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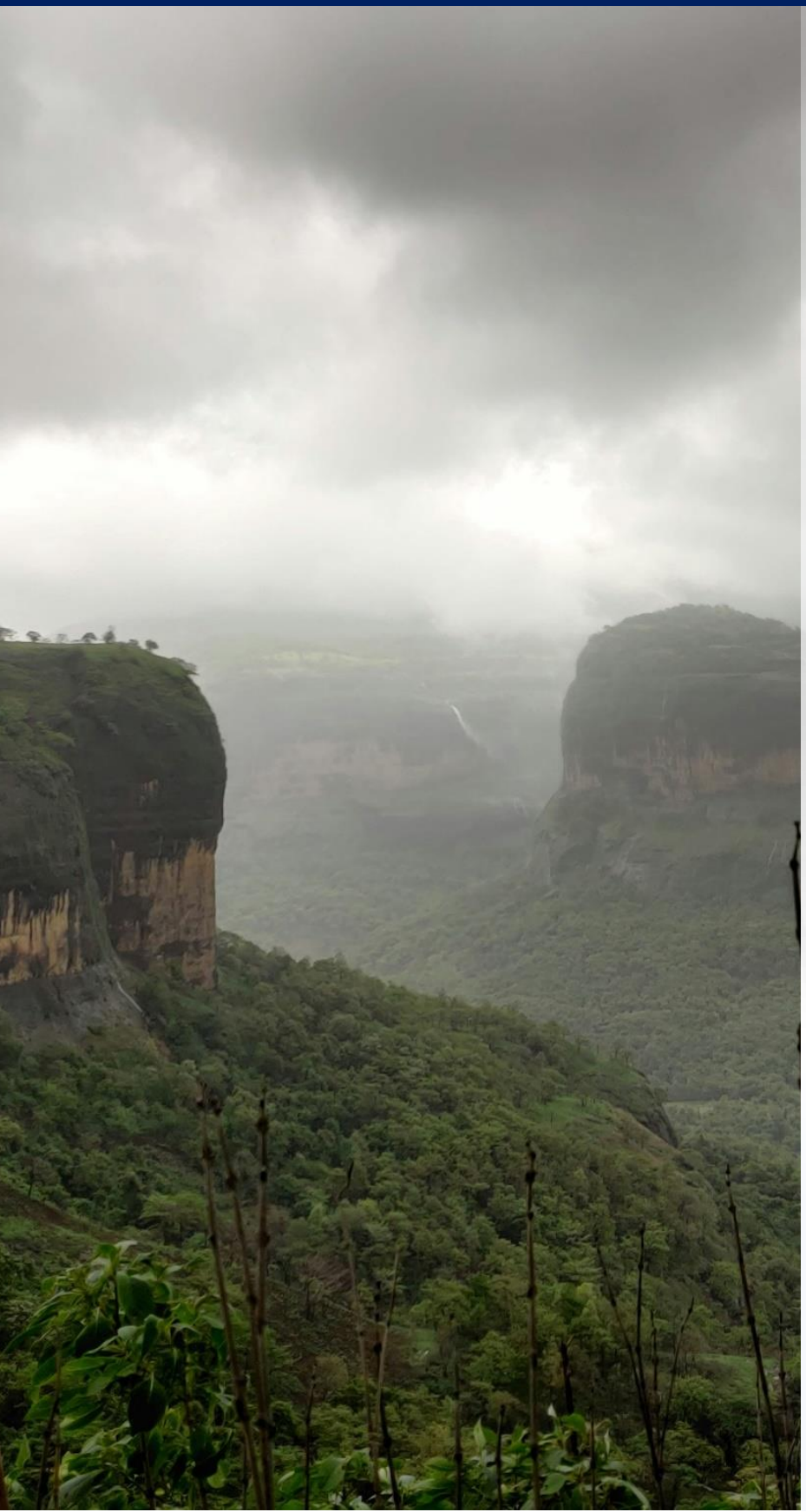
2024

Landslide Management Plan of Maharashtra



STATE DISASTER MANAGEMENT AUTHORITY
MAHARASHTRA

DISASTER MANAGEMENT, RELIEF & REHABILITATION DEPARTMENT, GOVRNMENT OF MAHARASHTRA

GOVERNMENT OF MAHARASHTRA

2/23/2024

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1. Landslide Risk Scenario in Maharashtra

1.1. Introduction

Landslides are downhill and outward movement of the slope elements i.e., rock, mud, debris, and earth, under the influence of gravity. Landslides have devastating consequences and causing enormous losses to human lives, economy, and social fabric. Landslides are very common phenomena in the mountainous and hilly regions of India due to its physiographic setup and multiple triggering factors.

In recent decades, out migration of people from village to cities has been observed in Maharashtra due to the rapid climate change and unsustainable agriculture, which are already facing challenges due space scarcity. Due to this, people from marginalized background find temporary settlement in unsafe locations like hill slopes or near open drains. This unmoderated expansion into hilly region results into slope disturbance and slope instability causing landslides. It has been estimated that almost 25% of the total losses are caused by the landslide or slope movement among all the natural hazards.

The Sahyadri Range is the physical backbone of Maharashtra and rising on an average to an elevation of 1000 m with steep cliffs. In the north, the Sahyadri or western ghat is flanked by the Satpura hills is known as Plateau region of Deccan, which run east-west in Maharashtra. The plateau's altitude ranges from 450 to 750 m. The Konkan, lying between the Arabian Sea and the Sahyadri Range is narrow coastal lowland, barely 50 km wide and average elevation of 200 m. The Konkan region is highly dissected and broken.

Landslide is a frequently occurring natural as well as a manmade hazard in the Sahyadri, Plateau region of Deccan and Konkan regions of Maharashtra. Most of these landslides are triggered by the incessant monsoonal rain that occurs mainly in the period between June and September of each year. It’s also important to note that many of the landslides in the region are triggered by anthropogenic activities such as road construction, mining etc.

1.2. Types of Landslides in Maharashtra

1.2.1. Physiography and Geology

The hilly range of Western Ghat covers 14 districts of Maharashtra, which run parallel to Indian peninsula. It is a UNESCO World Heritage Site and is one of the eight “hottest hotspots” of biological diversity in the world. Kalsubai (1648 m) and Salher (1567 m) form the highest peaks of the Western Ghats in Maharashtra state. Some of the prominent hill towns in this part of Western Ghats are Amboli, Khandala, Lavasa,

Lonavala, Mahabaleshwar, Matheran, and Panchgani. Apart from this the western part of Maharshtra falls under Zone IV and V of Seismic Zonation Map of India.

1.2.2. Physiography and Geomorphology

The Wester Ghat mainly characterizes by several fault and fracture along with the ridges and running from north to south direction. The landscape of Western Maharashtra is divided into three major physiographic divisions from west to east, viz., i) The Konkan Plain, ii) The Western Ghat Escarpment and iii) The Deccan Plateau. The Sahyadri range of Maharashtra separates Deccan plateau and the Konkan plain with an average elevation of 1200m, which runs north south direction, parallel to the Arabian sea.

1.2.3. Rainfall

The Maharashtra receives 1363mm rainfall annually and <80% rainfall occurs during monsoon period (June – October). The rainfall distribution of Maharashtra shows a wide variation viz. Konkan (2776mm), Vidarbha (966mm), Madhya Maharashtra (727mm), and Marathwada (669mm) because of the orographic effect of Western Ghat.

1.2.4. Types of landslides in Maharashtra

Geomorphologically, Landslide in Maharashtra are classified into five types viz. Rockslide/Fall, Rotational slide, Ground crack, Debris slide, and Main slope failure.

- **Rockslide/Fall:** Rockslide/falls occur when rocks or boulders become detached from a steep slope and fall or roll down the slope. These types of landslides are often triggered by weathering and erosion of the rock face, seismic activity, as well as by anthropogenic activity.

- **Rotational slide:** This is a slide in which the surface of rupture is curved concavely upward, and the slide movement is roughly rotational about an axis that is parallel to the ground surface and transverse across the slide.

- **Ground crack:** Ground cracks develop between sliding and stable masses when a landslide begins (resulting from tensile or shear stress or lateral expansion of a slope mass). The crack dimensions will eventually grow if the sliding body is continuously deforming.

- **Debris slide:** Debris slide is a rapid mass movement involving loose soil, rock, organic matter, air, and water to build a mixture and move downslope. Debris flows include <50% fine materials. Debris slides are often triggered by heavy rainfall, which erode loose soil or rock on steep slopes.

- **Main slope failure:** Main slope failures occur when driving forces overcome resisting forces. The driving force is typically gravity, and the resisting force is the slope material's shear strength. The main cause of a slope failure can be natural as well as anthropogenic.

The below image describes the different types of geomorphological landslides experienced in Maharashtra. Large scale damage has been experienced in the state due to main slope failures as seen at Malin landslide, Pune district in 2014.

Most of the landslide along the Malshej Ghat (along with National Highway) are debris slides and are restricted to the road corridors. Most of the landslide of Ratnagiri are either debris slide or soil slide. It has also been noted that there are sone debris cum soil slide in the Ratnagiri district.

Figure 1: Types of Landslides in Maharashtra

Based on the tiggering factors, the landslide of Maharashtra can be divided into two main classifications such as Rainfall induced landslides and Anthropogenic landslides.

a. Rainfall induced landslides:

The western part of Maharashtra receives enormous amount of rainfall (<200mm/month) during monsoon period (June-September). During this period, the eastward-moving winds are blocked by the high relief of the Western Ghats acting as a physiographic barrier. So, the winds are forced to rise against the Ghats and condense rapidly providing copious rains to the western side of the Ghats. Which tiggers lots of landslide events around the Maharashtra since 1994. Some of the rainfall induced landslide are Ghatkopar East landslide on 13 Jul 2000, Jui landslide, Raigad

on 25th Jul 2005, Sakinaka landslide, Raigad on 5th Sept 2009, Poomendi landlside, Ratnagiri on 30th Aug 2011 and Malin Landslide, Pune on 30th Jul 2014.

Therefore, it can be identified that the constant rainfall in a particular place of Maharashtra over a period of a 7 days, followed by extremely high-intensity rainfall >100mm/5hr, can be the main triggering factor for a landslide.

b. Anthropogenic landslide:

Maharashtra facing a significant loss of forest cover day by day due to the encroachment, expansion on urban settlement, infrastructure development, and mining and quarries. These phenomena in the hilly region leads towards huge soil erosion and decrease water bearing capacity of subsurface soil, may lead to the slope failure.

Inducive Factors:

As per the 2011 census, Maharashtra has the highest level of urbanization (29.5 %) in India. Especially rapid urbanization taking place in Thane, Raigad, and Pune district due to the influence of Mumbai expansion. This urbanization promoting huge constructions (Building, Dam, road, canals, power station etc), unplanned slope cutting, deforestation, soil erosion at the hill slope of western ghat and leading towards landslide. Generally, the construction activity at >30-degree slop angle with 40m vertical length of any hill prompts landslide.

Maharashtra is very rich in minerals i.e., coal, iron ore, manganese, limestone, bauxite, dolomite, silica sand, kyanite & sillimanite. So, there is huge number of mines available in the Vidarbha basin and Konkan region of Maharashtra. 60% of mines of Maharashtra are situated at Nagpur division. In Konkan and South Maharashtra, the districts of Ratnagiri, Thane, Raigad, Sindhudurg, and Kolhapur are the main areas of mining.

Thus, the different operations of mining produce a huge amount of vibrations, especially blasting techniques and its vibrations that can reach hundreds of meters under the soil surface and poses threat of landslide occurrence. Inadequate disposal of muck, excavated material from mining, cause man-made landslides. Unscientific cutting of slope for any development activity also triggers landslides.

1.3. Landslide Tragedies in Maharashtra

The gradual increase of fatal landslides in Maharashtra is a combined effect of climate change, temporal, and spatial variables in rainfall along with anthropogenic activity, i.e., Changes in land use and land cover, rapid urbanization, mining, and quarrying are factors that are potentially contributing to the susceptibility of slope failure during the monsoon season (May to August).

Irshalwadi landslide tragedy, Raigad District (2023): It was observed that the recent incident of landslide tragedy that occurred on 19th July 2023 in the Irshalwadi village in Raigad district of Maharashtra, 29 people were reported killed and 56 people got buried under the debris and could not be recovered. Out of the 228 village inhabitants, residing in 48 households, only 142 could survive in this event. Owing to severe rainfall for four consecutive days before the incident.

Also, extreme rainfall events exacerbated by climate change impacts in the state are triggering landslides in areas which have not experienced landslide incidences in the past. These areas include hilly regions of districts like Nashik, Nandurbar, Amravati etc.

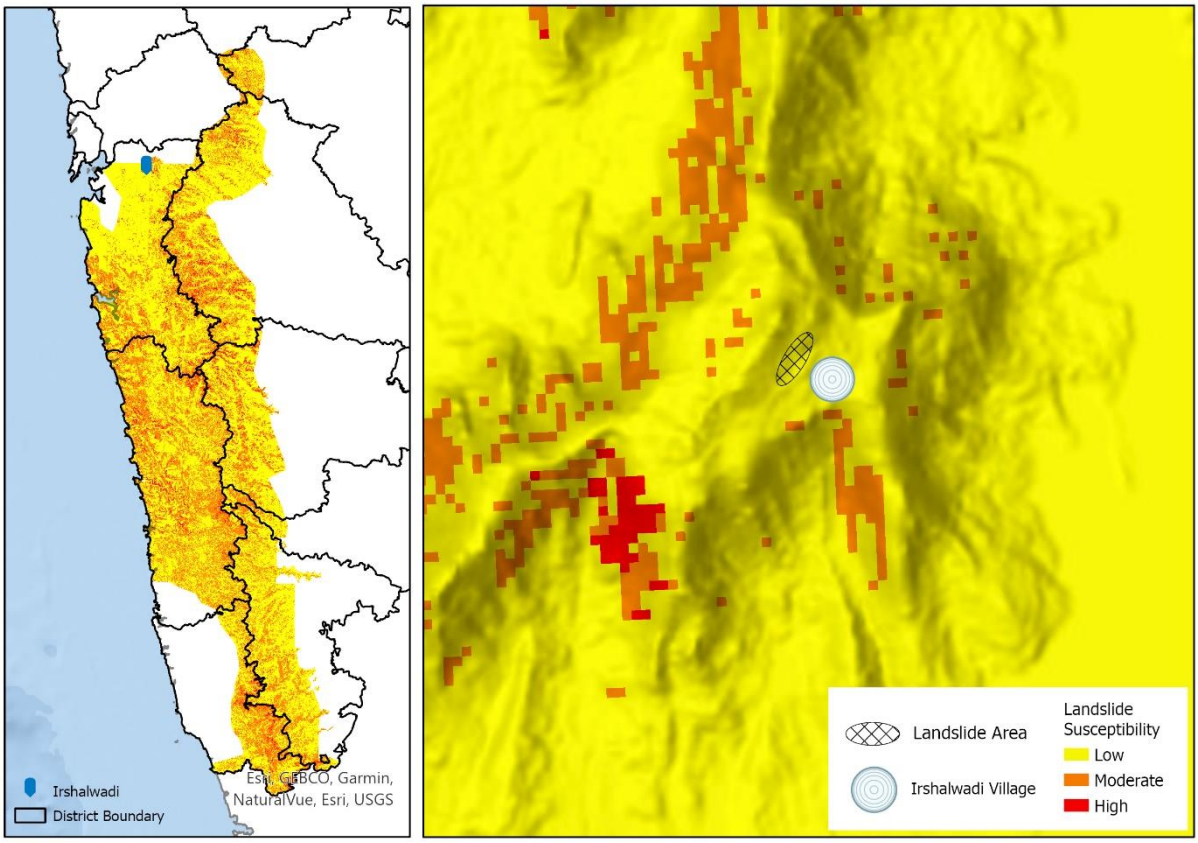


Figure 2: Categorisation of Irshalwadi as per GSI Susceptibility Mapping

Malin Landslide, Pune (2014): On July 30, 2014, a massive landslide washed down the village of Malin, in Maharashtra. A mound of mud and debris that slid from a nearby hill and destroyed almost the entire tribal village of around 50 families. Apart from this, 153 people were killed by this massive landslide and almost 100 people has gone missing.

