Government of Nepal
Ministry of Energy, Water Resources and Irrigation
Department of Hydrology and Meteorology

Flood Impact Analysis Based on SAR Image in Kanchanpur District of Nepal

05 November 2024

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Hydrologist Engineer

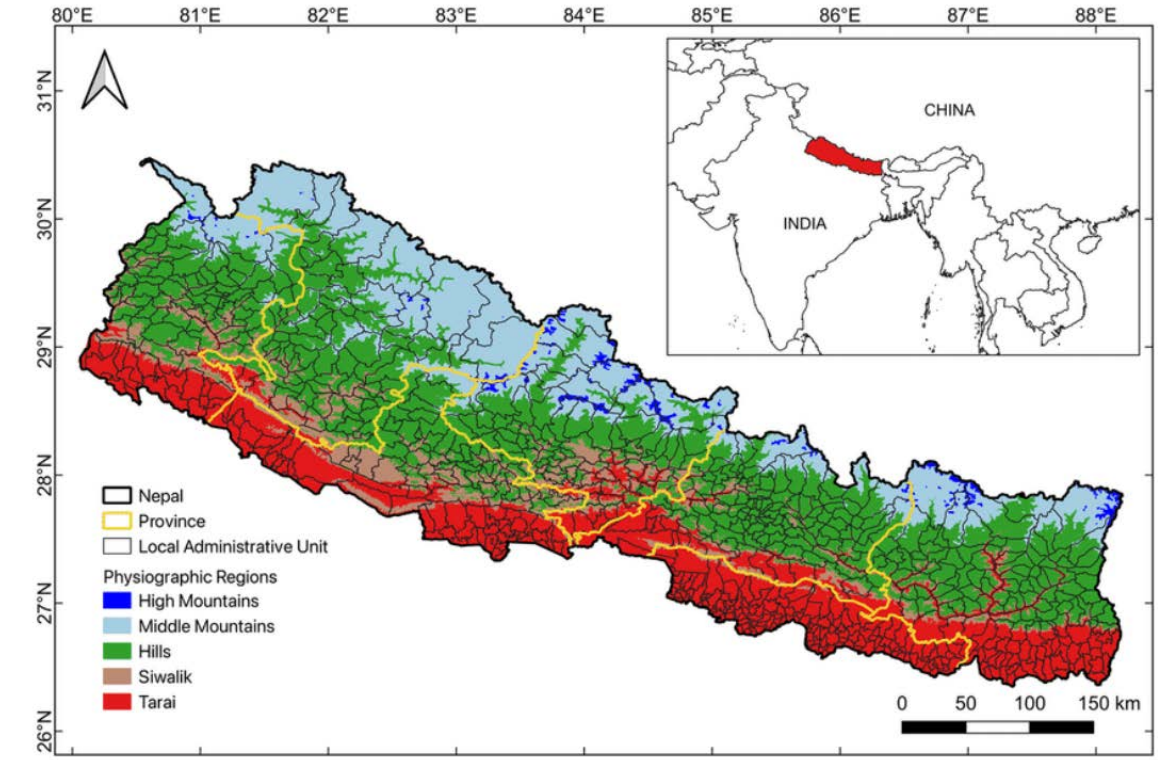
OUTLINE

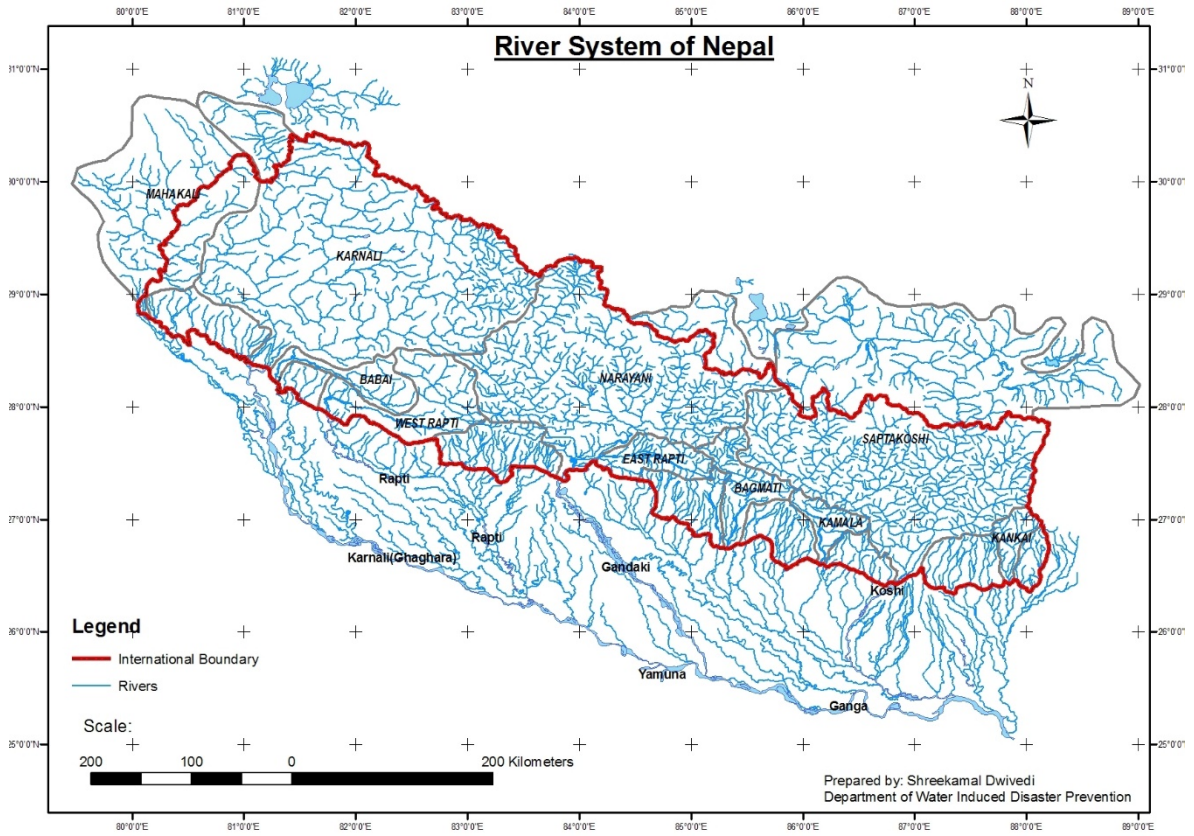
- Country Profile
- Brief Introduction of DHM
- Overview
- Kanchanpur district flood satellite imageries
- Emergency Observation and Satellite Imaging of Kathmandu Valley
- DHM - Sentinel Asia Collaboration
- Summary of EORs activated in 2024

Country Profile

Country divided into 3 physiographic regions

- Terai (Plains): 60m to 610m 17%
- Mid-hills: 610m to 4877 m 64%
- High Himalayas: 4877 m to 8848m 19%





