



Government of Nepal
Ministry of Energy, Water Resource and Irrigation
Department of Hydrology and Meteorology
Climate Division (Climate Analysis Section)
Babarmahal, Kathmandu

31st October 2023

Preliminary Precipitation and Temperature Summary
Monsoon Season (June – September), 2023

Highlights

Precipitation over the country as a whole during monsoon season (June – September, 2023) was 89.9% of the normal precipitation of the season. Most parts of the country recorded above normal maximum and minimum temperatures.

Onset and Withdrawal of Monsoon

The normal Monsoon onset and withdrawal date in Nepal is 13th June and 2nd October respectively. In Nepal, four months period from June to September is considered as Monsoon season. Monsoon entered into eastern Nepal one day later than normal onset day on 14th June and withdrew from eastern Nepal on 15th October delayed by thirteen days. The duration of Monsoon was 124 days, which was twelve days longer than normal Monsoon period (112 days). The dates of onset and withdrawal of monsoon over Nepal are shown in Figure 1.

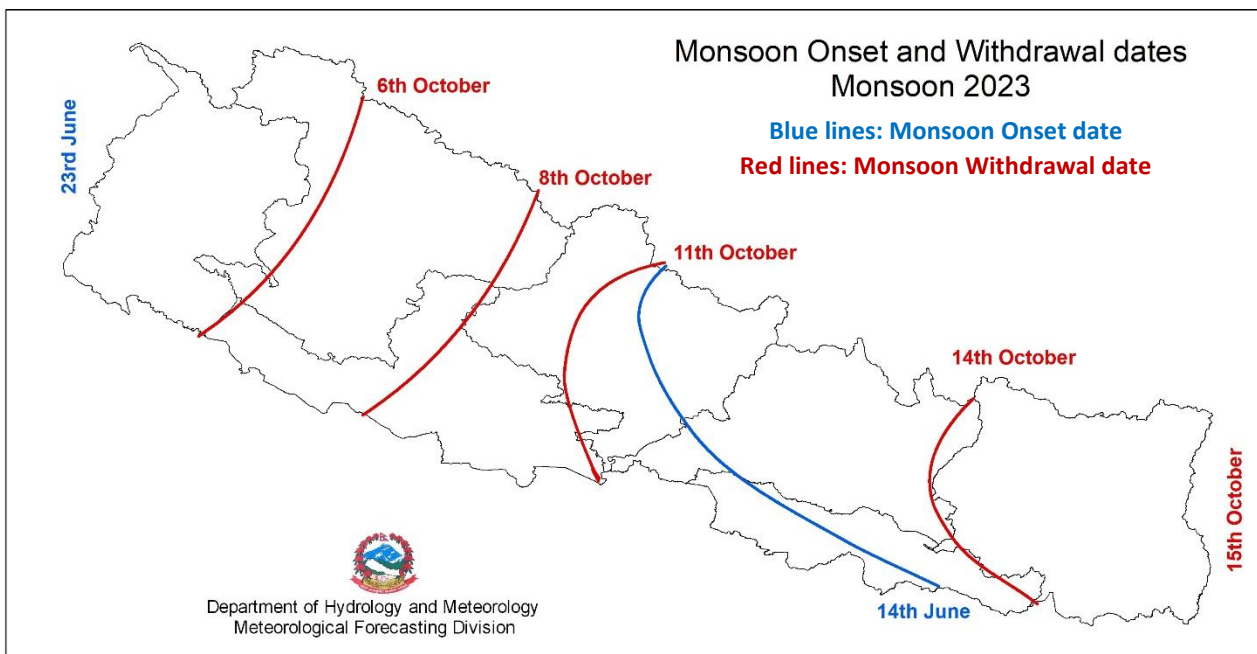


Figure 1: Monsoon onset and withdrawal dates in 2023.

Precipitation

Country received below normal precipitation during the Monsoon season. Some parts over Kaski district and Lamjung district of Gandaki Province recorded precipitation above 3000 mm while north-western part of Gandaki Province and northern part of Karnali Province recorded precipitation less than 500 mm (Figure 1). Southern part of Sudurpaschim Province, Karnali Province and Bagmati Province, central part of Lumbini Province, Madhesh Province and isolated part over Gandaki Province and Koshi Province received below normal precipitation while northern part of Gandaki Province, Karnali Province and Sudurpaschim Province received above normal precipitation in this Monsoon season. The remaining parts of the country received near normal precipitation (Figure 2).



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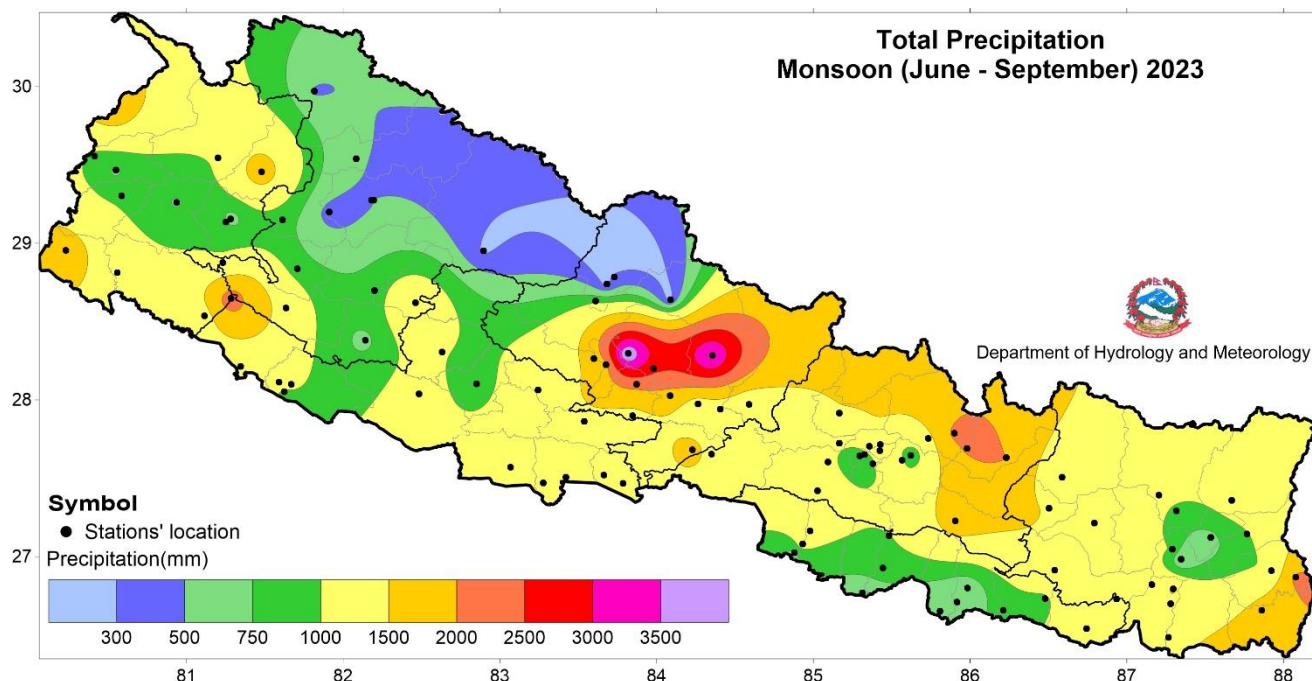


Figure 1: Total precipitation in Monsoon 2023.

