Landslide Early Warning System
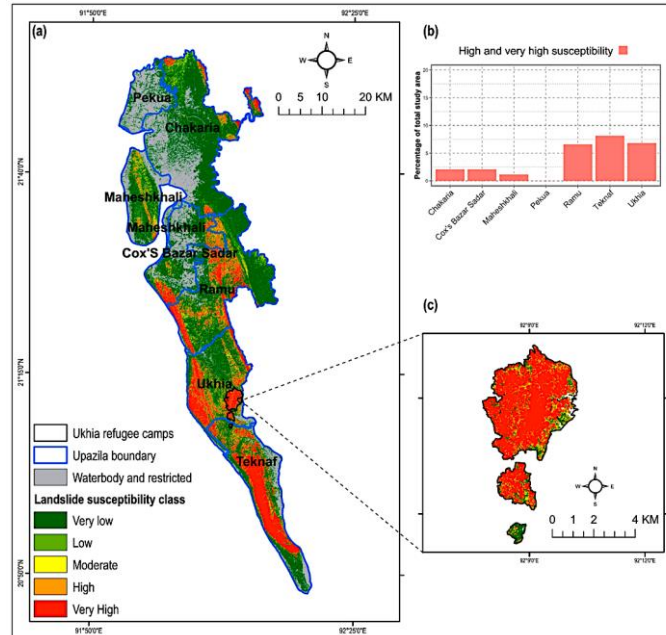
Historical Landslide Disasters – Cox's Bazar

Date	Location of Landslides	Rainfall Sequence	Consequences *
28 June 2015	Teknaf, Ramu, Chokoria, and Pekua Upazila, Cox's Bazar	5 days of heavy rainfall (674mm)	21 dead, roads and municipalities are flooded
27 July 2015	South Baharchharha area, Cox's Bazar	Several days of continuous rainfall	5 fatalities, and 4 houses buried
13 June 2017	All five hill districts	Several days of continuous rainfall	159 dead and 88 injured
25 July 2017	Sadar and Ramu Upazila, Cox's Bazar	Several days of continuous rainfall	5 dead and 5 injured
11 June 2018	Rohingya camps, Ukhia Upazila, Cox's Bazar	459 mm rainfall in 4 days	2 killed and 500 injured, 600 shelters destroyed
12 June 2018	Maheshkhali Upazila, Cox's Bazar		1 killed
25 July 2018	Miar Ghona, Cox's Bazar Municipality area, and Dokkhin Mithachori, Ramu Upazila, Cox's Bazar	228 mm rainfall in 24 hours	5 killed
11 May 2019	Camp 14, Hakimpara, Balukhali, Ukhia Rohingya camp	Few days of torrential rainfall	2 Rohingya children were killed

Conventional warning system

- **Now cast**
- **Have limited field inventory data**
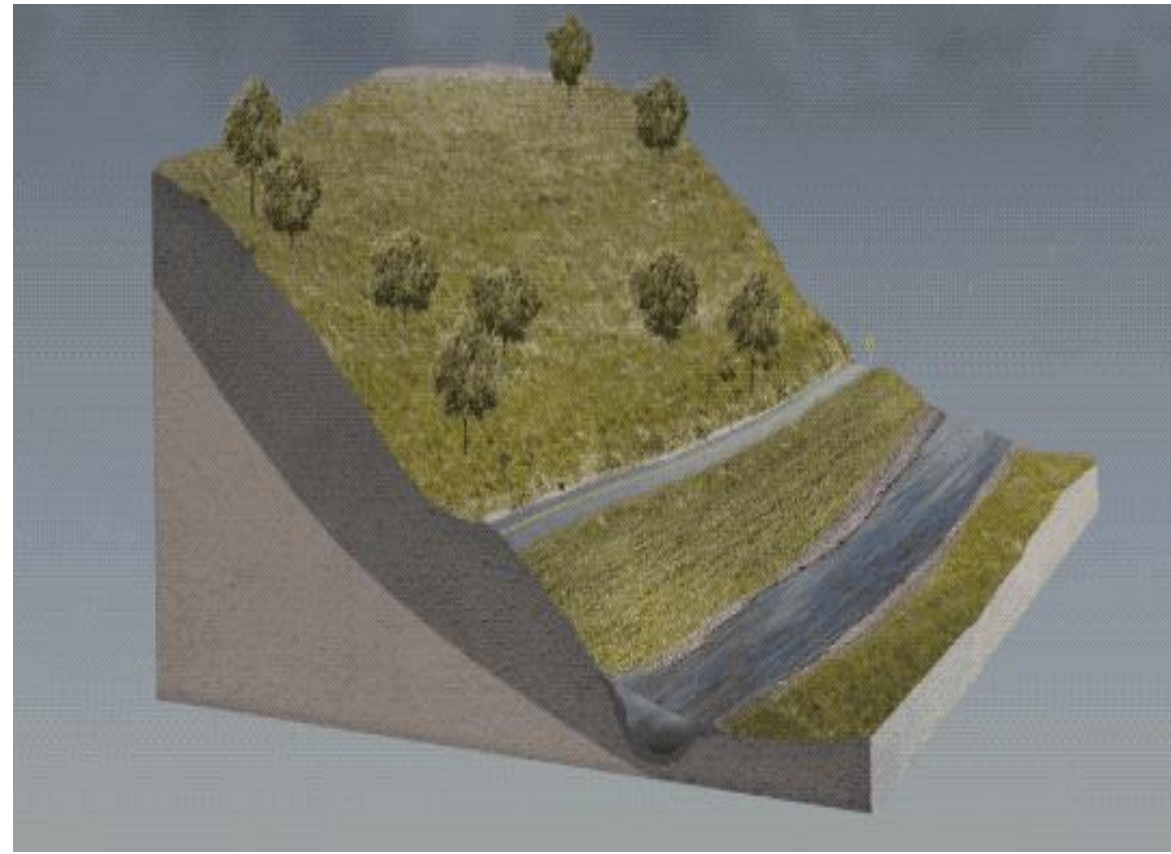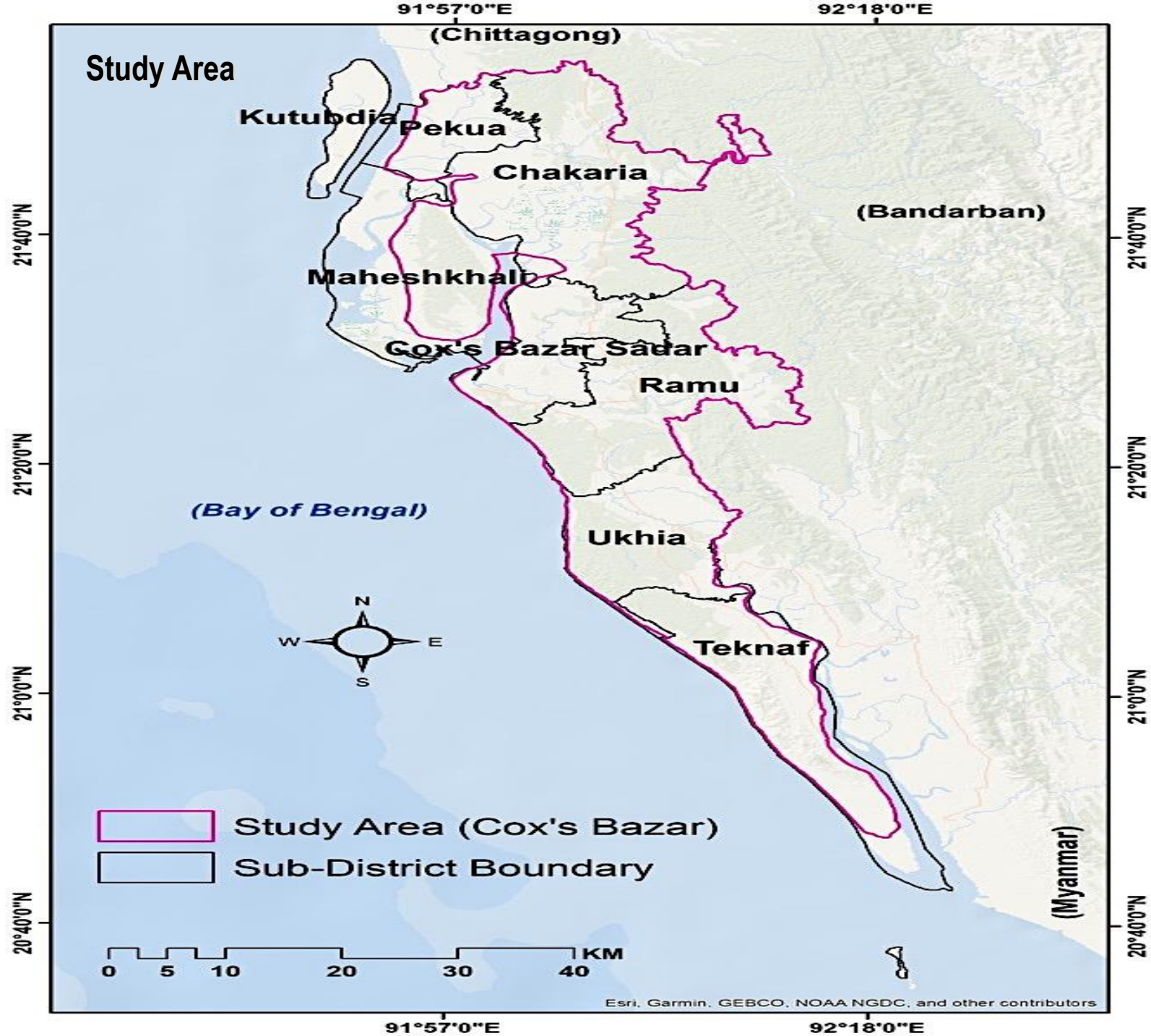
Proposed warning system