Overview

Department of Hydrology and Meteorology

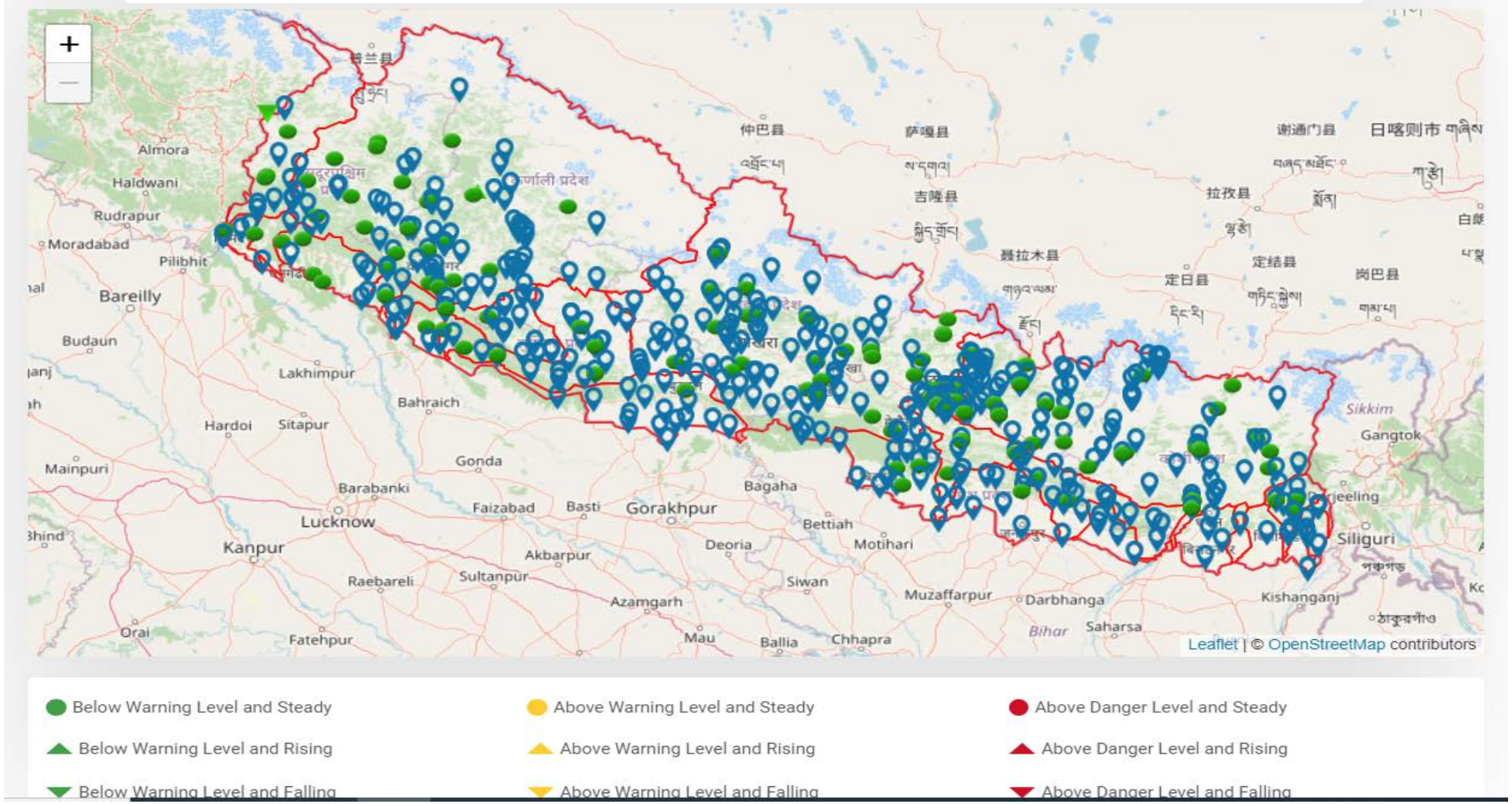
Mandate

- To monitor all hydrological and meteorological activities in Nepal

Principle Activities

- Collect and disseminate hydrological and meteorological information
- Issue hydrological and meteorological forecasts
- Conduct special studies required for policy makers and for the development of hydrological and meteorological sciences in the region.
- Promote relationships with national and international organizations

Hydro- meteorological Observation Network



- More than 275 Rainfall monitoring stations
- More than 200 Water level monitoring stations

OVERVIEW

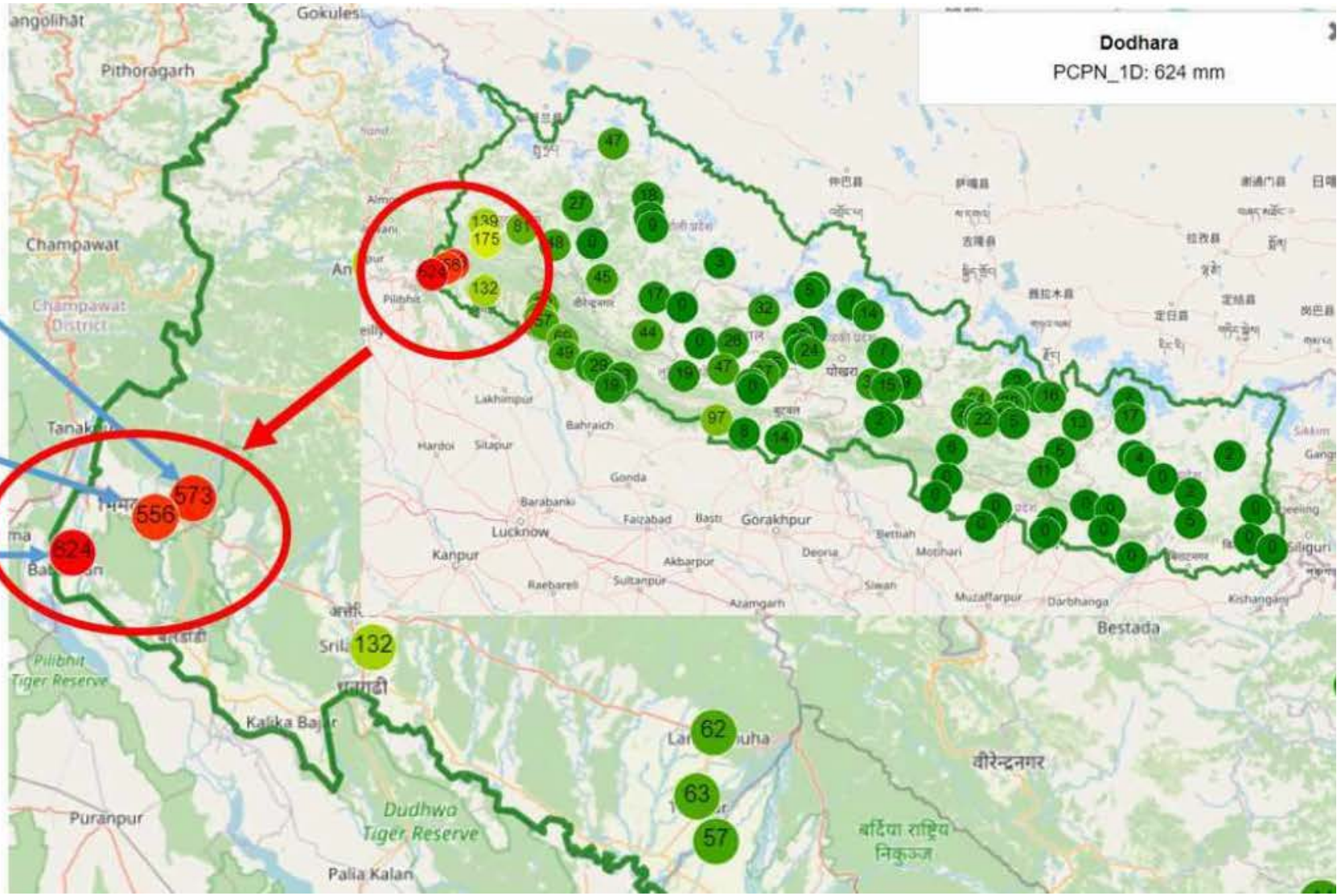
- Kanchanpur district lies in the south-western part of Nepal
- Extreme precipitation occurred on July 7-8, 2024
- Three rainfall stations of Kanchanpur recorded record breaking rainfall (measured between July 7, 8:45 am to July 8, 8:45 am NPT)
  - Dodhara station: 624 mm
  - Hanuman nagar: 573.6 mm
  - Sundarpur: 556.4 mm
- Previous highest recorded rainfall:
  - 516.2 mm in Hetauda station on August 13, 2017
  - 540.0 mm in Tistung station on July 20, 1993

