to above-average rainfall; the central part of the LMB and the eastern part of Cambodia are forecasted to be the wettest areas. Moving into July, it is forecasted that Cambodia, the Central Highlands of Viet Nam, and southern Lao PDR will be the driest areas in the region. In August, the entire LMB region is most likely to experience some meteorological drought, a situation when there is a prolonged period with less than average rainfall. Lastly, the lower part of the LMB covering eastern Cambodia and Viet Nam is anticipated to receive below average rainfall in September.

The 2021 dry season is relatively wetter than that of 2020 and the monsoon rain in the 2021 wet season has arrived earlier than it did in 2019 and 2020 especially over the upper and central parts of the LMB.

#### Table 2. Weekly River Monitoring Bulletin.



Mekong Bulletin Mekong River Commission Secretariat (MRCS) Regional Flood and Drought Management Centre (RFDMC) P.O. Box 623 #576, National Road #2, Chak Angre Krom, Meanchey, Phnom Penh, Cambodia Tel: (855-23) 425353, Fax: (855-23) 425363, Email: floodforecast@mrcmekong.org River Flood Forecast: 22 June - 26 June 2021

Date: 21 June 2021

Location	Country	24-hr Observed Rainfall (mm)	Zero gauge above M.S.L (m)	Flood level (m)	Alarm level (m)	Observe against z (	ed W. level tero gauge m)	Fo	recasted	l Water	Levels (I	m)	Th floo at i	nere od w mon th	is cu /arni itori ie M	urrei ing i ng s ekor	ntly n pla ites ng	no ace on
		20-Jun				20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	21	22	23	24	25	26
Jinghong	*2	0.0				537.63	537.75						♠	×	×	×	×	×
Chiang Saen		0.0	357.110	12.80	11.50	3.85	3.85	3.90	3.97	3.93							*	*
Luang Prabang	•	0.0	267.195	18.00	17.50	10.34	10.06	9.96	10.02	10.10	10.05	9.96	+					
Chiang Khan		0.0	194.118	16.00	14.50	8.30	8.00	7.67	7.56	7.53			+	+	+		*	*
Vientiane	•	0.0	158.040	12.50	11.50	6.00	5.65	5.33	5.00	4.88	4.83	4.88	+	+	+	+		
Nongkhai		0.0	153.648	12.20	11.40	5.77	5.45	5.13	4.80	4.68			+	+	+	+	*	*
Paksane	•	0.0	142.125	14.50	13.50	6.92	6.55	6.25	6.00	5.73	5.65	5.60	+	+	+	+		
Nakhon Phanom		0.0	130.961	12.00	11.50	5.89	5.58	5.25	5.07	4.94			+	+	+	+	*	*
Thakhek	•	0.0	129.629	14.00	13.00	7.04	6.72	6.38	6.19	6.05	5.86	5.79	+	+	+	+	+	
Mukdahan		0.0	124.219	12.50	12.00	5.79	5.48	5.20	5.00	4.90			+	+	+		*	*
Savannakhet		0.0	125.410	13.00	12.00	2.44	2.55	2.61	2.67	2.71	2.75	2.78	♠					
Khong Chiam		0.0	89.030	14.50	13.50	6.52	6.34	6.00	5.70	5.46			+	+	+	+	*	*
Pakse	•	0.0	86.490	12.00	11.00	4.96	4.85	4.88	4.63	4.50	4.40	4.33	+		+	+	+	+
Stung Treng	Add.	nr	36.790	12.00	10.70	5.13	5.06	5.01	4.89	4.71	4.60	4.52	+		+	+	+	+
Kratie	ARA	nr	-0.101	23.00	22.00	12.20	12.15	12.06	11.99	11.84	11.65	11.53	+	+	+	+	+	+
Kompong Cham	Adu	nr	-0.930	16.20	15.20	6.52	6.57	6.52	6.43	6.35	6.20	6.00	♠	+	+	+	+	+
Phnom Penh (Bassac)	AAA.	0.5	-1.020	12.00	10.50	3.44	3.48	3.50	3.45	3.40	3.33	3.24	♠		+	+	+	+
Phnom Penh Port	AAA.	-	0.070	11.00	9.50	2.46	2.50	2.53	2.47	2.41	2.33	2.23	♠	♠	+	+	+	+
Koh Khel (Bassac)	Add.	1.6	-1.000	8.40	7.90	3.30	3.35	3.37	3.38	3.34	3.30	3.25	1			+	+	+
Neak Luong	Adda.	0.2	-0.330	8.00	7.50	2.44	2.47	2.49	2.47	2.43	2.39	2.33	1			+	+	+
Prek Kdam	Add.	nr	0.080	10.00	9.50	2.55	2.59	2.62	2.56	2.51	2.44	2.35	♠	♠	+	+	+	+
Tan Chau	*	36.5	0.000	4.50	3.50	0.43	0.75	0.97	1.08	1.16	1.18	1.18	1	♠	♠	1		
Chau Doc	*	8.0	0.000	4.00	3.00	0.40	0.71	0.94	1.07	1.16	1.19	1.20	1	1		1	1	