Taliye landslide: Torrential rains and flash floods in Maharashtra;s Raigad district caused a massive landlside in Taliye village on 21st July 2021. Which claimed a total

85 lives were dead and several were injured, and several others injured after they were trapped under houses that had collapsed.

1.4. Major Landslide Incidences in Maharashtra

Table 1: Some prominent and fatal landslide events in Western Maharashtra (1994 - 2014); Source: GSI

Date/Time	Locality /Place	Loss/Damage	Triggering Factor	Type of Landslide
Jun 1994	Varandha Ghat, Pune	20 people killed; Breaching of Ghat road damaged to the extent of 1km at several places	~749.03 mm rainfall	Debris Slide
13th Jul 2000	Ghatkopar East, Mumbai	78 people died and 7 others injured; Damage to Chiragnagar-Azadnagar slums	Excessive & Torrential rains	Debris Slide
1st Jul 2005	Bhillar, Satara	Destruction of 35 houses, uprooting of trees, damage to roads, water supply lines, etc.	~46.7 mm rainfall in 24 hours	Rotational Slide
25th Jul 2005; 20:00 hrs	Jui, Raigad	96 people and 200 cattle heads died; 43 houses damaged in Marathwadi	~179.9 mm rainfall in 24 hours in Raigad district	Debris Slide
25th Jul 2005	Kondivate, Raigad	34 people died; Damage to property		Debris Slide
25th Jul 2005	Roha, Raigad	15 people died; Damage to property		Debris Slide
26th Jul 2005	Dasgaon, Raigad	48 people died; Damage to property	~210.3 mm rainfall in 24 hours	Debris Slide
26th Jul 2005; 14:30 hrs	Sakinaka, Mumbai	78 people died and 7 people were injured; Severe damage to Khadi No. 3 slums.	~350 mm rainfall in 24 hours	Debris Slide

Date/Time	Locality /Place	Loss/Damage	Triggering Factor	Type of Landslide
26th Jul 2005	Munde, Ratnagiri	Loss of lives; Damage to farmland and road	~217.5 mm rainfall in 24 hours	Debris Slide
31st Jul 2005; 21:30 hrs	Nerul, Mumbai	14 people died; Damage to property	Excessive rains	Debris Slide
11th Sep 2005; 10:45 hrs	Vikhroli, Mumbai	1 people died and 2 others injured; 34 houses were destroyed at Surya Nagar, Vikhroli Parksite Hilltop	Excessive rains	Debris Slide
29th Jun 2007	Vave, Raigad	3 people died, Damage to property	~1004.6 mm rainfall in 5 days	Debris Slide
5th Sep 2009; 23:30 hrs	Sakinaka, Mumbai	10 people died and 13 others injured; Damage to 10 houses at Lal Bahadur Shastri Nagar slums	Excessive rains	Debris Flow
30th Sep 2009	Vadad Hasol, Ratnagiri	8 people died and 1 house was razed to the ground	Excessive and heavy rains	Shallow Translational Debris slide,
Jun 2010	Harnai, Ratnagiri	8 people died and 2 houses were damaged	Excessive and heavy rains	Shallow Translational Debris slide
30th Aug 2011	Pomendi, Ratnagiri	No casualties; Damage to 20 m long retaining wall of Konkan rainways	~352.6 mm rainfall in 72 hours	Rock Fall
30th Jul 2014; 07:45 hrs	Malin, Pune	151 people died; Destroyed 40 houses, road and agricultural fields.	~157.50 mm rainfall in 2 days	Slope Failure

Date/Time	Locality /Place	Loss/Damage	Triggering Factor	Type of Landslide
Taliye landslide, 21st July 2021	Raigad	85 lives were dead, and several were injured	Excessive rainfall	Debris Flow
Irshalwadi landslide, 19th July 2023	Raigad	29 people were reported killed and 56 people got buried under the debris, Destroyed 48 houses	Excessive rainfall	Debris Slide

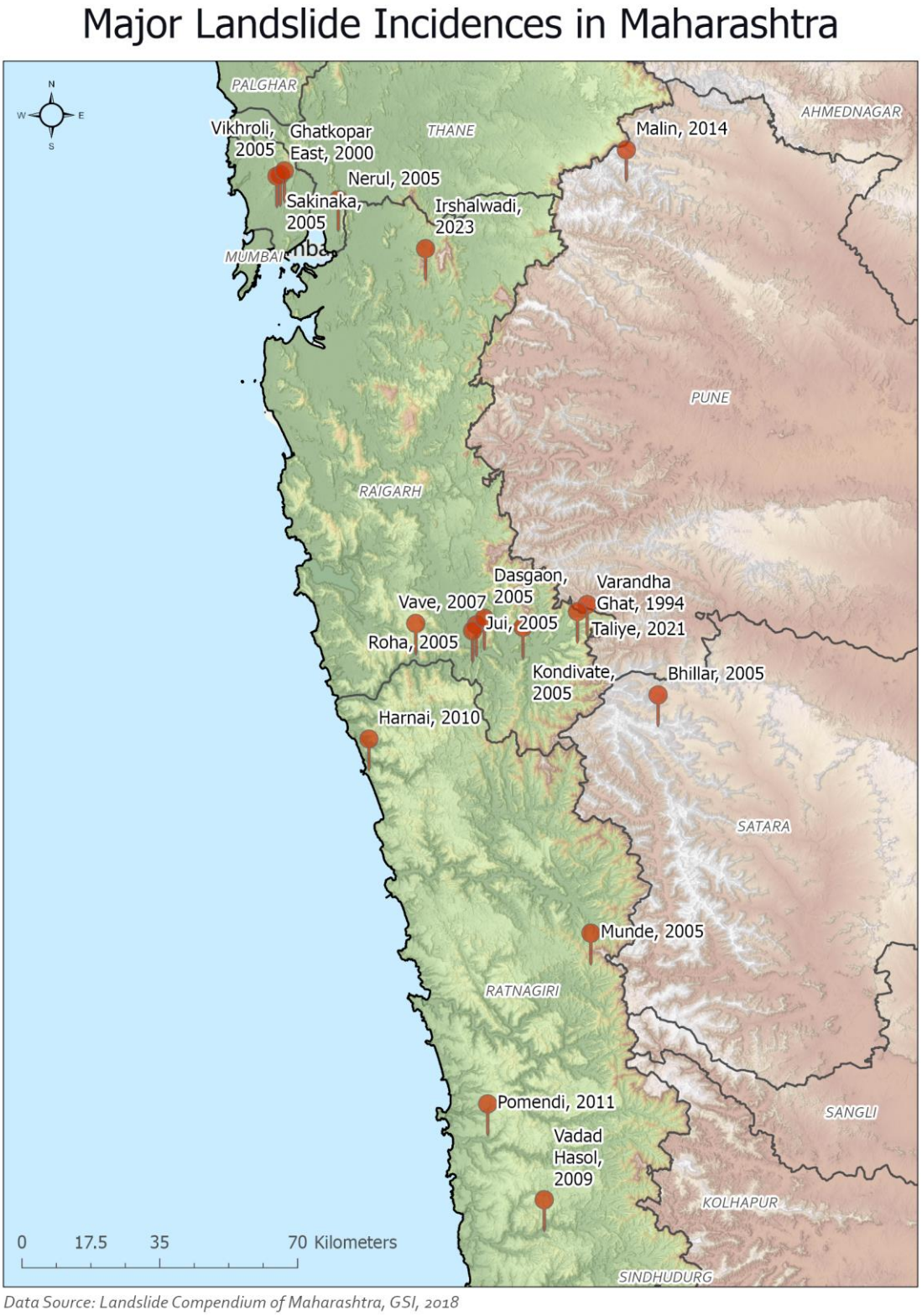


Figure 3: Some prominent and fatal landslide events in Western Maharashtra (1994 - 2014); Source: GSI

Table 2: District wise prominent and fatal landslide events in Western Maharashtra (1994 - 2014); Source: GSI

District	Total Fatal Landslide	Total death	Damages
Raigad	7	366	91 houses, 200 cattle and other properties
Mumbai	5	187	47 houses, and slums
Ratnagiri	4	16	3 house and 20 m retaining wall
Pune	2	171	48 houses and road
Satara	1	0	35 houses

1.5. Deaths due to Landslides

Landslides in the state are a major cause of fatality and incur colossal damage to the buildings stock, communication systems, agriculture, natural vegetation, and the environment. The table below depicts the human lives lost due natural calamities in the state during the past 6 years.

Table 3: Division wise Human lives lost due to landslide in last 6 years in Maharashtra. Source: Disaster Management Unit, Relief and Rehabilitation Department, Govt. Of Maharashtra

S. No.	Division	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	Total
1	Konkan	1	0	3	58	3	29	**67**
2	Pune	1	1	1	34	0	0	**37**
3	Nashik	0	1	1	1	0	0	**3**
4	Aurangabad	1	0	0	0	0	0	**1**
5	Amravati	0	8	8	12	9	0	**37**
6	Nagpur	0	0	0	0	0	0	**0**
#	Total	3	10	13	105	12	29	**145**

2. Landslide Susceptibility & Risk Assessment for Maharashtra

2.1. Landslide Inventory (2014-2020)

In India, Geological Survey of India (GSI), is the nodal agency for landslide studies and has been carrying out landslide related studies for more than a century with the first recorded slope stability study in 1880. GSI has collated the historical landslide datasets and developed a landslide inventory of the country including Maharashtra in GIS format which is available in public domain for the decision makers and the scientific community to utilize for further analysis. This data is of particular importance as the areas where landslides have occurred in the past are more likely to experience landslides in the future.

The maps below depict the locations of historical landslide or landslide inventories incidences in the Maharashtra and the triggering factors of those incidences.

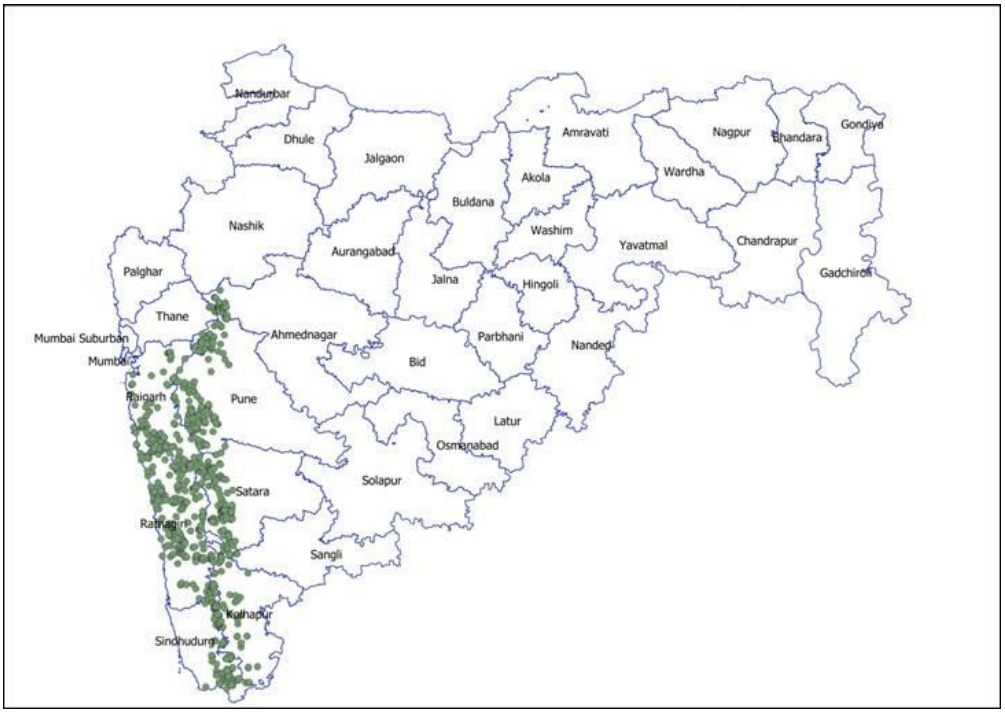
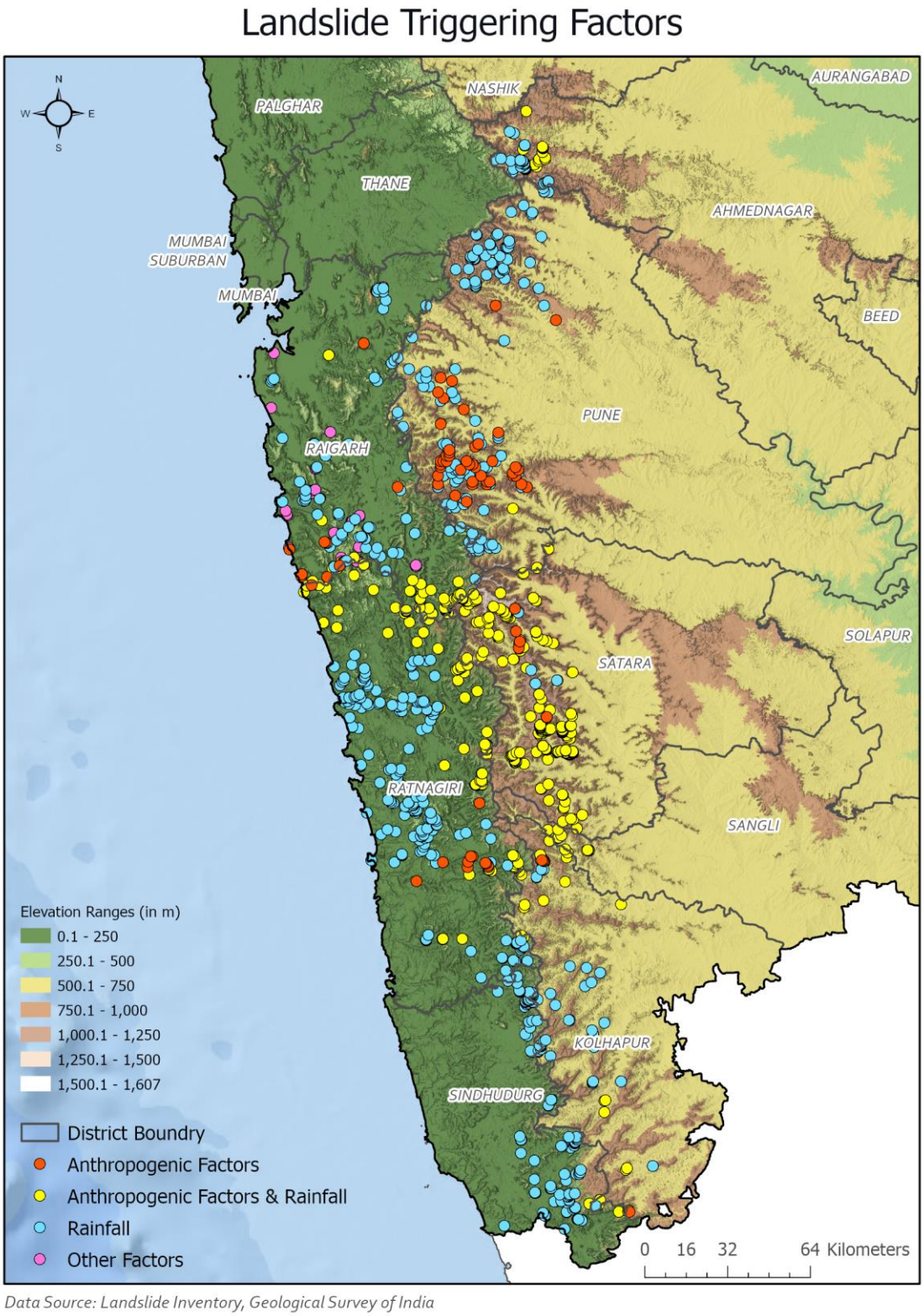


Fig. 1: *Historical Landslide event of Maharashtra as per GSI*

Ratnagiri, Pune and Satara districts are the most vulnerable districts with around **60%** of historical incidences of landslides as per the GSI datasets.