Extreme precipitation measured in 24 hrs between 7th to 8th July

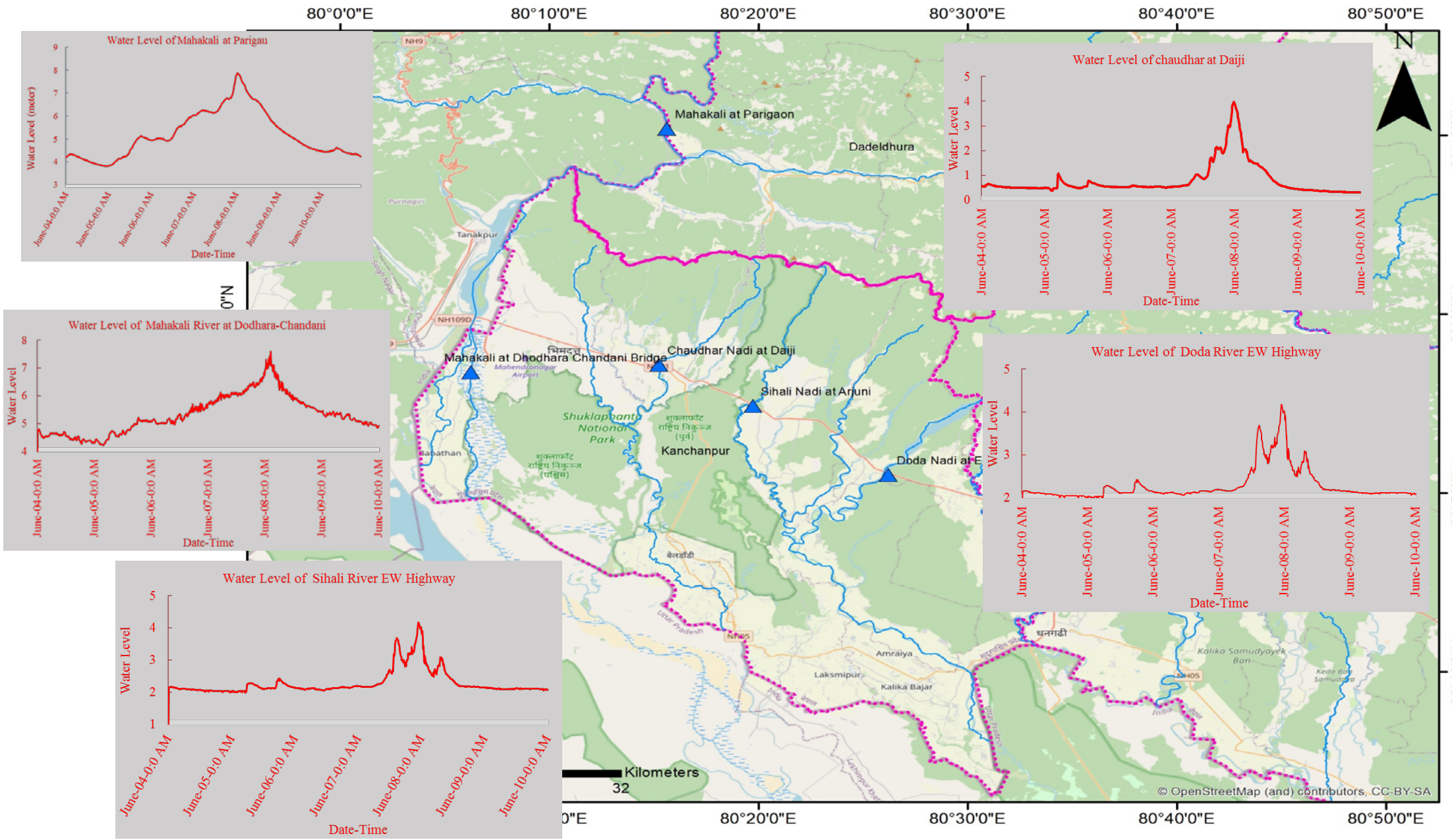
Hanmannagar: 573.6mm

Sundarpur: 556.4mm

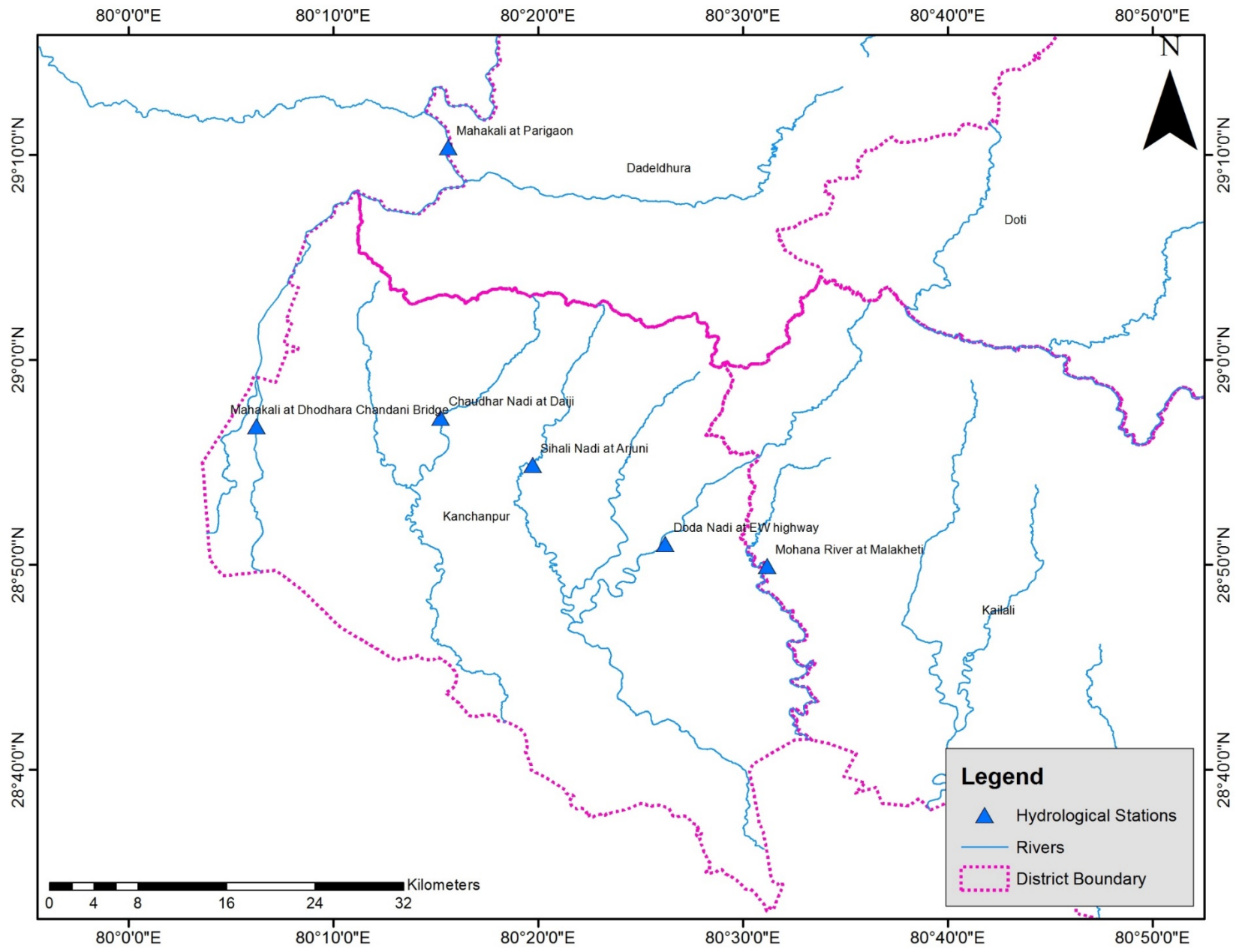
Dodhara: 624mm



Hydrological stations in Kanchanpur district

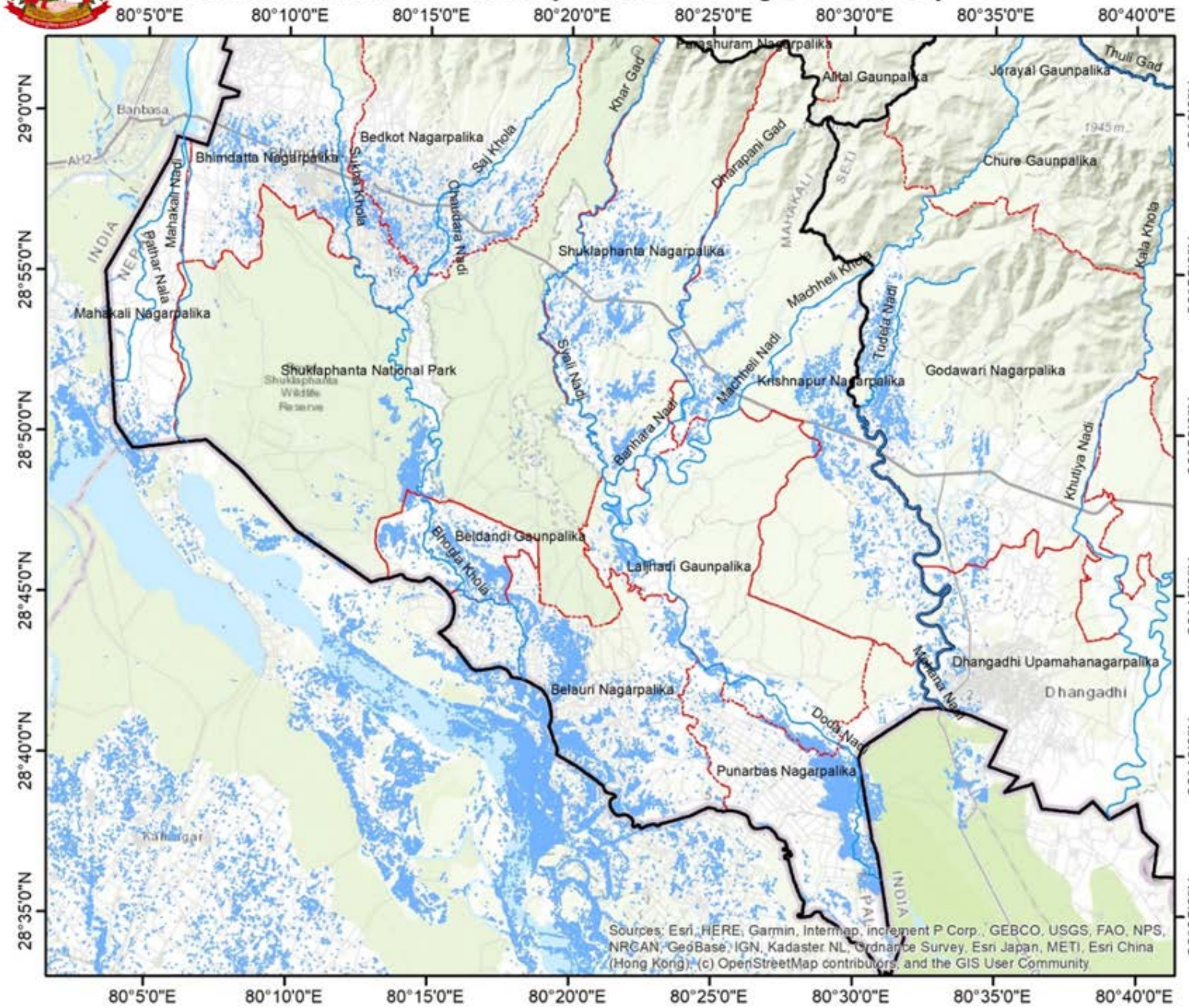


Hydrological stations in Kanchanpur district



Station	Peak WL (m)	Rise in WL (m)	Time
Mahakali River at Parigau	7.86	1.74	07/08/2024 00:50 AM
Mahakali River at Dodhara Chadani	7.6	1.66	07/08/2024 02:20 AM
Chaudhar River at Daiji	3.98	3.13	07/07/2024 23:50 PM