REMARKS:	LEGEND		
	rising water level	1	Note: Stable water level is defined as a daily change of less than 10cm
-: not available.	stable water level		from Chiang Saen to Savannakhet; less than 5cm at Pakse and Stung
nr: no rain.	falling water level	+	Treng; and no more than 3cm cm from Kratie downstream. Flood stage is when the flood level exceeds. A flood level is
	alarm stage		determined by each Member Country.
	alarm situation		Alarm stage is when the water level ranges between alarm and flood
	flood stage		levels.
	no data available	×	Alarm situation is when the water level is forecasted to reach the flood
	as suggested by Thailand, forecasted values are not displayed pending further improvement of the system	*	stage within the next three tays.

River Flood Forecaster



KHEM Sothea

NOTE: Discharge at Luang Prabang may be influenced by hydropower operations (at both upstream and downstream). For more info, please refer to this link: http://www.mrcmekong.org/, http://fw.mrcmekong.org/builetin\_wet.php; http://fw.mrcmekong.org/reportflood.php

### 7 Summary and Possible Implications

### 7.1 Rainfall and its forecast

Rain was observed from Chiang Saen in Thailand to Pakse in Lao PDR including the lower part in Cambodia and Viet Nam, varying from 1.20 millimetres (mm) to 42.50 mm.

Based on the forecasted satellite data, rainfall is forecasted for some areas of the LMB, with value ranging from 10 mm to 100 mm for the next seven days. The forecasting model using GFS data, on the other hand, shows that no significant rainfall (>70 mm) is likely to take place in the Mekong region 22 to 28 June 2021.

### 7.2 Water level and its forecast

According to MRC's observed water level data, the outflows at Jinghong hydrological station showed slightly increase over the monitoring period from 15 to 21 June 2021. It rose about 0.19 m from 536.99 metres (m) on June 14 to 537.75 m on June 21. The outflows increased from 2,124 cubic metres per second (m<sup>3</sup>/s) on June 15 to 2,782 m<sup>3</sup>/s on June 21.

From mid- to the end of May, the station's outflows experienced rapid fluctuations with a dropping trend. The outflows decreased from 3,285 m<sup>3</sup>/s on May 14 to 2,098 m<sup>3</sup>/s on May 30. Its daily average water level dropped by 1.33 m.

Due to the influence of below average rainfall from 15 to 21 June, water levels across most monitoring stations from Chiang Saen in Thailand to Thakhek in Lao PDR were decreasing, except from the stretches of the river between Stung Treng, Kratie and Kompong Cham in Cambodia water levels were increasing and were higher than their LTA.

Over the next few days, the water levels from Chiang Khan to Vientiane and from Nakhon Phanom to Pakse are expected to decrease by about 0.40 m and 0.77 m, respectively.

The flow volume of the Tonle Sap Lake is lower than its LTA. The reverse flow from the Mekong River into the Tonle Sap Lake was observed on 17 June 2021. From next week, the flow might continue to increase due to predicted rainfall in the inflow catchments and the increased water levels along the lower part of the Mekong and Bassac rivers.

From Stung Treng to Kampong Cham, the water levels will decrease but remain higher than their LTA. The water levels – at Neak Luong on the Mekong River, from Prek Kdam to Phnom Penh Port on the Tonle Sap, and from Chaktomuk to Koh Khel on the Bassac – are forecasted to remain close to their LTA.

The situation in Tan Chau on the Mekong River and Chau Doc on the Bassac River is expected to remain unchanged.

Since the beginning of June 2021, water levels across most monitoring stations in the LMB had moved higher than their LTA (from upper to lower stretches within the LMB) but started decreasing again from 15 to 21 June. For a more complete preliminary analysis of the

hydrological conditions in the LMB over July–December 2020 and November 2020 to May 2021 see this <u>Situation Report</u>.