1. Information collected at stakeholder level
2. Extensive field inventory
3. Analysis of meteorological data
4. Integration of different land use change parameter
5. Utilization of satellite imagery and remote sensing technologies
6. Development of web-based platform
7. Generate early warning for early action

Basic Information

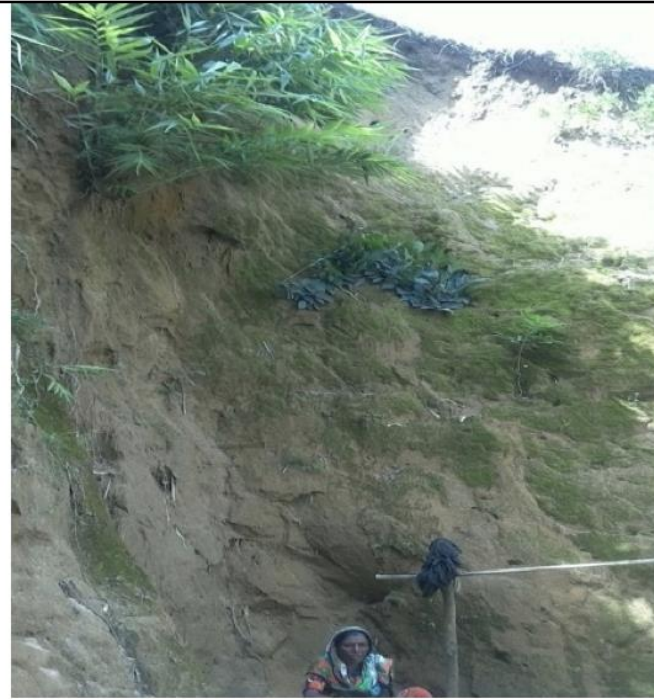|	
Landslide ID: 33	**Local Area:** Hondehata mricchaghna, Hnila, Teknaf
Coordinates: 21.0225255333N, 92.2288045167E	**Elevation (m):** 19
	Slope angle (°): 89
Width of displaced mass (m): 9.8	**Length of displaced mass (m):** 10.6
Depth of displaced mass (m): 10.2	**Overall risk intensity:** High