Table 4: District wise landslide instances distribution (2014-2020); Source: Landslide Inventory of Maharashtra, GSI

District	No. of Landslide Instances (2014-2020)	% of total landslides
Ratnagiri	276	23.7
Pune	237	20.4
Satara	184	15.8
Raigad	172	14.8
Sindhudurg	155	13.3
Kolhapur	66	5.7
Ahmednagar	64	5.5
Sangli	9	0.8
Total	1163	100



Data Source: Landslide Inventory, Geological Survey of India

Figure 4: Triggering Factors for Landslide Incidences in Maharashtra as per GSI

Table 5: Instance number of Tiggering factors for landslide in Maharashtra

District	Instances
Rainfall	656
Anthropogenic & Rainfall	363
Anthropogenic	102
Other reasons	42
Total	**1163**

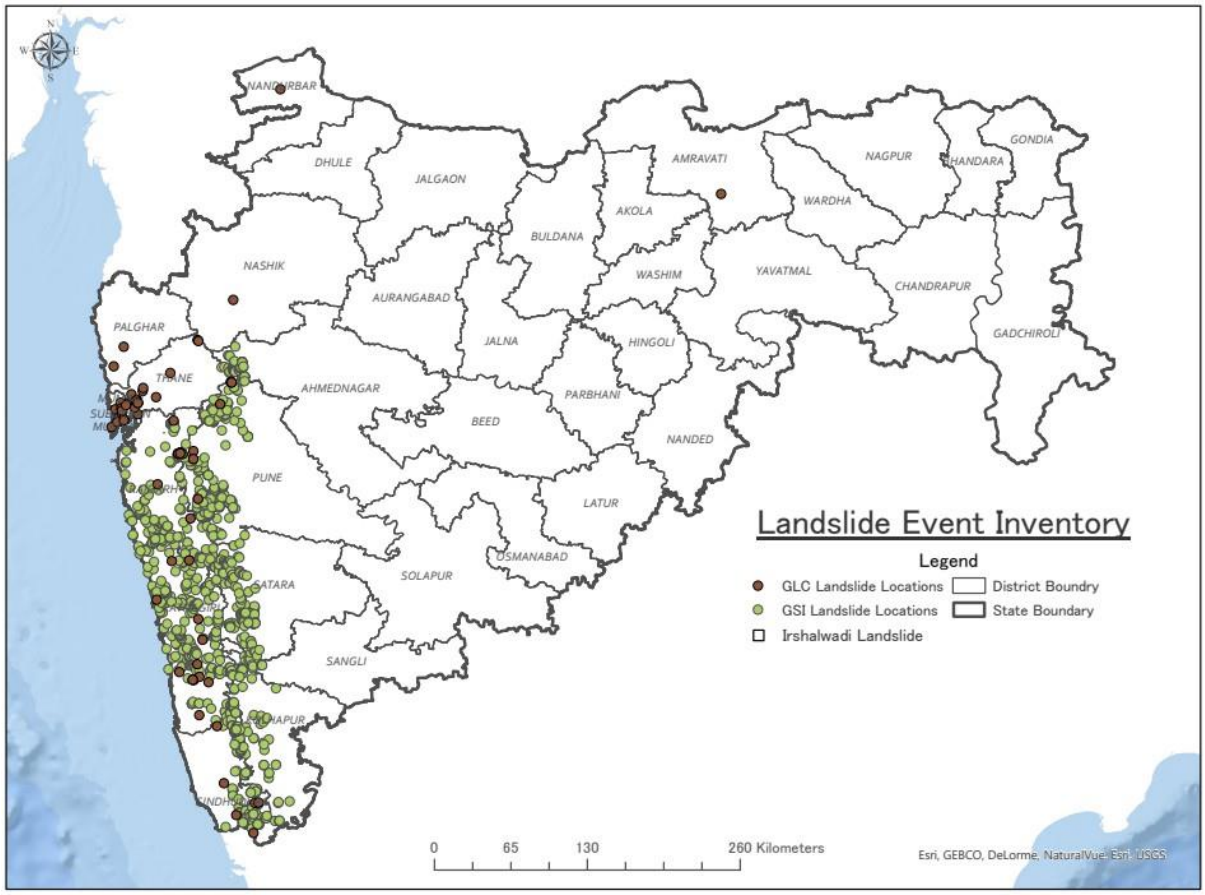


Figure 5: Landslide Inventory Combining GSI and NASA datasets (2014-2020)

It has also been observed that landslide inventory developed by GSI do not consider districts such as Nashik, Nandurbar and Amravati where landslide incidences have been reported in the past. In order to plug the gap in landslide occurrence data, the Global Landslide Catalogue (GLC) developed by NASA which cover incidences in these districts has also been referred (kindly refer the above map).

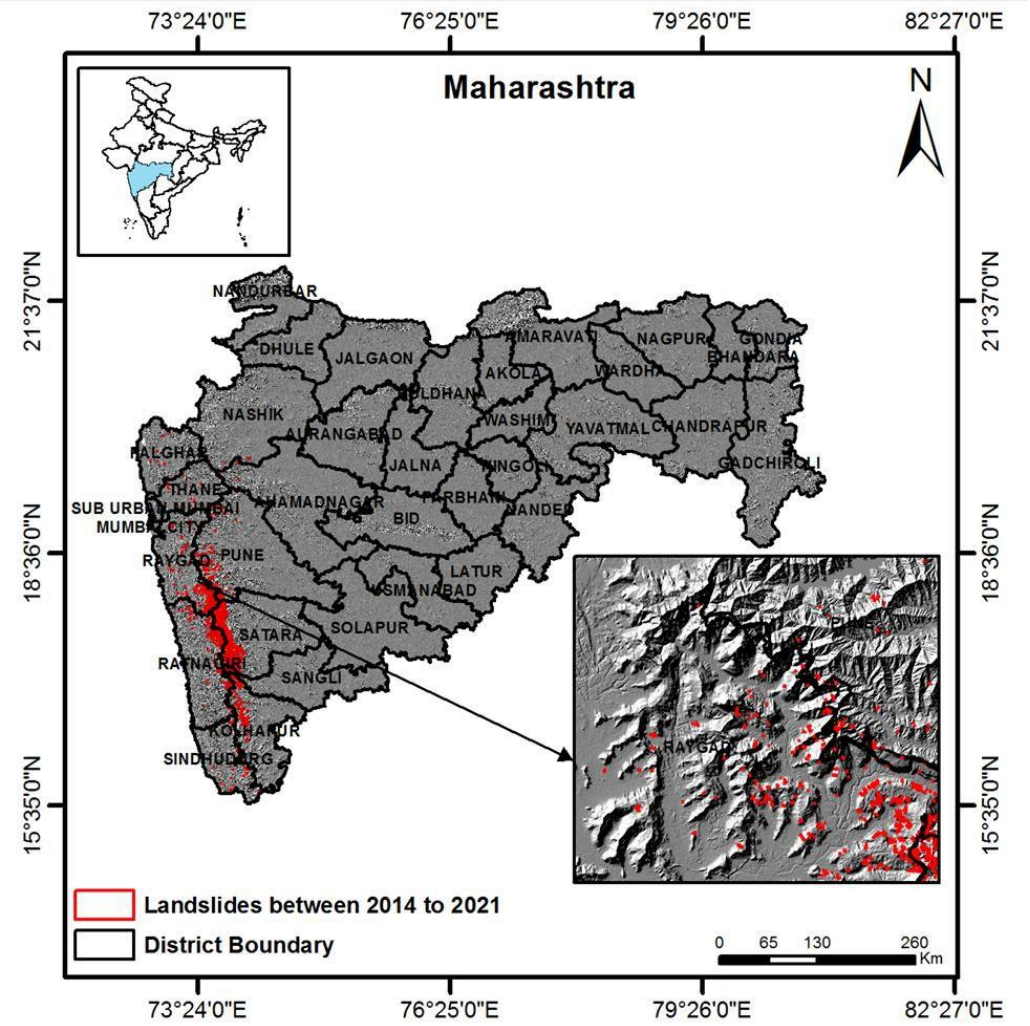


Figure 6: Landslide Atlas of India, NRSC, 2023 (2014 –2021)

Above map highlights the landslide occurrence areas in Maharashtra from 2014 to 2021 using high resolution satellite imagery.

2.2. Landslide Susceptibility studies for Maharashtra

2.2.1. Landslide susceptibility mapping by GSI under NLSMP

The GSI has developed the susceptibility map for some parts (Konkan division) of Maharashtra and identified 597 village as most susceptible villages of Maharashtra. Among them Ahmednagar has 19 villages, Kolhapur has 39 villages, Pune has 115 villages, Ratnagiri has168 villages, Raigad has 106 villages, Sangali has 6 villages, Satara has 93 villages, and Sindhudurg has 51 villages.

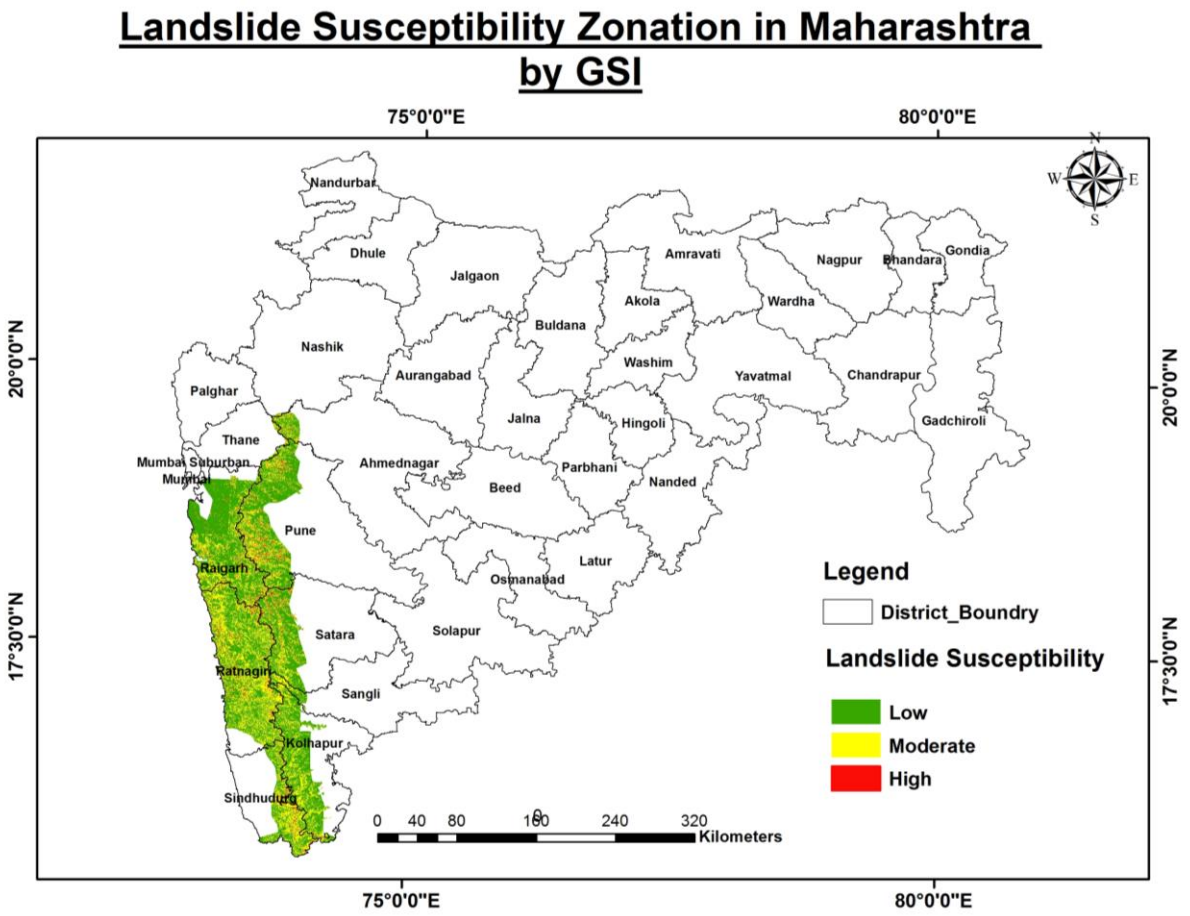


Figure 7: Landslide susceptibility zonation of Maharashtra as per GSI

Table 6: Area wise distribution of Landslide susceptibility Zone in Maharashtra as per GSI

Landslide susceptibility	Area (ha)	Percentage in Maharashtra
High	1,10,274	0.36
Moderate	10,04,485	3.26
Low	17,98,771	5.85
Total	**29,13,530**	**9.47**

Table 7: District wise landslide susceptibility area in ha. as per GSI

S. No	District	High	Medium	Low
1	Ahmednagar	2257	18418	34389
2	Kolhapur	3259	128358	271424
3	Nashik	203	1184	1085
4	Pune	27479	154309	318286
5	Raigarh	19362	150019	435536
6	Ratnagiri	29434	340046	404444
7	Sangli	517	12803	22076

8	Satara	13771	84476	198469
9	Sindhudurg	12903	108939	109195
10	Thane	1090	5931	3868

Table 8: District wise landslide susceptibility villages as per GSI

District	High	Moderate	Low	Total
AHAMEDNAGAR	78	3	0	81
KOLHAPUR	346	354	23	723
NASHIK	8	0	0	8
PUNE	803	91	14	908
RAIGAD	1171	312	264	1747
RATNAGIRI	1104	297	10	1411
SANGLI	52	20	2	74
SATARA	627	124	24	775
SINDHUDURG	214	72	8	294
THANE	20	2	2	24
Total	4423	1275	347	6045

2.2.2. Landslide susceptibility mapping by IIT Delhi

IIT, Delhi develop India's first national-scale machine learning based landslide susceptibility map in November 2023 at a resolution of 0.001º (~100 m). IIT, Delhi classified the susceptibility into five major classes viz. very low, low, medium, high, and very high with an accuracy of 95.73%.