Lumle station of Kaski district recorded the highest seasonal precipitation of 4030.3 mm while Humde station of Manang district recorded the lowest of 246 mm. Similarly, the highest (213.2%) and the lowest (53.3%) percentage of seasonal normal precipitation were recorded at Jomsom station of Mustang district and Janakpur Airport station of Dhanusha district respectively (Annex 1). Based on the average of 99 stations shown in figure 2, Nepal received 89.9% of the normal precipitation of the season. In general, less than 90% of normal precipitation is considered as below normal, 90 to 110% is considered as near normal, and more than 110% of normal precipitation is considered as above normal precipitation for the season.

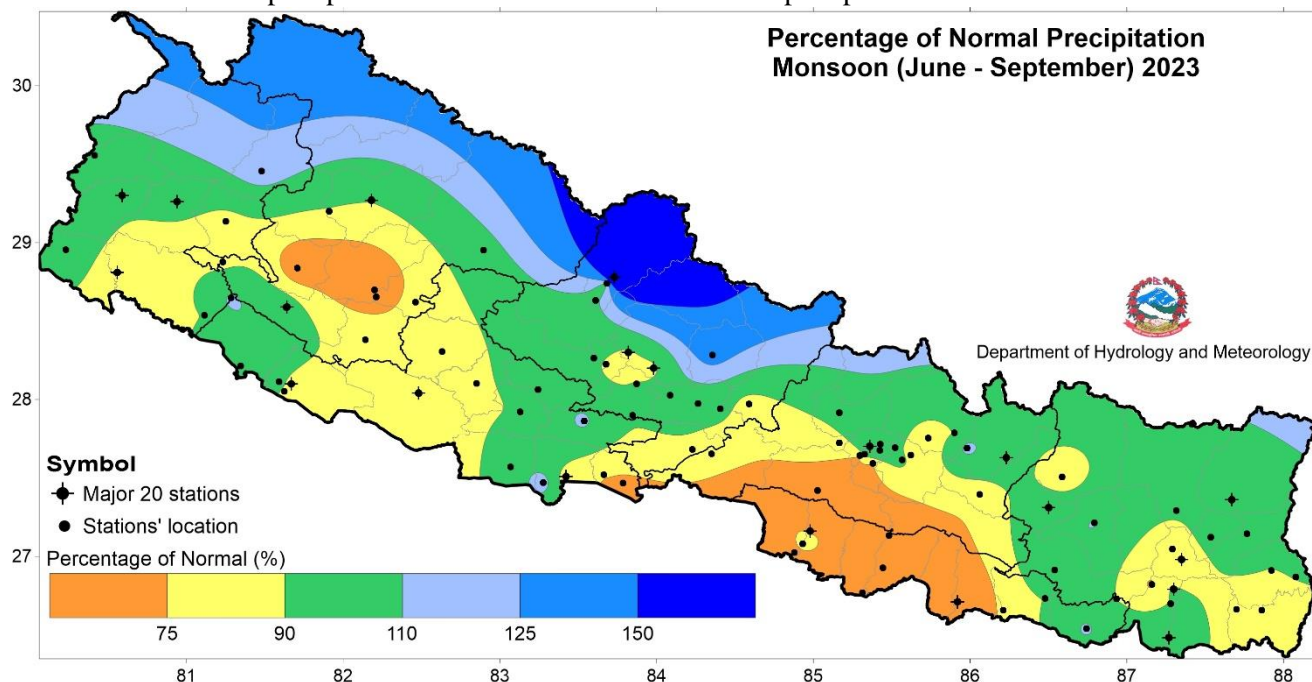


Figure 2: Percentage of normal precipitation in Monsoon 2023.



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Figures 3 and 4, respectively, show the temporal distribution of annual and Monsoon seasonal cumulative average of daily precipitation at 20 major stations located as shown in figure 2. The timeseries of precipitation shows that precipitation was below normal during the Monsoon season.

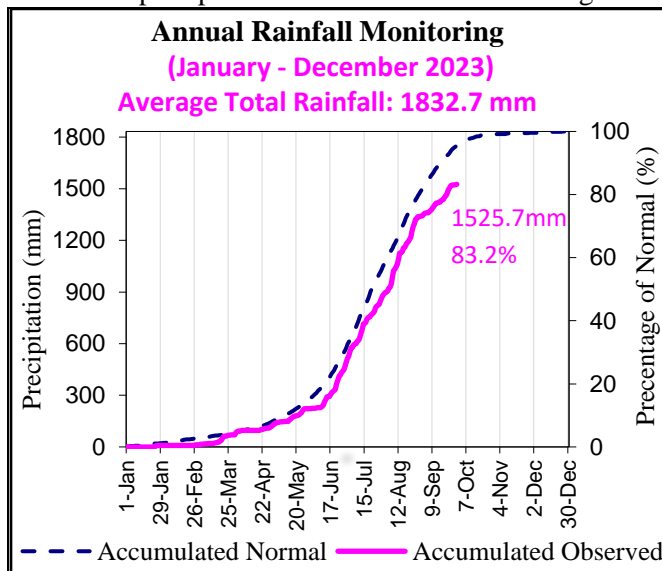


Figure 3: Cumulative average of daily normal and observed precipitation at throughout the year.

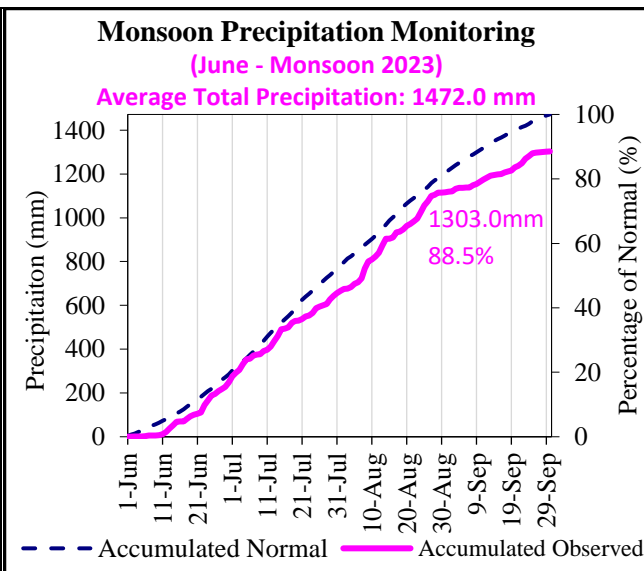


Figure 4: Cumulative average of daily normal and observed precipitation during Monsoon season.