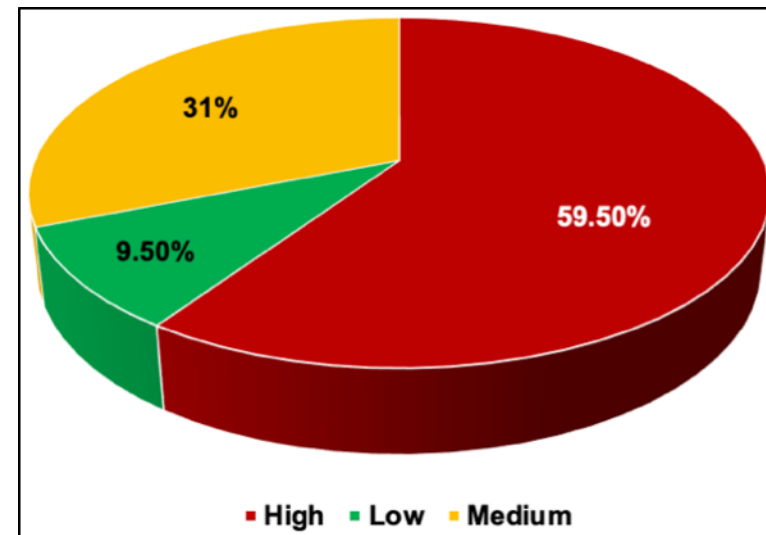## Landslide Mechanism

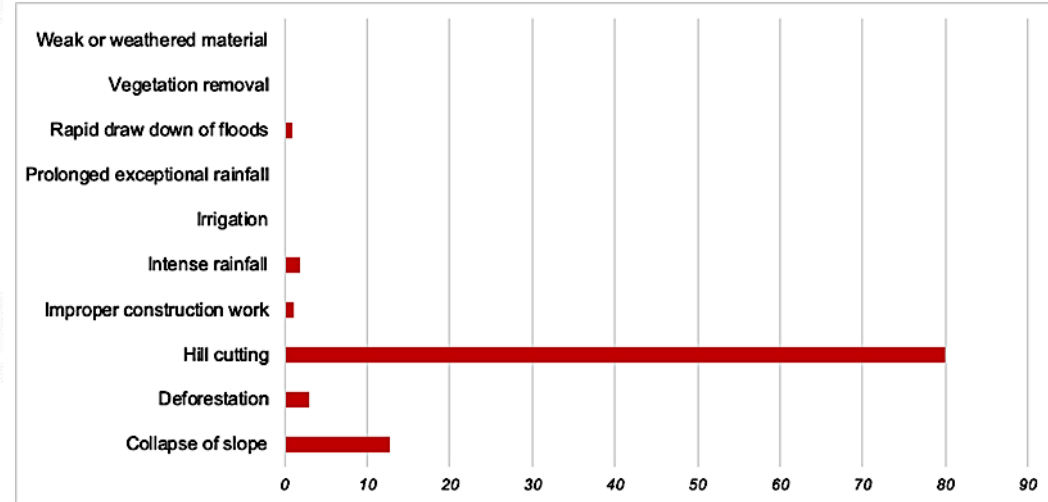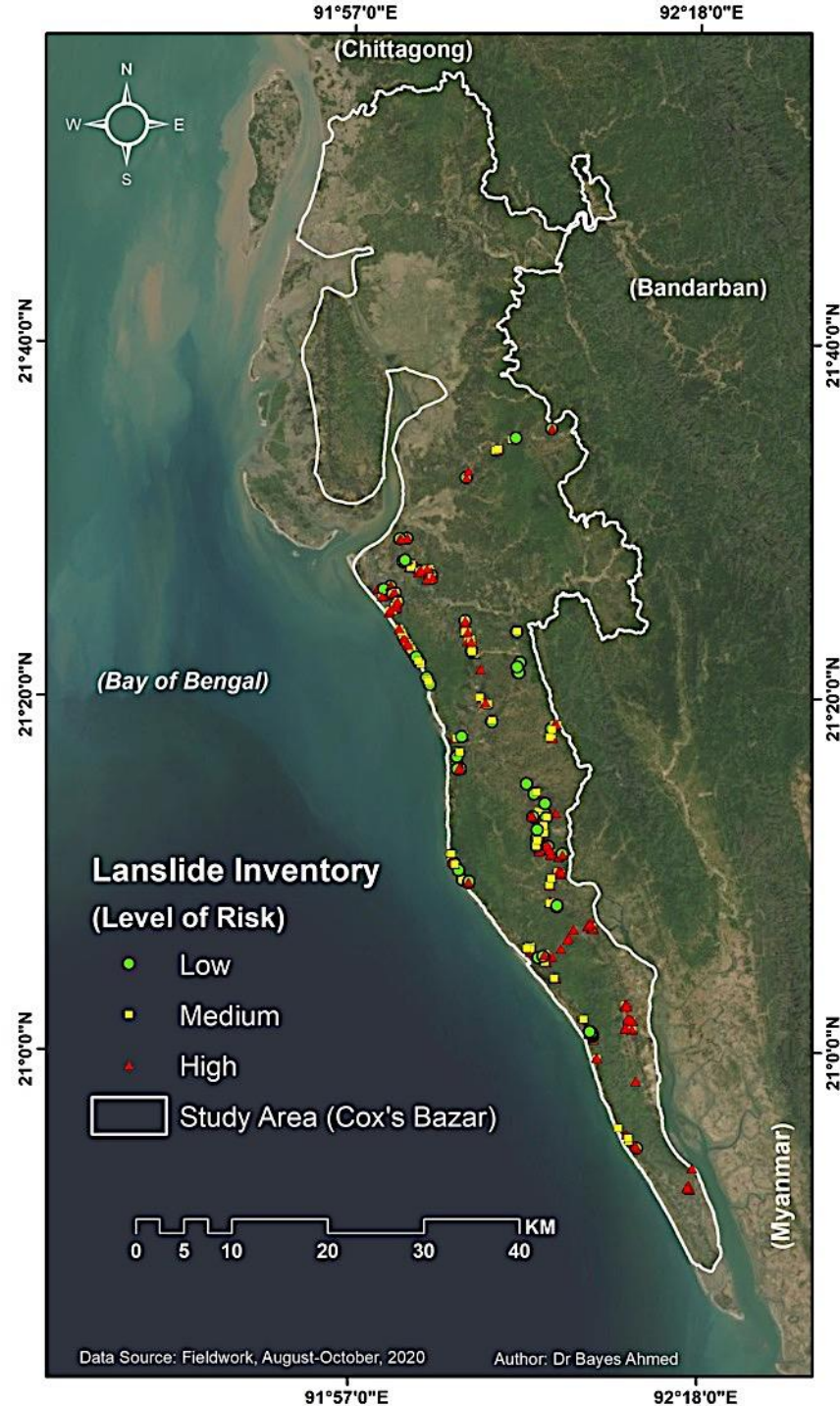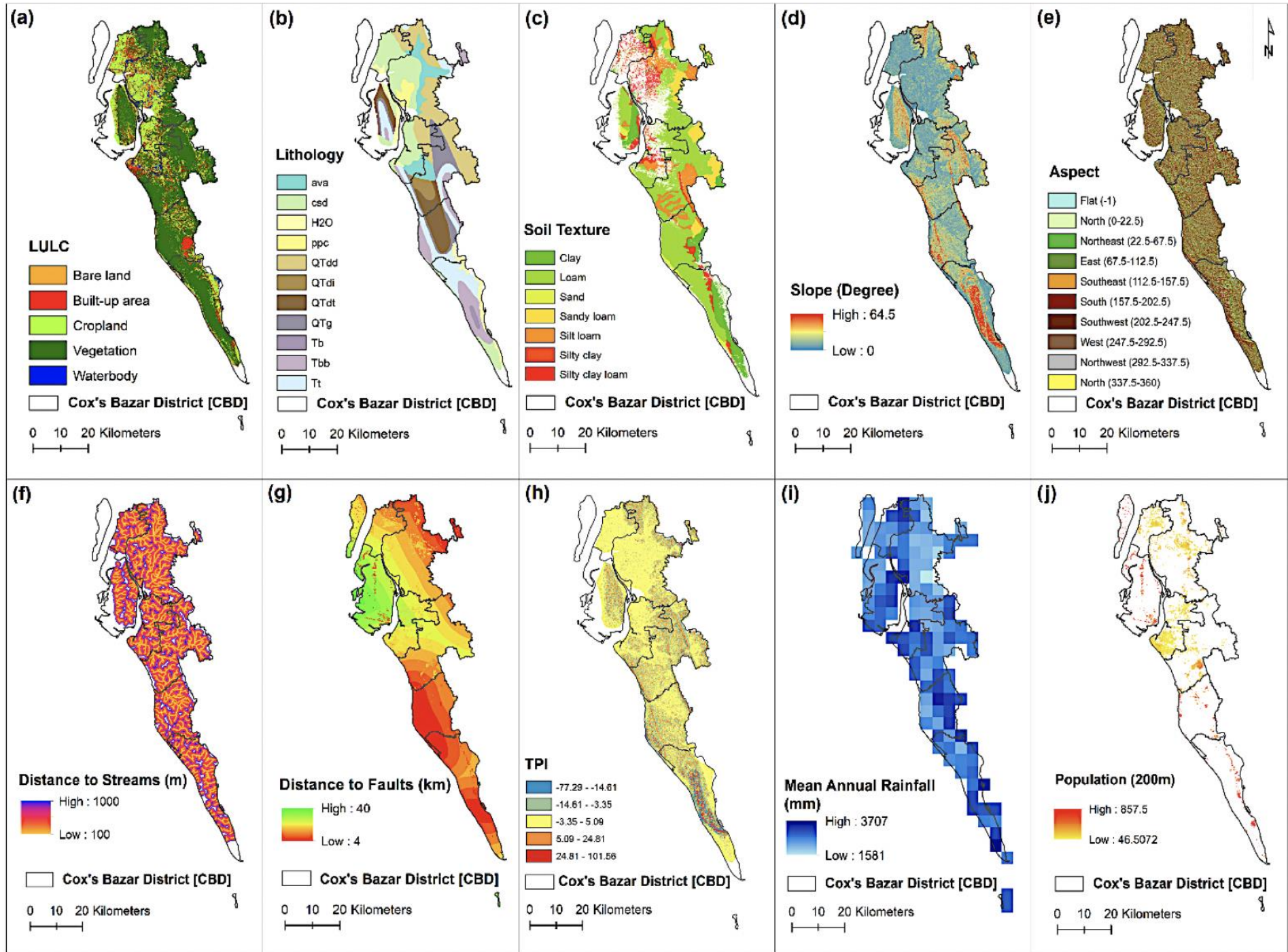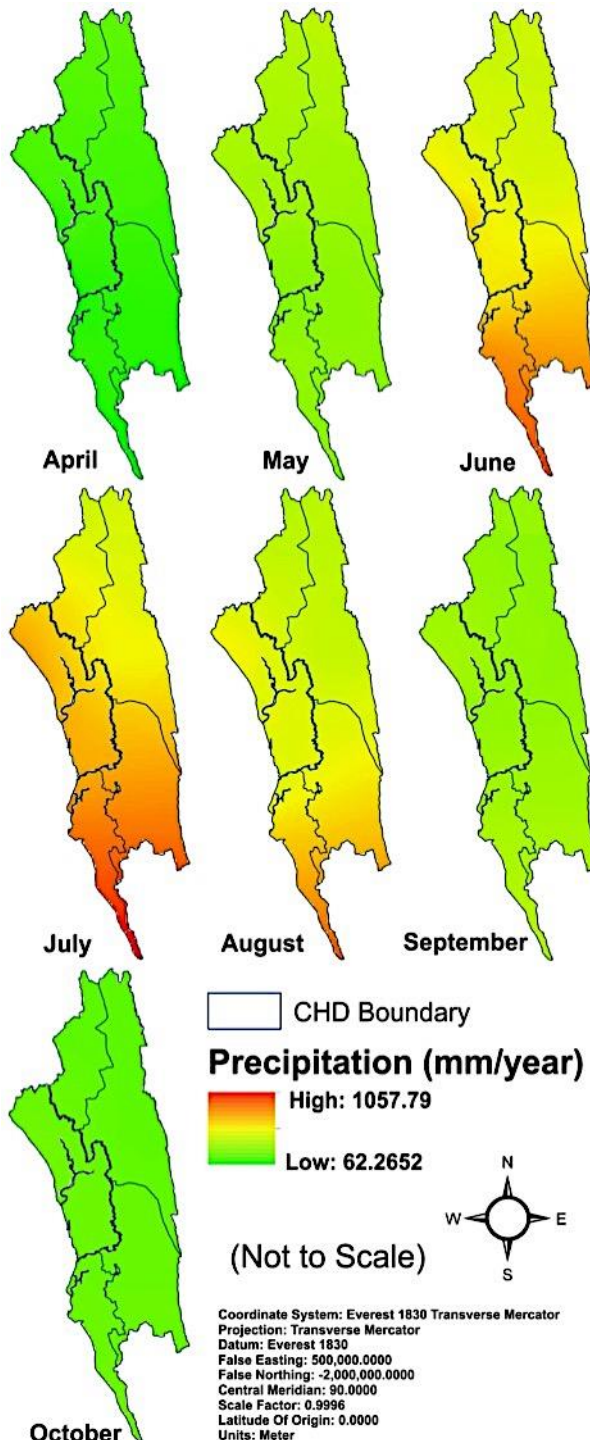|	
Type of movement: Complex	**Distribution:** Advancing
State: Active	**Style:** Multiple

Landslide Inventory Mapping

The fieldwork was conducted from 20 August to 19 October 2020 and the team collected detailed landslide inventory information of **890 locations**.


