

Training Workshop
on
Regional Severe Weather and Flash Flood Hazard Early
Warning Mechanism

15-17 October, 2019

SAARC Disaster Management Centre (IU)

*Status and Future Plans of Severe Weather and Flash Flood hazard
Early Warning Mechanism in Nepal*

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Ms. Sajeena Shakya

Loss of Human Life (MoHA-2018)- Nepal

Types of Hazard	Death	Percentage	Weight (%)
Epidemic	5	1	1
Fire	87	18	18
Flood	17	4	4
Landslide	91	19	19
Extreme Rain, wind	41	9	9
Thunder Bolt	75	16	15
Snakebite	14	3	3
Animal terror	22	5	5
Cold wave	47	10	10
Others	79	17	16
Total	478		100

Year-2015			
Types of Hazard	Death	Percent	Weight (%)
Earthquake	8962	96.9	97
Fire	57	0.6	1
Landslide	125	1.4	1
Strong Wind storm	8	0.1	0
Thunder Bolt	81	0.9	1
Others	15	0.2	0
	9248		100

How National Early Warning System Capture the Event

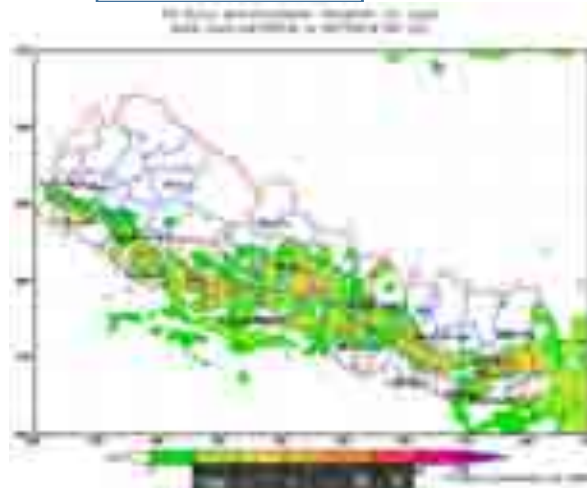
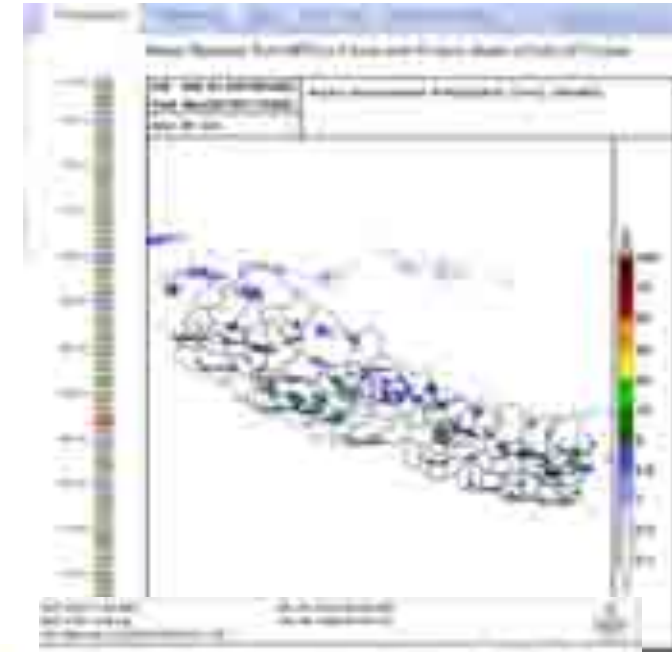
A) Based on Forecast

- i) 3 Days Rainfall Forecast (NWP)
- ii) 3 Days Flood Forecast Model (Koshi, West Rapti & Bagmati-MIKE-11, Narayani, Karnali HEC-HMS)
- iii) 15-30 Days Flood Forecast (GLOFAS)
- iv) 7 Days Numerical Weather Prediction (NWP) Model
Also issue 7 Days Agro met Advisory

B) Based on Monitoring & Observation

- i) Radar Level Sensors to Monitor Flood Water Level (Warning level and danger level fixed based on Hazard mapping)
- ii) Automatic Rainfall Stations
- iii) Weather Radar
- iv) Lightning Detection (Now Casting)
- v) Radiosonde

Weather Information for Flood Forecast

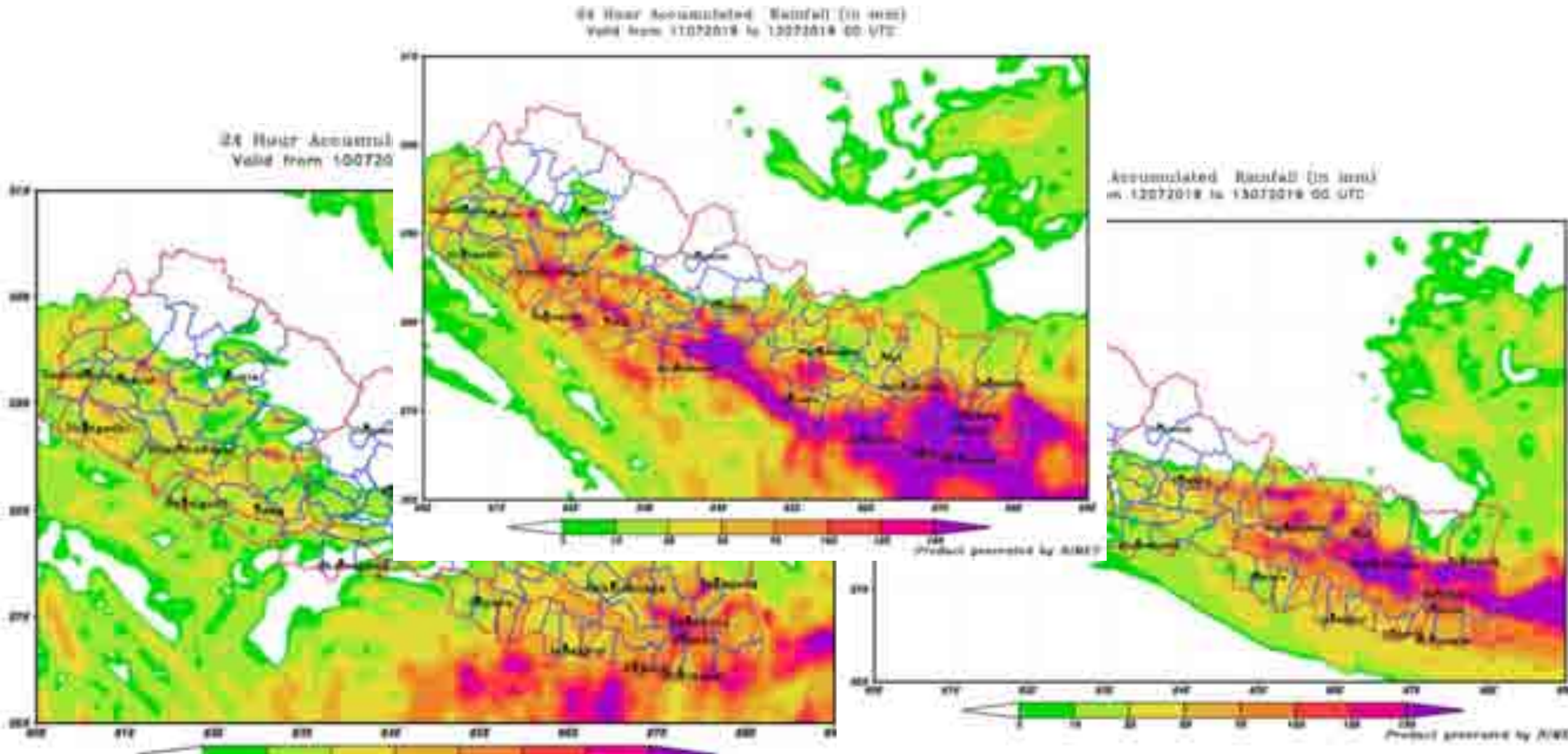


TMD

Rainfall prediction from NWP.

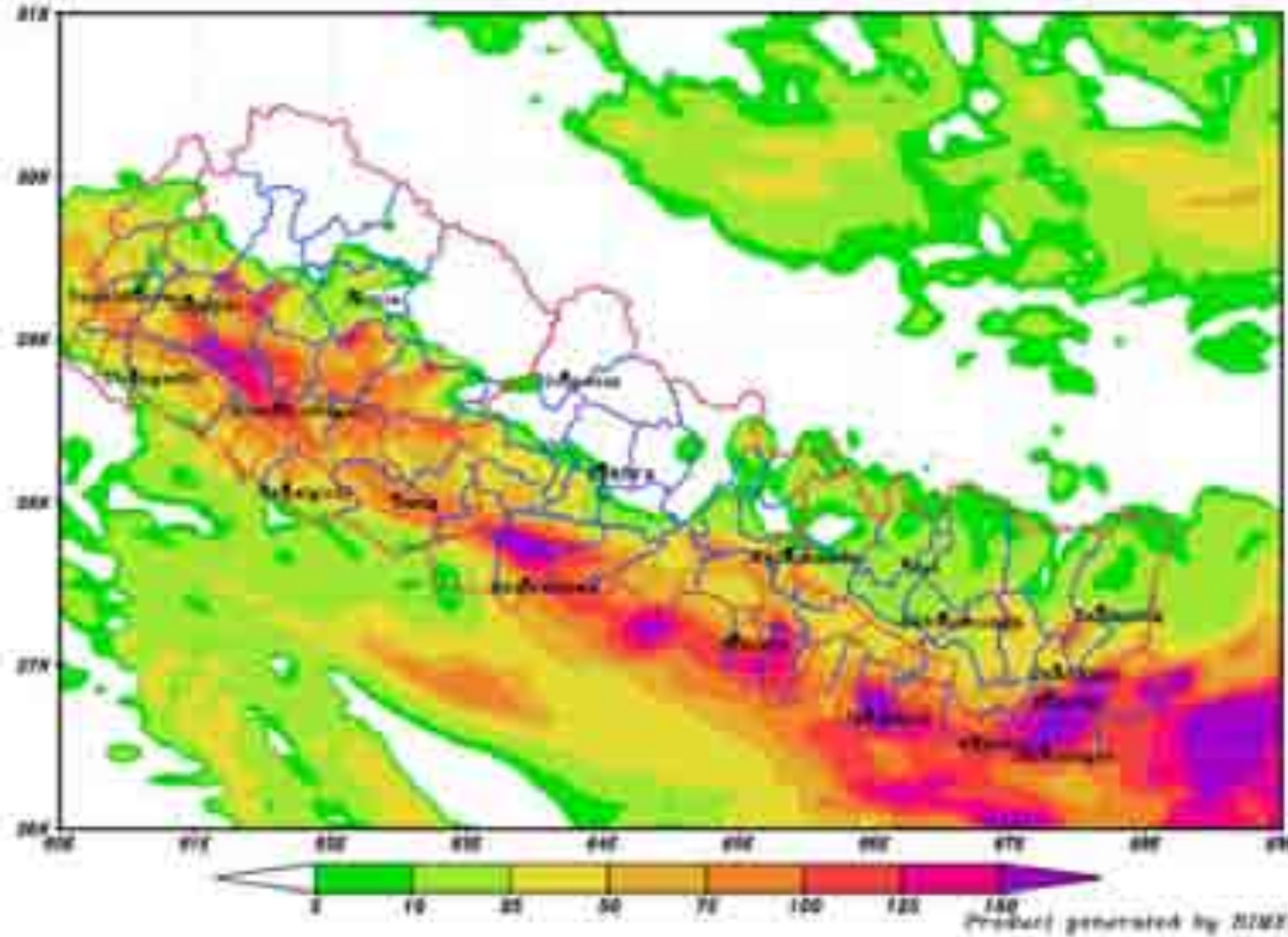


Forecasted Rainfall (July 10, 11 & 12)

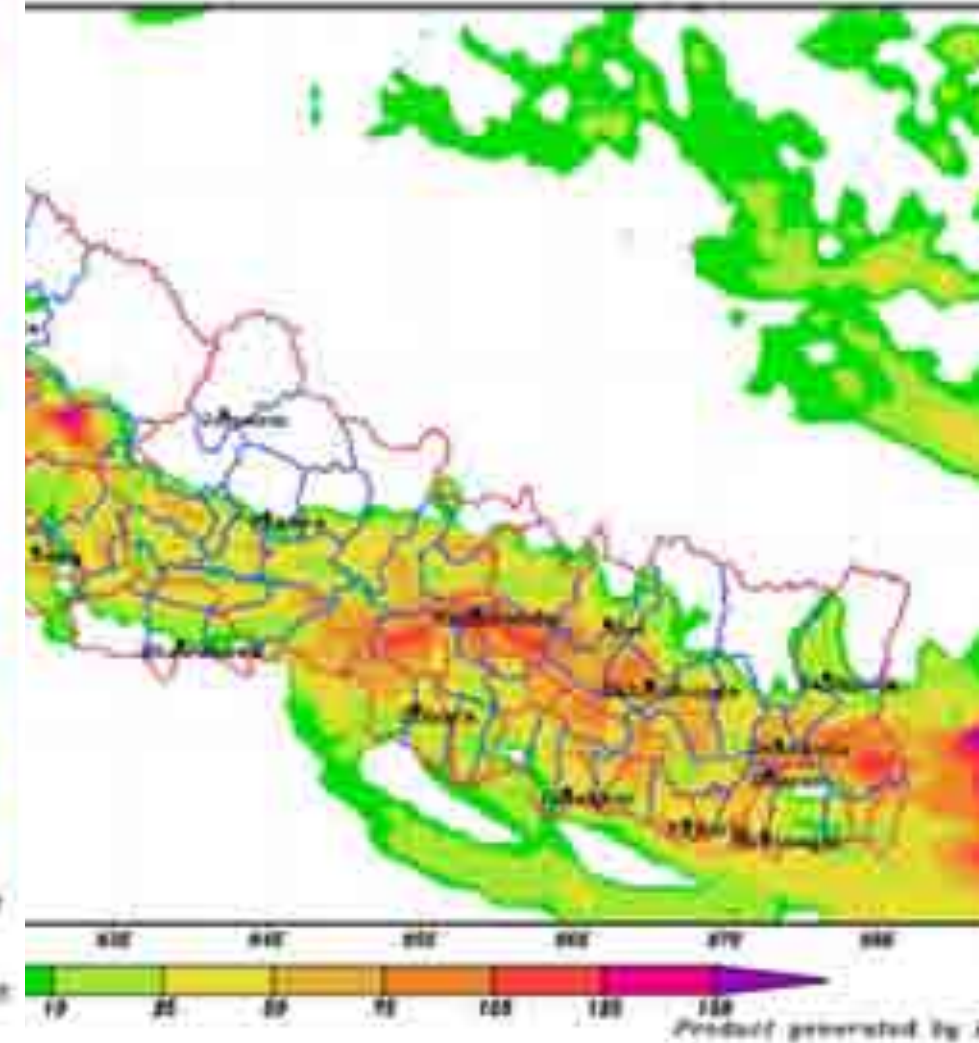


Forecasted Rainfall (July 12 & 13)