Sihali River at EW Highway	3.79	2.92	07/08/2024 00:20AM
Doda River at EW Highway	4.18	1.91	07/07/2024 22:50 PM

Flood Inundation as Observed by Sentinel-1 Images on 8th July 2024



Description

This map shows the flooded areas estimated using Sentinel 1 image analysis of Kanchanpur district on 8th of July 2024 after heavy rainfall in the Area.

Impact on Kanchanpur District

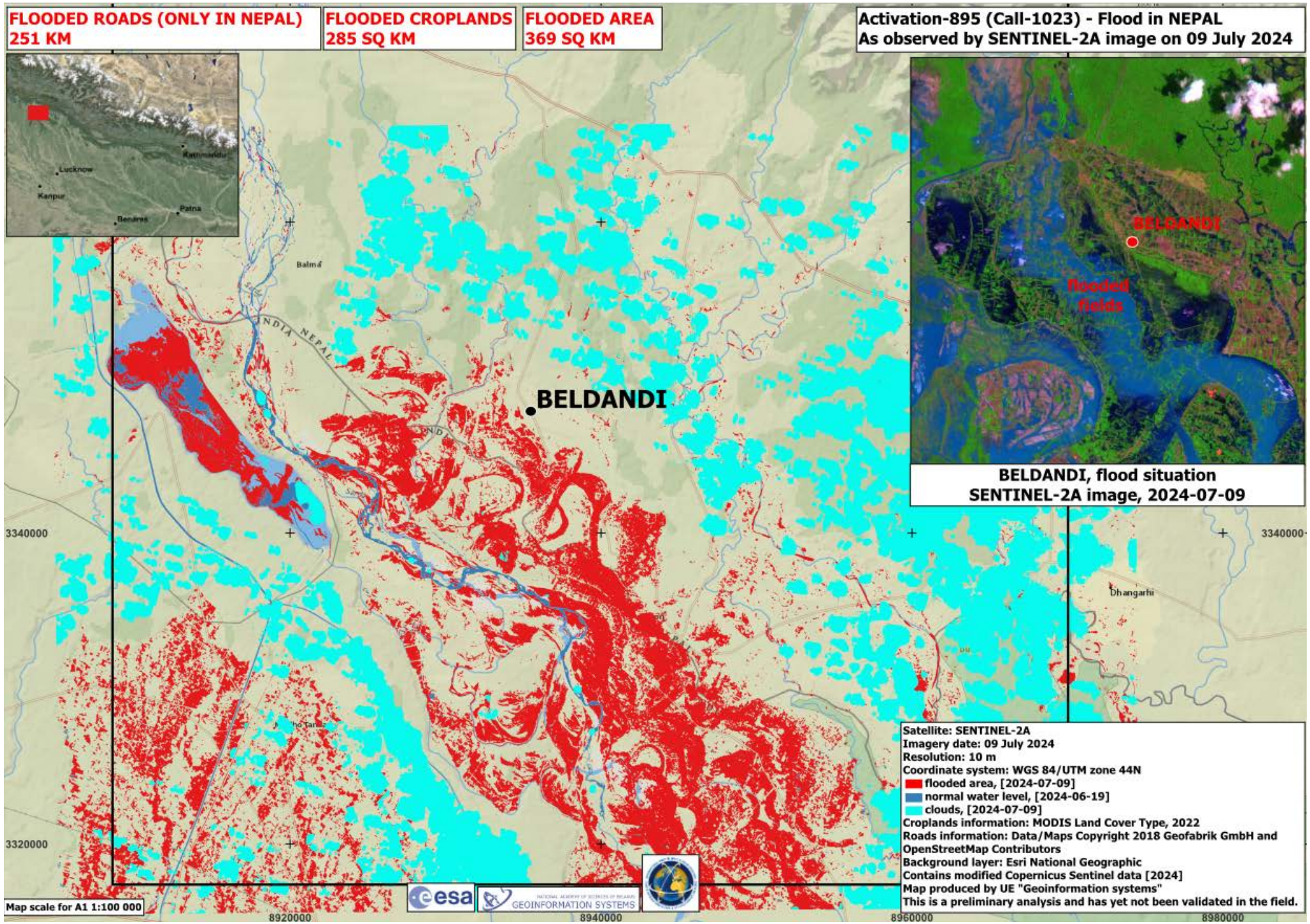
Total Inundated Area: 97.9 Sq.Km
Affected Houses : 14,315
Affected Agricultural Land : 85.27 Sq.Km