The contribution to the Mekong River's flow from the UMB in China (Yunnan component) is about 16% by the time the river discharges through the Mekong Delta into the Sea. By far the major contribution comes from the two major 'left-bank' (Eastern) tributaries between Vientiane – Nakhon Phanom and Pakse – Stung Treng, which together contribute more than 40% of the flows.

### 7.3 Flash flood and its trends

With the predicted small amount of rainfall for the coming week as mentioned earlier in <u>section 6.1</u>, no major flash floods are expected in the LMB during next week. Local heavy rain in a short period of time is also possible with unexpected short flash floods.

### 7.4 Drought condition and its forecast

From 12 to 18 June 2021, the whole part of LMB was normal; no thread was found for the LMB during the reporting week.

The ensemble prediction model forecasts that in June the entire LMB is likely to receive from average to above-average rainfall; the central part of the LMB and the eastern part of Cambodia are forecasted to be the wettest areas. Moving into July, it is forecasted that Cambodia, the Central Highland of Viet Nam, and southern Lao PDR will be the driest area in the region. In August, the entire LMB region is forecasted to experience some meteorological drought, a situation when there is a prolonged period with less than average rainfall. Lastly, the lower part of the LMB covering eastern Cambodia and Viet Nam is likely to receive below average rainfall in September.

### Annex 1: Performance of the weekly flood forecasting

### Accuracy

"Accuracy" here refers to the state where data recorded in the MRC's Mekong River Flood Forecasting System are cleaned and verified.

The adjustment of flood forecasting outcomes from the flood forecasting system requires flood forecasters to have extensive knowledge in hydrology and statistical modelling for estimating the relationships between stations upstream and downstream in the Mekong River Basin. Flood forecasting performance presented in the graph below shows the average flood forecasting accuracy at each key station along the Mekong mainstream from 15 to 21 June 2021.

The forecasting values from 15 to 21 June show that the overall accuracy is fair for a one-day to three-day forecast in lead time at stations in the middle to the lower parts of the Mekong River from Sovannakhet to Kompong Cham due to the effect of heavy rain in this area during the report period.



**Note:** The higher percentage of flood forecasting accuracy is due to several key factors as follows:

- Missing rainfall in Cambodia (DOM) data and data input are not sufficient to be used for inputting into the flood forecasting model system.
- The influence of heavy rainfall caused by storms and hydropower operations from upstream, tributaries inflows and the lower part of the Mekong floodplain.
- Luang Prabang, Chiang Khan, Paksane and Savannakhet stations have been affected by hydropower operations of Xayaburi and Nam Nguem (water retention and release).

Rainfall always accumulates at this spot, which could be causing rapidly high-water levels.

- Rapid fluctuations of the water levels at Tan Chau and Chau Doc stations due to daily tidal effects of the sea in the Mekong Delta.
- Satellite rainfall data was not representative of the actual rainfall at ground stations in some areas of the Mekong region.

### Performance based on data from the Member Countries

Flood forecasting performance is based on the hydro-met data received from the Member Countries. The flood forecasting achievement indicated in (%) and (cm) from 1 day to 5 days at each key station, against with Old Benchmark are presented in Table B1 and Table B2.

The evaluation of performance indicators, missing data and completion time for flood forecasting are presented in Table B3 and Figures B4, B5 and B6, respectively from 15–21 June 2021.

Lead-time Forecasted	Chiang Saen	Luang Prabang	Chiang Khan	Vientiane	Nongkhai	Paksane	Nakhon Phanom	Thakhek	Mukdahan	Savannakhet	Khong Chiam	Pakse	Stung Treng	Kratie	Kompong Cham	Phnom Penh (Bassac)	Phnom Penh Port	Koh Khel	Neak Luong	Prek Kdam	Tan Chau	Chau Doc
1-day	19	6	10	10	12	8	6	5	6	6	8	8	4	11	7	1	2	2	4	2	6	7
2-day	<u>39</u>	10	19	<u>20</u>	<u>26</u>	15	9	10	10	10	10	12	9	<u>26</u>	16	2	3	3	6	3	6	8
3-day	<u>47</u>	7	<u> 26</u>	<u>32</u>	<u>35</u>	<u>23</u>	14	14	11	7	11	11	15	<u>37</u>	24	2	5	5	6	2	7	10
4-day	59	<u>29</u>	<u>23</u>	<u>34</u>	<u>37</u>	<u>24</u>	16	14	12	7	11	9	19	<u>49</u>	<u>28</u>	3	6	6	6	5	10	16
5-day	64	<u>50</u>	<u>25</u>	<u>34</u>	<u>38</u>	<u>40</u>	14	16	4	4	11	14	24	63	<u>36</u>	1	5	5	6	4	8	19