Maximum Temperature

Northern part of the country recorded seasonal maximum temperature less than 9°C while southern plain recorded above 33°C during Monsoon season (Figure 5). Most parts of the country recorded above normal maximum temperature while a few parts across the country recorded near-normal to below normal maximum temperature (Figure 6).

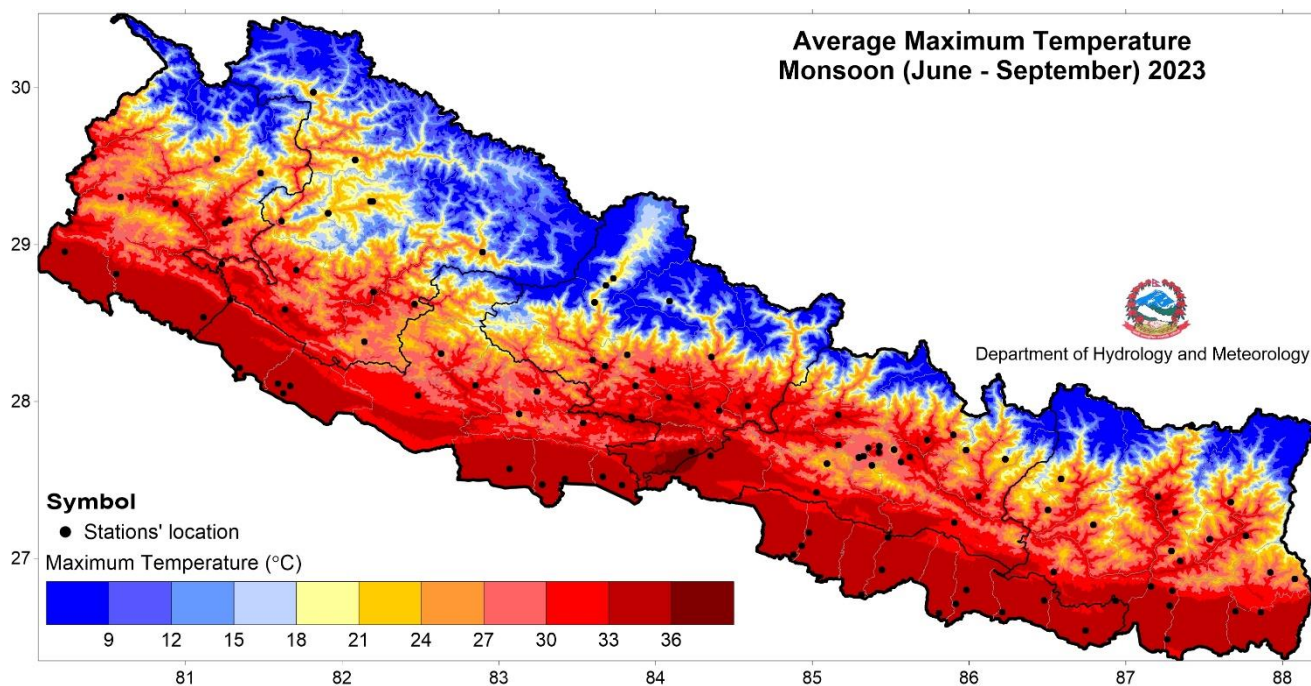


Figure 5: Maximum Temperature in Monsoon 2023.



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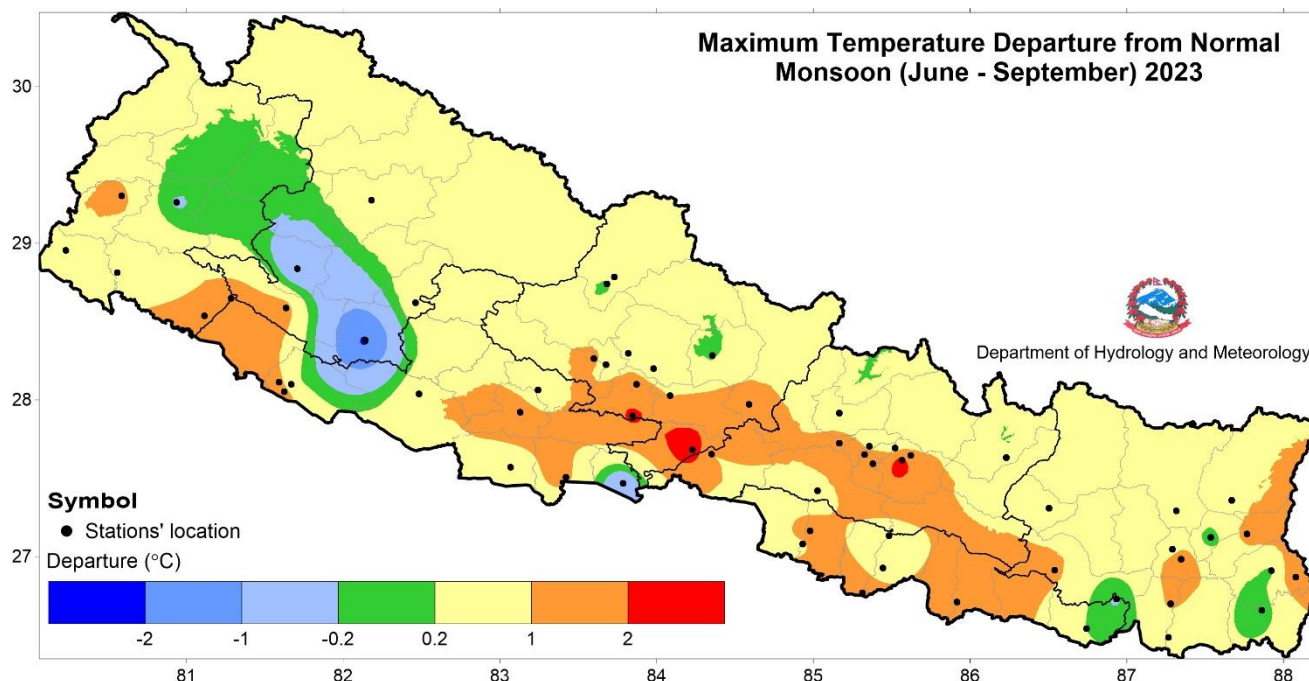


Figure 6: Departure from normal maximum temperature in Monsoon 2023.

Dumkauli station of Nawalparasi-East district and Humde station of Manang district recorded the highest and lowest seasonal maximum temperature of 36.8°C and 18.9°C respectively. Similarly, the highest seasonal anomaly of 2.8°C was recorded at Dumkauli station of Nawalparasi-East district and the lowest of -2.2°C was recorded at Salyan Bazar station of Salyan district (Annex 1). The highest daily maximum temperature of 44.8°C was recorded at Dumkauli station of Nawalparasi-East district on 9th June while the lowest daily maximum temperature of 11.1°C was recorded at Simikot of Humla district on 10th September. Some of the stations broke the previous record of highest maximum temperature in this Monsoon.

Minimum Temperature

Northern part of the country recorded seasonal minimum temperature less than 0°C while southern plain recorded more than 24°C during Monsoon season (Figure 7). Most parts of the country recorded above normal minimum temperature while the northern part of Gandaki Province and Karnali Province, as well as isolated places across the country recorded near-normal to below normal temperature (Figure 8).