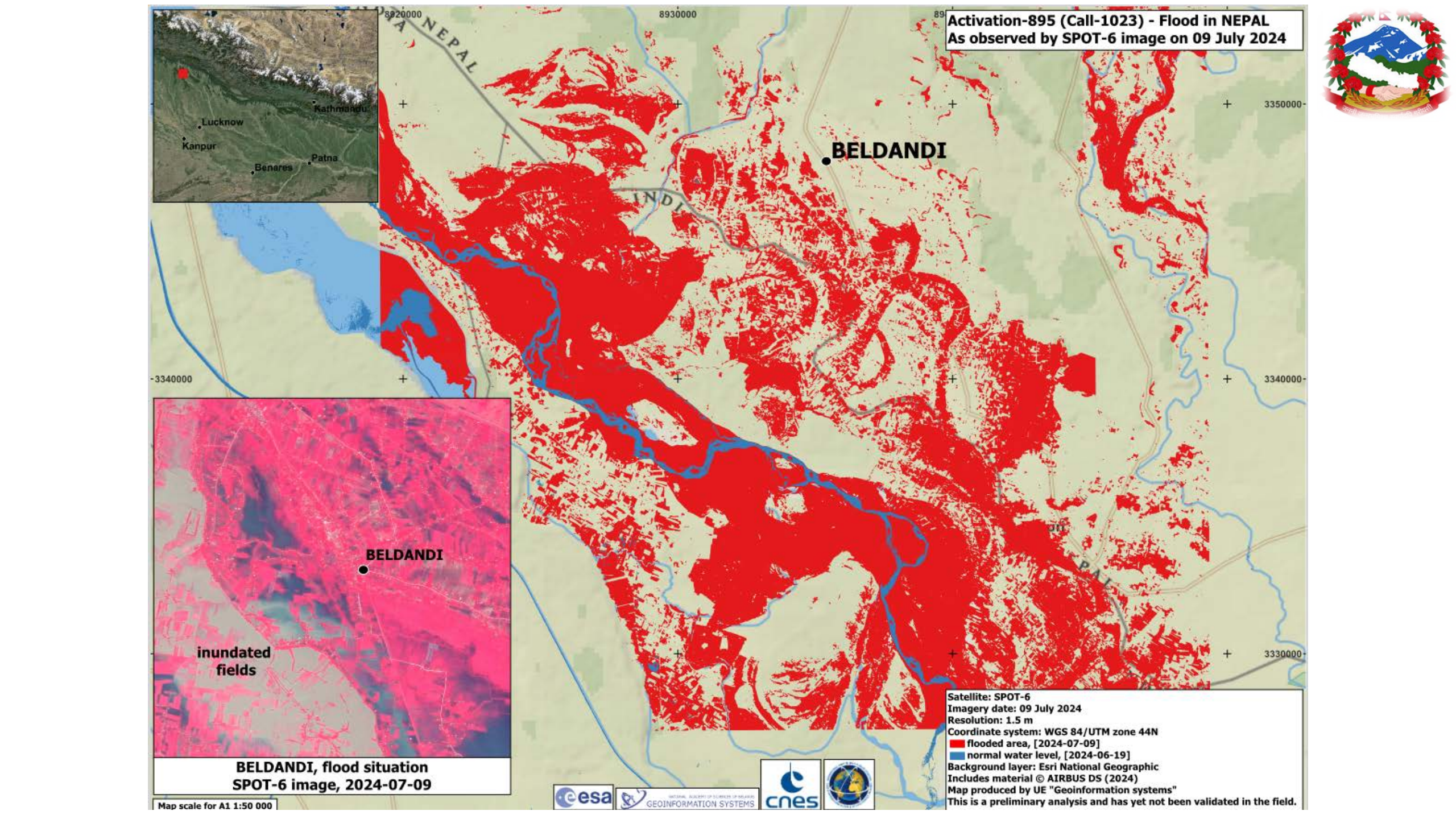
Data Source

Pre images: Sentinel 1, 21 May 2024
Post images: Sentinel 1, 08 July 2024
Land use map: ICIMOD 2020
Building shape files: OpenStreetMap

Legend

- Rivers
- District Boundary
- Local Bodies Boundary
- Observed Flood Extend


FLOODED ROADS (ONLY IN NEPAL)
251 KM
FLOODED CROPLANDS
285 SQ KM
FLOODED AREA
369 SQ KM
Activation-895 (Call-1023) - Flood in NEPAL
As observed by SENTINEL-2A image on 09 July 2024
Lucknow
Kanpur
Kathmandu
Patna
Benares
Balmā
INDIA
NEPAL
BELDANDI
BELDANDI
flooded fields
BELDANDI, flood situation
SENTINEL-2A image, 2024-07-09
3340000
3320000
Dhangarhi
8920000
8940000
8960000
8980000
Map scale for A1 1:100 000
esa
GEOINFORMATION SYSTEMS
Satellite: SENTINEL-2A
Imagery date: 09 July 2024
Resolution: 10 m
Coordinate system: WGS 84/UTM zone 44N
flooded area, [2024-07-09]
normal water level, [2024-06-19]
clouds, [2024-07-09]
Croplands information: MODIS Land Cover Type, 2022
Roads information: Data/Maps Copyright 2018 Geofabrik GmbH and OpenStreetMap Contributors
Background layer: Esri National Geographic
Contains modified Copernicus Sentinel data [2024]
Map produced by UE "Geoinformation systems"
This is a preliminary analysis and has yet not been validated in the field.