Table B1: The Mean Absolute Difference (Error) of Flood Forecasting base on old defined Benchmark from 15 to 21 June 2021 in cm

Table B2: The Mean Absolute Difference (Error) of Flood Forecasting base on old defined Benchmark from 15 to 21 June 2021 in %

Lead-time Forecasted	Chiang Saen	Luang Prabang	Chiang Khan	Vientiane	Nongkhai	Paksane	Nakhon Phanom	Thakhek	Mukdahan	Savannakhet	Khong Chiam	Pakse	Stung Treng	Kratie	Kompong Cham	Phnom Penh (Bassac)	Phnom Penh Port	Koh Khel	Neak Luong	Prek Kdam	Tan Chau	Chau Doc	Average
1-day	57.1	<u>28.6</u>	<u>28.6</u>	57.1	71.4	57.1	<u>42.9</u>	<u>42.9</u>	57.1	<u>28.6</u>	71.4	<u>28.6</u>	<u>28.6</u>	71.4	85.7	0.0	14.3	57.1	<u>28.6</u>	<u>28.6</u>	<u>28.6</u>	<u>28.6</u>	42.9
2-day	<u>50.0</u>	16.7	<u>33.3</u>	<u>33.3</u>	66.7	<u>50.0</u>	0.0	16.7	<u>33.3</u>	<u>33.3</u>	16.7	<u>50.0</u>	16.7	83.3	100.0	<u>50.0</u>	<u>50.0</u>	<u>50.0</u>	<u>33.3</u>	<u>33.3</u>	0.0	0.0	37.1
3-day	<u>40.0</u>	0.0	<u>20.0</u>	<u>20.0</u>	<u>40.0</u>	0.0	0.0	0.0	0.0	<u>20.0</u>	0.0	<u>20.0</u>	<u>40.0</u>	100.0	80.0	<u>40.0</u>	<u>20.0</u>	60.0	<u>40.0</u>	0.0	0.0	0.0	24.5
4-day	<u>50.0</u>	<u>25.0</u>	0.0	<u>25.0</u>	<u>25.0</u>	0.0	0.0	0.0	0.0	<u>25.0</u>	0.0	<u>25.0</u>	0.0	100.0	<u>50.0</u>	75.0	<u>25.0</u>	<u>50.0</u>	0.0	0.0	0.0	<u>25.0</u>	22.7
5-day	<u>33.3</u>	<u>33.3</u>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	66.7	0.0	0.0	0.0	0.0	0.0	<u>33.3</u>	<u>33.3</u>	13.6

		FF	time sen	t			Ar	rival time	of input	data				Miss	ing data	(number·	-mainstre	eam and	trib.st.)	
2021	FF completed and sent (time)	Stations without forecast	FF2 completed and sent (time)	Weather data available (time)	NOAA data	China	Cambodia - DHRW	Cambodia - DOM	Lao PDR - DMH	Thailand - DWR	Viet Nam - SRHMC	Viet Nam - HMS	NOAA data/2dataset	China/2	Cambodia - DHRW/15	Cambodia - DOM/34	Lao PDR - DMH/32	Thailand - DWR/13	Viet Nam - SRHMC/6	Viet Nam - HMS/39
week	10:28	00:00	-	-	08:15	07:10	07:04	08:57	08:20	08:11	07:26	08:04	0	0	0	102	70	14	2	0
month	10:30	00:00	-	-	08:15	07:10	07:31	08:26	08:33	08:16	07:23	08:03	0	0	14	170	0	28	5	38

### Table B3: Overview of performance indicators for the past 7 days from 15 to 21 June 2021



Fig. B4: Data delivery times for the past 7 days from 15 to 21 June 2021



Fig. B5: Missing data for the past 7 days from 15 to 15 June 2021



#### Fig. B6: Flood forecast completion time, stations without forecasts, and second forecasts need from 15 to 21 June 2021



### Mekong River Commission Secretariat

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