24 Hour Accumulated Rainfall (in mm)
Valid from 12072019 to 13072019 00 UTC

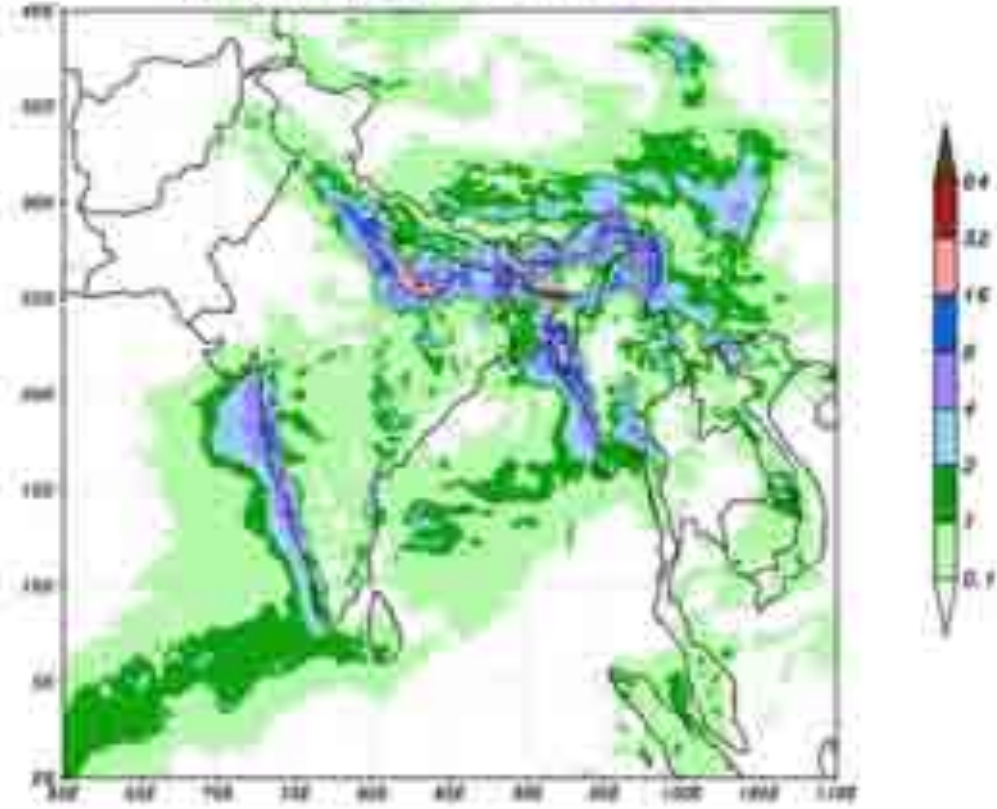


Hour Accumulated Rainfall (in mm)
Valid from 13072019 to 14072019 00 UTC

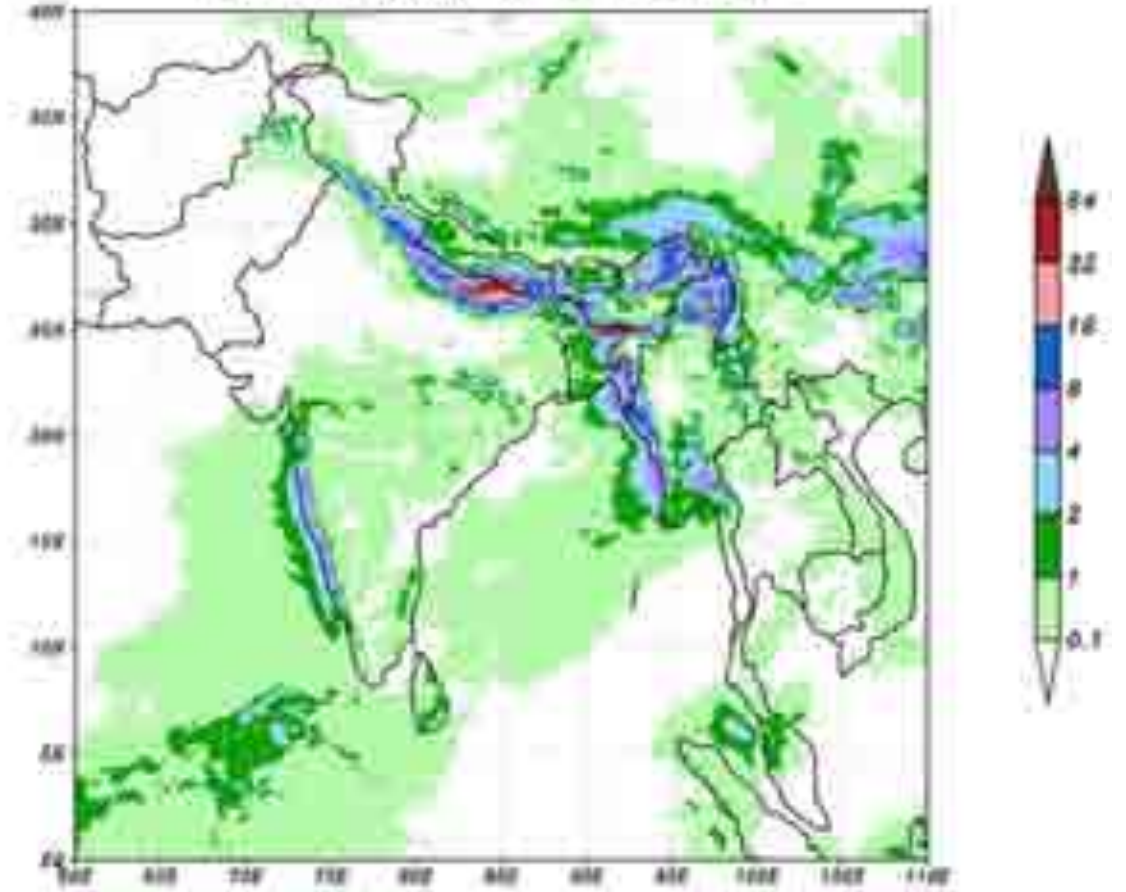


Forecasted Rainfall (July 10 & 11): NCMRWF

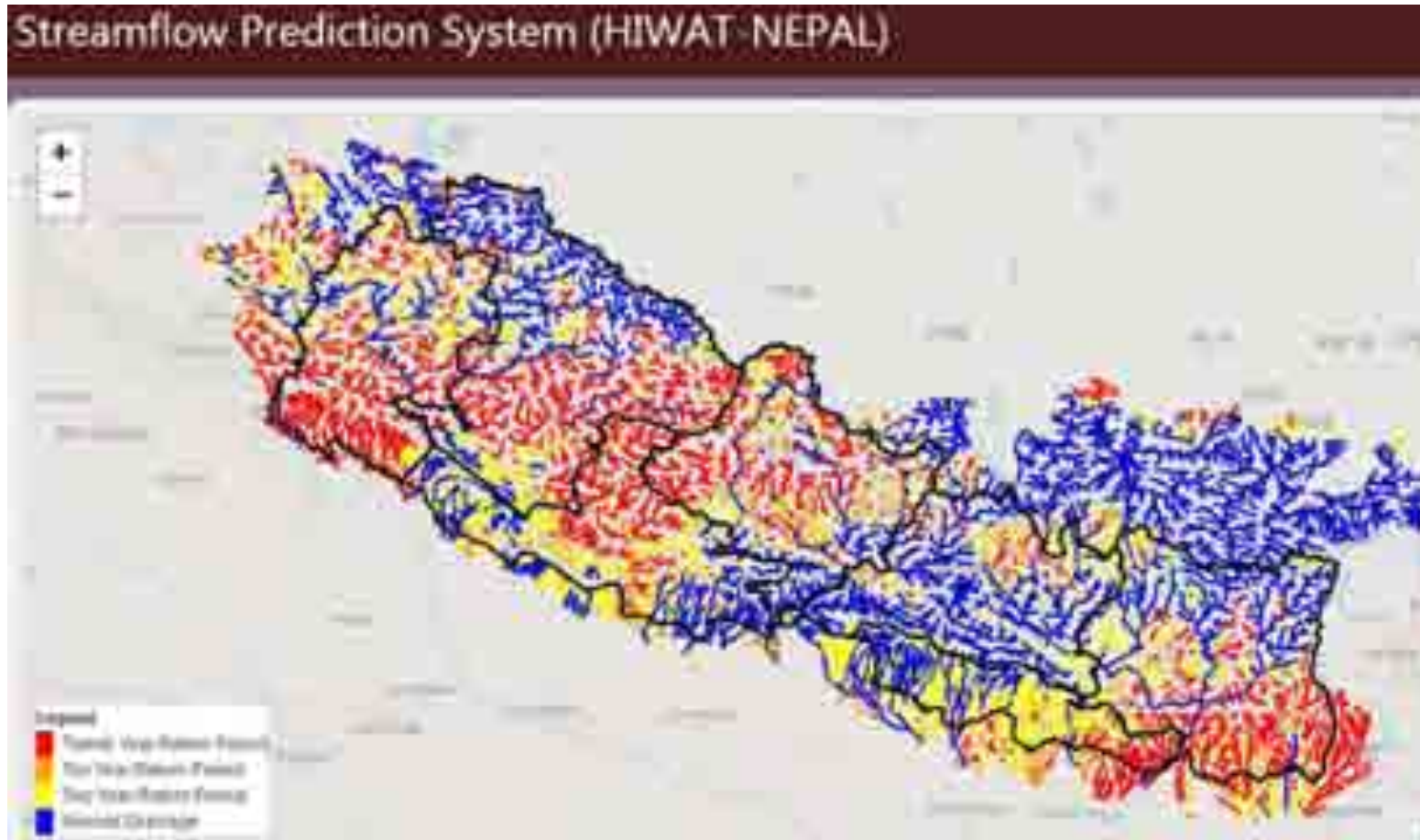
NCM 24 HR FORECAST VALID ON 032117JUL2019
RAINFALL(cm) CI=0.1,1,2,4,8



NCM 48 HR FORECAST VALID ON 032121JUL2019
RAINFALL(cm) CI=0.1,1,2,4,8



HIWAT Product for Flash Flood 10 July



Monitoring & Observation

Observed Data: 12 July, 5:50 am



Observed Data: 12 July, 4 am


 Department of Water
 Ministry of Energy, Water Resources and Irrigation
 Government of Karnataka
 Directorate of Hydrology and Meteorology
 Hydrology Division | Flood Forecasting Section



[HOME](#) | [REAL TIME DWD](#) | [WATER WATCH](#) | [WATER WATCH](#) | [CURRENT FORECAST](#) | [FLOOD WATCH MAP](#) | [COMMUNITY OUTREACH](#) | [PROJECTS](#) | [PUBLICATIONS](#)

Last updated on Fri, Jul 12, 2019 4:01 AM

Sl. No.	Station Name	Station Index	Stream Name	Recommended Flood Level (m) (MFL)					Status
				1 Day	3 Day	6 Day	12 Day	24 Day	
1	Basavara	001	Basavara	18	18.5	19	19.5	19.5	Normal
2	Basavara	002	Basavara	18	18.5	19	19.5	19.5	Normal
3	Basavara	1207	Basavara	18	18	18	18	18	Normal
4	Basavara	1208	Basavara	18	18.5	19	19.5	19.5	Normal
5	Basavara	1209	Basavara	18	18.5	19	19.5	19.5	Normal
6	Basavara		Basavara	18	18	18	18	18	Normal
7	Basavara	001	Basavara	18	18	18	18	18	BELOW NORMAL LEVEL
8	Basavara	002	Basavara	18	18	18	18	18	BELOW NORMAL LEVEL

Observed Data: 12 July, 5:45 am

Government of Nepal
Ministry of Energy, Water Resources and Irrigation
Department of Hydropower and Mining
Nepal Electricity Board (Nepal Power Co. Ltd.)