Birgunj station of Parsa district and Humde station of Manang district recorded the highest and lowest seasonal minimum temperature of 27.5°C and 9.7°C respectively. Similarly, the highest seasonal anomaly of 2.5°C was recorded at Chainpur station of Sankhuwasava district and the lowest anomaly of -2.9°C was recorded at Jomsom station of Mustang district (Annex 1). The highest daily minimum temperature of 31.2°C was recorded at Gaida (Kankai) station of Jhapa district on 17th August while the lowest daily minimum temperature of 1.0°C was recorded at Humde station of Manang district on 3rd June.



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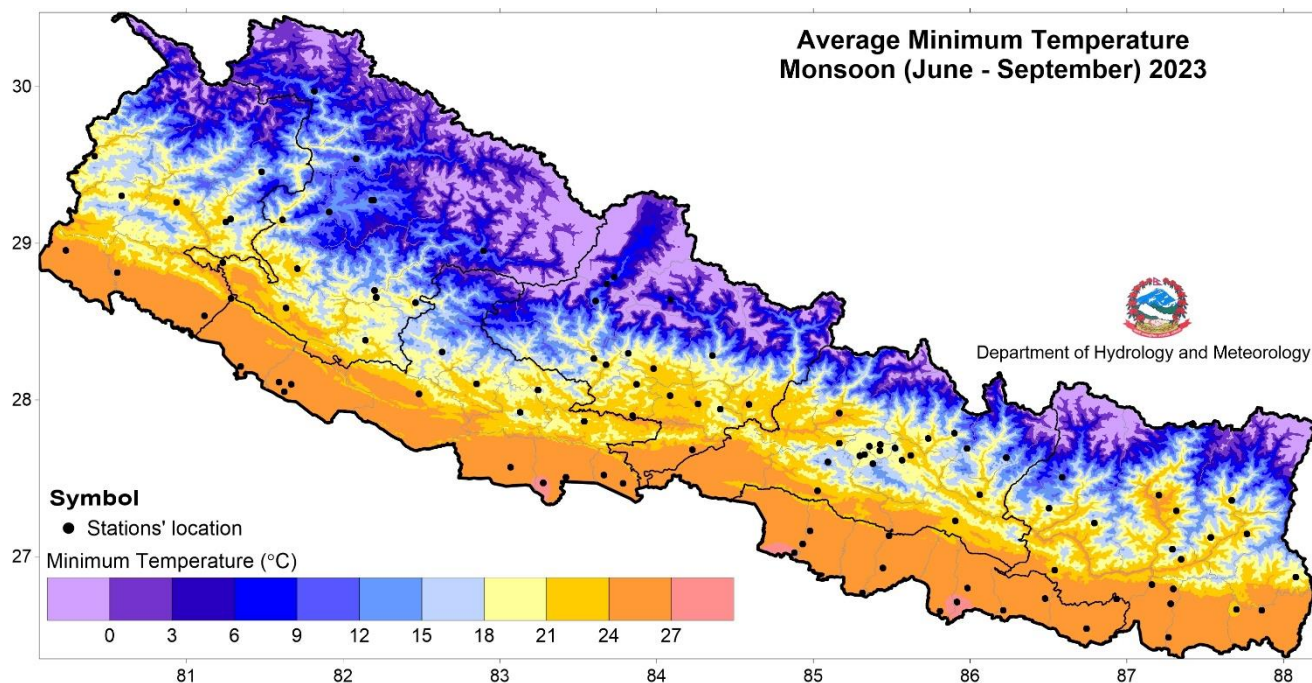


Figure 7: Minimum Temperature in Monsoon 2023.

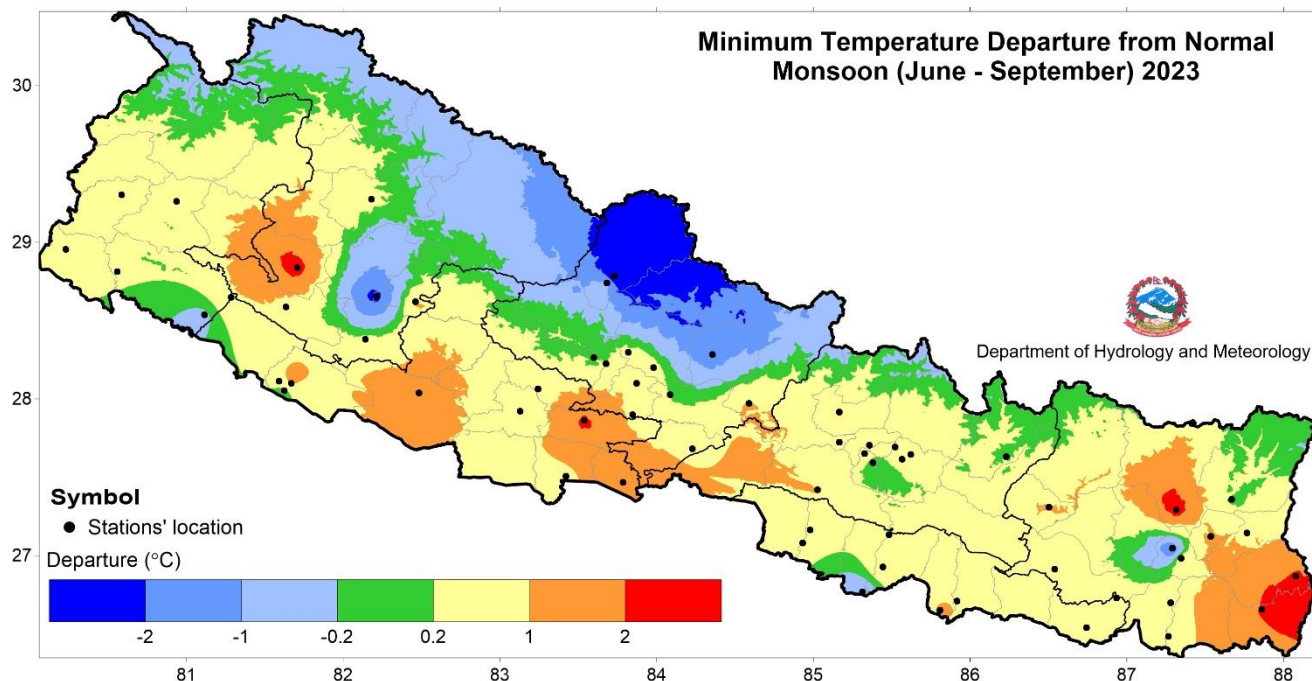


Figure 8: Departure from normal minimum temperature in Monsoon 2023.

Hot days and Heat wave

Sudden increase in maximum temperature by the end of May led to mild to severe heat wave conditions over large parts of the country and it continued until the second week of June (Figure 9). The heat wave was persistent over central and western parts of the country until third week of June, before the



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onset of monsoon over the region. The temperature was exceeding 42°C for a few days at some places in the southern parts specially Kapilbastu, Rupandehi, Nawalparasi-West, Chitwan, Parsa, Bara, Sarlahi, Dhanusha, Mahottari and Siraha districts.