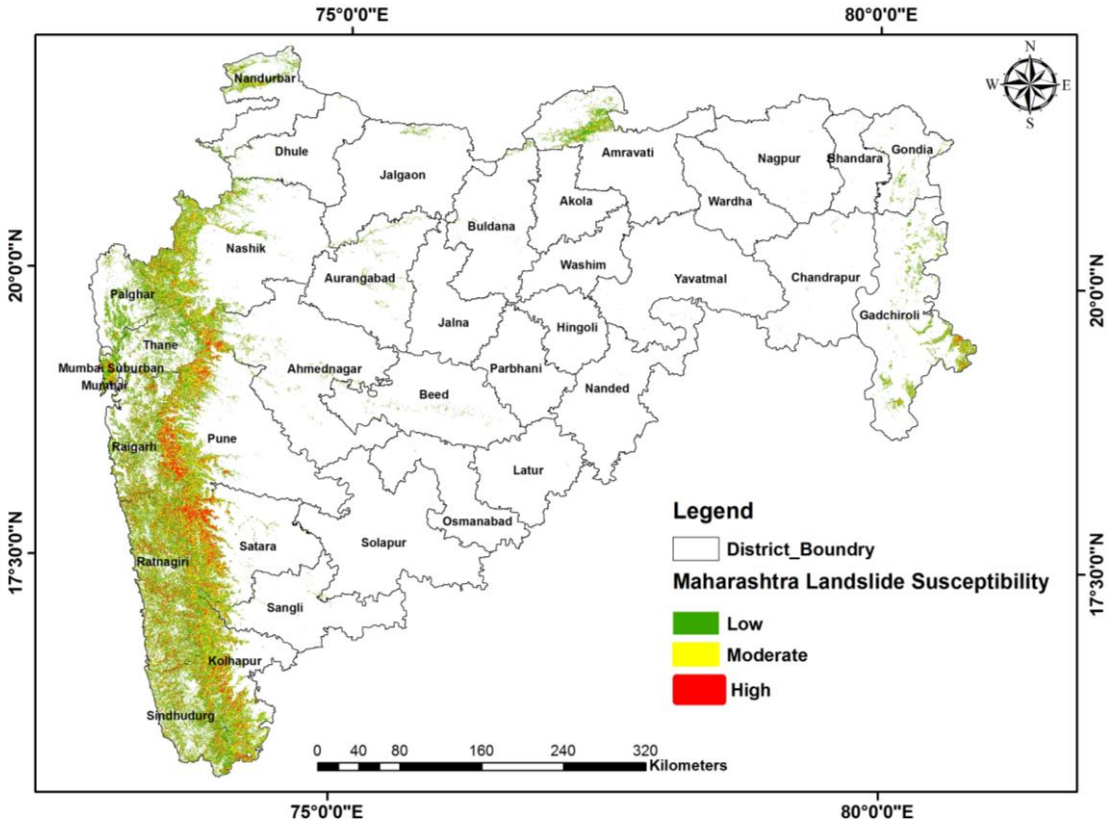


Figure 8: Landslide Susceptibility Zonation of Maharashtra as per IIT Delhi

Table 9: Area wise distribution of Landslide susceptibility Zone in Maharashtra as per IIT Delhi

Landslide susceptibility	Area (ha)	Percentage in Maharashtra
Very high	5,57,186	1.81
High	9,81,166	3.19
Moderate	12,76,324	4.15
Low	7,12,631	2.32
Total	35,27,308	11

Table 10: District wise landslide susceptibility area in ha. as per IIT Delhi study

S. No.	District	Very High	High	Medium	Low
1	Ahmednagar	14062	25971	30146	19036
2	Akola	75	172	264	256
3	Amravati	2599	11591	33561	24739
4	Aurangabad	163	1796	6530	7177
5	Beed	39	553	2791	4552
6	Bhandara	17	63	311	422
7	Buldana	44	400	2245	3060

S. No.	District	Very High	High	Medium	Low
8	Chandrapur	15	84	527	823
9	Dhule	68	710	2416	2454
10	Gadchiroli	8384	25976	47400	34656
11	Gondia	135	1222	5239	5825
12	Hingoli	0	0	2	16
13	Jalgaon	63	852	3603	4302
14	Jalna	1	11	98	175
15	Kolhapur	70168	151848	138440	53250
16	Latur	0	16	63	107
17	Mumbai	573	2579	1907	228
18	Mumbai Suburban	4631	10777	11430	3189
19	Nagpur	0	13	101	234
20	Nanded	0	19	277	598
21	Nandurbar	2951	12103	25677	20810
22	Nashik	30421	90116	118265	59248
23	Osmanabad	0	15	111	193
24	Palghar	15768	41522	86687	52099
25	Parbhani	0	0	7	22
26	Pune	102318	148786	110421	42776
27	Raigad	60187	84257	143592	94347
28	Ratnagiri	104627	148422	223487	120953
29	Sangli	4555	12766	12971	6040
30	Satara	84836	108041	74252	26712
31	Sindhudurg	37834	70835	122050	71245
32	Solapur	15	143	615	611
33	Thane	12636	29498	70693	52119
34	Wardha	0	6	12	27
35	Washim	0	0	39	84
36	Yavatmal	0	5	94	246
#	TOTAL	**5,57,185**	**9,81,168**	**12,76,324**	**7,12,631**

Table 11: District wise landslide susceptibility villages as per IIT Delhi

District	Very High	High	Medium	Low	Total
Ahmednagar	194	132	102	59	487
Akola	1	1	16	11	29
Amaravati	40	52	61	38	191
Aurangabad	45	130	110	66	351
Beed	17	91	110	70	288

Bhandara	5	21	24	19	69
Buldhana	10	21	42	48	121
Chandrapur	4	7	50	48	109
Dhule	16	23	39	27	105
Gadchiroli	113	148	161	98	520
Gondia	37	62	61	41	201
Hingoli	0	0	2	10	12
Jalgaon	7	6	11	7	31
Jalna	1	3	16	18	38
Kolhapur	868	96	37	19	1020
Latur	0	4	7	9	20
Nagpur	0	5	27	42	74
Nanded	0	9	53	56	118
Nandurbar	96	92	75	32	295
Nashik	710	237	144	64	1155
Osmanabad	0	6	19	18	43
Palghar	451	209	98	60	818
Parbhani	0	0	4	8	12
Pune	913	133	99	53	1198
Raigad	1469	204	109	62	1844
Ratnagiri	1489	42	5	1	1537
Sangli	92	50	65	30	237
Satara	914	131	105	52	1202
Sindhudurg	656	51	22	4	733
Solapur	5	4	12	9	30
Thane	445	257	116	49	867
Wardha	0	3	1	8	12
Washim	0	0	13	10	23
Yavatmal	0	4	40	57	101
Total	8598	2234	1856	1203	**13891**

2.3. Landslide Risk Assessment for Maharashtra

2.3.1. Need for Risk Assessment

Landslide Risk Assessment is very important for Maharashtra as it experiences number of landslides every year. These landslides cause huge losses of property and lives in Maharashtra. Therefore, some of the important points regarding need for landslide risk assessment are as follows:

- Macro level identification of the very high-risk prone area for landslides.

- Estimation of possible damages viz. fatality or economic loss due to the landslides.
- Carry out risk informed planning and development activities in high-risk areas.
- To create awareness about landslide risk among the community to avoid casualties in the future.
- Implementation of landslide risk management strategies based on monitoring and early warning solutions.
- Identifying and prioritising appropriate landslide mitigation strategies.

2.3.2. Approach & Methodology

SDMA has considered multiple sources of data for comprehensive landslide susceptibility mapping of the state and carried out the village wise landslide risk analysis and to arrive at our suggestions for proposing broader landslide mitigation strategies for Maharashtra. The step wise methodology for analysing historical landslide incidences in the state are as follows:

- After procuring the open database on landslide inventory for the state from GSI, the locations of historical landslide incidences from 2014 to 2020 have been mapped using geospatial software (QGIS).
- Further count-based analysis has been carried out to identify the districts experiencing highest frequency of landslide occurrences and landslide incidents have been analysed for categories landslide types.
- Landslide susceptible zones compiled by GSI and IIT Delhi have been analysed for identifying areas under High, Moderate and Low susceptible zones.
- The susceptible zone has been integrated with the built-up area (Construction, Hotels, Dams, Settlement etc) for the risk assessment.
- At last, the integrated susceptibility map has been overlayed with the village boundaries of Maharashtra using GIS.
- The villages falling under high landslide risk have been extracted and prioritise for taking suitable risk reduction measures.

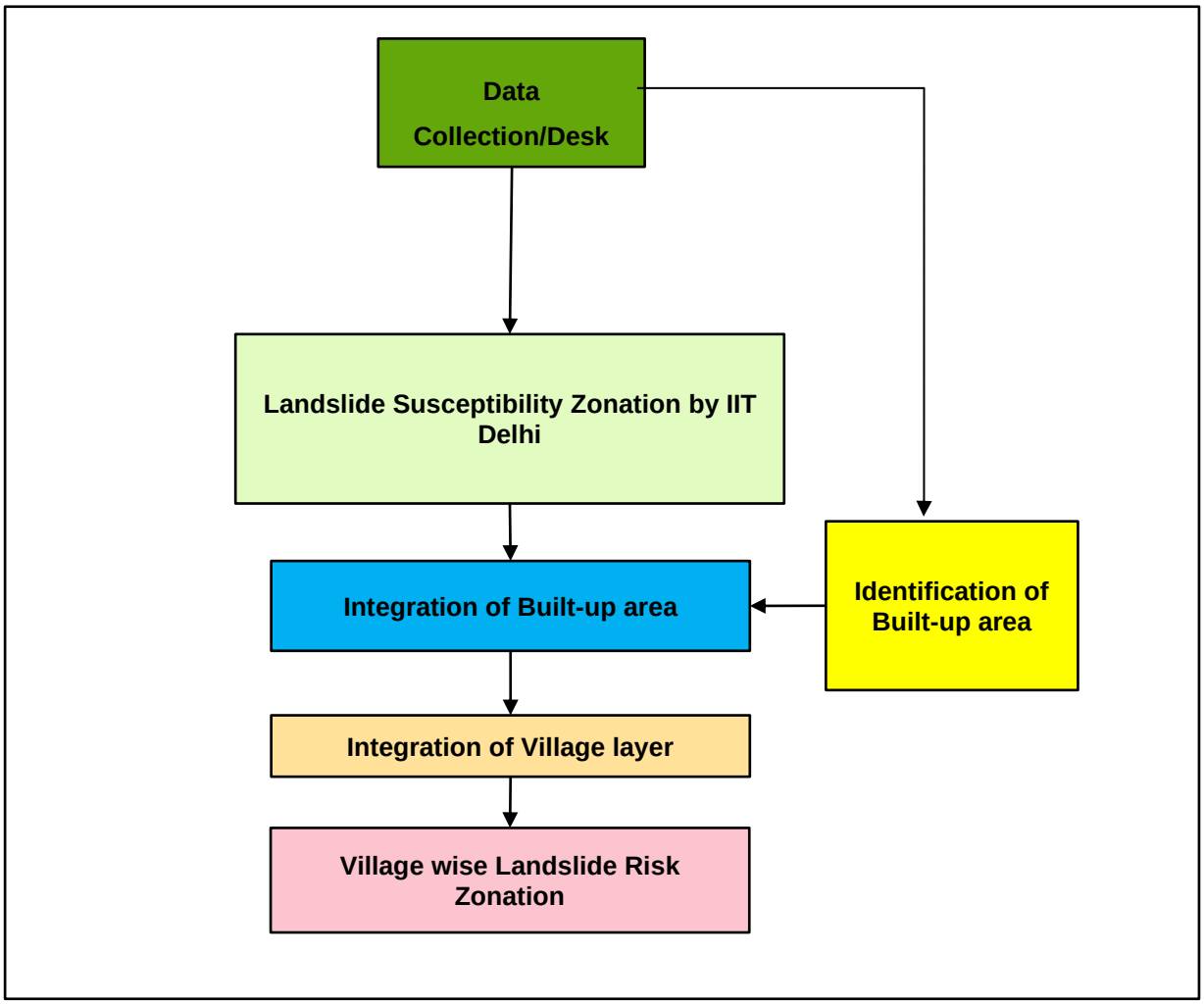


Figure 9: Methodology flow chart for developing village wise landslide risk zonation

2.4. Landslide Exposed Built Up in Maharashtra

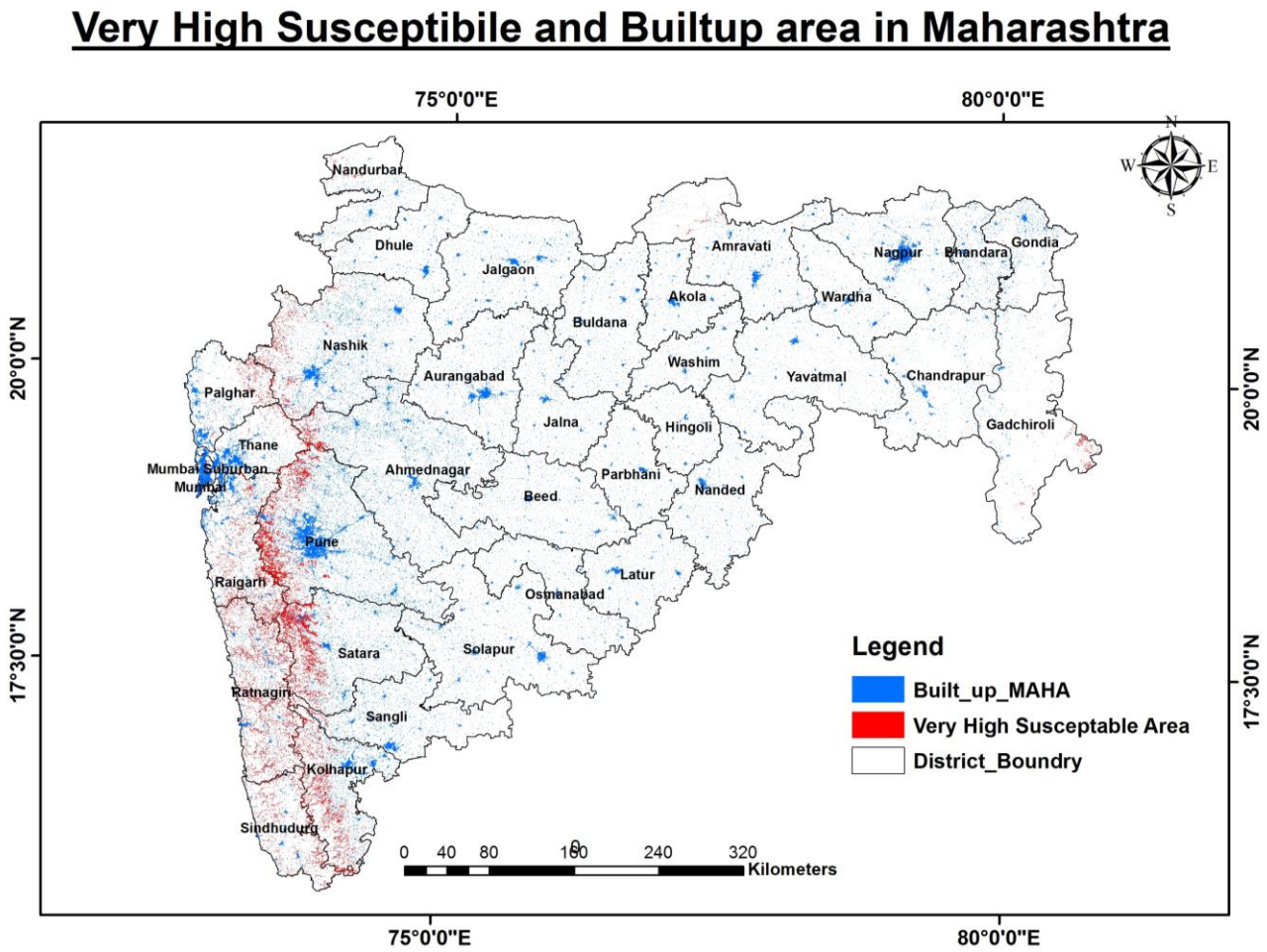


Figure 10: Very high landslide susceptible area and built-up area in Maharashtra

2.5. Village Level Landslide Risk Mapping for Maharashtra

Identification of the priority villages was done by first identifying the built up areas in Maharashtra1. Following this, the very high and high susceptible areas from the landslide susceptibility map of IIT Delhi was used to identify the built up areas falling under the very high and high susceptibility zones to identify the risk. This was then categorised based on the area of built up having high and very high susceptibility to establish the priorities. A total 4,934 villages of Maharashtra coming under different levels of landslide risk. The summary of the risks are as follows:

[1] Sentinel-2 10m Land Use/Land Cover – Esri, Impact Observatory, and Microsoft.