Home | Real Time Data | System Status | Archived Data | Current Forecast | Flood Forecast | Damaged Damages | Reports | Publications

Last updated on 12 Jul 2019 04:45 AM

S.N.	Station Name	Station Index	Station Name	Accumulated (measured by mm 24 hours)					Status
				1 Day	2 Day	3 Day	12 Day	24 Day	
1	Bhimsen	111	Bhimsen (Joshi)	41	111.1	161.1	111.1	111.1	Normal
2	Bhimsen	112	Bhimsen				111.1	111.1	Normal
3	Bhimsen	113	Bhimsen	11	11.1	11.1	111.1	111.1	Normal
4	Bhimsen	114	Bhimsen (Joshi)	11	11	11.1	111.1	111.1	Normal
5	Bhimsen	115	Bhimsen (Joshi)	4	11.1	11.1	111.1	111.1	Normal
6	Bhimsen	116	Bhimsen		11	11.1	111.1	111.1	Normal
7	Bhimsen	117	Bhimsen		11	11.1	111.1	111.1	Normal
8	Bhimsen	118	Bhimsen		11	11.1	111.1	111.1	Normal
9	Bhimsen	119	Bhimsen (Joshi)		11.1	11.1	111.1	111.1	Normal
10	Bhimsen	120	Bhimsen (Joshi)		11.1	11.1	111.1	111.1	Normal

River Stage Data (with RLS): 13 July, 11 am

Government of Nepal
Ministry of Energy, Water Resources and Irrigation
Department of Hydrology and Meteorology
Hydrology Division, Level Forecasting Section

HOME | REAL TIME DATA | RIVER WATCH | RIVER FALL WATCH | CURRENT FORECAST | FLOOD WARNING MAP | COMMUNITY OUTREACH | PRODUCTS | PUBLICATIONS

सुदूर पश्चिम प्रदेशको बागमती नदीको बाढको खतरा बढेको छ। बाढको खतरा बढेको छ। बाढको खतरा बढेको छ।

Last updated on: 13/07/2019 11:00 AM

S/N	Station Name	Station Index	Station Name	Water Level (m)	Accum. Flow (m ³ /sec)	Warning Level (m)	Target Level (m)	Flow	Status	U & M by
1	Chandani	101	Chandani River at Chandani (101) Jul 12, 2019 8:00 PM	17.0		17.0	17.0	10000	Warning	7:30
2	Chandani	102	Chandani River at Chandani (102) Jul 12, 2019 8:00 PM	18.0		18.0	18.0	10000	Warning	7:30
3	Chandani	103	Chandani River at Chandani (103) Jul 12, 2019 8:00 PM	19.0		19.0	19.0	10000	Warning	7:30
4	Chandani	104	Chandani River at Chandani (104) Jul 12, 2019 8:00 PM	20.0		20.0	20.0	10000	Warning	7:30
5	Chandani	105	Chandani River at Chandani (105) Jul 12, 2019 8:00 AM	21.0		21.0	21.0	10000	Warning	7:30
6	Chandani	106	Chandani River at Chandani (106) Jul 12, 2019 8:00 AM	22.0		22.0	22.0	10000	Warning	7:30
7	Chandani	107	Chandani River at Chandani (107) Jul 12, 2019 8:00 AM	23.0		23.0	23.0	10000	Warning	7:30
8	Chandani	108	Chandani River at Chandani (108) Jul 12, 2019 8:00 AM	24.0		24.0	24.0	10000	Warning	7:30
9	Chandani	109	Chandani River at Chandani (109) Jul 12, 2019 8:00 AM	25.0		25.0	25.0	10000	Warning	7:30
10	Chandani	110	Chandani River at Chandani (110) Jul 12, 2019 8:00 AM	26.0		26.0	26.0	10000	Warning	7:30

बाढीको
अवस्था
२६-२८ असार
Flood
Situation (11-
13 July)

Government of Nepal
Ministry of Energy, Water Resources and Irrigation
Department of Hydrology and Meteorology
Hydrology (English) | Flood Forecasting Section

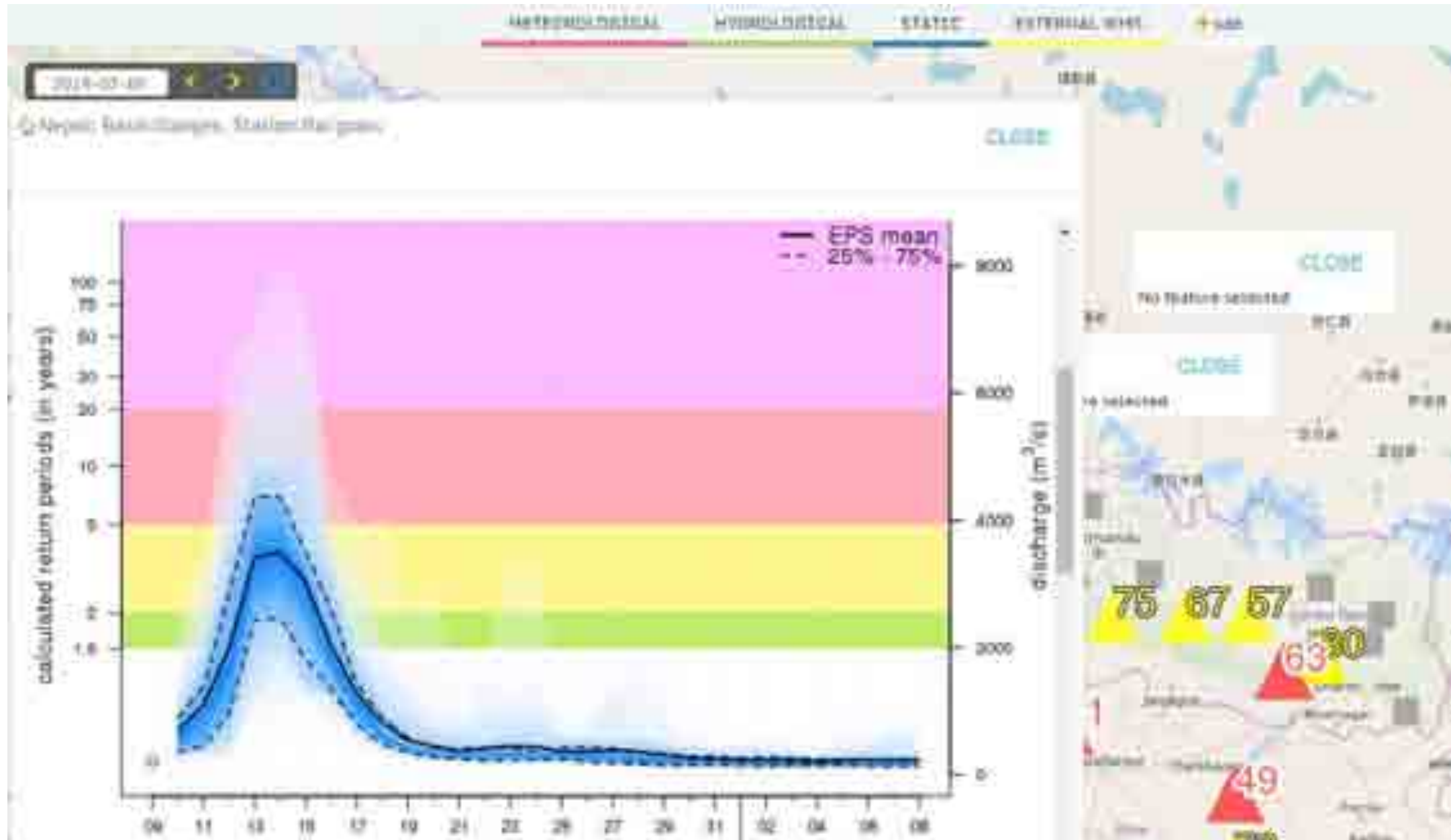
HOME REAL TIME DATA RIVER WATCH RAINFALL WATCH CURRENT FORECAST FLOOD HAZARD MAP COMMUNITY OUTREACH
ENQUIRY PUBLICATIONS

॥ असार २६ असार सावन्ती जकाई, कोशी र सप्तरी सभै नदिहरू चुपकोली, चुपकोली, हार्ने बगराबगर, हार्ने बगराडी, बगरा, चुपौ

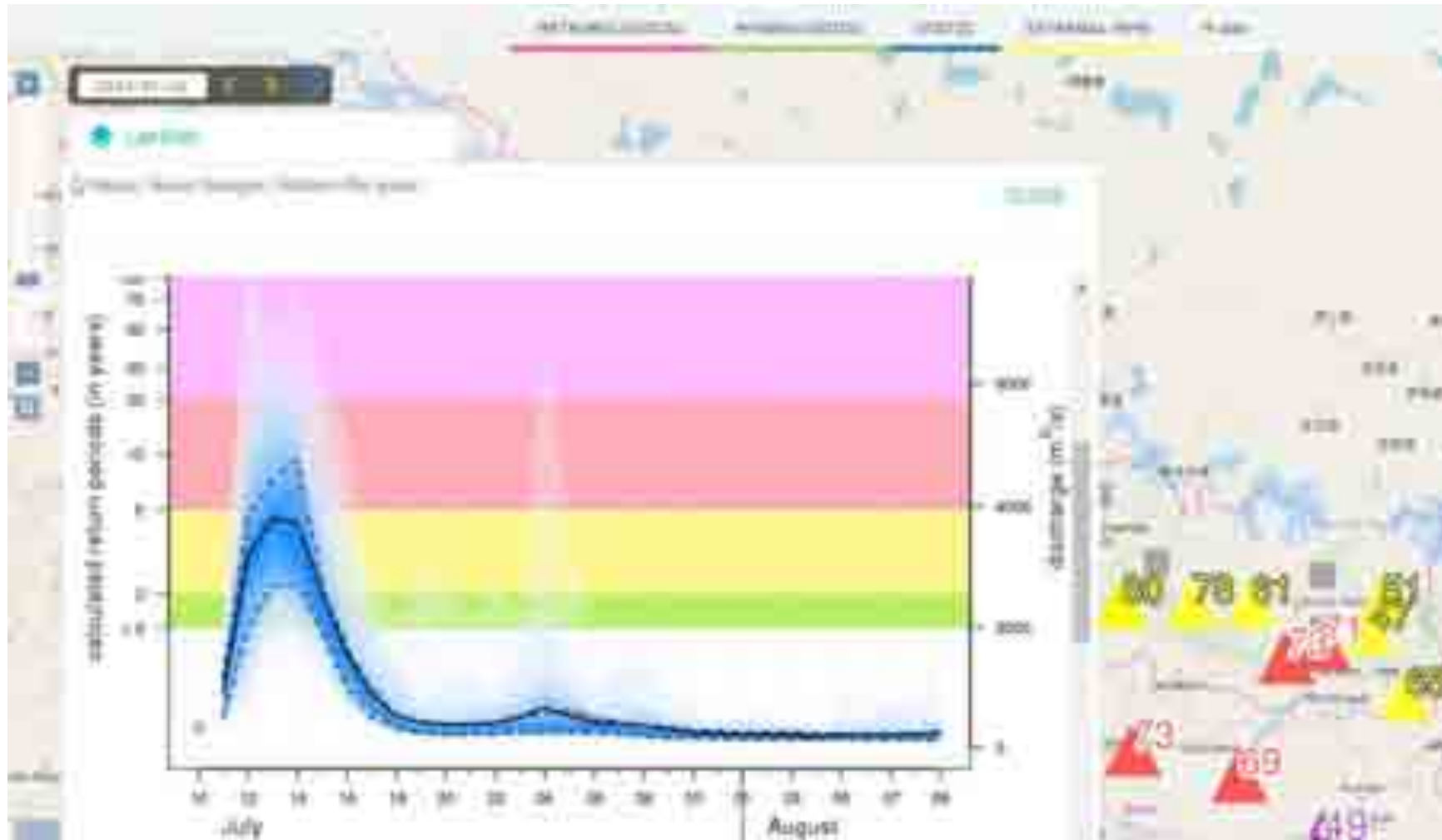
Last updated on Sat, Jul 13, 2019 2:44 PM

S.N	River Name	Station Index	Station Name	Water Level (m)	Approx Flow (m ³ /sec)	Warning Level (m)	Danger Level (m)	Trend	Status	O & M by
1	Baghmati	500	Baghmati River at Rai Conch Fri, Jul 12, 2019 4:00 PM	11.50	---	7.50	8.50	RIISING	DANGER	DHM
2	Koshi	801	Sankoshi River at Harpochauri Sat, Jul 13, 2019 8:10 AM	12.20	---	10.50	11.50	RIISING	DANGER	DHM
3	Koshi	801	Tamok River at Thewel Sat, Jul 13, 2019 2:00 PM	18.70	---	8.0	10.0	FALLING	DANGER	DHM
4	Koshi	805	Sankoshi at Chauri (old) Sat, Jul 13, 2019 2:20 PM	7.54	---	6.00	7.00	STEADY	DANGER	DHM
5	West Koshi	175	West Rapti at Kurem Sat, Jul 13, 2019 2:20 PM	3.28	---	3.0	5.4	RIISING	WARNING	DHM
6	Koshi	805	East Koshi at Chauri (new) Sat, Jul 13, 2019 2:15 PM	6.11	---	4.0	7.0	STEADY	WARNING	DHM