Activation-895 (Call-1023) - Flood in NEPAL
As observed by SPOT-6 image on 09 July 2024
Kathmandu
Lucknow
Kanpur
Patna
Benares
BELDANDI
8920000
8930000
3350000
3340000
3330000
BELDANDI
inundated fields
BELDANDI, flood situation
SPOT-6 image, 2024-07-09
Map scale for A1 1:50 000
Satellite: SPOT-6
Imagery date: 09 July 2024
Resolution: 1.5 m
Coordinate system: WGS 84/UTM zone 44N
flooded area, [2024-07-09]
normal water level, [2024-06-19]
Background layer: Esri National Geographic
Includes material © AIRBUS DS (2024)
Map produced by UE "Geoinformation systems"
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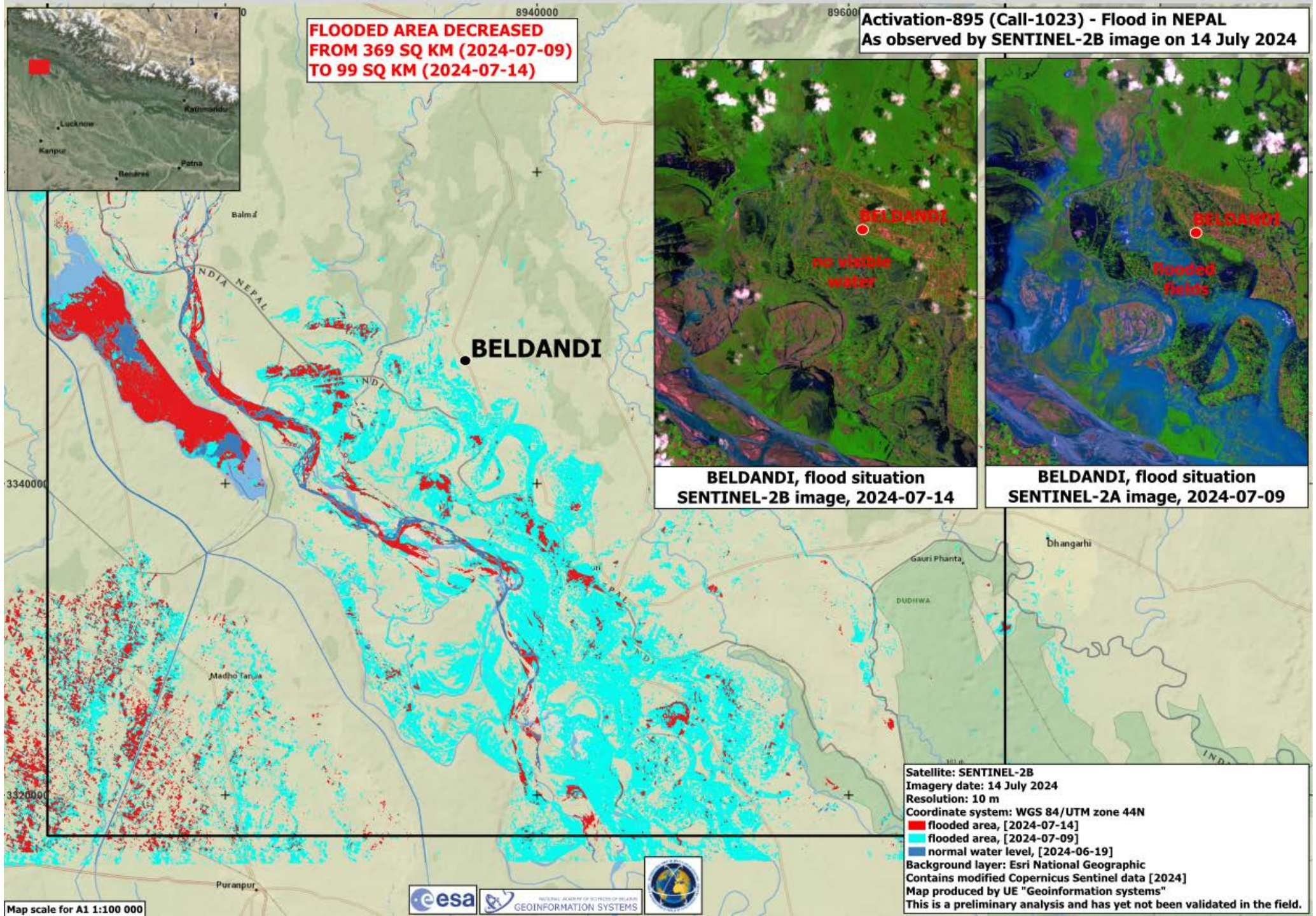
Activation-895 (Call-1023) - Flood in NEPAL
As observed by SENTINEL-2B image on 14 July 2024
FLOODED AREA DECREASED
FROM 369 SQ KM (2024-07-09)
TO 99 SQ KM (2024-07-14)
Lucknow
Kanpur
Varanasi
Patna
Kathmandu
BELDANDI
INDIA
NEPAL
Balmd
Madho Tanda
Puranpur
Gauri Phanta
DUDHWA
Dhangarhi
8940000
8960000
3340000
3320000
BELDANDI
no visible water
BELDANDI, flood situation
SENTINEL-2B image, 2024-07-14
BELDANDI
flooded fields
BELDANDI, flood situation
SENTINEL-2A image, 2024-07-09
Satellite: SENTINEL-2B
Imagery date: 14 July 2024
Resolution: 10 m
Coordinate system: WGS 84/UTM zone 44N
flooded area, [2024-07-14]
flooded area, [2024-07-09]
normal water level, [2024-06-19]
Background layer: Esri National Geographic
Contains modified Copernicus Sentinel data [2024]
Map produced by UE "Geoinformation systems"
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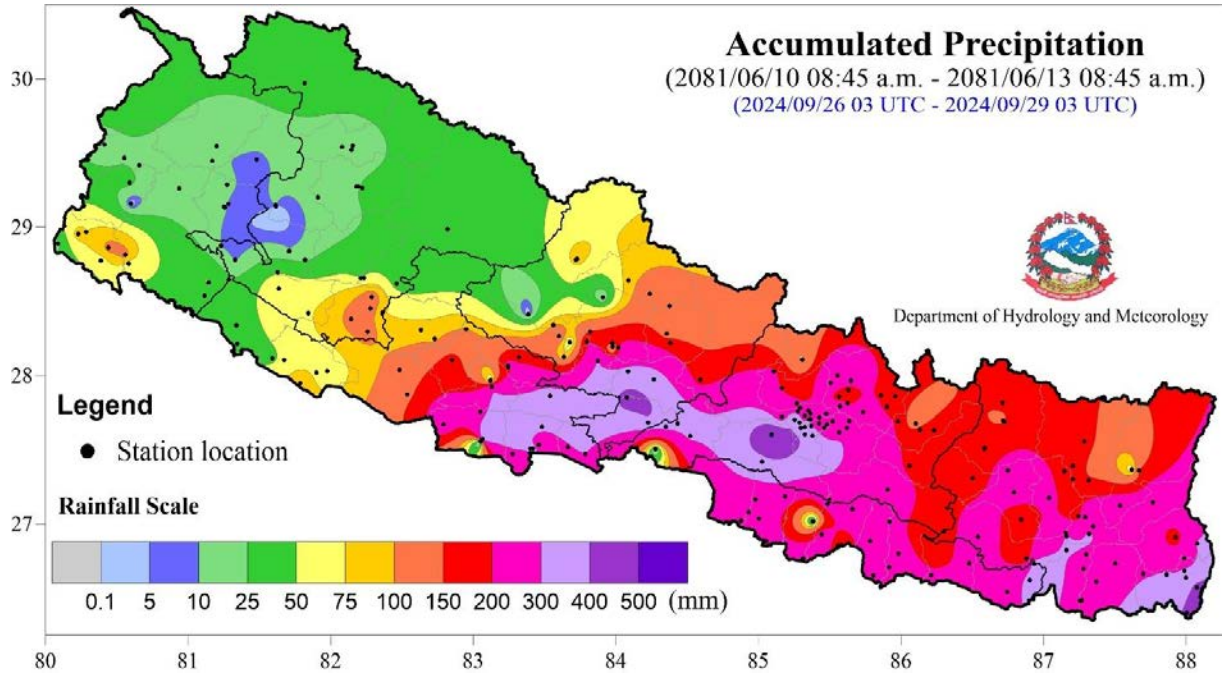
esa
GEOINFORMATION SYSTEMS
Map scale for A1 1:100 000

Observed Precipitation

- Extreme rainfall in Koshi, Madhesh, Bagmati, and other provinces.
- Daman recorded highest precipitation: 517.0 mm.
- 25 stations set new records on 28 September.