Data Source: Fieldwork, August-October, 2020   Author: Dr Bayes Ahmed

(a) LULC
- Bare land
- Built-up area
- Cropland
- Vegetation
- Waterbody

Cox's Bazar District [CBD]
0 10 20 Kilometers

(b) Lithology
- ava
- csd
- H2O
- ppc
- QTdd
- QTdi
- QTdt
- QTg
- Tb
- Tbb
- Tt

Cox's Bazar District [CBD]
0 10 20 Kilometers

(c) Soil Texture
- Clay
- Loam
- Sand
- Sandy loam
- Silt loam
- Silty clay
- Silty clay loam

Cox's Bazar District [CBD]
0 10 20 Kilometers

(d) Slope (Degree)
High : 64.5
Low : 0

Cox's Bazar District [CBD]
0 10 20 Kilometers

(e) Aspect
- Flat (-1)
- North (0-22.5)
- Northeast (22.5-67.5)
- East (67.5-112.5)
- Southeast (112.5-157.5)
- South (157.5-202.5)
- Southwest (202.5-247.5)
- West (247.5-292.5)
- Northwest (292.5-337.5)
- North (337.5-360)

Cox's Bazar District [CBD]
0 10 20 Kilometers

(f) Distance to Streams (m)
High : 1000
Low : 100

Cox's Bazar District [CBD]
0 10 20 Kilometers

(g) Distance to Faults (km)
High : 40
Low : 4

Cox's Bazar District [CBD]
0 10 20 Kilometers

(h) TPI
- -77.29 - -14.61
- -14.61 - -3.35
- -3.35 - 5.09
- 5.09 - 24.81
- 24.81 - 101.56

Cox's Bazar District [CBD]
0 10 20 Kilometers

(i) Mean Annual Rainfall (mm)
High : 3707
Low : 1581

Cox's Bazar District [CBD]
0 10 20 Kilometers

(j) Population (200m)
High : 857.5
Low : 46.5072

Cox's Bazar District [CBD]
0 10 20 Kilometers

Rainfall Threshold Analysis

April, May, June, July, August, September, October

CHD Boundary

Precipitation (mm/year)
High: 1057.79
Low: 62.2652

(Not to Scale)

Coordinate System: Everest 1830 Transverse Mercator
Projection: Transverse Mercator
Datum: Everest 1830
False Easting: 500,000.0000
False Northing: -2,000,000.0000
Central Meridian: 90.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

| Event Date (dd/mm/yyyy)	Number of days prior to major landslide events							
	-7	-6	-5	-4	-3	-2	-1	0
	Rainfall (mm)							
16/06/2003	17	21	110	66	13	42	8	77
29/07/2003	5.08	24.89	0	7.11	36.07	56.90	36.07	82.04
10/06/2006	107.95	11.94	1.02	1.02	41.91	55.12	105.92	117.09
11/06/2007	0.00	0.00	0.00	0.00	36.07	2.03	25.91	181.10
06/07/2007	0.00	16.00	180.59	72.90	58.93	66.04	149.10	21.08
06/07/2008	27	131	188	74	65	100	90	107
29/07/2009	34.04	10.92	28.96	0.00	36.07	51.05	11.94	141.99
15/06/2010	0.00	0.00	0.00	41.91	1.02	74.93	77.98	248.92
26/06/2012	173.99	134.11	0.00	10.92	19.05	32.00	111.00	21.08
27/06/2015	2.03	59.94	74.93	82.04	430.02	255.02	262.89	97.03
27/07/2015	0.00	80.01	41.91	129.03	138.94	213.11	78.99	89.92
04/07/2017	0.00	0.00	5.08	22.10	16.00	71.12	116.08	64.01
25/07/2017	0.00	6.10	103.12	105.92	33.02	167.89	175.01	91.95
10/06/2018	0.00	1.02	0.00	7.87	0.00	0.00	61.98	242.06
12/06/2018	7.87	0.00	0.00	61.98	242.06	66.04	88.90	93.73
25/06/2018	0.00	2.03	0.00	0.00	19.05	42.93	102.11	82.04
04/07/2018	102.11	82.04	4.06	2.03	10.41	29.97	8.89	116.08
25/07/2018	2.29	5.08	3.05	22.61	11.94	35.31	164.34	365.00
Mean	26.63	32.56	41.15	39.30	67.14	75.64	93.06	124.40
Median	02.16	11.43	3.56	22.36	34.55	56.01	89.45	95.38