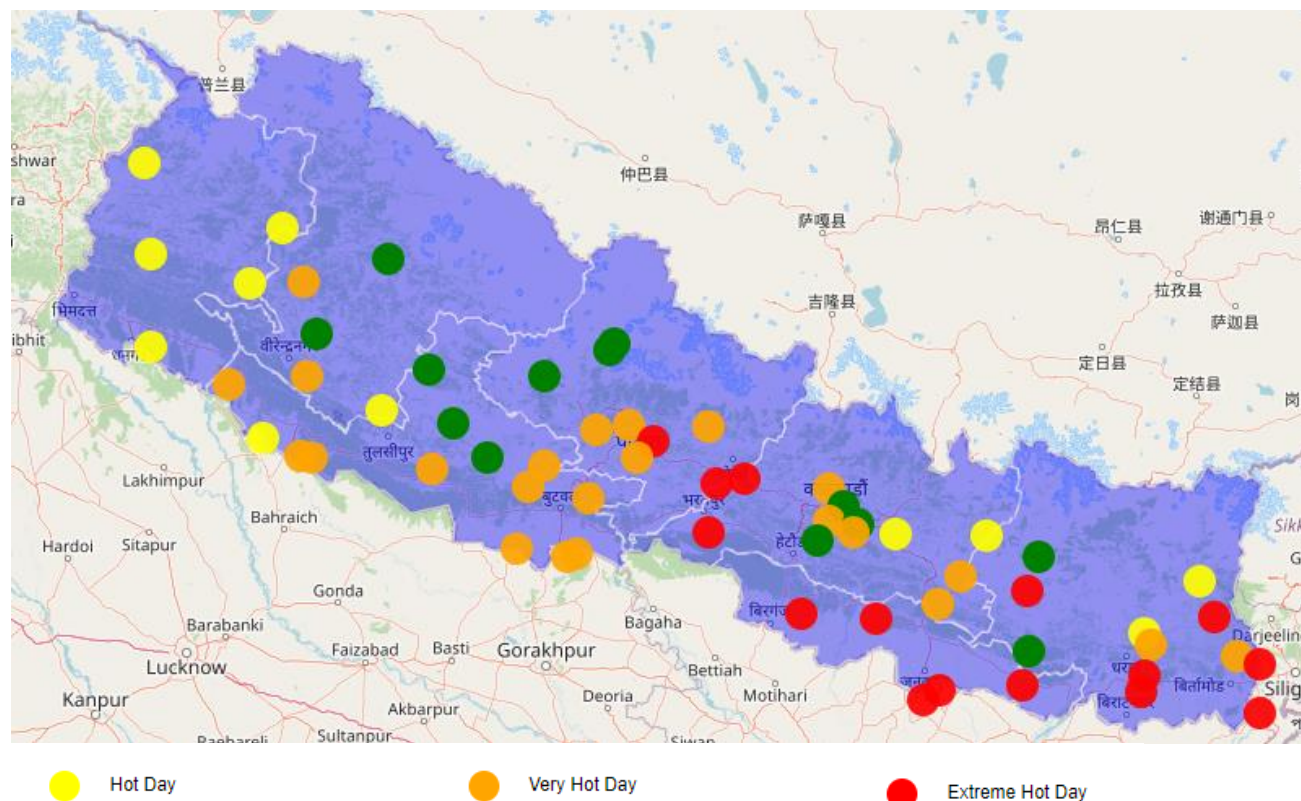


Figure 9: Observed hot days and heat wave alert on 8th June 2023.

Drought

Central and western part of Madhesh Province, southern part of Bagamati Province and isolated part of Karnali province faced moderate drought condition during Monsoon season (Figure 2). Drought has been categorized based on the observed precipitation compared to normal. A drought is defined as moderate, severe and extreme as given in the table below.

Table 1: Categorization of Drought

S.N.	Percentage of normal precipitation (%)	Drought category
1	50 - 75	Moderate drought
2	30 - 50	Severe drought
3	< 30	Extreme drought



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Heavy Precipitation Events

1. Flood and Landslide of Hewa Khola and nearby areas from 17th to 18th June

Moderate to heavy precipitation was recorded over Sankhuwasabha, Taplejung and Panchthar districts on 18th of June which caused floods and landslides over the region. According to Nepal Disaster Risk Reduction Portal, 3 people were died from the flood in Hewa Khola and Piluwa Khola on 17th of June. Similarly, 2 people died from flood on Majhitar and Hilihang Rural municipality of Panchthar district and 2 people each from Taplejung and Panchthar district died from landslide on 18th of June. Figure 10 shows the precipitation amount from 16th to 20th June at stations of Phidim, Taplejung and Sankhuwasabha districts.

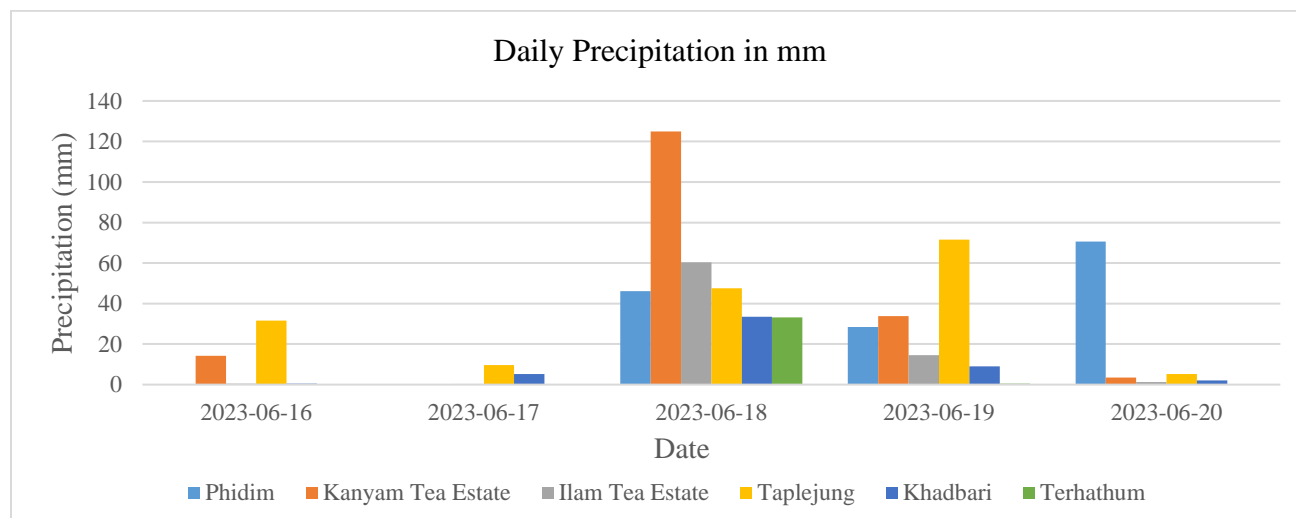


Figure 10: Precipitation from 16th to 20th June.