Table 12: List of priority villages

Priority Levels	No. of Priority Villages
Very High Priority	485
High Priority	696
Moderate Priority	1143
Low Priority	2135
Very Low Priority	475
Total	**4934**

Table 13: Very high priority villages across districts and the area

District	Number of Very High Priority villages	Area (Ha)
Satara	88	2681.33
Ratnagiri	139	2329.54
Pune	94	2168.72
Kolhapur	59	868.81
Raigad	48	764.15
Thane	23	467.41
Sindhudurg	17	239.17
Ahmednagar	8	118.26
Nashik	5	68.43
Palghar	2	67.00
Sangli	2	22.06
Total	**485**	**9,794.88**

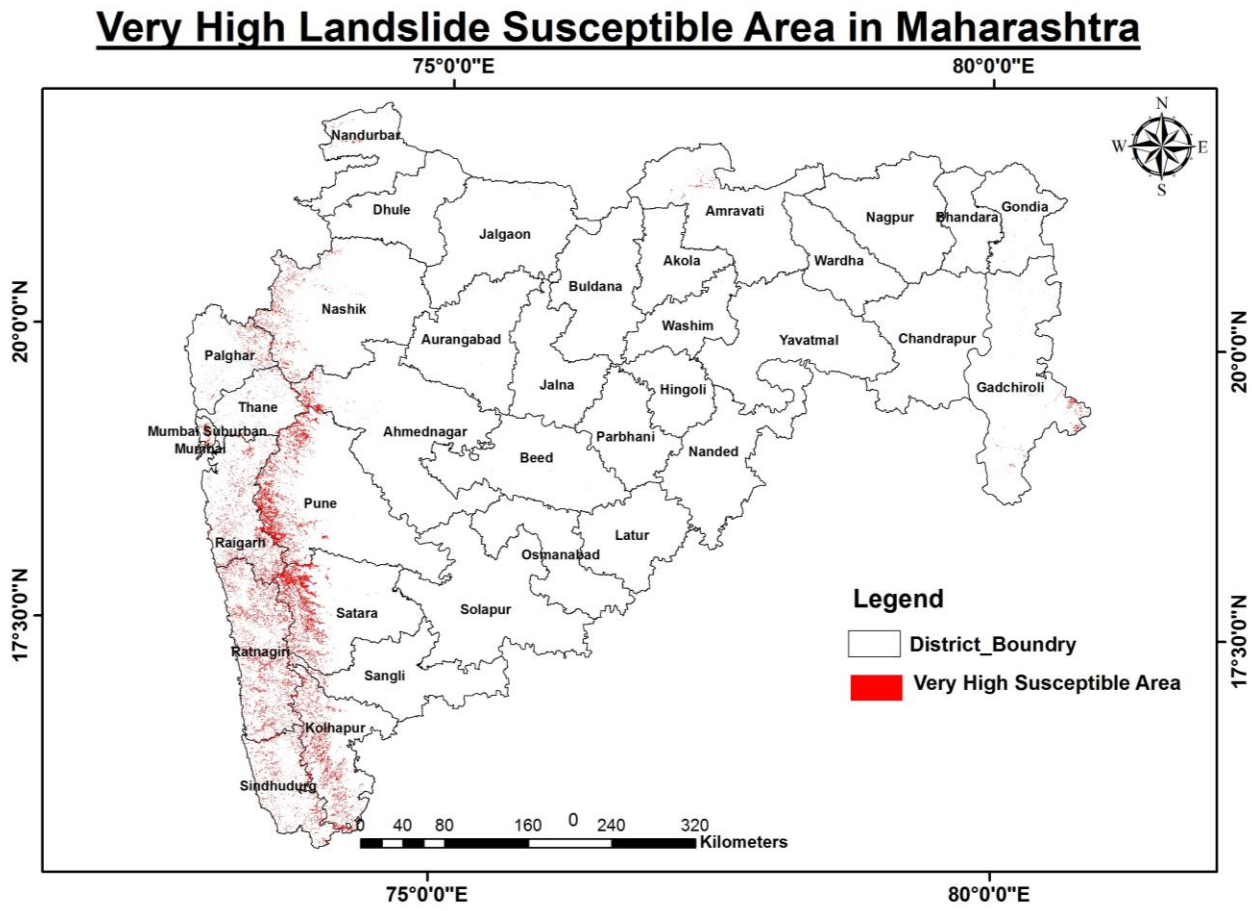


Figure 11: Very High Landslide susceptible area in Maharashtra as per IIT Delhi

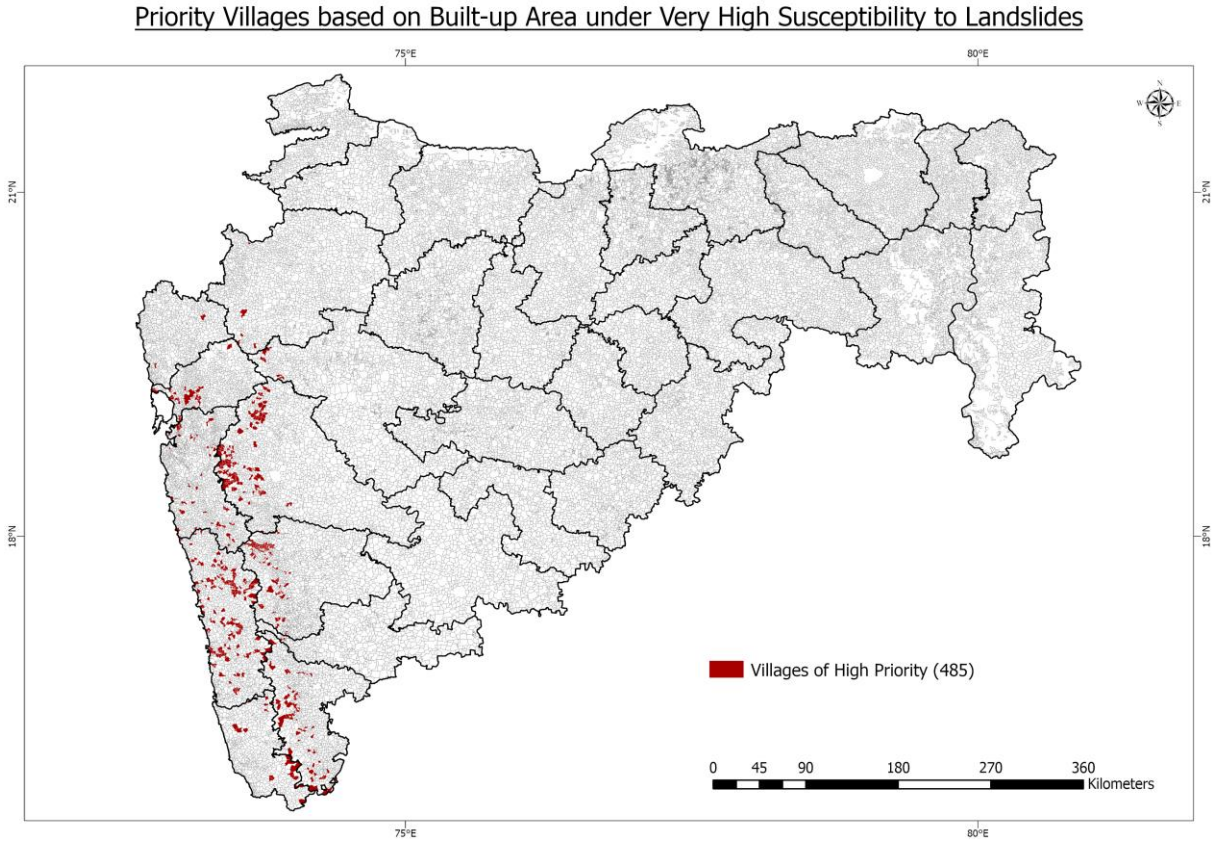


Figure 12: Prioritization of village falling under very high landslide susceptibility zone in Maharashtra

3. Landslide Risk Management Strategy

Maharashtra is highly vulnerable to landslides due to its distinct topography, geology, and rainfall patterns. The Western Ghats, a mountain range prone to landslides due to the consistency of steep slopes and loose soil. Maharashtra has a high concentration of critical infrastructure, such as buildings, roads, railways, Dam, Industries, and power lines. Apart from this Maharashtra has numbers of mineral mines, which are also very vulnerable of landslide. Based on the above analysis the following suggestions for management of landslide risks in Maharashtra are provided:

3.1. Regulatory Measures

1. The District Disaster Management Authority should take action to mandatorily rehabilitate the citizens temporarily or permanently, taking into account the danger of the place where the citizens are residing in the potentially cracked area, especially in the 485 prioritized villages.

2. Landslides are likely to occur due to mining and other activities carried out in the land area under the jurisdiction of the Revenue Department. Taking this matter into consideration, it will be necessary for the Collector of the concerned district to take care that no landslides will occur at that place while giving such permission/approval.

3. In the land area under the jurisdiction of the Forest Department, while giving various permits/approvals, the concerned Forest Department officials will have to take care that there will be no landslides at that place in future.

4. Local Gram Panchayats / Municipal Councils / Municipal Corporations / Municipal Corporations are expected to conduct periodical survey of the construction of houses as per the Act / Rules of their department in the places which are likely to have cracks. Also, it is necessary to urgently take action to forcibly permanently or temporarily resettle the families of the population living in potentially cracked areas to safe places.

5. The Urban Development Department has administrative control over Municipal Corporations, Municipalities, Nagar Parishads, Nagar Panchayats, CIDCO, MHADA and besides MMRDA, PMRDA, NMRDA Nagpur and similar organizations in the state. According to the 73rd constitutional amendment, the local self-government bodies are the local control authorities and they are responsible for land use planning, development plan (DP), construction regulations etc. in their area of operation. Therefore, the Urban Development Department will ensure that there is no damage due to landslides by taking risk

assessments and mitigation works in accordance with the Risk Mapping prepared by the Relief and Rehabilitation Department from the local self-government bodies, authorities and similar organizations under their jurisdiction.

6. The ownership rights of the land under the local self-government body belong to any of the private autonomous bodies, private individuals etc. If there is a possibility of landslides on that land due to the geographical situation, then the land should be immediately gentrified by the organization that has the ownership rights of the land.

7. In case of unauthorized construction, encroachment, etc., immediate eviction action should be taken. If any settlement exists with the approval of the local authority and if the local authority is convinced of the damage caused by the landslide, the forced temporary or permanent resettlement of those families should be done with the advice of the District Disaster Management Authority.

8. This department has divided the prone area into four parts and according to Very High, High, Medium & Low the Collector will notify the Very High and High zones accordingly. The notified land will be a No Construction Zone for any type of construction. On land classified as Moderate, the local authority will not grant construction permission without the recommendation of the District Disaster Management Authority as well as the Public Works Department.

9. Local authorities in Low classification areas will take decision based on strategic situation.

10. Apart from this, water resources, forest, housing construction, water supply and sanitation as well as soil and water conservation departments should implement projects in Very High and High zone areas only with the approval of the District Disaster Management Authority.

11. In the places where the road works are done by the Public Works Department, there are accidents due to landslides during monsoons and most of the time the roads are closed and the traffic is obstructed. For this, the Public Works Department needs to periodically survey whether or not the road laws have been complied with. Also, the Public Works Department must strictly follow the suggested measures while preparing the roads to avoid landslides. Crack preventive measures should be taken immediately in places where roadside works are likely to be prone to cracking.

12. The state government has taken a decision as per GR No. FLD-2019/C.R 129/R-12 for the rehabilitation of villages, settlements, and habitations affected by landslides triggered by extreme rainfall in the high-risk regions. In this

regard, the DDMAs are to submit proposals to initiate the rehabilitation work at safe locations with proper infrastructure facilities.

13. Activities such as construction of buildings, roads, quarrying and mining should be avoided in the following areas:

    a. Landslide susceptible zone
    b. Developed hillslopes with drain fields or leach fields septic systems; and places where landslides have already occurred.
    c. At the top or bottom of a steep cut slope, an old fill slope, or in or near the base of a first-order drainage or streamline.

14. The following actions are to be ensured before any construction is undertaken in the landslide susceptible zones:

    a. Getting sites verified (manually) from DDMA, supported by PWD, by physical verification of the villages.
    b. Classification of susceptibility through hybrid mode – physical survey and susceptibility mapping
    c. Identification of suitable places for rehabilitation
    d. Development of village level evacuation route
    e. A consulting report from an expert, such as a geotechnical or civil engineer, for any type of hillside construction.

3.2. Structural Measures

Structural measures such as the ones below shall be used to mitigate the risk of landslides.

- **Slope Stabilization:** Slope stabilization techniques reinforce the stability of hillsides and slopes prone to landslides. This can be achieved by constructing retaining walls, terracing, reducing general slope angles either by soil/debris or adding material, and using other soil reinforcement methods. These measures help prevent soil erosion and reduce the likelihood of landslides by providing structural support to the terrain.

- **Landslide retention walls:** Retention walls such as gravity retaining walls, crib block walls, and reinforced concrete walls, designed explicitly for landslide mitigation, are structural solutions that provide physical barriers to stabilize slopes and prevent soil/mud movement. These walls not only reinforce vulnerable slopes but also help to reduce the impact of landslides, thereby enhancing the overall safety and resilience of the affected regions.

- **Nature-Based Solutions:** Afforestation and reforestation initiatives involve planting trees and vegetation in landslide-prone areas. The roots of trees help bind the soil, reducing erosion and enhancing stability. By increasing vegetation cover, these efforts contribute to soil retention and the prevention of landslides.

- **Engineering Solutions:** Various engineering solutions can be employed to mitigate landslide risks. Drainage systems, including surface and subsurface drains, can redirect water away from potential landslide areas, reducing water-induced soil instability. Controlled blasting can be used in construction and mining activities to minimize the risk of slope failures. Additionally, dewatering techniques can be employed to lower groundwater levels, which can contribute to slope stability.

- **Soil Nails:** Soil nails are basically rigid bars which are driven into soil or pushed into boreholes which can be subsequently filled completely with grout. Together with the in-situ soil, they chart a coherent structural body supporting an excavation or holding the movement of an unstable slope. Soil nail walls are a widely used technology for retaining vertical cuts, nearly vertical cuts in soil and any slope which is at an angle steeper than the soil parameters would normally permit.