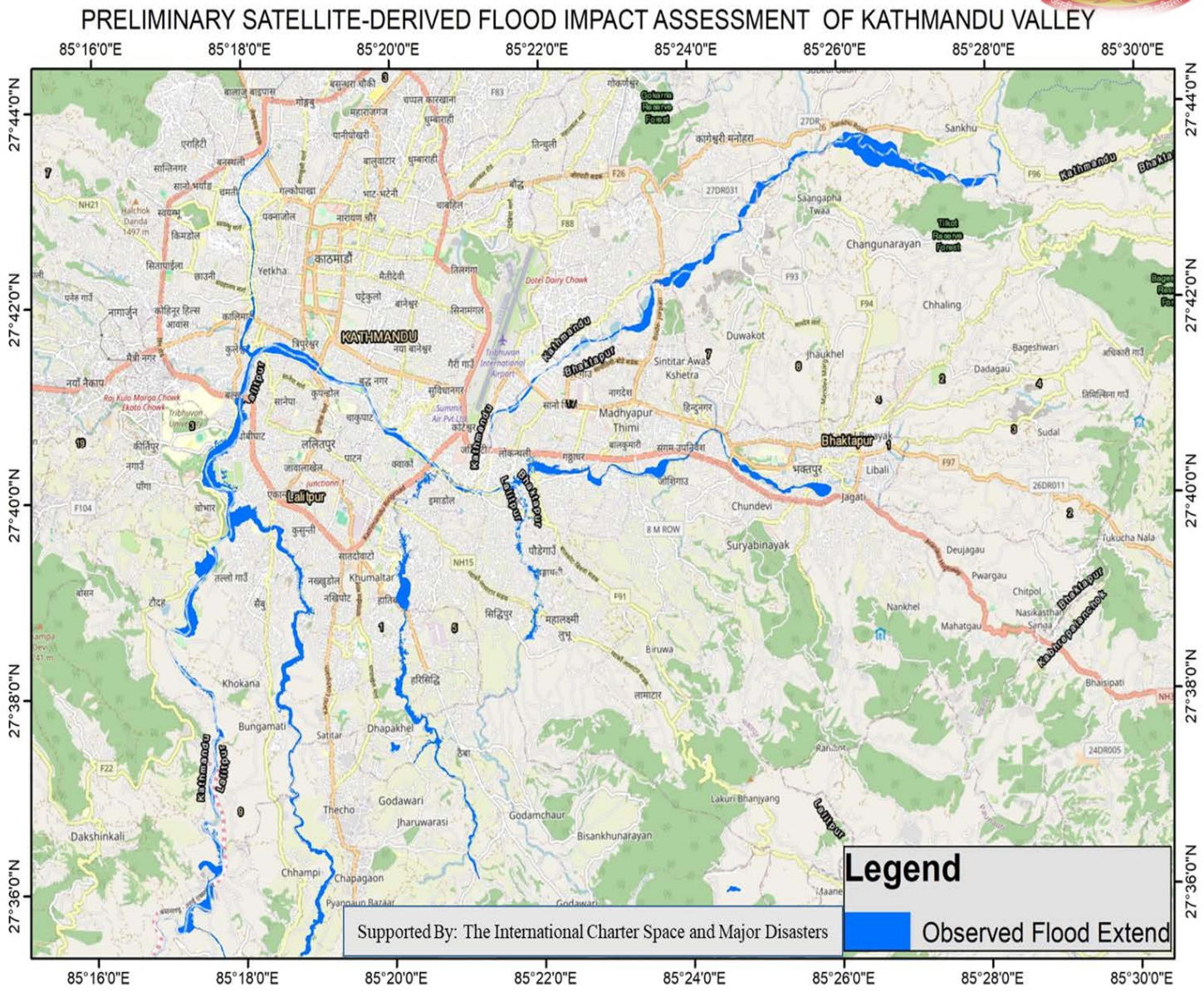


Record breaking precipitation stations (24-hour accumulated) on 28 September, 2024 at 8:45 A.M.

S. N.	Station Name	District	Precipitation (mm) recorded on 28 September (8:45 AM)	Previous record (mm)	Date of previous record
1	Sandhikharka	Arghakhanchi	196.6	166.0	16-Jun-2021
2	Nangkhel	Bhaktapur	194.5	191.5	23-Jul-2002
3	Govindabasti	Chitwan	264.0	196.0	19-Jul-2024
4	Gajuri	Dhading	261.2	131.3	2-Jul-2021
5	Chandragadi Airport	Jhapa	256.0	188.2	28-Jun-2022
6	Panipokhari	Kathmandu	206.6	198.0	14-Jun-1971
7	Kathmandu Airport	Kathmandu	239.7	177.0	23-Jul-2002
8	Buddhanilakantha	Kathmandu	178.3	159.0	23-Jul-2002
9	Jitpurphedhi	Kathmandu	178.3	128.2	7-Jul-2019
10	Nagarjun	Kathmandu	205.4	147.5	13-Sep-2014
11	Khopasi(Panauti)	Kavrepalanchok	331.6	276.9	3-Sep-2015
12	Panchkhal	Kavrepalanchok	232.5	145.0	21-Oct-1999
13	Dhulikhel	Kavrepalanchok	224.6	220.0	23-Jul-2002
14	Godavari	Lalitpur	311.6	225.2	23-Jul-200
15	Khumaltar	Lalitpur	294.4	136.0	10-Aug-2022
16	Tikathali	Lalitpur	264.0	207.0	23-Jul-2002
17	Khokana	Lalitpur	297.3	249.2	23-Jul-2002
18	Chapagaun	Lalitpur	323.5	200.5	23-Jul-2002
19	Daman	Makwanpur	410.0	373.2	20-Jul-1993
20	Kakani	Nuwakot	169.2	161.0	28-Jul-1972
21	Baldyanggadi	Palpa	252.0	90.4	16-Sep-2012
22	Phidim	Panchthar	172.0	148.9	20-Oct-2021
23	Baunepati	Sindhupalchok	190.6	137.5	16-Jul-1978
24	Sakhar at Tanahun	Tanahun	214.0	173.2	21-Jul-2020
25	Khairini Tar	Tanahun	252.3	241.9	17-Jul-1983