2. Heavy precipitation from 7th to 9th August

Heavy precipitation was recorded over central and southern part of the country from 7th to 9th August 2023. The precipitation event caused flooding and landslides over large regions with human casualties in Kailali, Makwanpur, Dolakha, Mahottari and Myagdi districts. Table 2 shows the very heavy 24-hour precipitation records during the event.

Table 2: Extreme 24-hour daily precipitation records from 7th to 9th August 2023.

S.N.	Station Name	District	24-hour precipitation (mm)	Date
1	Chisapani (Karnali)	Kailali	424.2	2023-08-08
2	Sindhuli Madhi	Sindhuli	180.5	2023-08-08
3	Karmaiya	Sarlahi	158.5	2023-08-08
4	Syangja	Syangja	192.3	2023-08-09
5	Khairini Tar	Tanahun	192.2	2023-08-09
6	Damauli	Tanahun	159.0	2023-08-09



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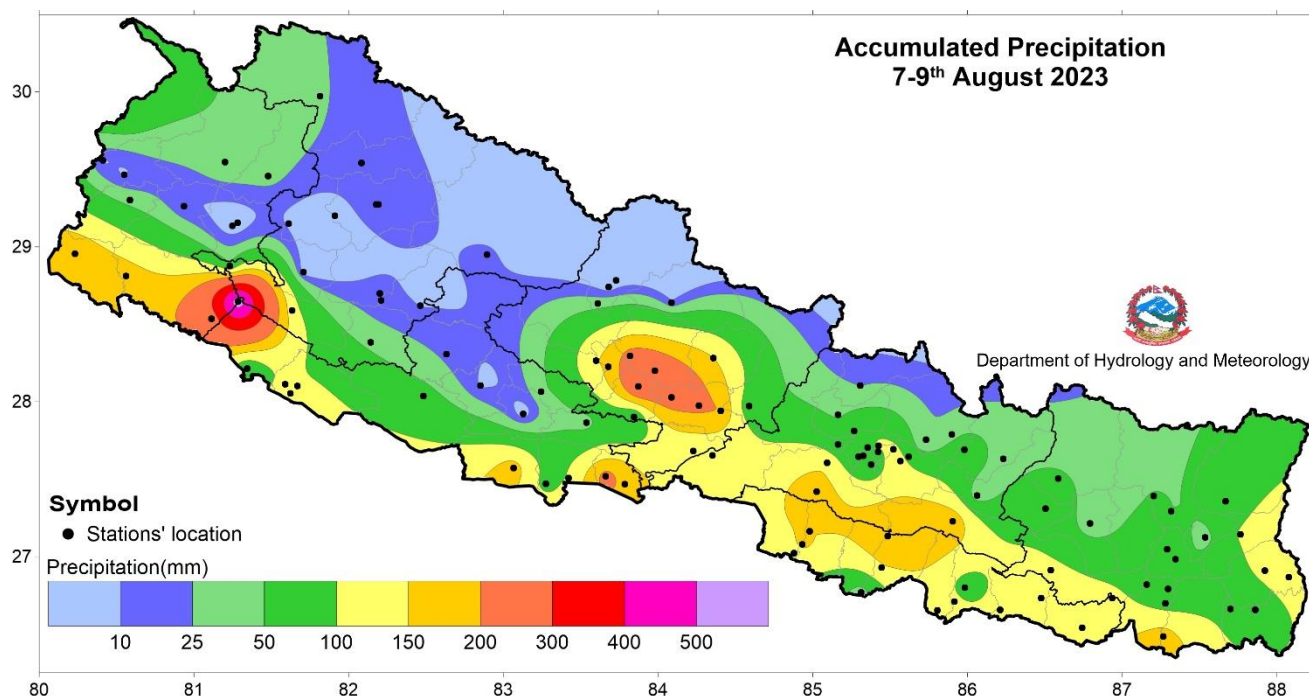


Figure 11: Precipitation from 7th to 9th August

3. Flood at Kagbeni river of Mustang district on 13th August

Flood in Kagbeni river on 13th August caused widespread damages to structures including houses, bridges and vehicles. The flood was due to the burst of a dam created by the landslide in the upstream. Figure 12 shows the precipitation amount from 11th to 15th August at stations of Mustang district.

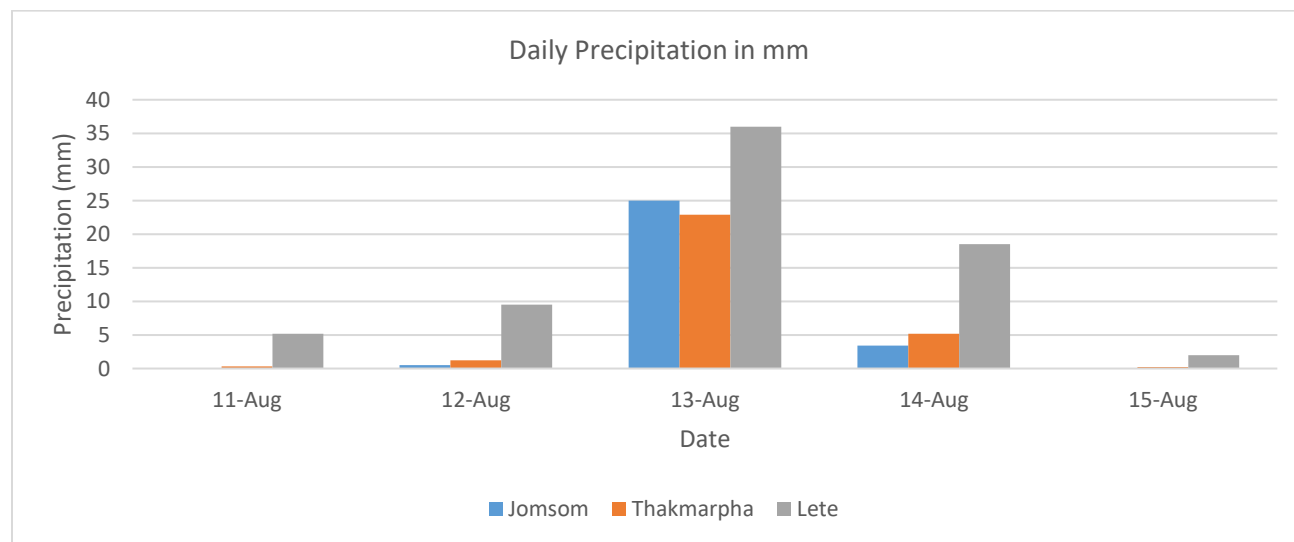


Figure 12: Precipitation from 11th to 15th August.



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Historical record break

In this Monsoon, several stations broke the previous record of extremes of temperature and precipitation (Table 3 & 4).

Table 3: List of stations breaking previous record of ever-recorded highest daily maximum temperature in Monsoon 2023.