- **Removal of soil from the head of a slide:** This method reduces the driving force and thereby improves slope stability. This method is suitable only for cuts into deep soil where rotational landslides may occur. It can reduce the stress at the top of the slope, which may insist to stable the slope.

- **Reducing the height of the slope:** The height of the slope should be reduced by cutting the head of the steep slope before any road construction.

- **Mesh reinforcement:** Installation of mesh at the surface of the slope near any construction area can avoid the rock fall.

- **Surface Drainage:** It is very essential at the top of the slope, as it can reduce the water infiltration. So, the water baring capacity of the slope soil would not increase. Therefore, development of surface drainage should be included with any development work at the slope.

- **Landslide resistant infrastructure:** Proper engineering techniques should be adopt for construction of infrastructure.

- **Multi-Hazard Shelters:** The construction of multipurpose shelters at safe sites away from high landslide risk and proper maintenance of roads in risk-prone areas should be completed before developing any industry or settlement.

3.3. Non-Structural Measures

Non-structural measures such as the ones below shall be used to mitigate the risk of landslides.

- **Public Awareness:** Community education and awareness campaigns are crucial in landslide-prone areas. These programs inform residents about the risks of landslides, the warning signs, and proper evacuation procedures. Educated communities are better prepared to respond to landslide threats.

- **Disaster Preparedness:** Establishing local disaster management committees and conducting regular drills can enhance the preparedness of communities. These committees can create and implement emergency response plans, coordinate evacuations, and facilitate the efficient use of available resources during landslide events.

- **Training:** Establish, coordinate and implement national training program to enhance the capacity building of stakeholders involved in slope engineering and management.

- **Research and Development (R&D):** Better understanding of the slope safety factor, water baring capacity of slope, development of fold and fracture along the slope through research and development can provide the critical warning of landslide. Which can minimize the impact and help for better mitigation strategies.

- **Dissemination of warnings:** Coordinate with central agencies for quick, clear, and effective dissemination of information. Development of a model on landslide forecasting and dissemination of warnings. These initiatives can reduce the intensity of the slide.

- **Land Use Planning:** Effective land use planning involves identifying high-risk prone areas, inventory mapping of critical infrastructure and other vulnerable buildings, multi-hazard risk mapping and modelling of vulnerable areas, infrastructure planning based on probabilistic damage estimates and implementing regulations restricting construction and development. Zoning laws can help ensure that vulnerable regions are not urbanized, reducing the potential human and economic losses associated with landslides.

- **Hazard Zoning, mapping and HRVCA in regions prone to landslides**: Preparation of landslide hazard vulnerable zone maps and studies and monitoring of risk prone areas on site and using GIS at macro level. Undertake HRVCA as part of any development planning at vulnerable are.

- **Training and Capacity Building:** Train professionals on how to handle slope failures and their remediation and landslide emergencies by promoting observational methods of design and construction with training on the development of contingency plans. Provide support to and collaboration with National Agencies to conduct training to all government officials involved in the planning and implementation of Preparedness, Mitigation Response and Relief Work. Conduct Training Programmes for the Elected Representatives, officers, staff of Panchayat Raj Institutions and NGOs.

- **Geophysical and Geotechnical survey:** Undertaking this survey as compulsory part of any blueprint development for construction. As geophysical survey (GPR) can identify the subsurface fault/fracture, which can lead towards landslide and geotechnical survey can explain the bearing of holding capacity of slope soil, which can also avoid the landslide.

- **Policy and Code:** Develop effective policy, building code and institutional frameworks for landslide risk reduction, mitigation and disaster preparedness.

3.3.1. Early Warning

Early warning systems are integral to preparedness measures in both structural and non-structural approaches for landslide mitigation. These systems provide timely alerts, enabling proactive measures to safeguard life and property against impending landslide threats.

- **Rainfall Monitoring:** Continuous rainfall monitoring is essential for landslide early warning systems. Rain gauges detect heavy precipitation that can saturate the soil, increasing its landslide susceptibility. When certain rainfall thresholds are exceeded, warnings can be issued to alert vulnerable communities.

- **Seismic Monitoring:** Seismometers detect seismic activity, which can trigger landslides. Early warning systems integrate seismic data to issue alerts when significant seismic events occur.

- **Geotechnical Sensors:** These sensors measure ground movement and provide data that can be used to detect slope instability. By continuously monitoring changes in soil conditions, these sensors can trigger warnings when signs of potential landslides are detected.

- **Remote Sensing:** Satellite imagery and remote sensing data are valuable for detecting changes in land surface conditions that may indicate landslide risks. These technologies can identify shifts in topography, land deformation, or increased moisture levels that suggest heightened landslide susceptibility.

- **Community-Based Systems:** Establishing a network of local observers who can report unusual geological and meteorological conditions to authorities is another component of early warning systems. Local knowledge can be invaluable in identifying warning signs of potential landslides.
- **Communication Channels:** Efficient communication systems are crucial for disseminating early warnings to vulnerable communities promptly. These systems should ensure that residents receive timely and precise information about impending landslide risks and evacuation procedures.
- **The Global Positioning System (GPS):** It can be used as an alternative surveying tool to assist in geotechnical evaluations of steep slopes by providing a 3D coordinate Time series of displacements at discrete points on the sliding surface.
- **Installation of early dissemination warning system:** The proper installation of early warning dissemination system i.e., speaker, siren at the slope surrounded settlement, industry, hotels and mine can reduce the impact of this hazard. Undertaking installation of EWS as a part of the development planning.

3.4. Expenditure Strategy

The strategy for expenditures towards landslide risk reduction is as follows:

- First priority villages to be funded through State Budget
- Then remaining village works can be taken up under SDMF
- District administration should submit site specific proposal for first priority villages

State government has allocated funds INR 168.62 Cr. & INR 6.73 Cr (Total INR 175.36 Cr.) to MSRDC and PWD respectively under SDMF for taking up construction of retaining walls in landslide prone regions of Raigad, Sindhudurg, Pune and Jalna districts. Letter of Allocation (LoA) have been issued to the concerned agencies to initiate the works in high landslide risk regions on a priority basis. Details of the works are provided in the table below:

Table 14: Village wise SDMF allocation for Maharashtra (2022-23)

Village	Susceptibility Zone	Taluka	District	Cost (Rs)	Fund	Year (allocation)	IA
-		Thane	Thane	1456440000	SDMF	2022-23	MSRDC
Mumbra		Thane	Thane	19843000	SDMF	2021-22	MSRDC
Raigadwadi		Raigad	Raigad	209953000	State	2023-24	MSRDC
Rajpuri Koliwada		Murud	Raigad	6200000	SDMF	2021-22	PWD

Zolambe Dapatewadi		Dodamarga	Sindhudurg	9988400	SDMF	2022-23	PWD
Zolambe Dapatewadi to Vaze		Dodamarga	Sindhudurg	4730483	SDMF	2022-23	PWD
Sarambal		Kudal	Sindhudurg	9913274	SDMF	2022-23	PWD
Kochra Bhatwadi		Vengurla	Sindhudurg	15273940	SDMF	2022-23	PWD
Pirwadi		Badnapur	Jalna	16254640	SDMF	2021-22	PWD
Bhiwade		Junnar	Pune	5000000	SDMF	2021-22	PWD
			Total	**1,75,35,96,737**			

3.5. Pipeline project for landslide mitigation works under SDMF

To expedite the implementation of proposals received for landslide prevention works in Raigad, Pune, Satara and Nandurbar districts amounting to a total of INR 372.06 Cr., letter has been issued to DDMAs to the proposals as per the guidelines issued by NDMA for speedy approval under SDMF allocation for the year 2023-24. Details of the proposed works are provided in the table below:

Table 15: Proposed work for landslide mitigation in Maharashtra under SDMF

S. No.	Proposed Works	Cost INR (in Cr.)
1	Construction of Protection wall at Jui Tal, Mahad, Raigad	0.5037
2	Construction of Protection wall at Tajpur, Raigad	0.964
3	Construction of Retaining wall at Sahilnagar, Raigad	0.2576
4	Landslide mitigation works in Raigad district	46.02
5	Landslide mitigation works in Raigad district	20.26
6	Landslide mitigation & drainage works at Mahad, Raigad district	11.86
7	Strengthening of bridges & landslide protection, Raigad district	91.92
8	Landslide mitigation & drainage works at Mahad, Raigad district	49.22
9	Construction of retaining wall and other works at Podalpur, Raigad	18.77
10	Construction of protection wall for storage tank in Varathi village, Raigad district	0.875
11	Landslide mitigation & drainage works in 33 villages, Raigad district	66.10
12	Construction of retaining wall at Maval, Pune district	0.7725
13	Construction of retaining wall at Khed, Pune	2.20
14	Landslide mitigation works in Satara district	12.67
15	Landslide mitigation works at Akkalkuwa, Nandurbar district	49.67
	Total	**372.06**

4. Way Forward

4.1. Directives for signage installation

As per the landslide susceptibility carried out by GSI, SDMA has issued directives to district administration of 10 district to install signages in 6047 villages falling under landslide prone areas.

4.2. Monsoon Preparedness for Landslides

As most of the landslides of Maharashtra are rainfall induced landslides, there should be a proper management plan or preparedness plan before monsoon. Some of the important points are as follows:

4.2.1. SDMA

- Consultation with line departments for developing respective SOPs on monsoon preparedness for landslides.
- Setup systems for continuous monitoring of rainfall and forecast.
- Collaboration with IMD/RMC for high resolution forecast specifically for high-risk villages.
- Dissemination and Communication mechanisms of early warning.
- Guidelines for landslide rescue, recovery, and rehabilitation.
- Village remoteness assessment for high-risk villages.
- Upgradation and prepositioning of search and rescue equipment.
- Coordination with concern department on regulating/ restricting quarrying and mining activities during the monsoon season in high landslide risk zones.
- Established communication channels with first responders (Apada mitra/Local police) and relevant agencies (SDRF/NDRF) to support response and recovery.
- Development of Emergency Management committee and emergency helpline

4.2.2. DDMA

- DDMO consultation for Landslide Risk Reduction
- Development of evacuation plans including pets for high-risk villages.

- Communicating with the response forces about the high-risk villages, their access routes, and temporary resettlement sites.
- Guideline for prepositioning of home guard with respect to Landslide Risk assessment.
- Identification of suitable locations for setting up temporary shelters during emergencies in consultation with the local community.
- Preparation for setting up of temporary shelters while ensuring humanitarian standards.
- Listing of JCBs, trucks, Helicopters for on call response.
- Identification of suitable areas for landing of response helicopters and airdropping of relief supplies.
- Stocking and prepositioning of search, rescue equipment and logistics.
- Stocking and supply chain development for adequate supply of relief materials i.e., tent, water, food, medicines, toilet and sanitation kit.
- Identify and linkages with source of fodder and safe locations for animal camps and canalization with veterinary hospitals, clinics and agencies working for animals.
- Development and identification of proper transportation facilities ang routes for sick or critically injured animals, if any during an landslide and places for burial of dead animals.
- Identification and listing of poor structure/buildings situated on the slope for retrofitting.

4.3. Resettlement & Rehabilitation - DDMO Consultation

- Questionnaire development for addressing challenges in resettlement and rehabilitation.
- Development of temporary and permanent rehabilitation measures of very high landslide susceptible villages.

4.4. Prioritized activity plan for next 3 months

Table 16: Prioritised activity plan for next 3 months

Activity	Mar	April	May
SDMA			
DDMO consultation for Landslide Risk Reduction			
Consultation with line departments for developing respective SOPs on monsoon preparedness for landslides.			
Setup systems for continuous monitoring of rainfall and forecast.			
Collaboration with IMD/RMC for high resolution forecast specifically for high-risk villages.			
Dissemination and Communication mechanisms of early warning.			
Guidelines for landslide rescue, recovery, and rehabilitation.			
Village remoteness assessment for high-risk villages.			
Upgradation and prepositioning of search and rescue equipment.			
Coordination with concern department on regulating/ restricting quarrying and mining activities during the monsoon season in high landslide risk zones.			
Established communication channels with first responders (Apada Mitra/Local police) and relevant agencies (SDRF/NDRF) to support response and recovery.			
Development of Emergency Management committee and emergency helpline			
DDMA			
Development of evacuation plans, including livestock for high-risk villages.			
Communicating with the response forces about the high-risk villages, their access routes, and temporary resettlement sites.			
Guideline for prepositioning of home guards with respect to Landslide Risk assessment.			

Activity	Mar	April	May
Identification of suitable locations for setting up temporary shelters during emergencies in consultation with the local community.			
Preparation for setting up of temporary shelters while ensuring humanitarian standards.			
Listing of JCBs, trucks, Helicopters for on call response.			
Identification of suitable areas for landing of response helicopters and airdropping of relief supplies.			
Stocking and prepositioning of search, rescue equipment and logistics.			
Stocking and supply chain development for adequate supply of relief materials i.e., tent, water, food, medicines, toilet and sanitation kit.			
Identify and linkages with source of fodder and safe locations for animal camps and canalization with veterinary hospitals, clinics and agencies working for animals.			
Development and identification of proper transportation facilities ang routes for sick or critically injured animals, if any during an landslide and places for burial of dead animals.			
Identification and listing of poor structure/buildings situated on the slope for retrofitting.			

5. Annexures

5.1. Expert Studies

5.1.1. Gadgil Committee Report, 2011

- Declaration of eco-sensitive zones (64%) in the landslide-prone areas of western ghats.
- Setting up of Authority to regulate development activities in the eco-sensitive areas.
- Micro-level hazard and vulnerability mapping of the landslide-prone areas.
- Restriction of development activities in high-risk zones.
- Mining activities should be avoided in risk areas.
- Master plan to be prepared for susceptible areas to take up development without disturbing the ecology.
- Suitable buffer zones to be created with due consideration to slope and soil conditions.

5.1.2. Kasturirangan Committee Report, 2014

- Around 37% of the area of western ghats is identified as an ecologically sensitive area (ESA).
- Argues setting up of Grant-in-aid from central government for western ghats and also devolution of funds through local conservation trust funds for community driven initiatives.
- Recommends setting up of Decision support and Monitoring Centre for Western Ghats.
- Recommends taking up climate change risk projection studies and developing ecosystem change models for devising long-term adaptation strategies/Nature-based solutions.

5.1.3. Landslide Compendium of Maharashtra, GSI, 2018

- The study compiles the inventory of landslide incidences in the western Ghat region of Maharashtra from 1983 to 2015.
- Multi-dimensional landslide investigations such as inventory mapping, site-specific detailed geological and topographical mapping, landslide

susceptibility mapping, post-disaster investigation, etc., are part of the compendium.

- The compendium also provides landslide event-specific remedial measures along with detailed landslide susceptibility mapping of Malshej ghat, Pune and Thane districts.