Landslide Susceptibility Maps
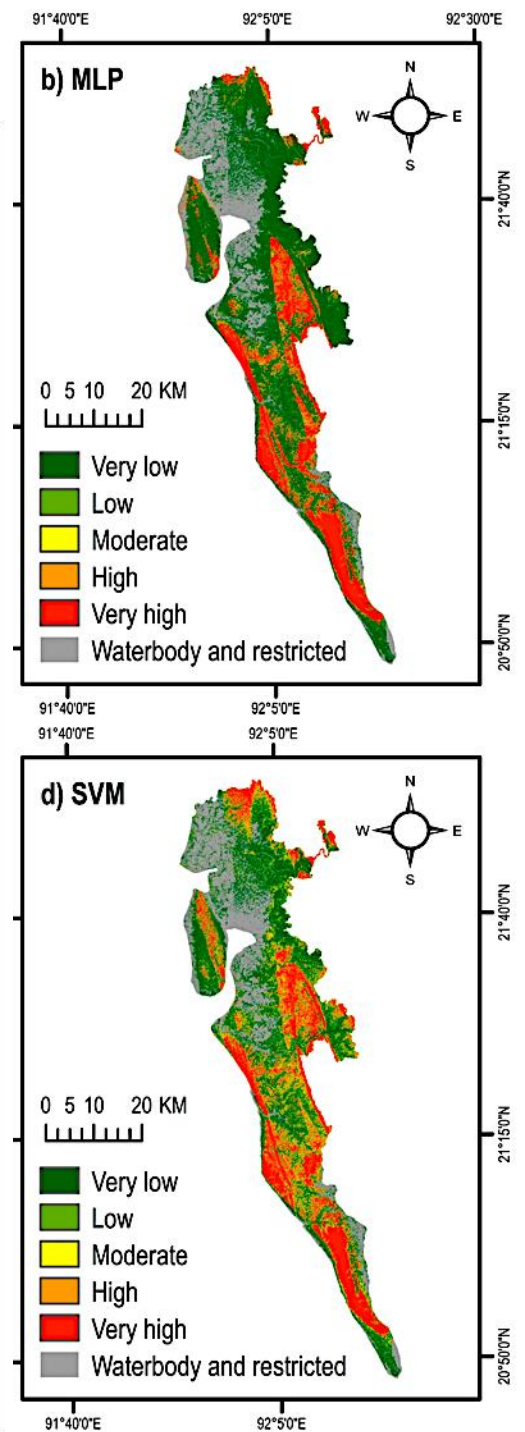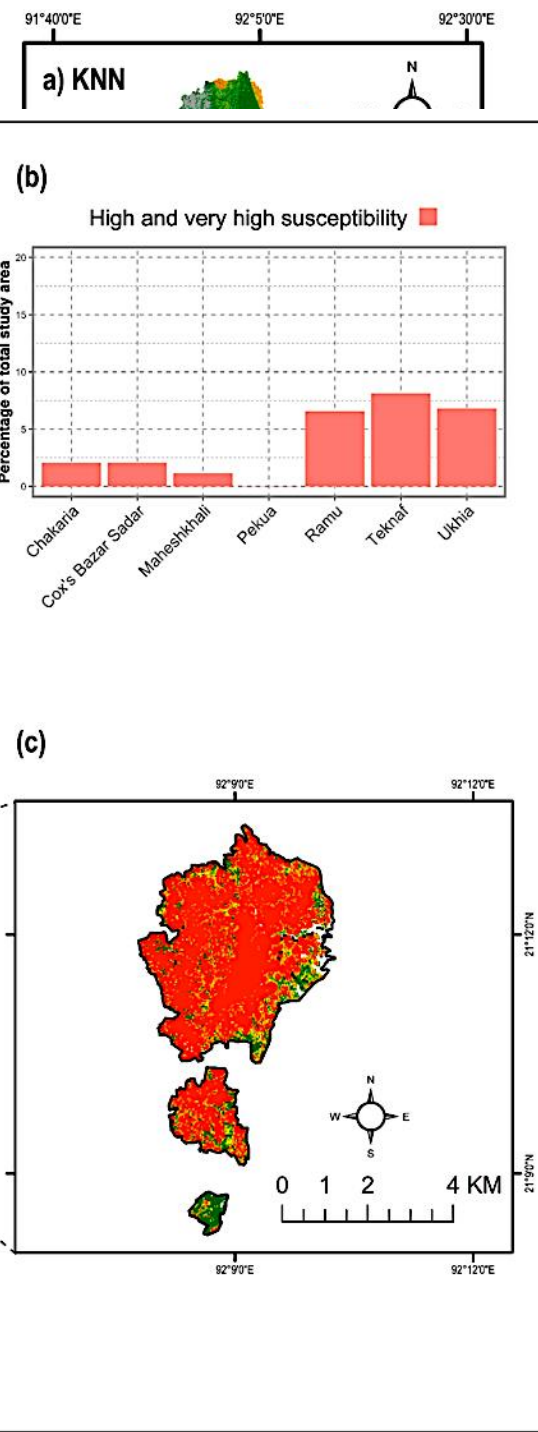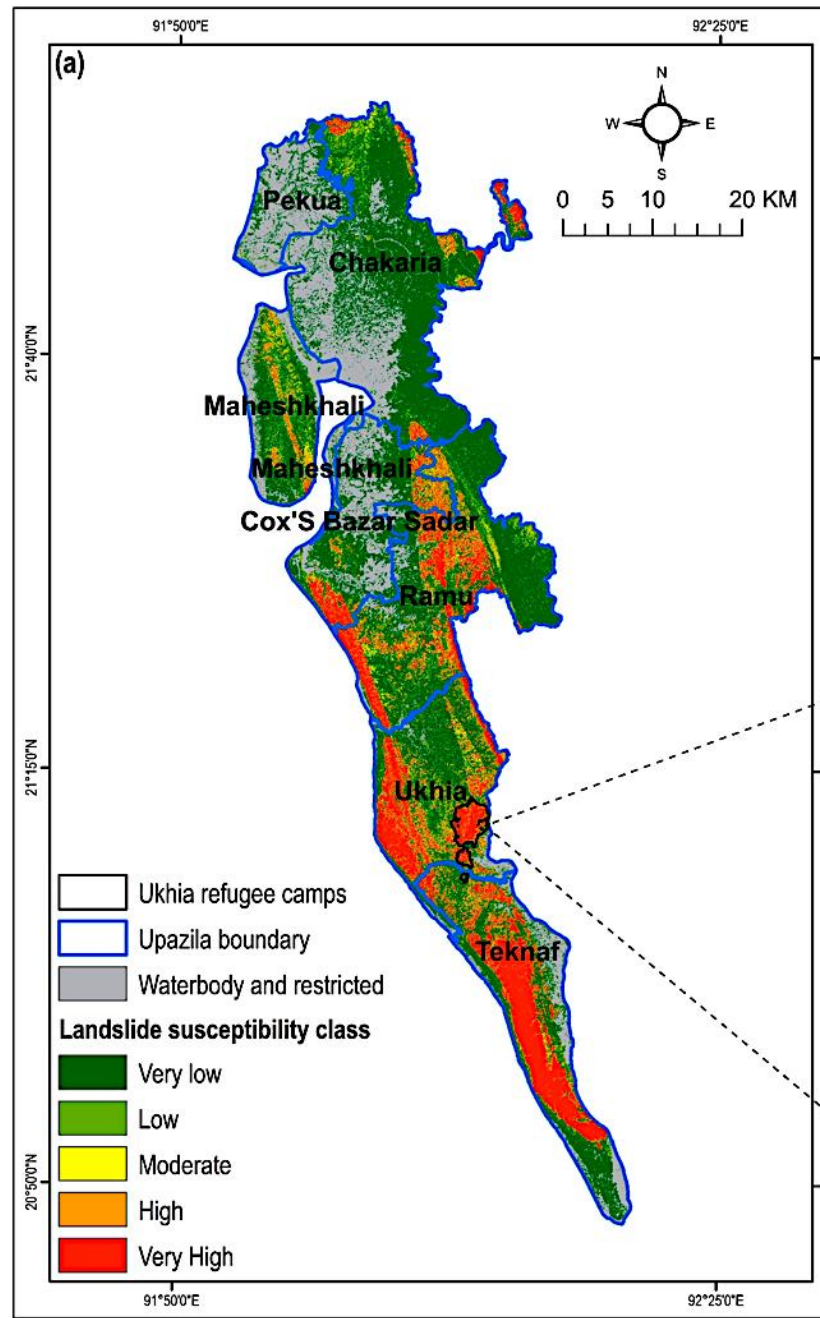
Early Warning System
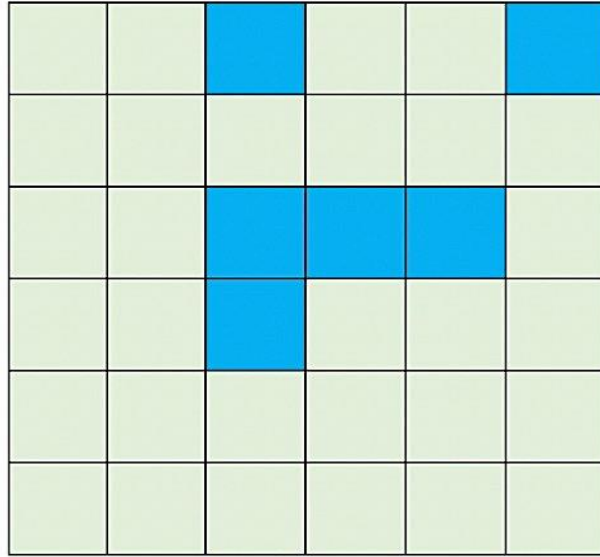
(a) Scenario 1: Low Rainfall (R1)