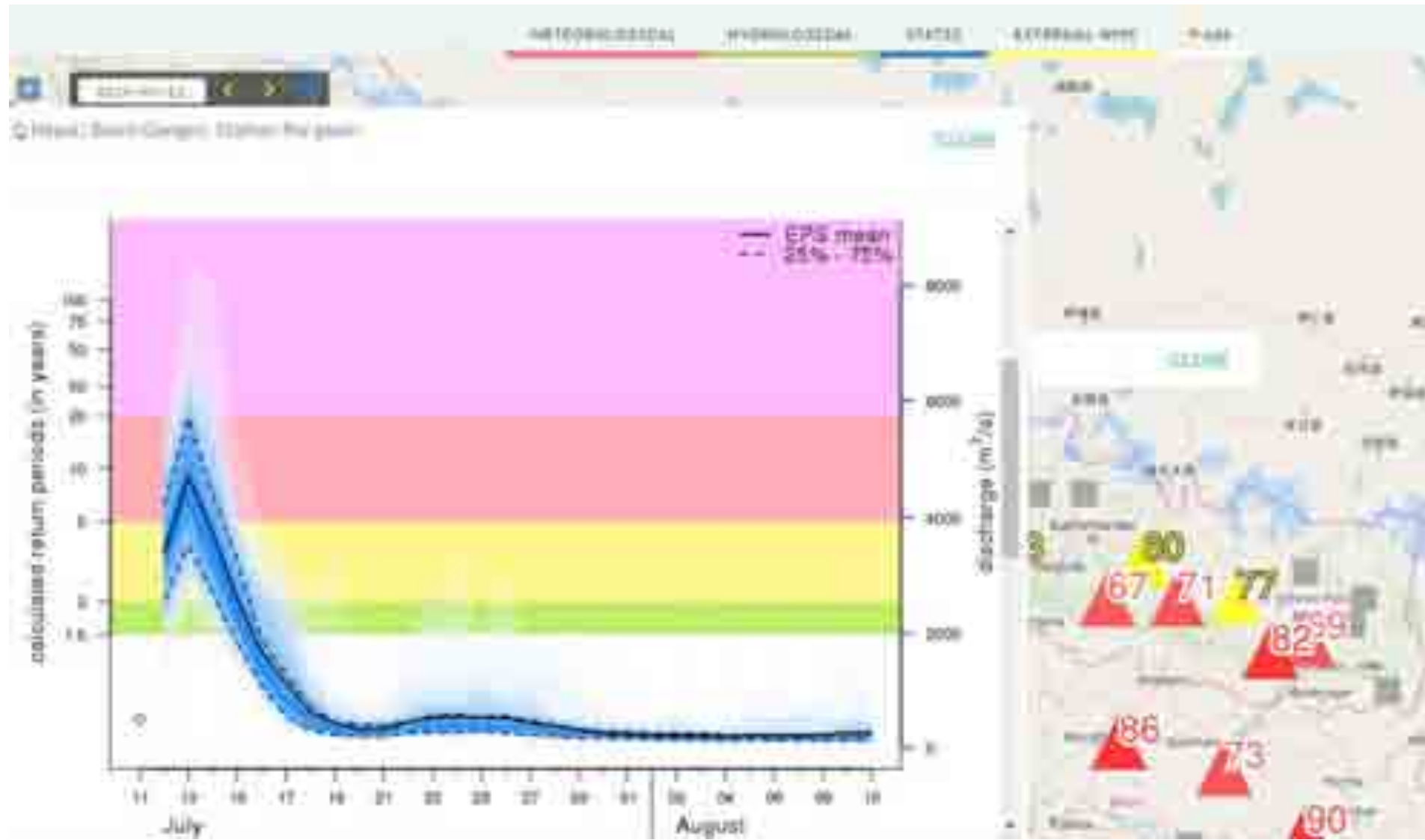
Forecast at 09 July, 2019, GLOFAS



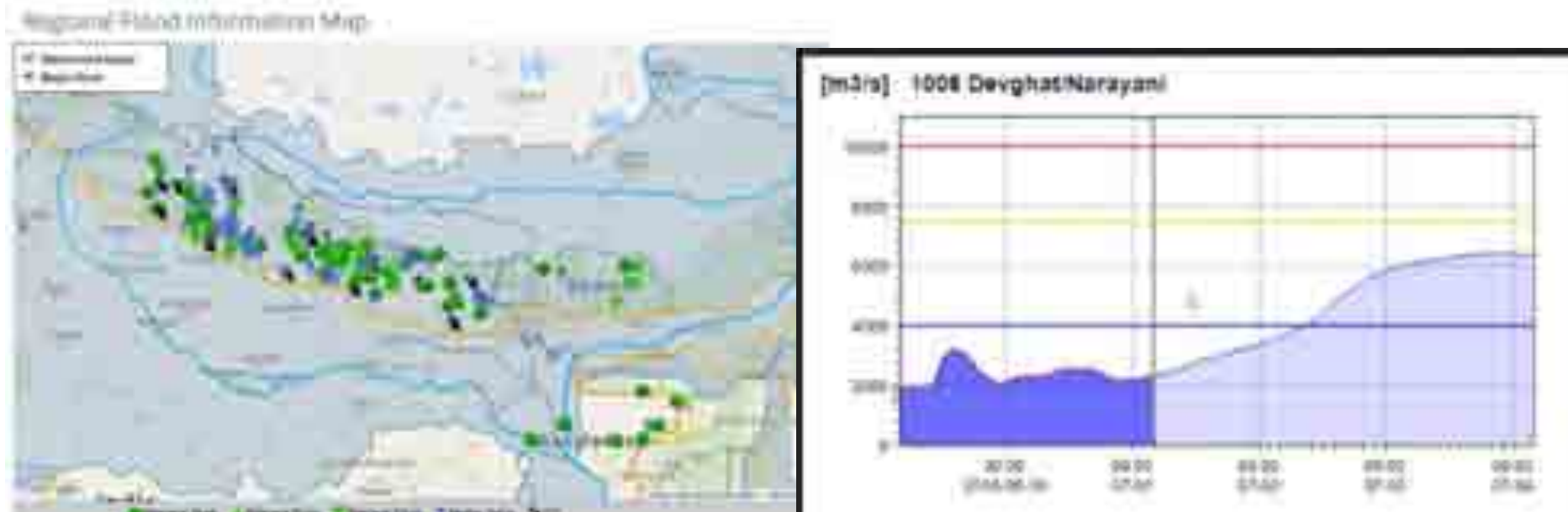
Forecast at 10 July, 2019, GLOFAS



Forecast at 11 July, 2019

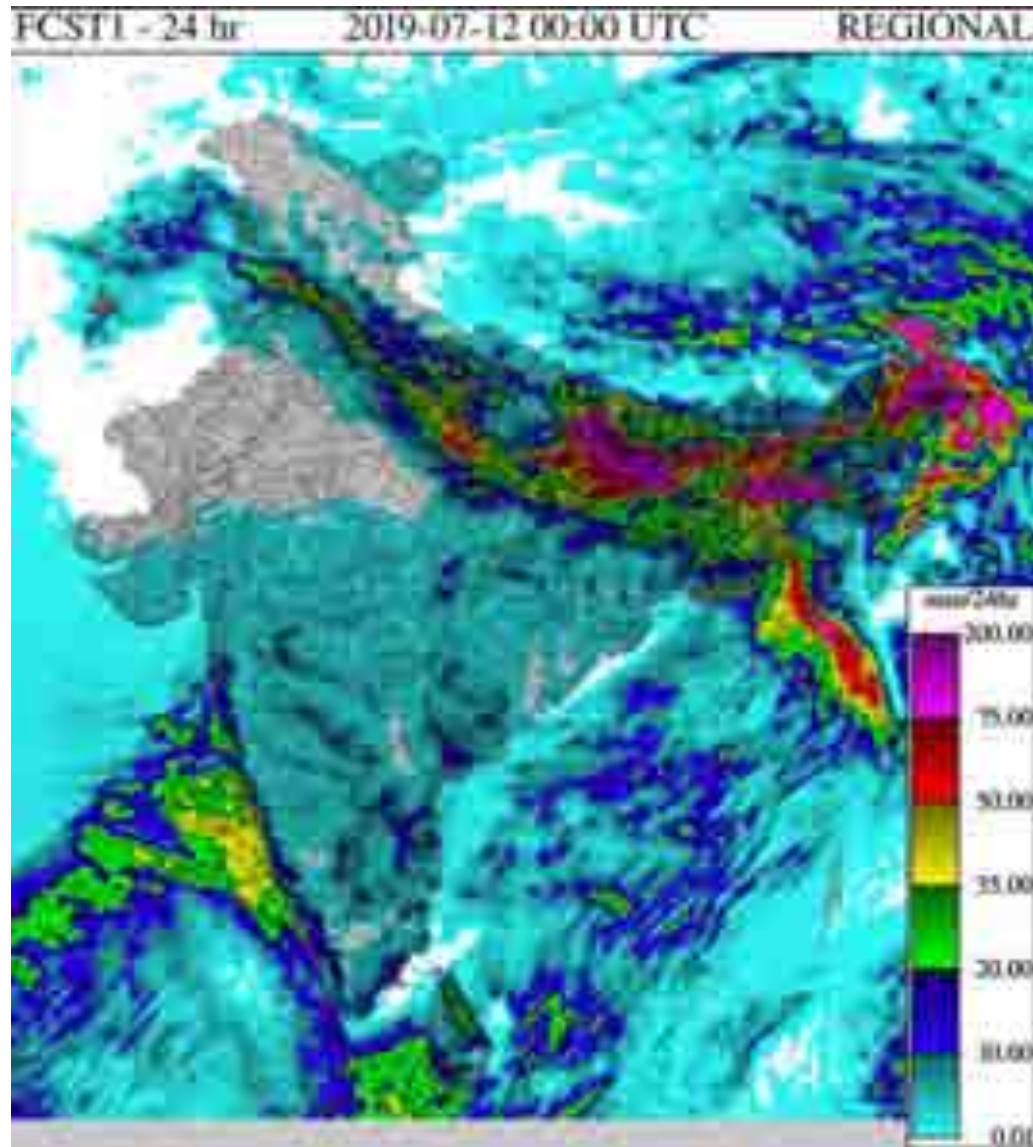


Flood Forecasting Using Mike-11 Model



Mike 11 model is being run in 5 river basins using GFS(Global Forecast System) rainfall forecast and WRF(Weather Research and Forecasting) Rainfall forecast Data Assimilation part is also included in the model

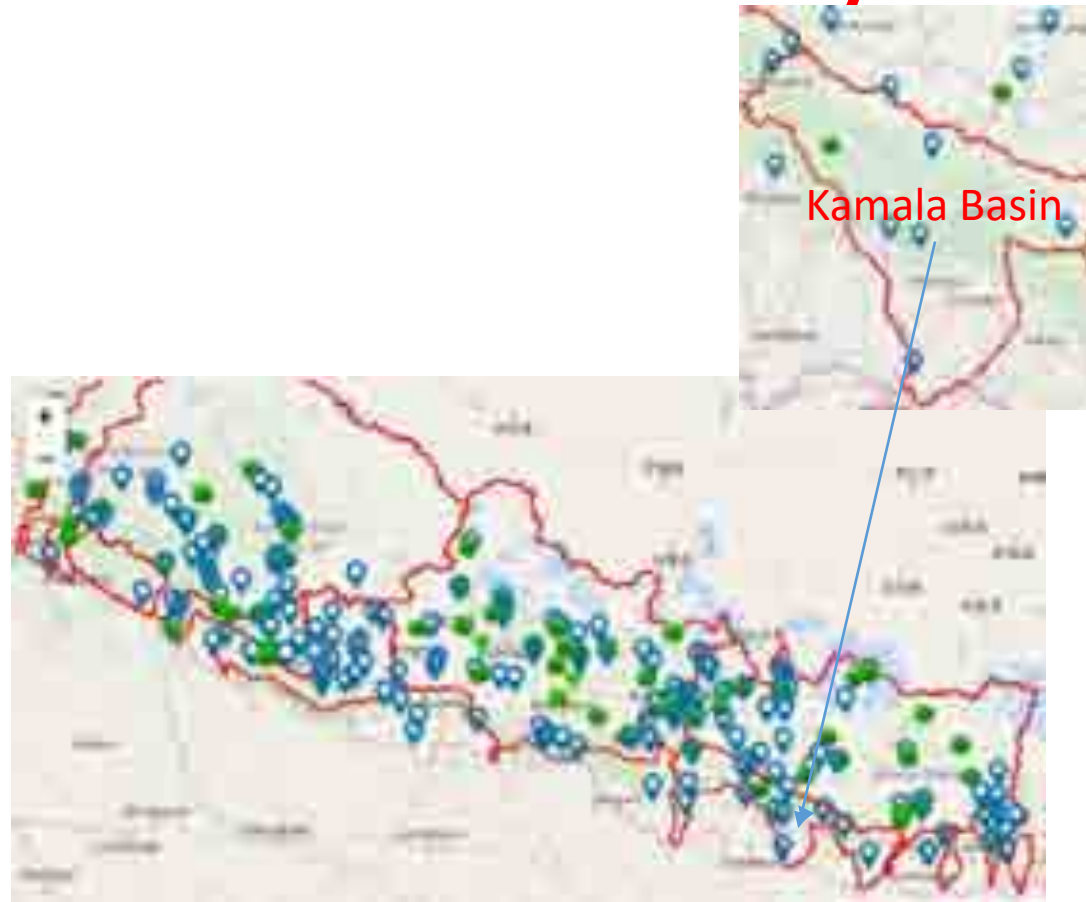
Regional Forecast: SasiaFFGS (IMD NWP)