5.2. List of Villages at Very High Risk from Landslides in Maharashtra

S.No.	District	Tehsil	Village	Area (in Ha)
1	Ahmednagar	Akole	Bhandardara	18.6808
2	Ahmednagar	Akole	Jaynawadi	18.5117
3	Ahmednagar	Akole	Palsunde	18.2444
4	Ahmednagar	Akole	Shendi	16.5246
5	Ahmednagar	Akole	Satewadi	13.4737
6	Ahmednagar	Akole	Waranghushi	11.8129
7	Ahmednagar	Akole	Senit Kh. (N.V.)	10.5495
8	Ahmednagar	Akole	Murshet	10.4611
9	Kolhapur	Radhanagari	Radhanagari	29.7477
10	Kolhapur	Panhala	Panhala (Rural)	29.4412
11	Kolhapur	Radhanagari	Keloshi Bk.	26.9008
12	Kolhapur	Chandgad	Chandgad	26.4179
13	Kolhapur	Bhudargad	Kadgaon	24.0639
14	Kolhapur	Bhudargad	Mhasave.	23.0128
15	Kolhapur	Gaganbavda	Gagan Bavda	21.3801
16	Kolhapur	Shauwadi	Malkapur	20.7386
17	Kolhapur	Ajra	Ajra	20.4252
18	Kolhapur	Radhanagari	Shirgaon	20.2069
19	Kolhapur	Panhala	Wadi Ratnagiri	19.9454
20	Kolhapur	Radhanagari	Reservoir (submerged)	19.3223
21	Kolhapur	Radhanagari	Tarle Kasaba	17.4564
22	Kolhapur	Panhala	Wetavade	16.507
23	Kolhapur	Bhudargad	Dindewadi	16.1664
24	Kolhapur	Radhanagari	Konoli Tarf Asandoli	16.1028
25	Kolhapur	Gaganbavda	Tisangi	16.0673
26	Kolhapur	Chandgad	Ibrahimpur	15.7884
27	Kolhapur	Karvir	Ghanawade	15.1764
28	Kolhapur	Chandgad	Kodali	15.1426
29	Kolhapur	Ajra	Dewarde	14.5373
30	Kolhapur	Chandgad	Vinzane	14.3143
31	Kolhapur	Radhanagari	Dhamod	14.2184
32	Kolhapur	Radhanagari	Avali Bk.	13.4931
33	Kolhapur	Chandgad	Mangaon	13.46
34	Kolhapur	Bhudargad	Hedvade	13.3602
35	Kolhapur	Radhanagari	Pandewadi	13.2506
36	Kolhapur	Radhanagari	Padali	12.9552
37	Kolhapur	Panhala	Rakshi	12.6776

S.No.	District	Tehsil	Village	Area (in Ha)
38	Kolhapur	Chandgad	Here	12.5815
39	Kolhapur	Radhanagari	Kanthewadi	12.4547
40	Kolhapur	Karvir	Teraswadi	12.3553
41	Kolhapur	Panhala	Injole	12.2773
42	Kolhapur	Bhudargad	Mathagaon	12.2534
43	Kolhapur	Chandgad	Tudiye	12.0413
44	Kolhapur	Chandgad	Mirwel	12.0176
45	Kolhapur	Karvir	Chafodi	11.8678
46	Kolhapur	Chandgad	Mhalunge Khalsa	11.8628
47	Kolhapur	Radhanagari	Gavashi	11.828
48	Kolhapur	Panhala	Nebapur	11.7038
49	Kolhapur	Shauwadi	Yelan J.Gai	11.6067
50	Kolhapur	Karvir	Bololi	11.2171
51	Kolhapur	Bhudargad	Phaye	11.0303
52	Kolhapur	Gaganbavda	Dhundavade	11.0008
53	Kolhapur	Gaganbavda	Saitavade.	10.9942
54	Kolhapur	Radhanagari	Shirse	10.93
55	Kolhapur	Chandgad	Halkarni	10.8849
56	Kolhapur	Chandgad	Asagaon	10.8538
57	Kolhapur	Shauwadi	Parali	10.7653
58	Kolhapur	Chandgad	Ambewadi	10.7305
59	Kolhapur	Bhudargad	Palshivane	10.5783
60	Kolhapur	Gaganbavda	Borbet	10.5169
61	Kolhapur	Chandgad	Bijur	10.5136
62	Kolhapur	Shauwadi	Udgiri	10.4356
63	Kolhapur	Bhudargad	Akurde	10.4041
64	Kolhapur	Radhanagari	Piral	10.3506
65	Kolhapur	Chandgad	Devarwadi	10.313
66	Kolhapur	Shauwadi	Ghungur	10.082
67	Kolhapur	Chandgad	Halkarni	10.0792
68	Nashik	Surgana	Surgana (Urban)	18.8687
69	Nashik	Igatpuri	Pimpalgaon Bhatata	14.0282
70	Nashik	Igatpuri	Talegaon	13.3476
71	Nashik	Trimbakeshwar	Anjanneri	11.8215
72	Nashik	Igatpuri	Kanadwadi	10.3668
73	Palghar	Jawhar	Jawhar Rural	43.695
74	Palghar	Vasai	Naragi	23.3054
75	Pune	Mulshi-Paud	Dasave	175.3889
76	Pune	Mawal	Lonavale	80.3841

S.No.	District	Tehsil	Village	Area (in Ha)
77	Pune	Mawal	Khandale	79.1426
78	Pune	Mulshi-Paud	Tata Talav	63.636
79	Pune	Mulshi-Paud	Mulshi Kh.	47.1565
80	Pune	Mulshi-Paud	Visakhar	44.8108
81	Pune	Mulshi-Paud	Warak	43.0764
82	Pune	Ambegaon	Gohe Bk.	42.2695
83	Pune	Mawal	Kune N.m.	38.5586
84	Pune	Mulshi-Paud	Devghar	37.6104
85	Pune	Mawal	Tungarli	37.5755
86	Pune	Mulshi-Paud	Ambavane	36.7689
87	Pune	Mulshi-Paud	Peth Shahapur	36.3032
88	Pune	Mawal	Shilimb	35.7567
89	Pune	Mawal	Mawal	34.8148
90	Pune	Mawal	Kurvande	32.002
91	Pune	Mawal	Lohagad	30.762
92	Pune	Ambegaon	Borghar	29.8529
93	Pune	Mawal	Tung	27.6106
94	Pune	Junnar	Chawad	27.2897
95	Pune	Mawal	Vehergaon	26.6748
96	Pune	Mulshi-Paud	Kumbhori	26.4653
97	Pune	Mawal	JOVAN	25.5039
98	Pune	Mawal	Ambegaon	24.5527
99	Pune	Mulshi-Paud	Bhoini	23.7793
100	Pune	Mulshi-Paud	Pirangut	23.5982
101	Pune	Haveli	Agalambe	22.9338
102	Pune	Mawal	Morave	21.7798
103	Pune	Mawal	Gevhande Khadak	21.5276
104	Pune	Mulshi-Paud	Bhugaon	21.2941
105	Pune	Mawal	Apati	21.0962
106	Pune	Khed	Naiphad	20.9517
107	Pune	Saswad-Purandhar	Gherapurandhar	20.3819
108	Pune	Ambegaon	Phaladewadi Ugalewadi	20.0824
109	Pune	Khed	Valad	20.0522
110	Pune	Mulshi-Paud	Valane	20.0199
111	Pune	Mulshi-Paud	Lavale	19.4145
112	Pune	Haveli	Ghera Sinhagad	19.1539
113	Pune	Velhe	Shirkoli	18.6761
114	Pune	Mawal	Chavsar	18.6525
115	Pune	Khed	Chikhalgaon	18.6127

S.No.	District	Tehsil	Village	Area (in Ha)
116	Pune	Haveli	Thoptewadi	18.591
117	Pune	Khed	Avadar	18.4871
118	Pune	Mulshi-Paud	Ambarwet	18.4607
119	Pune	Ambegaon	Rajewadi	18.4478
120	Pune	Khed	Kharoshi	17.642
121	Pune	Mawal	Bhaje	17.6357
122	Pune	Bhor	Korle	17.2948
123	Pune	Mawal	Tikona	17.2903
124	Pune	Mulshi-Paud	Kemasewadi	16.9925
125	Pune	Junnar	Shiroli Tarf Kukadneher	16.7182
126	Pune	Mulshi-Paud	Rihe	16.6368
127	Pune	Khed	Awhat	16.4013
128	Pune	Haveli	Sambarewadi	16.1712
129	Pune	Ambegaon	Asane	15.907
130	Pune	Mawal	Dudhivare	15.5231
131	Pune	Mulshi-Paud	Nive	15.4635
132	Pune	Mulshi-Paud	Male	15.1468
133	Pune	Ambegaon	Phulvade	15.1387
134	Pune	Khed	Kohinde Kh.	15.0338
135	Pune	Mulshi-Paud	Sambhave	14.7399
136	Pune	Ambegaon	Mapoli	14.714
137	Pune	Ambegaon	Tale Ghar	14.501
138	Pune	Mawal	Malawali N.m.	14.3398
139	Pune	Mawal	Patan	14.1239
140	Pune	Junnar	Pur	13.9494
141	Pune	Mulshi-Paud	Man	13.5887
142	Pune	Junnar	Hadsar	13.5359
143	Pune	Mawal	Inglun	13.4817
144	Pune	Junnar	Nimgiri	13.0398
145	Pune	Velhe	Velhe Bk.	13.008
146	Pune	Khed	Wada	12.706
147	Pune	Junnar	Ingaloon	12.6666
148	Pune	Mawal	Pangaloli	12.6637
149	Pune	Mulshi-Paud	Lavharde	12.0245
150	Pune	Ambegaon	Pokhari	11.8001
151	Pune	Ambegaon	Dimbhe Bk.	11.7612
152	Pune	Haveli	Manerwadi	11.72
153	Pune	Mawal	Shilatane	11.6778
154	Pune	Khed	Kude Bk.	11.5288

S.No.	District	Tehsil	Village	Area (in Ha)
155	Pune	Mulshi-Paud	Khamboli	11.5101
156	Pune	Mulshi-Paud	Saiv Kh	11.3147
157	Pune	Junnar	Keli	11.3034
158	Pune	Junnar	Sonawale	11.2574
159	Pune	Junnar	Tambe	11.2229
160	Pune	Mulshi-Paud	Tamhini Bk	11.1968
161	Pune	Haveli	Mandvi Bk.	11.1549
162	Pune	Haveli	Sonapur	10.8459
163	Pune	Mulshi-Paud	Kolavade	10.694
164	Pune	Ambegaon	Shinoli	10.5332
165	Pune	Mawal	Waksai	10.5223
166	Pune	Mulshi-Paud	Bhambarde	10.2541
167	Pune	Mulshi-Paud	Materewadi	10.2133
168	Pune	Mawal	Umbare Navalakh	10.1723
169	Ratnagiri	Ratnagiri	Zadgaon	57.0503
170	Ratnagiri	Rajapur	Rajapur	49.2091
171	Ratnagiri	Chiplun	Mirjoli	46.9474
172	Ratnagiri	Chiplun	Pophali	41.1814
173	Ratnagiri	Chiplun	Kolkewadi	39.9109
174	Ratnagiri	Sangmeshwar	Mabhale	34.2791
175	Ratnagiri	Sangmeshwar	Sangameshwar	31.3475
176	Ratnagiri	Chiplun	Donavali	29.0185
177	Ratnagiri	Rajapur	Sheel	28.9913
178	Ratnagiri	Rajapur	Tithavali (N.V.)	28.7068
179	Ratnagiri	Mandangad	Bankot	27.963
180	Ratnagiri	Ratnagiri	Pavas	26.6308
181	Ratnagiri	Chiplun	Kasbe Chiplun	25.8769
182	Ratnagiri	Sangmeshwar	Dhamapur Tarf Sangameshwar	25.7498
183	Ratnagiri	Chiplun	Pedhe	25.6435
184	Ratnagiri	Ratnagiri	Shirgaon	24.958
185	Ratnagiri	Chiplun	Waloti	24.1332
186	Ratnagiri	Dapoli	Dabhol	23.0039
187	Ratnagiri	Khed	Khed_(bhadgaon)	22.9108
188	Ratnagiri	Chiplun	Walope	22.6999
189	Ratnagiri	Sangmeshwar	Nive Bk.	22.6097
190	Ratnagiri	Guhaghar	Karul	22.399
191	Ratnagiri	Ratnagiri	Khedoshi	21.4206
192	Ratnagiri	Rajapur	Kodavali	21.2705
193	Ratnagiri	Chiplun	Pedhe Parshuram	21.2121

S.No.	District	Tehsil	Village	Area (in Ha)
194	Ratnagiri	Khed	Sukivali	20.7839
195	Ratnagiri	Ratnagiri	Nachne	20.6604
196	Ratnagiri	Chiplun	Kondhe	20.5327
197	Ratnagiri	Khed	Dhamandevi	20.4405
198	Ratnagiri	Ratnagiri	Velvand	20.3375
199	Ratnagiri	Sangmeshwar	Wandri	19.9896
200	Ratnagiri	Ratnagiri	Gadnaral	19.8641
201	Ratnagiri	Chiplun	Khadpoli	19.3087
202	Ratnagiri	Ratnagiri	Ghavaliwadi	19.1204
203	Ratnagiri	Sangmeshwar	Lovale	19.0889
204	Ratnagiri	Sangmeshwar	Parchuri	18.7926
205	Ratnagiri	Sangmeshwar	Pedhambe	18.2382
206	Ratnagiri	Chiplun	Kadwad	18.2115
207	Ratnagiri	Sangmeshwar	Phansavane	18.0926
208	Ratnagiri	Chiplun	Karjikar Mohalla	17.456
209	Ratnagiri	Ratnagiri	Someshwar	17.3998
210	Ratnagiri	Dapoli	Pharare	17.2463
211	Ratnagiri	Khed	Anjani	16.9846
212	Ratnagiri	Khed	Tisangi	16.9782
213	Ratnagiri	Dapoli	Talsure	16.7656
214	Ratnagiri	Chiplun	Dhamanvane	16.7523
215	Ratnagiri	Chiplun	Kapsal	16.7366
216	Ratnagiri	Ratnagiri	Tike	16.7335
217	Ratnagiri	Khed	Shirshi	16.6936
218	Ratnagiri	Chiplun	Pilavali Tarf Sava	16.5678
219	Ratnagiri	Guhaghar	Kajurlee	16.5613
220	Ratnagiri	Lanja	Waked	16.5534
221	Ratnagiri	Sangmeshwar	Rampeth	16.3793
222	Ratnagiri	Ratnagiri	Harchiri	16.362
223	Ratnagiri	Ratnagiri	Malgund	16.2809
224	Ratnagiri	Dapoli	Kamp Dapoli	16.2721
225	Ratnagiri	Guhaghar	Bhatgaon Tisang	15.9295
226	Ratnagiri	Khed	Shiv_mohalla	15.814
227	Ratnagiri	Sangmeshwar	Navdi	15.6115
228	Ratnagiri	Khed	Veral	15.3859
229	Ratnagiri	Sangmeshwar	Murshi	15.3164
230	Ratnagiri	Dapoli	Harnai	15.1951
231	Ratnagiri	Dapoli	Mauje_Dapoli	15.1601
232	Ratnagiri	Lanja	Vangule	15.0092