S.N.	Station Name	District	Record break maximum temperature (°C)/Date	Previous highest maximum temperature(°C)/Date
1	Bandipur	Tanahun	35.7/2023-06-08	35.5/2018-06-12
2	Chatara	Sunsari	40.7/2023-08-01	40.5/2016-04-25
3	Chautara	Sindhupalchok	35.6/2023-06-23	34.8/2011-04-26
4	Dharan Bazar	Sunsari	39.3/2023-06-07	38.8/2013-04-12
5	Dumkauli	Nawalparasi-East	44.8/2023-06-09	43.7/1979-06-05
6	Gorkha (Birenchowk)	Gorkha	39.0/2023-06-08	38.0/2014-05-08
7	Janakpur Airport	Dhanusha	42.5/2023-06-09	42.2/1989-05-07
8	Kanyam Tea Estate	Ilam	30.0/2023-06-03	29.0/1973-07-10
9	Okhaldhunga	Okhaldhunga	32.5/2023-06-09	30.9/1999-04-28
10	Rampur	Chitwan	43.5/2023-06-08	43.2/1989-05-06
11	Simara Airport	Bara	42.6/2023-06-08	42.4/1979-06-02
12	Siraha	Siraha	42.5/2023-06-08	41.5/2012-05-15

Table 4: List of stations breaking previous record of ever-recorded highest daily precipitation in Monsoon 2023.

S.N.	Station Name	District	Record break daily precipitation (mm)/Date	Previous highest precipitation(mm)/Date
1	Diktel	Khotang	205.4/2023-06-12	158.6/1993-07-21



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Annex 1: Seasonal precipitation and temperature data of Monsoon 2023