Flood and Flash Flood Case-Study

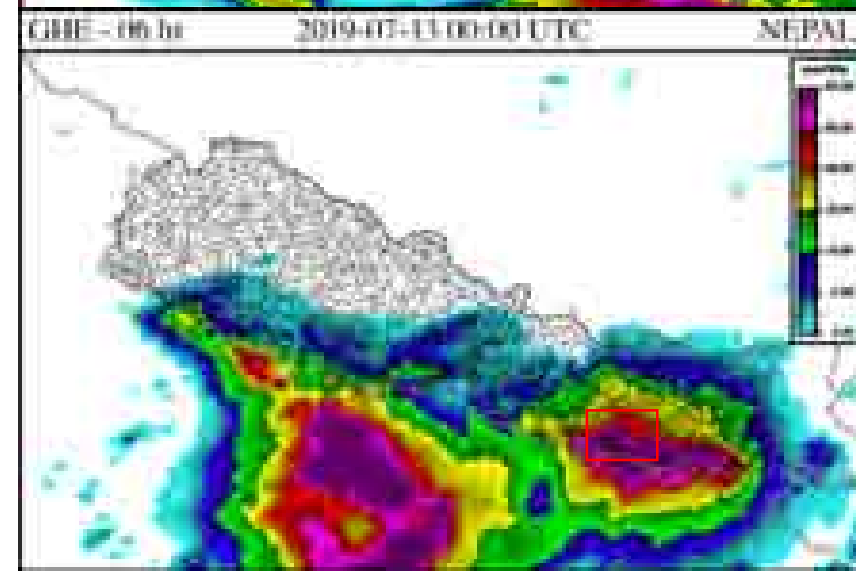
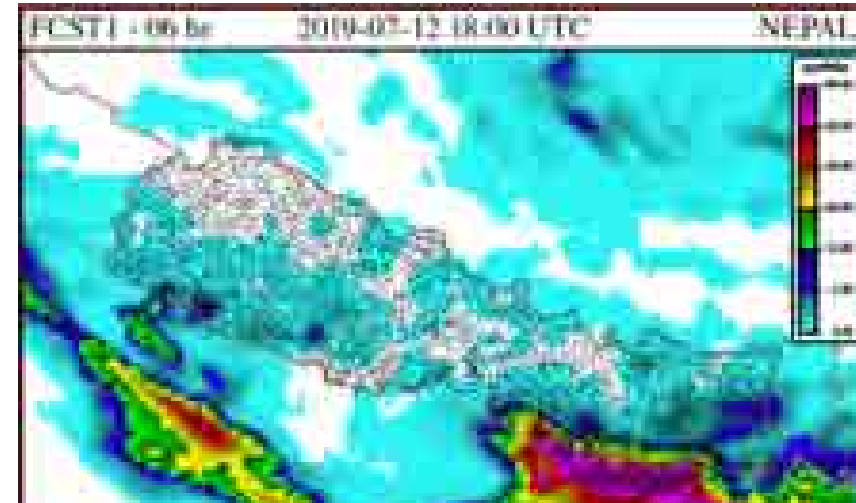
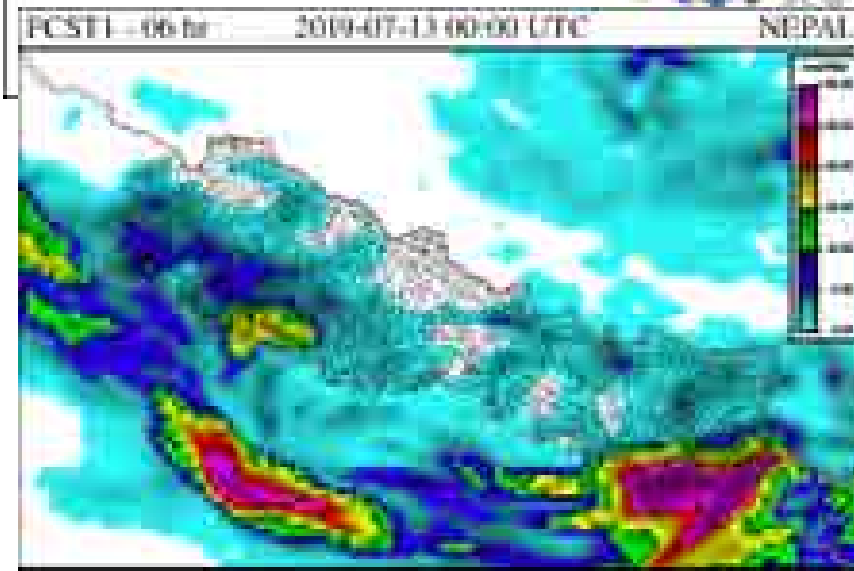
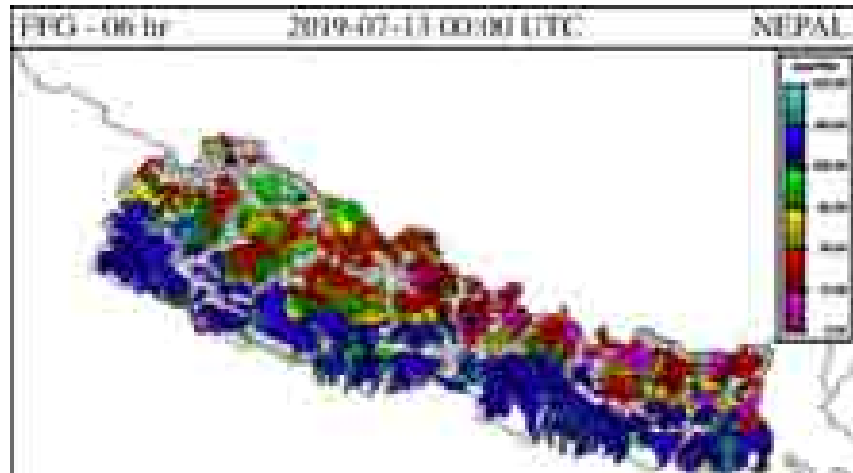
Kamala Basin and Nearby Area

- During 12-13 July 2019, heavy rainfall in Sindhuli & Siraha district of Central Nepal caused deadly flood and flash flood with loss of life and property affecting major highways, bridges and more than 1200 houses. Rainfall activity was active for more than 3 days prior to the event.



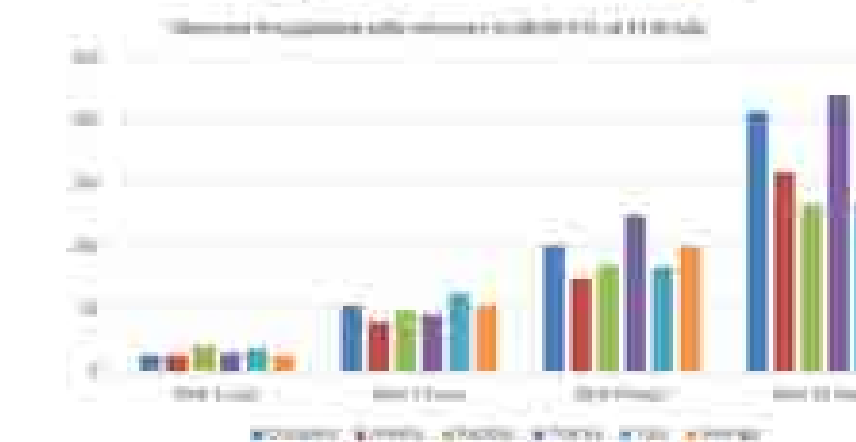
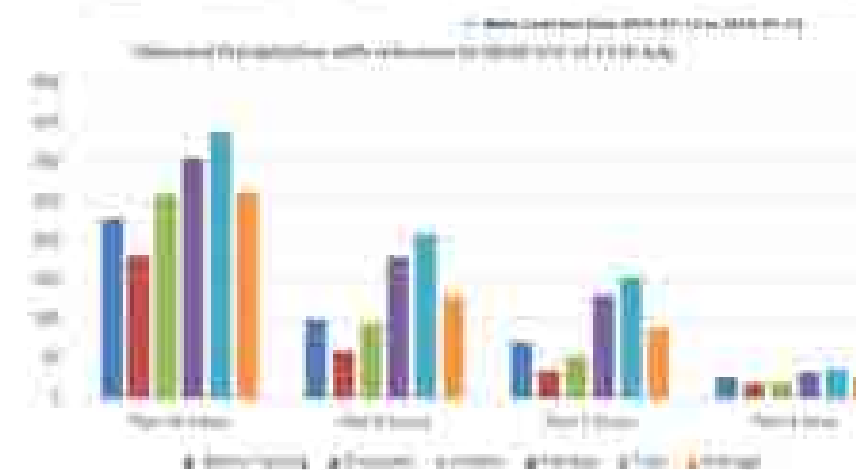
Indicators to Flash Flood

The 6 hour GHE precipitation observed at 00:00 UTC of 13th July, shows the heavy precipitation that may cause flash flood. FFGS product do not indicate any flash flood threat.



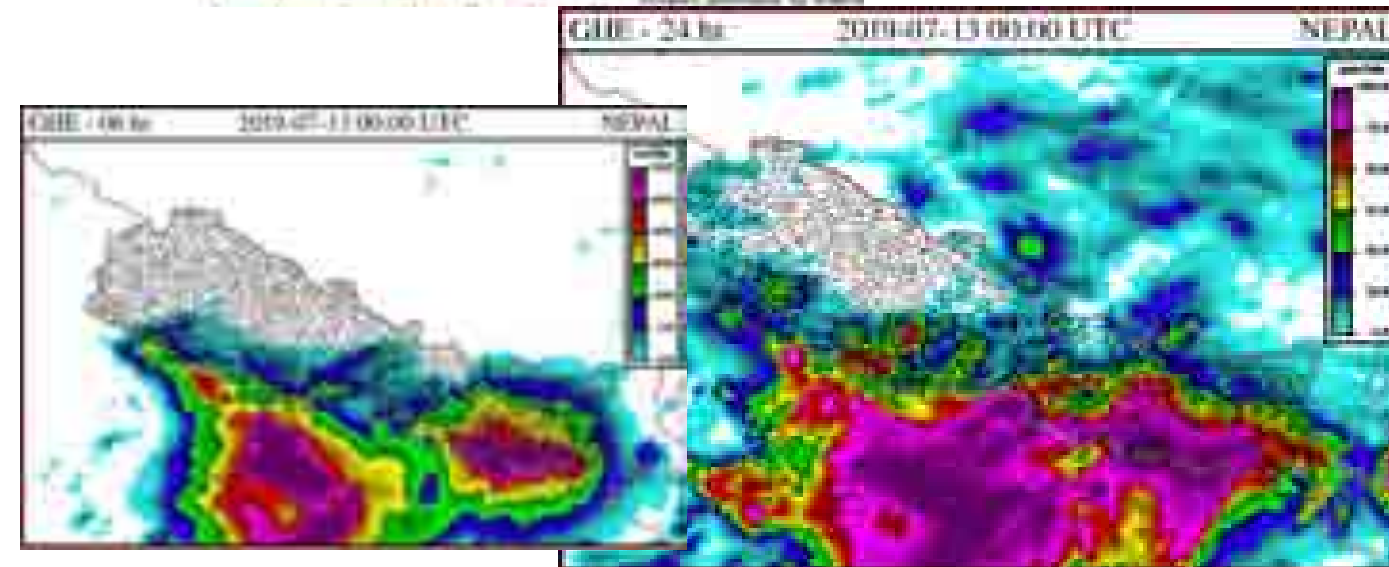
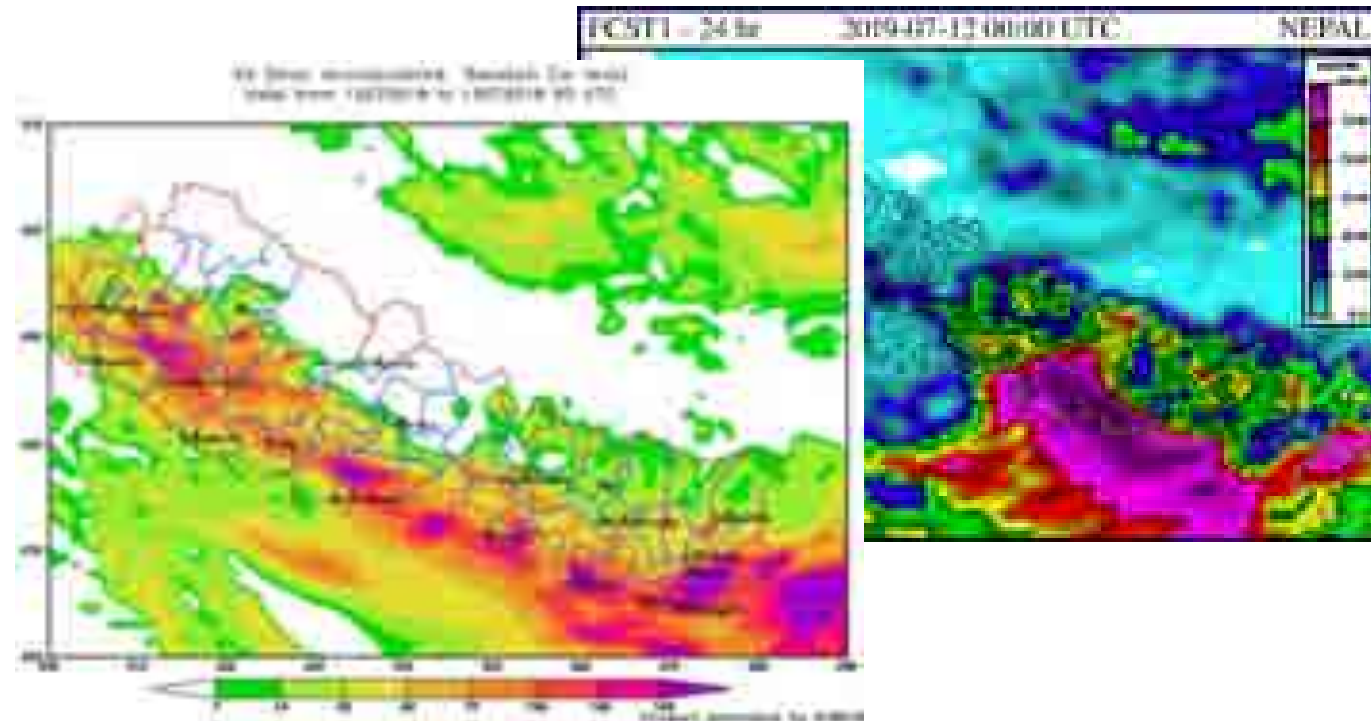
Real Ground Observation

- Being Flashy basin, DHM has established 2 water level station and 7 rainfall stations (both automatic) to monitor and issue warning based on ground observation.
- At 00:00 UTC of 13th July, the last 6 hour observed rainfall in some stations was in the range of 200mm and more than 80% occurred in last 3 hours.
- Again, the next 6 hour rainfall in all stations is in the range of 100mm and more than 60% of it occurred in next 3 hours.
- Due to the observed heavy rainfall and increased stage above danger level, **flash flood warning was issued** even FFGS was not indicating it.