S.No.	District	Tehsil	Village	Area (in Ha)
233	Ratnagiri	Sangmeshwar	Golavali	14.9188
234	Ratnagiri	Sangmeshwar	Kundi	14.6787
235	Ratnagiri	Ratnagiri	Miravane	14.5912
236	Ratnagiri	Khed	Chinchghar	14.2233
237	Ratnagiri	Dapoli	Mandivali	14.1602
238	Ratnagiri	Khed	Bharana_Naka	14.1599
239	Ratnagiri	Khed	Gunade	14.1303
240	Ratnagiri	Khed	Kotwali	14.115
241	Ratnagiri	Sangmeshwar	Kase	14.0277
242	Ratnagiri	Sangmeshwar	Sakharpa	13.9002
243	Ratnagiri	Ratnagiri	Karle	13.8563
244	Ratnagiri	Chiplun	Tiware	13.8219
245	Ratnagiri	Chiplun	Kamathe	13.7092
246	Ratnagiri	Dapoli	Asud	13.4659
247	Ratnagiri	Chiplun	Chinchghari	13.4607
248	Ratnagiri	Guhaghar	Naravan	13.3898
249	Ratnagiri	Ratnagiri	Panwal	13.3526
250	Ratnagiri	Sangmeshwar	Kondgaon	13.3314
251	Ratnagiri	Ratnagiri	Tembhye	13.2275
252	Ratnagiri	Ratnagiri	Karvachiwadi	13.1651
253	Ratnagiri	Dapoli	Sarang	13.1425
254	Ratnagiri	Khed	Ghanekhunt	13.0991
255	Ratnagiri	Chiplun	Pali	12.9873
256	Ratnagiri	Guhaghar	Mouje Anjanvel	12.888
257	Ratnagiri	Chiplun	Mundhe Tarf Chiplu	12.8226
258	Ratnagiri	Guhaghar	Palshet	12.8004
259	Ratnagiri	Ratnagiri	Umare	12.6894
260	Ratnagiri	Khed	Natu_Nagar	12.6594
261	Ratnagiri	Khed	Dhamani	12.5915
262	Ratnagiri	Khed	Songaon	12.4629
263	Ratnagiri	Mandangad	Panderi	12.3694
264	Ratnagiri	Guhaghar	Abloli	12.1939
265	Ratnagiri	Guhaghar	Velaneshwar	12.1503
266	Ratnagiri	Lanja	Indavati	12.1498
267	Ratnagiri	Sangmeshwar	Ozare Bk.	12.0846
268	Ratnagiri	Chiplun	Waghivare	12.0682
269	Ratnagiri	Sangmeshwar	Dhamani	12.0381
270	Ratnagiri	Khed	Karjee	12.021
271	Ratnagiri	Chiplun	Akale	12.0206

S.No.	District	Tehsil	Village	Area (in Ha)
272	Ratnagiri	Chiplun	Riktoli	11.9675
273	Ratnagiri	Khed	Kulvandi	11.9437
274	Ratnagiri	Dapoli	Onanvase	11.8184
275	Ratnagiri	Khed	Bahiravali	11.7096
276	Ratnagiri	Ratnagiri	Bendrewadi	11.6897
277	Ratnagiri	Ratnagiri	Nanij	11.4644
278	Ratnagiri	Khed	Murde	11.3112
279	Ratnagiri	Ratnagiri	Chanderai	11.2592
280	Ratnagiri	Guhaghar	Are	11.2483
281	Ratnagiri	Rajapur	Kondhe Tarf Rajapur	11.2255
282	Ratnagiri	Chiplun	Pilawali Tarf Vela	11.184
283	Ratnagiri	Guhaghar	Sakhari Agar	11.1073
284	Ratnagiri	Lanja	Bhade	11.0362
285	Ratnagiri	Sangmeshwar	Dabhole Bk.	11.0176
286	Ratnagiri	Sangmeshwar	Makhajan	10.896
287	Ratnagiri	Guhaghar	Welamb	10.7713
288	Ratnagiri	Dapoli	Katran	10.7487
289	Ratnagiri	Dapoli	Dabhil	10.7039
290	Ratnagiri	Rajapur	Bhoo	10.6246
291	Ratnagiri	Ratnagiri	Ravnangwadi	10.5842
292	Ratnagiri	Rajapur	Hardi	10.5543
293	Ratnagiri	Khed	Furus	10.5502
294	Ratnagiri	Khed	Dhamanand	10.4151
295	Ratnagiri	Dapoli	Unhavare	10.3434
296	Ratnagiri	Sangmeshwar	Devade	10.3174
297	Ratnagiri	Ratnagiri	Jamatwadi	10.2258
298	Ratnagiri	Chiplun	Kherdi	10.2039
299	Ratnagiri	Khed	Lote	10.1719
300	Ratnagiri	Mandangad	Nigadi	10.1608
301	Ratnagiri	Sangmeshwar	Kolambe	10.1504
302	Ratnagiri	Dapoli	Pangari_Tarf_Haveli	10.1493
303	Ratnagiri	Sangmeshwar	Dingni Kuran	10.1105
304	Ratnagiri	Guhaghar	Bandarwadi	10.0915
305	Ratnagiri	Guhaghar	Vadad	10.0524
306	Ratnagiri	Sangmeshwar	Sarand	10.05
307	Ratnagiri	Khed	Shivtar	10.0235
308	Raigad	Karjat	Neral	29.0176
309	Raigad	Tala	Tala	28.4871
310	Raigad	Panvel	Wahal	27.2509

S.No.	District	Tehsil	Village	Area (in Ha)
311	Raigad	Uran	Boripakhadi	27.1243
312	Raigad	Khalapur	Khopoli	26.6817
313	Raigad	Murud	Rajpuri	26.6637
314	Raigad	Karjat	Matheran	26.0566
315	Raigad	Poladpur	Poladpur	24.3972
316	Raigad	Mahad	Dasgaon	22.8353
317	Raigad	Panvel	Apte	19.9915
318	Raigad	Panvel	Gavhan	19.1303
319	Raigad	Mahad	Gherakilla Raigad (Raigadwadi)	19.1214
320	Raigad	Mahad	Mahad	18.139
321	Raigad	Mangaon	Morba	17.0904
322	Raigad	Mahad	Pale	16.9375
323	Raigad	Mahad	Birwadi	16.8943
324	Raigad	Mahsala	Pangaloli	15.9307
325	Raigad	Tala	Mandad	15.0366
326	Raigad	Mahad	Lower Tudil	14.8507
327	Raigad	Uran	Jui	14.7531
328	Raigad	Uran	Jasai	14.6579
329	Raigad	Panvel	Chawane	14.4317
330	Raigad	Panvel	Nhave	14.259
331	Raigad	Roha	Roha (Gaulwadi)	13.949
332	Raigad	Mangaon	Devali	13.8839
333	Raigad	Roha	Padum	13.7802
334	Raigad	Poladpur	Cholai	13.6208
335	Raigad	Poladpur	Kapade Bk.	13.6081
336	Raigad	Sudhagad	Kasbe Pali	13.0765
337	Raigad	Shrivardhan	Shrivardhan	12.6241
338	Raigad	Mahad	Pachad	12.5919
339	Raigad	Khalapur	Vadval	12.5588
340	Raigad	Khalapur	Honad	12.177
341	Raigad	Khalapur	Durshet	11.878
342	Raigad	Mahad	Kamble Tarf Birwadi	11.6513
343	Raigad	Alibag	Vaijali	11.4305
344	Raigad	Khalapur	Adoshi	11.3394
345	Raigad	Mahsala	Waral	11.058
346	Raigad	Poladpur	Kondhawi	10.8075
347	Raigad	Mahsala	Kalsuri	10.7243
348	Raigad	Murud	Murud (rural)	10.6439
349	Raigad	Khalapur	Shil	10.5819

S.No.	District	Tehsil	Village	Area (in Ha)
350	Raigad	Roha	Killa	10.5454
351	Raigad	Khalapur	Kaire	10.4976
352	Raigad	Mahsala	Talavade	10.4748
353	Raigad	Shrivardhan	Devaghar	10.4555
354	Raigad	Mahad	Wahoor	10.2447
355	Raigad	Poladpur	Lohare	10.2123
356	Sangli	Shirala	Arale	11.6483
357	Sangli	Shirala	Kharale	10.412
358	Satara	Mahabaleshwar	Bhose	159.1069
359	Satara	Mahabaleshwar	Panchagani	156.5768
360	Satara	Mahabaleshwar	Khengar	146.5971
361	Satara	Mahabaleshwar	Kaswand	141.2314
362	Satara	Mahabaleshwar	Bhilar	114.7528
363	Satara	Mahabaleshwar	Malkampeth	113.718
364	Satara	Mahabaleshwar	Kshetra mahabaleshwar	74.9539
365	Satara	Mahabaleshwar	Godavali	70.8171
366	Satara	Wai	Taighat	66.79
367	Satara	Mahabaleshwar	Metgutad	64.7647
368	Satara	Wai	Dandeghar	61.0975
369	Satara	Wai	Mandhardeo	60.3265
370	Satara	Mahabaleshwar	Ambral	45.8916
371	Satara	Mahabaleshwar	Pangari	38.8456
372	Satara	Satara	Yavateshwar	38.19
373	Satara	Patan	Kisrule	34.6849
374	Satara	Patan	Gokul tarf helwak	34.1057
375	Satara	Mahabaleshwar	Machutar	33.7094
376	Satara	Satara	Kasbe Satara	33.2604
377	Satara	Jaoli	Ruighar	32.307
378	Satara	Mahabaleshwar	Kumbharoshi	30.9217
379	Satara	Mahabaleshwar	Danvali	30.87
380	Satara	Mahabaleshwar	Devali	29.8325
381	Satara	Jaoli	Nandgane	29.6468
382	Satara	Jaoli	Dhangarwadi	28.9355
383	Satara	Jaoli	Ghoteghar	28.6964
384	Satara	Mahabaleshwar	Bhekavali	28.0195
385	Satara	Mahabaleshwar	Nakinda	27.108
386	Satara	Mahabaleshwar	Kalamgaon	26.2365
387	Satara	Jaoli	Umbari	26.0596
388	Satara	Patan	Salave	25.1399

S.No.	District	Tehsil	Village	Area (in Ha)
389	Satara	Mahabaleshwar	Gureghar	25.0478
390	Satara	Wai	Rajpuri	23.3202
391	Satara	Mahabaleshwar	Taldev	20.9667
392	Satara	Jaoli	Ranjni	20.5141
393	Satara	Mahabaleshwar	Parut	19.9244
394	Satara	Patan	Jinti	19.8355
395	Satara	Jaoli	Rengadiwadi (N.V.)	19.678
396	Satara	Jaoli	Varoshi	19.507
397	Satara	Wai	Nagewadi	19.2893
398	Satara	Patan	Ghot	19.2634
399	Satara	Patan	Banpuri	19.0863
400	Satara	Mahabaleshwar	Moleshwar	18.5078
401	Satara	Mahabaleshwar	Avakali	18.1697
402	Satara	Mahabaleshwar	Manghar	17.5807
403	Satara	Patan	Dasale	17.4459
404	Satara	Wai	Yeruli	17.4133
405	Satara	Jaoli	Bhuteghar	17.4025
406	Satara	Jaoli	Vadgare	16.1961
407	Satara	Jaoli	Kotroshi	16.135
408	Satara	Mahabaleshwar	Shindola	15.903
409	Satara	Mahabaleshwar	Met	15.8571
410	Satara	Mahabaleshwar	Navali	15.825
411	Satara	Satara	Kusavade	15.7851
412	Satara	Mahabaleshwar	Haroshi	15.5296
413	Satara	Jaoli	Kusumbi	15.1366
414	Satara	Jaoli	Kavadi	14.7725
415	Satara	Jaoli	Vanavli t. ategaon	14.5628
416	Satara	Jaoli	Marli	14.4766
417	Satara	Jaoli	Hatgeghar	14.321
418	Satara	Satara	Pangare	13.78
419	Satara	Satara	Parambe	13.5865
420	Satara	Patan	Davari	13.1055
421	Satara	Patan	Kalambe	13.0106
422	Satara	Patan	Padekarwadi (N.V.)	12.5998
423	Satara	Patan	Rasati	12.5871
424	Satara	Jaoli	Katavali	12.5766
425	Satara	Jaoli	Bahule	12.5499
426	Satara	Patan	Killemorgiri	12.4117
427	Satara	Satara	Sambarwadi	12.3159

S.No.	District	Tehsil	Village	Area (in Ha)
428	Satara	Jaoli	Dhardev	12.3063
429	Satara	Jaoli	Asani	12.2421
430	Satara	Jaoli	Punavadi	11.9533
431	Satara	Mahabaleshwar	Tekavali	11.7324
432	Satara	Jaoli	Mhate kh.	11.713
433	Satara	Jaoli	Apti	11.7076
434	Satara	Patan	Mahind	11.6895
435	Satara	Wai	Chikhali	11.6769
436	Satara	Patan	Bambavade	11.4814
437	Satara	Wai	Dhavali	11.2965
438	Satara	Satara	Agudewadi	11.2358
439	Satara	Patan	Jalu	11.0163
440	Satara	Satara	Borne	10.7622
441	Satara	Patan	Kusavade	10.7585
442	Satara	Satara	Thoseghar	10.2649
443	Satara	Patan	Mharwand (N.V.)	10.2169
444	Satara	Jaoli	Vahagaon	10.0973
445	Satara	Patan	Kalgaon	10.0116
446	Sindhudurg	Sawanthwadi	Charathe	23.5507
447	Sindhudurg	Kankavli	Kharepatan	22.9636
448	Sindhudurg	Sawanthwadi	Amboli	21.5971
449	Sindhudurg	Sawanthwadi	Nene	15.911
450	Sindhudurg	Vaibhavwadi	Sangulwadi	15.1467
451	Sindhudurg	Devgad	Are	14.0583
452	Sindhudurg	Dodamarg	Terwan	13.2512
453	Sindhudurg	Kudal	Shivapur	12.0681
454	Sindhudurg	Dodamarg	Mangeli	12.0451
455	Sindhudurg	Vaibhavwadi	Het	11.8577
456	Sindhudurg	Sawanthwadi	Majgaon	11.7876
457	Sindhudurg	Vaibhavwadi	Kumbhavade	11.6278
458	Sindhudurg	Devgad	Devgad	11.5078
459	Sindhudurg	Devgad	Kinjawade	11.0612
460	Sindhudurg	Sawanthwadi	Shirshinge	10.452
461	Sindhudurg	Sawanthwadi	Chaukul	10.2033
462	Sindhudurg	Devgad	Kuvale	10.0763
463	Thane	Thane	Moumbre tarf Pachband	79.0888
464	Thane	Ambarnath	Wadi	33.9404
465	Thane	Kalyan	Kalyan dombivali muncipal corporation	33.786
466	Thane	Thane	Koinse	27.0721

S.No.	District	Tehsil	Village	Area (in Ha)
467	Thane	Thane	Kasbe kalwe	22.1887
468	Thane	Shahapur	Mokhavane	22.1664
469	Thane	Bhiwandi	Tamghar	19.684
470	Thane	Thane	Parsik	18.7398
471	Thane	Thane	Dongri tarf Dharavi	17.5002
472	Thane	Thane	Panchparwadi	17.4813
473	Thane	Ambarnath	Ambarnath (R)	17.3452
474	Thane	Bhiwandi	Nagaon	17.1289
475	Thane	Ambarnath	Morivali	16.7053
476	Thane	Thane	Shirawne tarf Khairanpedha Thane	14.7446
477	Thane	Ambarnath	Jambivali	14.5537
478	Thane	Thane	Kasbe Shahabaj	14.383
479	Thane	Thane	Kolshet	12.7477
480	Thane	Thane	Majiwade	12.6057
481	Thane	Thane	Bhaindar pada	11.7058
482	Thane	Ambarnath	Kahoj khuntivali	11.6753
483	Thane	Ambarnath	Kajsai	10.948
484	Thane	Thane	Belapur	10.9359
485	Thane	Thane	Uthan	10.2806
Total				9794.878