[Zone 4] = 6 cells affected
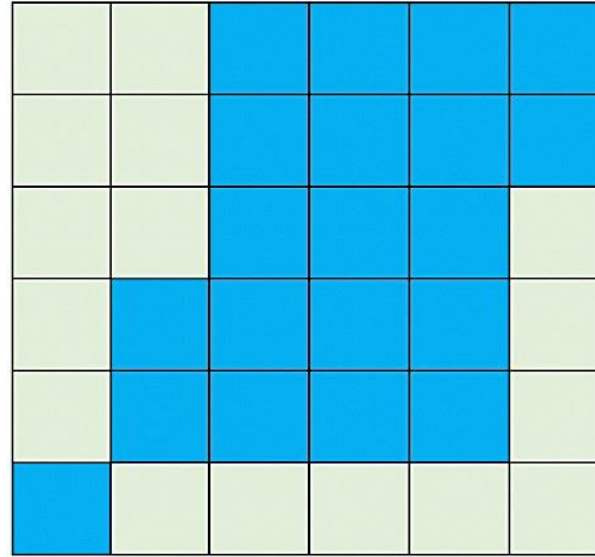
(b) Scenario 2: Medium Rainfall
(R2) [Zones 4+3] = 20 cells affected
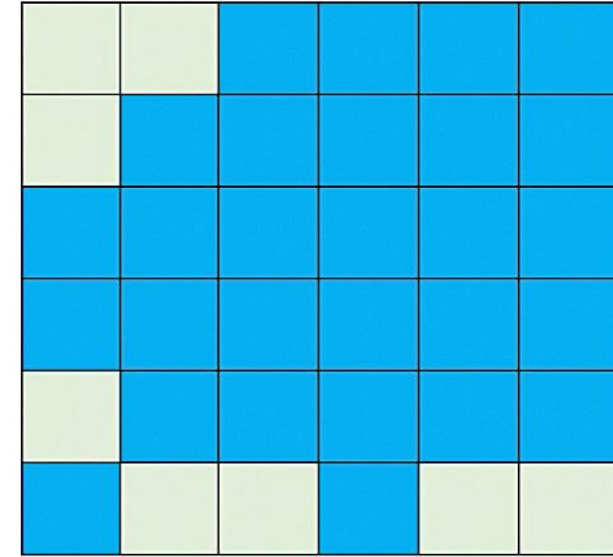
(c) Scenario 3: High Rainfall (R3)
[Zones 4+3+2] = 28 cells affected