Information Available at 00:00 UTC of 13th July

- Past 1, 3, 6, 12 and 24 hours real time ground rainfall observations and river stage data
- Past 1, 3, 6 and 24 hours remotely sensed precipitation.
- Next 24 hours daily RIMES rainfall forecast
- Next 3, 6 and 24 hours WRF product from FFGS.



Information Available at 00:00 UTC of 13th July

- All nearby larger basins showing the high probability of crossing danger level at any time during that day: GLOFAS
- Real Time water level of the all nearby basins crossing warning and danger level



ID	Basin Name	Area (km²)	Water Level (m)	Warning Level (m)	Danger Level (m)	Current Status	Alert Level	Alert Type
1	Basin 1	100	10.5	10.0	10.2	Warning	High	GLOFAS
2	Basin 2	150	11.0	10.5	10.8	Warning	High	GLOFAS
3	Basin 3	200	11.5	11.0	11.3	Warning	High	GLOFAS
4	Basin 4	250	12.0	11.5	11.8	Warning	High	GLOFAS
5	Basin 5	300	12.5	12.0	12.3	Warning	High	GLOFAS
6	Basin 6	350	13.0	12.5	12.8	Warning	High	GLOFAS
7	Basin 7	400	13.5	13.0	13.3	Warning	High	GLOFAS
8	Basin 8	450	14.0	13.5	13.8	Warning	High	GLOFAS
9	Basin 9	500	14.5	14.0	14.3	Warning	High	GLOFAS
10	Basin 10	550	15.0	14.5	14.8	Warning	High	GLOFAS

Flood Verification of 13 July, 2019 Event

- Flash Flood and landslide Reported in Kamala and other nearby basins
- Due to the observed heavy rainfall and increased stage above danger level, **flash flood warning was issued**



Flooding Highway



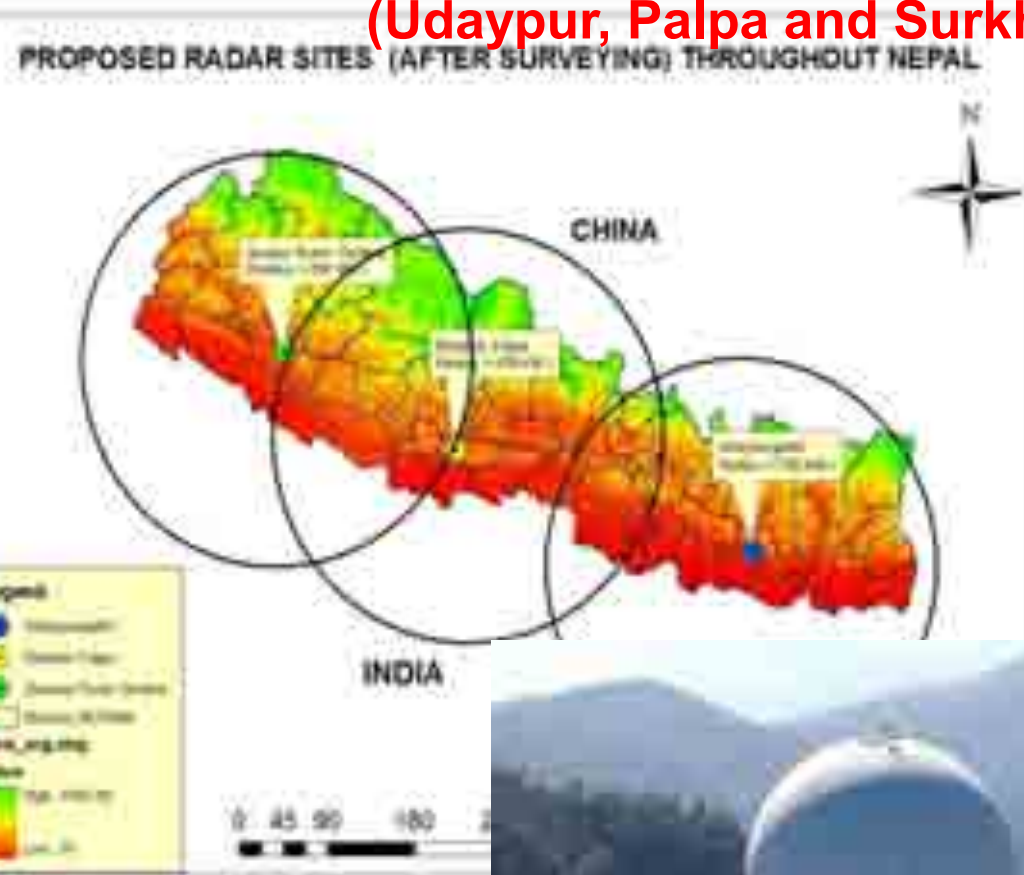
**Overtopping of
Kamala Bridge on
13th July**

<http://annapurnapost.com/news/132899>

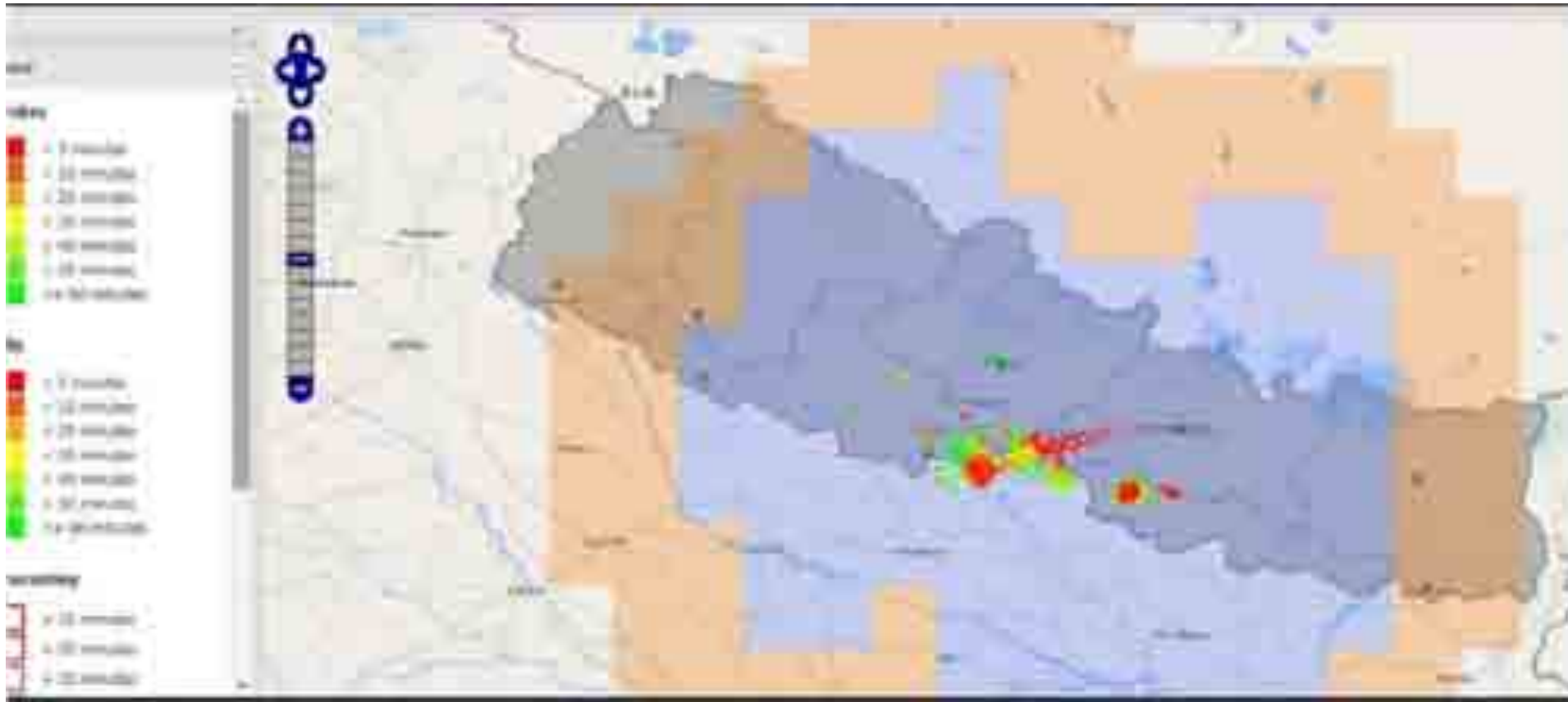
3 People Missing on Kamala
due to Flood and Landslide

**But based on real time
observation, Flood
Forecasting Section issued
warning to evacuate on
timely manner and saved
many people**

3 Doppler Weather Radar (Udaypur, Palpa and Surkhet), Installation in Surkhet Completed



Lightening: Monitoring



GLOF Detection Sensors Downstream of Imja Lake



Radars Level Sensors (RLS) on Lothar Khola, Lothar & Arun River, Ubagaun

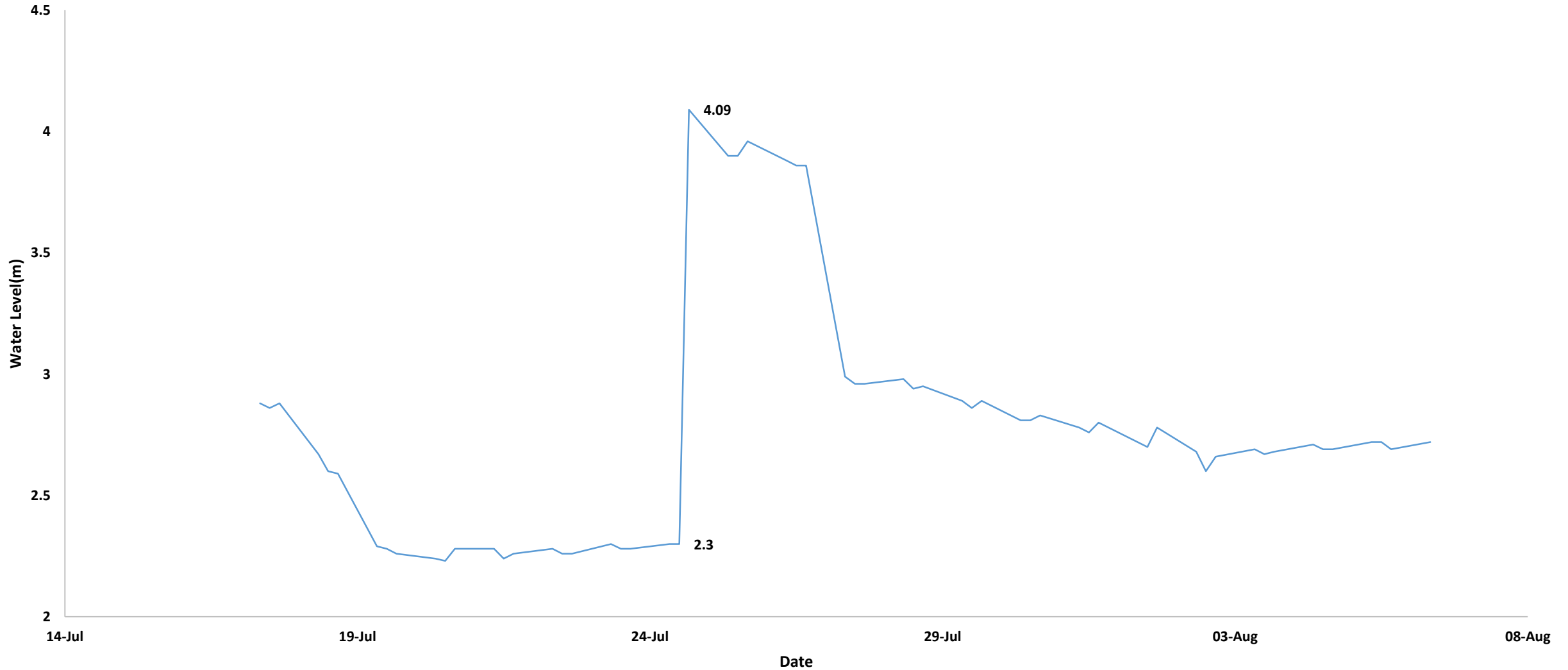


Glacier Lake Outburst Flood (GLOF) detection sensor at outlet of lake and Downstream of Tsho-Rolpa Glacier lake