Station	Latitude	Longitude	Elevation	Precipitation		Temperature			
				Total (mm)	Percentage of Normal (%)	Maximum		Minimum	
						Average (°C)	Departure from normal (°C)	Average (°C)	Departure from normal (°C)
Baglung	28.2636	83.6003	964	1668.7	102.5	32.5	1.3	21.5	0.2
Bahrabise	27.7887	85.9000	884	2079.8	90.3	32.0	-	21.6	-
Baitadi (Gothalapani)	29.5574	80.4132	1352	919.9	100.8	30.3	-	19.5	-
Bajura (Martadi)	29.4570	81.4804	1598	1813.4	120.2	28.1	-	19.0	-
Bandipur	27.9418	84.4064	991	1227.4	97.6	29.8	-	17.5	-
Bhairahawa Airport	27.5068	83.4204	108	1110.6	81.1	35.2	1.2	26.5	0.7
Bhaktapur	27.6767	85.4240	1315	1128.8	106.9	31.2	-	20.5	-
Bijuwara Tar	28.1035	82.8520	835	842.8	88.6	33.0	-	22.8	-
Biratnagar Airport	26.7670	87.2670	72	1447.0	103.1	33.1	0.3	26.1	0.5
Birganj	27.0232	84.8782	67	671.9	53.4	35.8	-	27.5	-
Chainpur (East)	27.2921	87.3170	1277	890.6	91.2	28.7	0.9	20.9	2.5
Chainpur (Bajhang)	29.5459	81.2011	1405	1043.4	-	28.9	-	-	-
Changu Narayan	27.7161	85.4268	1502	1455.7	108.0	29.2	-	19.4	-
Chapakot	27.8999	83.8459	617	1321.8	91.1	34.7	2.2	23.7	0.8
Charikot	27.6902	85.9802	2132	2043.2	114.7	24.9	-	15.9	-
Chatara	26.8204	87.1592	105	1230.9	72.9	35.2	-	25.7	-
Chaurjhari Tar	28.6540	82.2103	863	624.7	65.6	-	-	19.7	-2.5
Chautara	27.7538	85.7321	1552	1341.2	81.1	30.1	-	18.3	-
Chisapani (Karnali)	28.6472	81.2854	201	2318.5	113.4	34.2	1.6	26.0	0.9
Dadeldhura	29.3014	80.5878	1879	933.6	93.4	26.1	1.2	17.5	0.7
Dailekh	28.8381	81.7085	1394	887.5	62.4	28.4	-1.0	19.6	2.4
Damak	26.6623	87.6988	119	1568.6	83.8	33.6	-	23.6	-
Daman	27.6044	85.0920	2265	1097.5	-	23.0	-	14.9	-
Damauli	27.9737	84.2651	347	1209.6	96.7	34.8	-	24.9	-
Darchula New	28.8429	80.5388	887	1803.0	-	32.7	-	21.7	-
Dhangadhi (Attariya)	28.8127	80.5600	184	1267.7	78.4	34.6	0.8	25.6	0.3
Dhankuta	26.9832	87.3460	1192	494.5	74.5	29.5	1.7	20.7	0.5
Dharan Bazar	26.7922	87.2978	310	1545.5	92.3	32.7	-	25.3	-
Dhulikhel	27.6161	85.5655	1543	1105.5	95.6	28.2	2.5	18.6	0.4
Dhunchel	28.1053	85.3077	2005	1384.8	-	-	-	-	-
Dhumibesi	27.7229	85.1643	991	1070.6	83.7	32.1	1.5	22.2	0.6
Diktel	27.2125	86.7919	1612	1183.0	110.9	25.0	-	18.9	-
Dipayal (Doti)	29.2621	80.9369	563	729.4	95.5	34.2	-0.3	23.9	0.5
Dumkauli	27.6807	84.2285	183	1685.5	85.7	36.8	2.8	26.2	0.9
Dunai	28.9507	82.8960	2098	279.2	101.1	29.0	-	13.7	-
Gaida (Kankai)	26.6569	87.8607	107	1700.4	80.1	33.2	-0.1	25.9	2.1
Gaur	26.7671	85.3130	77	584.5	56.7	35.8	2.0	24.0	-1.0
Ghorai (Dang)	28.0372	82.4842	663	1165.5	87.5	31.9	0.9	24.1	1.6
Godavari	27.5929	85.3788	1527	994.4	74.7	27.5	1.5	17.7	-0.1
Gorkha (Birechowk)	27.9714	84.5894	724	1023.4	80.9	32.4	1.6	23.2	1.1
Gulariya	28.2128	81.3452	126	1172.1	104.9	34.4	-	26.3	-
Hardinath	26.8000	85.9833	93	518.8	-	33.6	-	26.7	-
Hetauda N.F.I.	27.4202	85.0252	452	1389.5	70.7	33.1	0.6	24.4	1.0
Humde	28.6399	84.0881	3401	246.0	-	18.9	-	9.7	-
Ilam Tea Estate	26.9096	87.9231	1208	1049.1	89.0	26.2	0.1	-	-
Jajarkot	28.6990	82.2001	1236	863.1	60.3	31.5	-	17.4	-
Jalesor	26.6522	85.8073	68	518.8	-	34.9	-	26.8	1.0
Janakpur Airport	26.7097	85.9172	76	637.7	53.3	34.9	1.7	27.3	1.0
Jiri	27.6304	86.2321	1877	2003.2	99.6	24.4	0.2	16.5	0.2
Jomsom	28.7840	83.7298	2741	338.0	213.2	23.0	0.7	10.0	-2.9
Jumla	29.2747	82.1796	2363	484.3	90.7	26.1	0.9	14.9	0.5
Jumla Airport	29.2740	82.1942	2384	502.5	-	25.3	-	14.6	-
Kanyam Tea Estate	26.8681	88.0783	1570	2089.2	90.5	24.9	1.7	18.7	2.1
Karmajya	27.1330	85.4841	139	984.2	62.6	34.5	0.6	26.1	0.2
Kathmandu Airport	27.7038	85.3562	1337	1283.3	109.1	29.9	0.9	20.0	0.3
Khadbari	27.3911	87.2044	1064	1292.3	-	30.2	-	22.4	-
Khairini Tar	28.0270	84.0866	515	1790.5	106.4	33.8	1.0	23.7	0.2
Khajura (Nepalgunj)	28.1137	81.5903	129	1112.3	102.4	35.6	1.4	26.2	0.7
Khanchikot	27.9221	83.1298	1801	1239.4	90.7	25.3	1.5	17.6	0.3
Khokana	27.6438	85.2967	1309	749.2	75.8	29.5	-	19.6	-
Khudi Bazar	28.2822	84.3564	838	3634.1	133.6	30.9	0.1	19.5	-1.5
Khumaltar	27.6517	85.3257	1334	810.3	92.2	29.4	1.4	20.6	0.9
Kushma	28.2249	83.6769	900	1830.6	85.8	31.9	0.4	21.6	0.3
Lahan	26.7327	86.4776	110	918.1	90.4	34.4	-	26.6	-
Lete	28.6327	83.6092	2490	971.9	109.4	22.4	-	14.3	-
Libang Gaun	28.3062	82.6323	1314	1025.6	83.1	30.4	-	18.7	-
Lumbini	27.4703	83.2761	95	1310.1	119.4	35.2	-	27.2	-
Lumle	28.2965	83.8179	1738	4030.3	86.5	24.6	0.8	17.6	0.4
Mahendra Nagar	28.9548	80.2305	197	1747.1	105.4	34.6	0.7	25.6	0.5
Mangalsen	29.1361	81.2501	1310	865.4	83.4	30.4	-	20.3	-
Manma	29.1488	81.6135	1729	849.4	-	25.6	-	18.2	-
Manthali	27.3947	86.0612	497	553.9	78.7	34.8	-	23.8	-
Manusmara	26.9280	85.4451	90	870.0	75.0	34.2	0.4	26.7	0.9
Musikot (Rukumkot)	28.6190	82.4625	1412	1436.1	80.9	29.1	0.8	20.0	1.1
Nagarkot	27.6933	85.5209	2147	1394.6	93.1	23.0	0.6	15.7	0.6
Nagma	29.2006	81.9106	2017	412.3	88.3	25.8	-	15.6	-
Nepalgunj Airport	28.1006	81.6682	165	1037.7	81.3	34.7	0.4	26.5	1.1
Nepalgunj (Reg. Off.)	28.0520	81.6228	141	966.9	86.2	35.5	1.6	26.0	-0.3
Nuwakot	27.9150	85.1646	966	1455.5	96.1	30.9	0.3	22.3	0.8
Okhaldhunga	27.3081	86.5042	1731	1467.7	105.5	25.6	0.6	18.3	1.0
Oli Gaun (Patkani)	29.1559	81.2831	989	616.2	-	31.1	-	19.4	-
Pakhribas	27.0463	87.2925	1720	978.3	82.7	24.1	0.6	15.5	-1.9
Panchkhal	27.6451	85.6209	857	734.2	84.9	33.3	1.3	22.5	0.6
Parasi	27.5193	83.6622	112	1047.1	75.9	34.6	-	26.4	-
Parwanipur	27.0789	84.9327	87	1110.5	85.5	34.4	0.9	26.4	0.6
Patan new	29.4664	80.5506	1299	711.9	-	-	-	-	-
Phattepur	26.7305	86.9348	101	1353.2	90.0	33.8	-0.3	25.8	0.6
Phidim (Panchther)	27.1437	87.7656	1157	967.6	104.9	30.8	1.3	21.7	0.9
Pokhara Airport	28.2002	83.9795	827	2611.9	85.3	30.8	0.4	22.3	0.5
Pusma Camp	28.8755	81.2327	953	1098.2	86.2	29.4	-	21.4	-
Rajbiraj	26.5407	86.7425	68	1329.0	112.6	33.5	0.2	26.2	0.9
Rampur	27.6540	84.3508	189	1349.0	80.4	34.8	1.0	-	-
Rara	29.5401	82.0818	2989	530.8	-	20.9	-	11.3	-
Salleri	27.5051	86.5862	2383	1046.9	77.7	26.0	-	13.3	-
Salyan Bazar	28.3821	82.1423	1557	670.9	89.6	25.4	-2.2	19.4	0.4
Semari	27.4682	83.7861	110	1127.7	71.7	34.9	-1.0	26.5	1.7
Simara Airport	27.1642	84.9800	137	1101.9	73.3	34.7	1.3	25.9	0.6
Simikot	29.9715	81.8161	2993	481.2	-	21.2	-	12.3	-
Sindhuli Madhi	27.2281	85.9050	556	1761.5	-	32.3	-	23.2	-
Siraha	26.6561	86.2117	63	871.8	77.9	34.6	-	26.8	-
Surkhet Airport	28.5879	81.6352	683	1331.6	103.4	33.1	1.4	23.6	0.7
Syangja	28.0988	83.8722	871	2123.4	91.3	32.5	1.5	22.5	1.0
Tamghas	28.0636	83.2435	1547	1409.1	95.86	26.9	0.5	18.7	0.494
Tansen	27.8637	83.5387	1183	1449.6	113.8	29.8	-	21.4	2.198
Taplejung	27.3586	87.67	1744	1226	90.5	25.9	0.7	17.6	-0.02
Tarahara	26.6987	87.2786	120	1378	90.64	33.5	1.1	25.7	0.701
Taulihawa	27.5711	83.0672	106	1124.6	94.95	34.3	0.6	26.4	-
Terhathum	27.123	87.5362	1525	675.85	96.91	26.5	-0.1	18.8	1.026
Thakmarpha	28.7409	83.6816	2655	248.72	106.3	21.6	0	11.2	-0.56
Tikapur	28.5366	81.115	149	1267.3	90.74	35.2	1.2	24.7	-0.4
Udayapur Gadhi	26.913	86.5397	469	1463.7	106.8	32.3	1.2	24.4	0.378

Note:

- “mm” = millimeter; “temp” = temperature; “-” = Data Not Available.
- This summary is prepared based on the precipitation and temperature received at 111 meteorological stations during Monsoon, 2023. Out of 111 stations, 96 stations have normal precipitation data, 64 stations have normal maximum temperature data and 64 stations have normal minimum temperature data. Normal precipitation/temperature is the average of the seasonal precipitation/temperature for period of 1991-2020.