No-Warning State   Warning State

Rainfall Amount (mm) [Consecutive 5 Days Cumulative]	Zone and Scenario Delineation	LSM Index Value Coverage
Low Rainfall (R1) = 95 – 220	Zone 4 [Scenario 1]	0.73 – 1
Medium Rainfall (R2) = 221 – 345	Zones 4+3 [Scenario 2]	0.62 – 1
High Rainfall (R3) > 345	Zones 4+3+2 [Scenario 3]	0.54 – 1
No Warning	Zone 1	0 – 0.53

Early Warning System
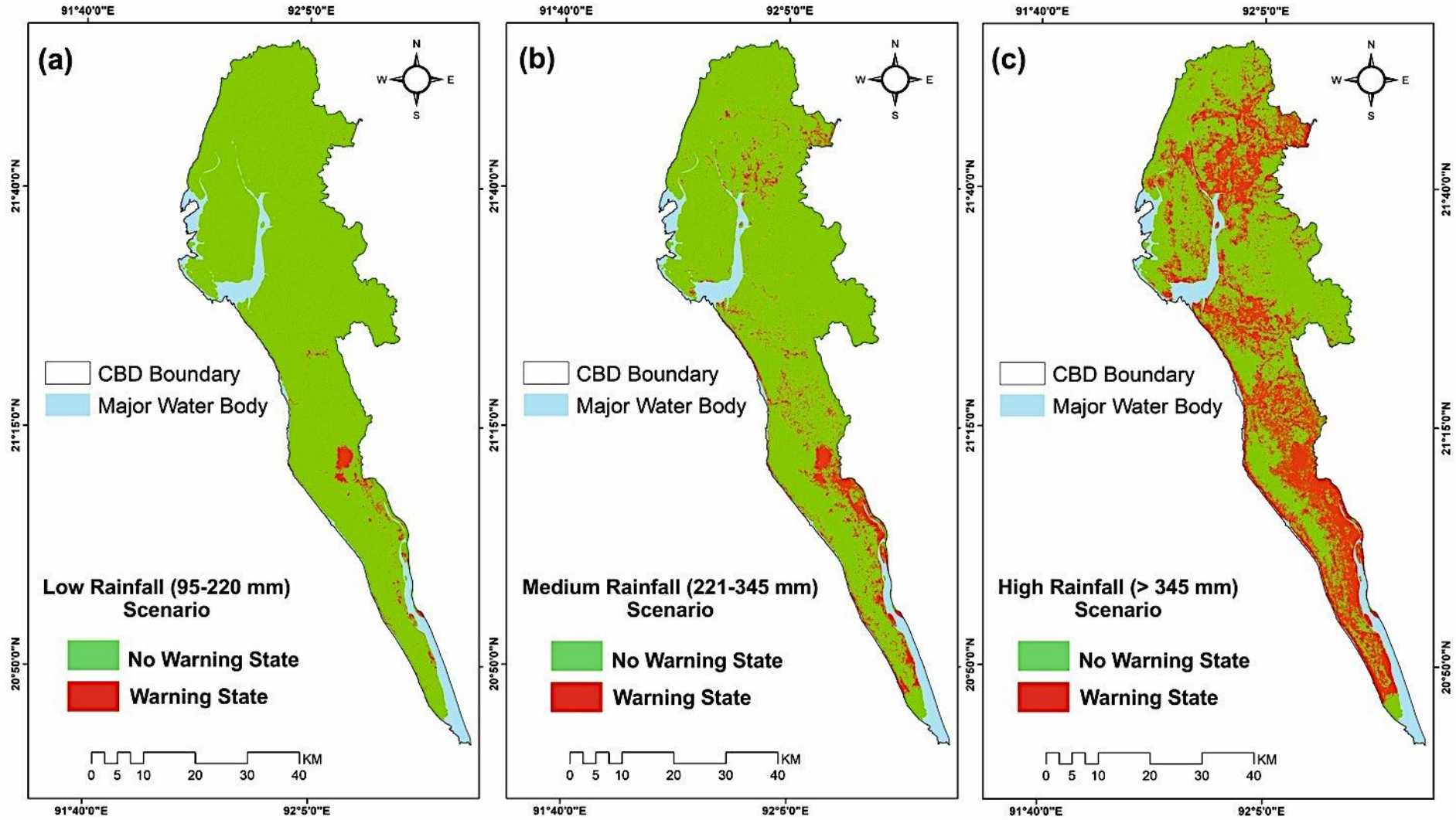
Method Flowchart
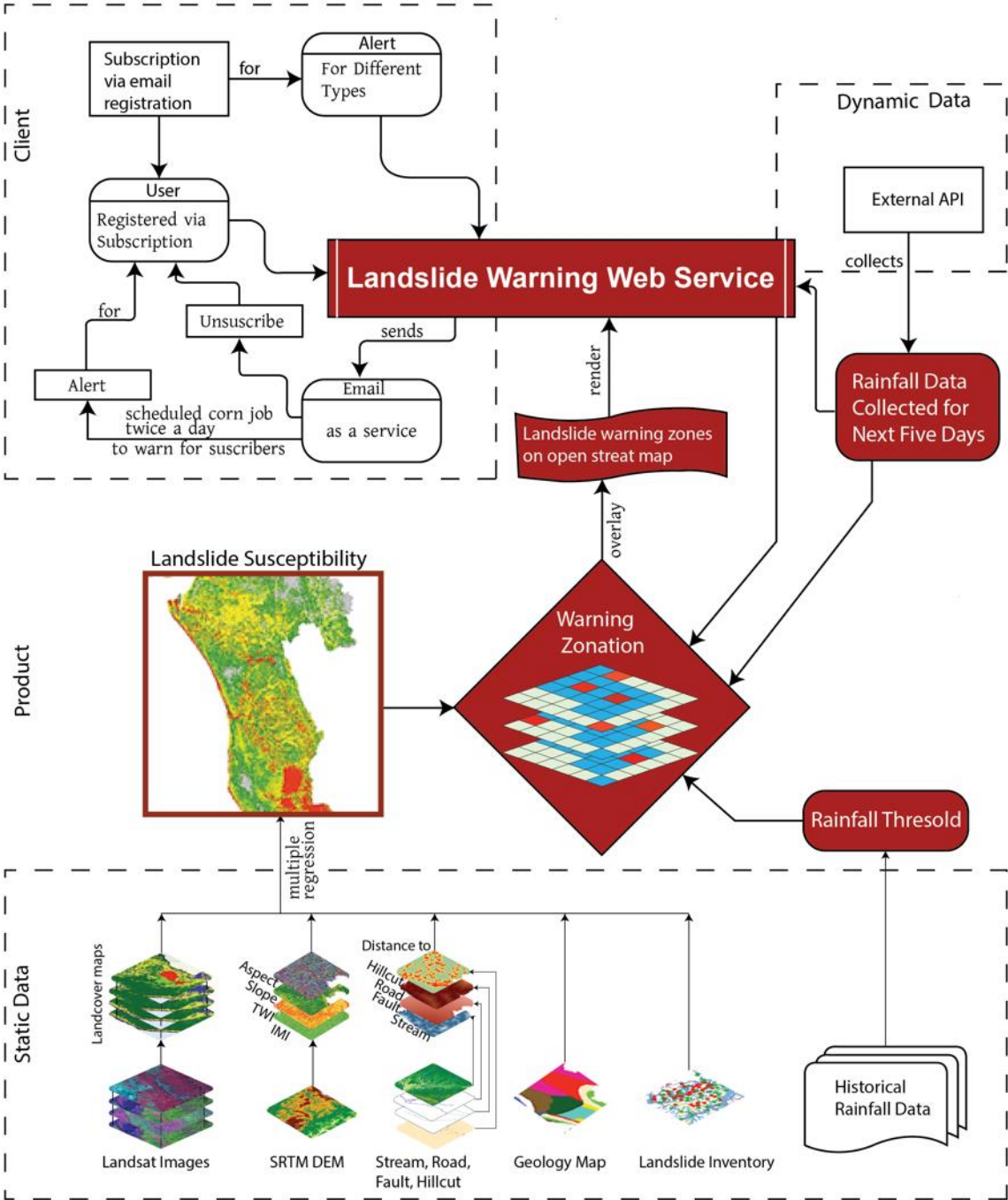
URL: www.landslidebd.com

Sustainability?

Future Plan?

**Thanks so much for your attention;
Any question?**