REAL TIME WATER LEVEL OF DORDI RIVER AT AMBOTE DURING FLOOD EVENT

Water Level at Dordi (439.4), Ambote

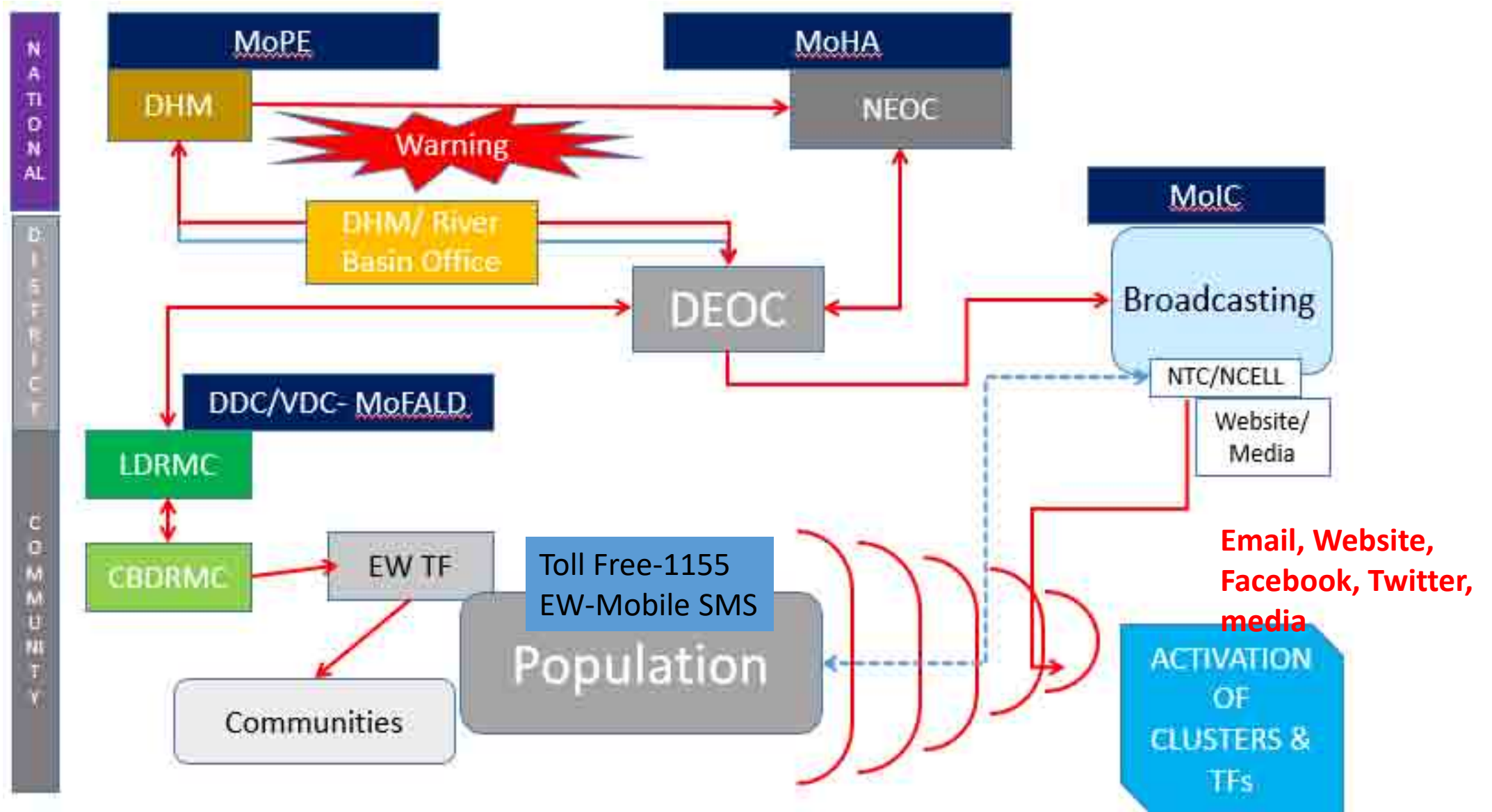


बाढी बुलेटिन २५ आषाढ २०७६ (Forecast 10 July)

सरोकारवालाको लागि परामर्श (Advisory):

- आज, भोली र पर्सा प्रमुख नदीहरु कोसी, नारायणी, कर्णाली र महाकालीमा बहाव उल्लेख्य बढ्ने र केहीमा सतकेता तह आसपास हुने संभावना रहेकाले मध्यम जोखिम छ।
- आज प्रदेश १, २ र ३ को प्रायः जिल्ला भरि बढ्ने साना र मझौला नदीहरुमा आकस्मिक बाढीको संभावना छ।
- पूर्वमा मेघि, विरिड, निन्दा लगायत झापा, मोरङ, सुनसरी, ईलामबाट बढ्ने साना नदीहरुमा बहाव उल्लेख्य बढ्ने तथा केहीमा बहाव सतकेता तह आसपास सम्म पुग्न सक्ने आणक्यमा अपेक्षा रही।
- आज सुदूरपश्चिम प्रदेश र प्रदेश ५ को धुरे र महाकाल बढ्ने तथा कर्णाली प्रदेशको पहाडी क्षेत्रबाट बढ्ने केही साना नदीहरुमा आकस्मिक बहाव हुने संभावना उच्च छ।
- भोली प्रदेश १, २, ३, गण्डकी प्रदेश, प्रदेश ५ तथा सुदूरपश्चिम प्रदेशको तराईको अधुमा बढ्ने साना तथा मझौला नदीहरुमा आकस्मिक बहावको उच्च संभावना रहेकाले विशेषगरी उक्त प्रदेशको तराईका जिल्लामा आर्जेडिखि पूर्वतयारी र प्रतिकारको लागि तयार गरी।
- पर्सा पनि प्रदेश १, २ र ३ बाट बढ्ने प्रायः सबै नदीहरुमा बहाव बढ्ने, कोसी, कञ्चनगुँ, कमाज, बागमती लगायत उक्त प्रदेश भन्ने बढ्ने अन्य नदीहरुमा बहाव सतकेता तह आसपास हुने तथा अन्य प्रायः साना नदीहरुमा साना तह पार गर्ने संभावना रहेकाले पूर्वतयारीमा तयार गरी।
- भोली र पर्सा देशीभर तराई र मध्यपहाडी क्षेत्रमा उच्च सतकेता अपेक्षा छै। पूर्वतयारी र प्रतिकारमा जुटी।
- (बाढी पूर्वतयारी बुलेटिनमा यस विषयको लेखकको नाम www.dwa.gov.np मा तल्लो हेर्न सकिने छ।) विभागको केन्द्रिय वेब www.dwa.gov.np Flood Alert (नेपाल बाढी सूचना) हेर्न। विभागको ट्विटर पेज https://twitter.com/dwa_nepal (नेपाल बाढी सूचना) हेर्न।

Flood Early Warning Dissemination



Effectiveness in 2019 Flood

- Used to warn public 3-4 days in advance about the severe flood in the probable affected area
- Based on forecast information, the weather & flood forecast bulletin was prepared & send to the media (FM, TV, Radio, Newspaper, Online media), disaster management authorities.
- The monitoring river stage and automatic rainfall data was used to send MASS SMS to the public.
- Disaster management authorities (Ministry of home affairs) moved the security forces for evacuation, Search and Rescue.

DHM-NCELL-NTC Collaboration for Mass SMS

Please add "-DHM" at the end of SMS location while sending		SMS Messaging			
ID	Polygon Name (File Name in FTP location)	Message Content	Sender ID	Priority	Category
1	Shankar_Basin_Hydro_Short_Rain_Arizona	Shankar_Basin_Hydro_Short_Rain_Arizona	Shankar_Basin_Hydro_Short_Rain_Arizona	High	Hydro
2	Shankar_Basin_Hydro_Short_Rain_IDH	Shankar_Basin_Hydro_Short_Rain_IDH	Shankar_Basin_Hydro_Short_Rain_IDH	High	Hydro
3	Shankar_Basin_Hydro_Short_Rain_Texas	Shankar_Basin_Hydro_Short_Rain_Texas	Shankar_Basin_Hydro_Short_Rain_Texas	High	Hydro
4	Shankar_Basin_Hydro_Short_Rain_Texas	Shankar_Basin_Hydro_Short_Rain_Texas	Shankar_Basin_Hydro_Short_Rain_Texas	High	Hydro
5	Shankar_Basin_Hydro_Short_Rain_Malaysia	Shankar_Basin_Hydro_Short_Rain_Malaysia	Shankar_Basin_Hydro_Short_Rain_Malaysia	High	Hydro
6	Shankar_Basin_Hydro_Short_Rain_Bahia	Shankar_Basin_Hydro_Short_Rain_Bahia	Shankar_Basin_Hydro_Short_Rain_Bahia	High	Hydro
7	Shankar_Basin_Hydro_Short_Rain_SocialMedia	Shankar_Basin_Hydro_Short_Rain_SocialMedia	Shankar_Basin_Hydro_Short_Rain_SocialMedia	High	Hydro
8	Shankar_Basin_Hydro_Short_Rain_Japan	Shankar_Basin_Hydro_Short_Rain_Japan	Shankar_Basin_Hydro_Short_Rain_Japan	High	Hydro

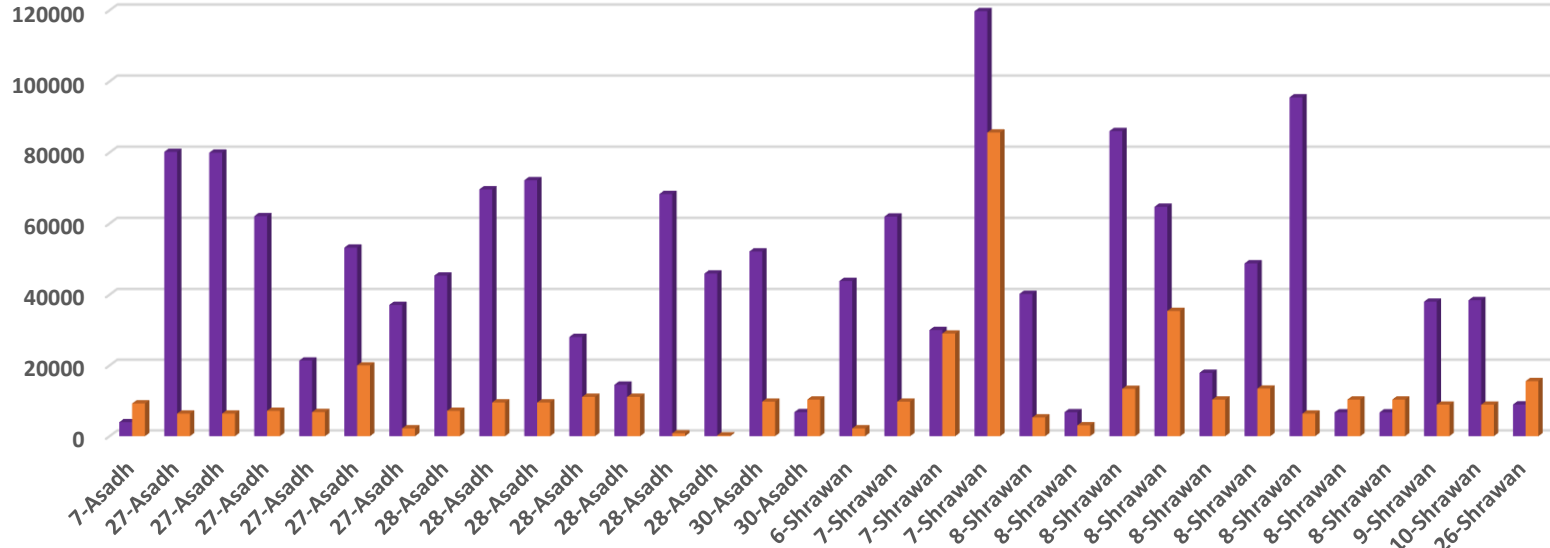
Bagmati at Padheradovan (Karmaiya): 3 Days Continuously over danger level) (11-13 July)