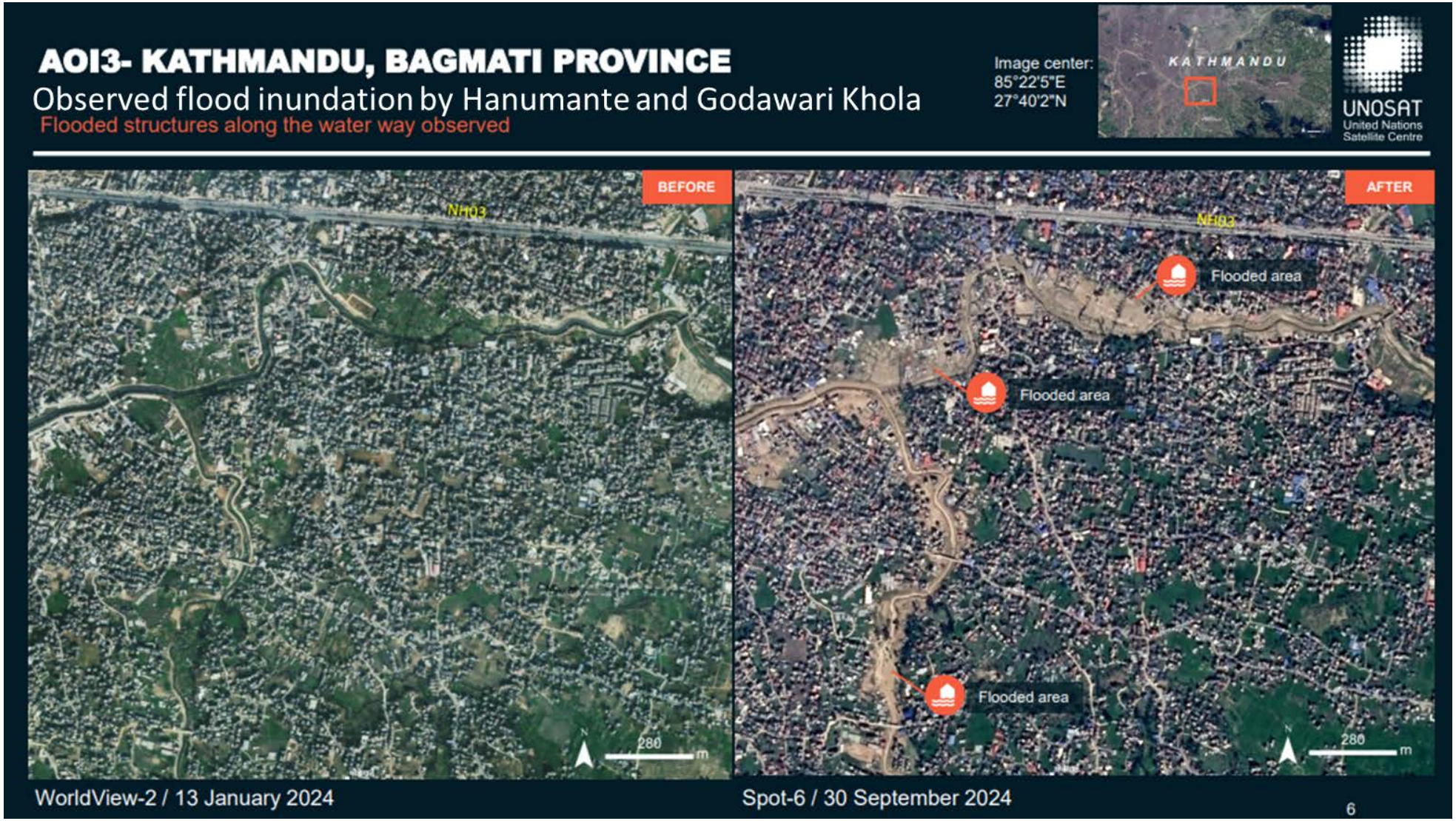
Emergency Observation and Satellite Imaging of Kathmandu Valley

- Extreme rainfall occurred 27-29 Sep
- 25 stations set new records on 28 September.
- Emergency Observation Request (EOR) issued by DHM to Sentinel Asia Platform (29 Sep 2024).
- International Disaster Charter: Value added product.
- Satellite images shows flood extent in Kathmandu Valley.

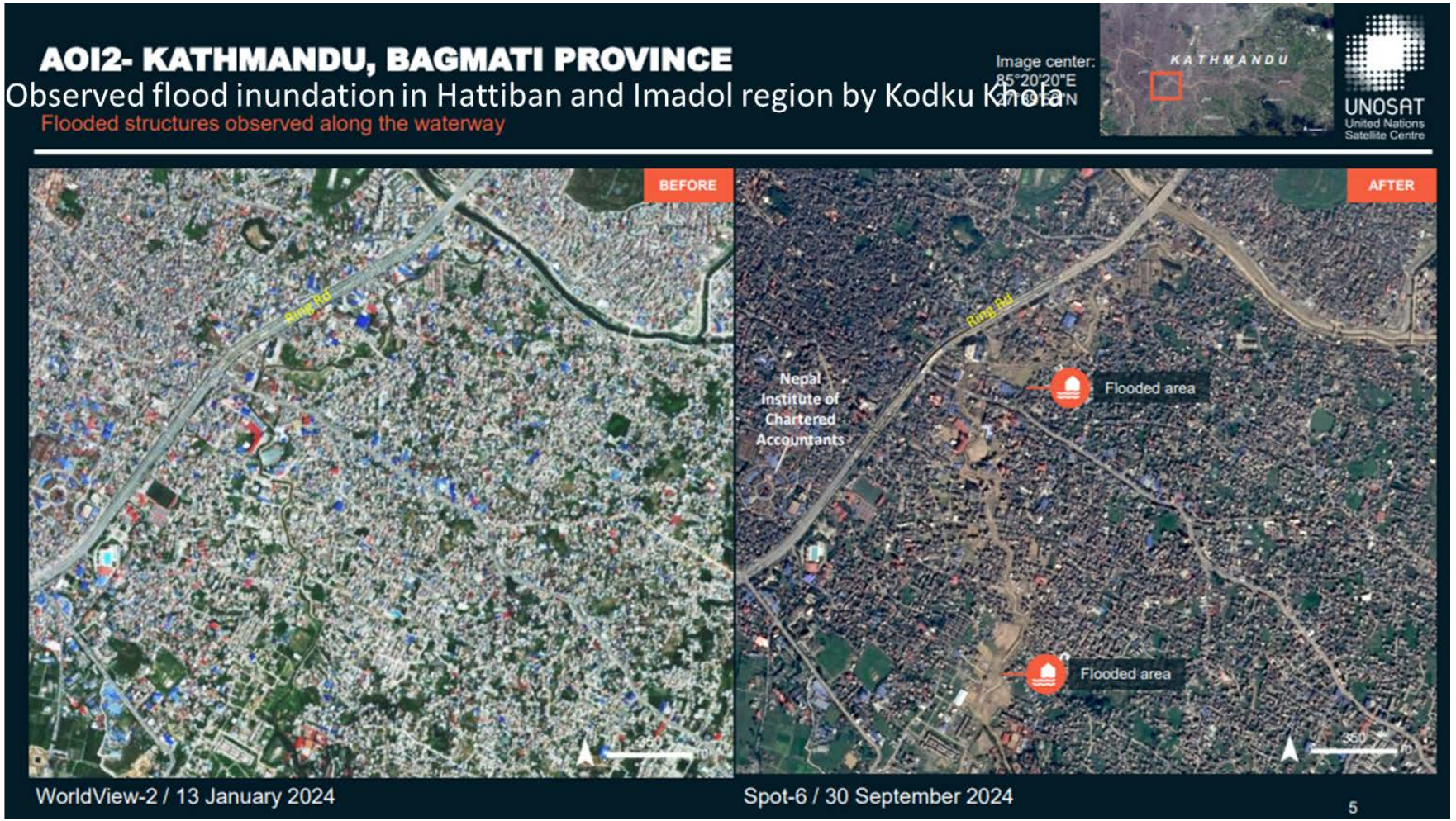


Emergency Observation- Satellite Imaging

Emergency Observation- Satellite Imaging



Emergency Observation- Satellite Imaging



DHM - Sentinel Asia Collaboration

- Since the OPTEMIS portal was introduced in April 2024, DHM has been frequently requesting for activation of EoRs
- First Started in 2015 through email requests to Sentinel Asia
- Since then, DHM has been continuously requesting EORs and receiving support for observation and analysis
- During COVID, there was a gap in regular communication
- After the launch of the OPTEMIS portal in 2023 April, it has been easier to generate and manage requests.
- 8 numbers of EORs has been activated in 2024

Summary of EORs activated in 2024

Number	Disaster	Create date	AOI	Disaster charter activation
20240928-Nepal-Flood-00551	Flood	9/28/2024	Kathmandu, Koshi, Narayani, Khurkot	Yes
20240823-Nepal-Landslide-00540	Landslide, Other	24/08/2024	Boksi Khola, Mustang	No
20240816-Nepal-Flood-Other-00534	Flood, GLOF	16/08/2024	Thame	Yes
20240730-Nepal-Flood-00530	Flood	05/08/2024	Kathmandu	No
20240707-Nepal-Flood-00515	Flood	08/07/2024	Kanchanpur	Yes
20240706-Nepal-Flood-00513	Flood	07/07/2024	Narayani	No
20240604-Nepal-Flood-00509	Flood	26/06/2024	Itahari	No
20240421-Nepal-Flood-Other-00498	Flood, GLOF	21/04/2024	Birendra Tal	No

Thank you for your time and attention!!