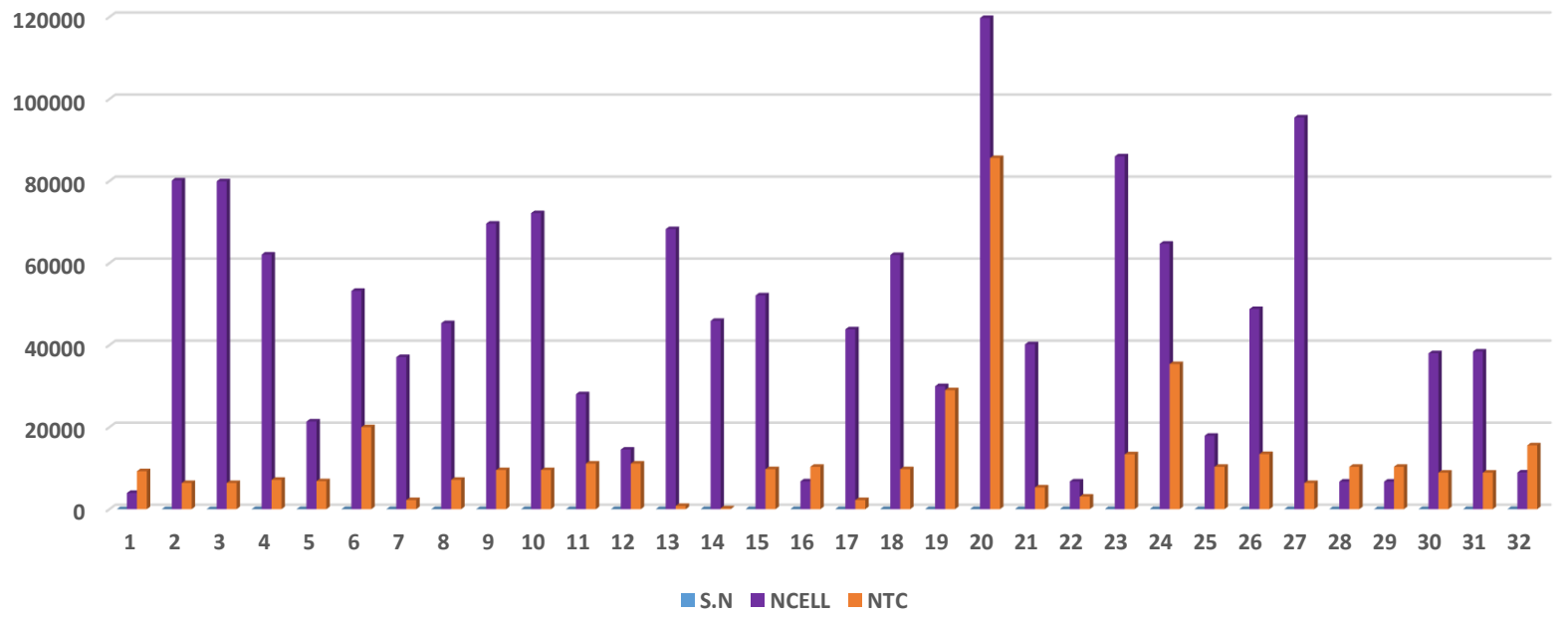
Delivered SMS status

S.N	Campaign Name	English Dat	Nepali Dat	NCELL	NTC
1	Narayani Basin Madi Rain Madi Whole	6/22/2019 14:00	7-Asadh	3961	9256
2	Bagmati Basin Bagmati Padheradovan	7/12/2019 4:00	27-Asadh	80160	6395
3	Bagmati Basin Bagmati Padheradovan	7/12/2019 7:45	27-Asadh	79947	6395
4	Kamala Basin Hydro Kamala d/s 1	7/12/2019 9:15	27-Asadh	62078	7169
5	Kamala Basin Hydro Kamala uls	7/12/2019 10:30	27-Asadh	21383	6835
6	Narayani Basin EastRapti Hydro EastRapti	7/12/2019 15:15	27-Asadh	53230	19986
7	Kankai Basin Hydro kankai d/s	7/12/2019 16:00	27-Asadh	37090	2223
9	Kamala Basin Hydro Kamala d/s	7/13/2019 6:15	28-Asadh	45356	7169
10	Koshi Basin Hydro Koshi d/s13 2	7/13/2019 7:00	28-Asadh	69619	9534
11	Koshi Basin Hydro Koshi d/s	7/13/2019 9:30	28-Asadh	72176	9534
12	WestRapti Basin Hydro WestRapti Kusum	7/13/2019 14:00	28-Asadh	28030	11120
13	WestRapti Basin Hydro WestRapti River Kusum	7/13/2019 16:00	28-Asadh	14542	11120
14	KoshiWest Small Basins Khando River Saptari	7/13/2019 18:00	28-Asadh	68294	807
15	KoshiWest Small Basins Mauli River Barmajhiya	7/13/2019 18:00	28-Asadh	45924	233
16	NarayaniWest Small Basins Hydro Tinau River Butwal ds	7/15/2019 15:30	30-Asadh	52132	9756
17	Narayani Basin Madi Rain Madi Whole	7/15/2019 18:00	30-Asadh	6797	10344
18	Kankai Basin Hydro kankai d/s2	7/22/2019 10:45	6-Shrawan	43852	2223
19	NarayaniWest Small Basins Hydro Tinau River Butwal ds	7/23/2019 6:30	7-Shrawan	61968	9756
20	KamalaWest Small Basins Rato Bighi khola	7/23/2019 0:00	7-Shrawan	30000	29007
21	BagmatiWest Small Basins Simara Parwanipur Rain	7/23/2019 11:00	7-Shrawan	119751	85625
22	Babai Basin Hydro Babai Chepang poligon	7/24/2019 5:30	8-Shrawan	40200	5298
23	BagmatiWest Small Basins Thori Parsa Rain	7/24/2019 8:00	8-Shrawan	6766	3080
24	NarayaniWest Small Basins Hydro Banganga Gudung River Highway	7/24/2019 9:45	8-Shrawan	86017	13385
25	Narayani Basin Narayani Rain Danda Kawashoti Giriuwari Khola	7/24/2019 10:00	8-Shrawan	64721	35397
26	Narayani Basin Madi Rain Madi Whole	7/24/2019 10:00	8-Shrawan	17912	10344
27	KoshiEast Small Basins Hydro Lohandra Chisang Khola Haraicha	7/24/2019 10:45	8-Shrawan	48799	13453
28	Bagmati Basin Bagmati Padheradovan	7/24/2019 11:00	8-Shrawan	95505	6395
29	Narayani Basin Madi Rain Madi Whole	7/24/2019 13:15	8-Shrawan	6730	10344
30	Narayani Basin Madi Rain Madi Whole	7/24/2019 13:45	8-Shrawan	6730	10344
31	KoshiEast Small Basins Hydro River Kanepokhari Location1	7/25/2019 5:30	9-Shrawan	38019	8912
32	KoshiEast Small Basins Hydro River Kanepokhari Location	7/26/2019 0:00	10-Shrawan	38436	8912
33	Karnali Basin Veri Rain Jajarkot Rain	8/11/2019 6:00	26-Shrawan	8952	15577
			Sum	1455077	395928
			Grand Total	1851005	

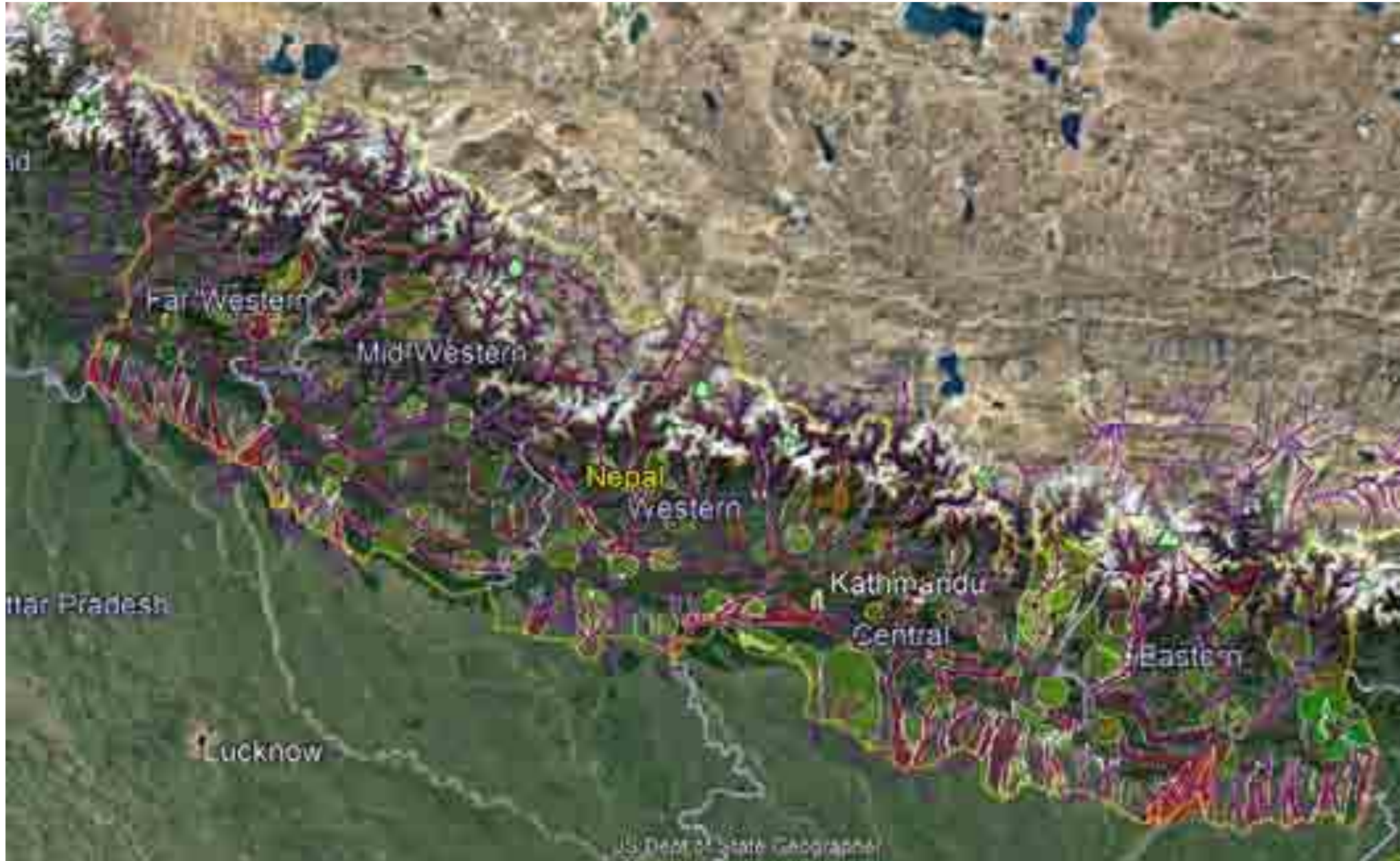
SMS Status



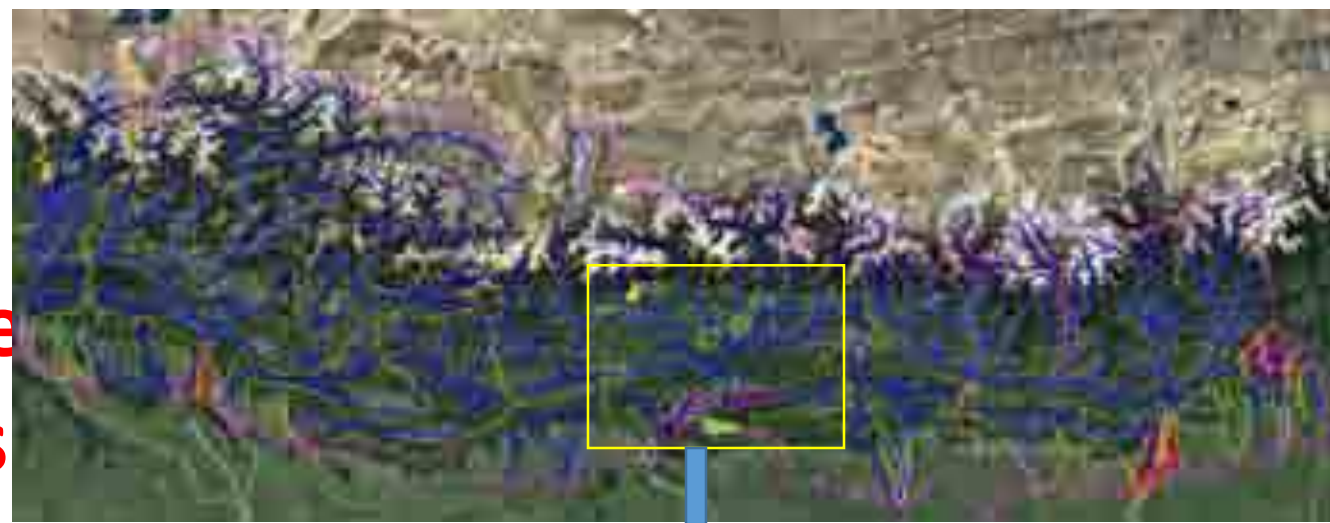
SMS Status



Communication 246 MASS SMS Polygons



**Mass SMS
To vulnerable
communities**



**246 polygons
in river basins**

**Targeted
particularly
for flood and
landslide**

Narayani

Google Earth

Flood Alert Information through MASS Till Date, 2019



What Needs Improvement/Future Plan

- Extend existing early warning system to small river basins originated from Churia & Terai part of Nepal where frequent flash flood occur
- Flood Forecast model development for all major river basins.
- Flood Forecast model development on small river basins covering Nepal
- Landslide monitoring and early warning system
- Installation of Weather Radar to monitor extreme rainfall and wind event (1 Installed, 2 in process)
- CAP
- Detail Flood Hazard Mapping
- Establishment of GLOF detection sensors river basins where there is glaciers on upstream
- Detection of river stage blocked due to landslide

How can regional Co-operation support better monitoring, warning and prediction ?

- Large glacier lake exist on the China part of the Bhotekoshi and Trishuli river basin. If GLOF information is available through regional co-operation, we can warn our people in timely manner.
- Data of Trans boundary river for flow forecast model development. 60 % of catchment of Mahakali river is on India, data not shared to develop flood forecast model.
- Downstream country (India, Bangladesh) may get benefited through our data, increases their lead time.

THANKS