

## Executive Summary



# ANNUAL LIGHTNING REPORT 2021-2021

**Lightning Resilient India Campaign 2019-2022**

A joint initiative by Climate Resilient Observing Systems  
Promotion Council (CROPC), India Meteorological Department,  
Ministry of Earth Science, Government of India, Indian Institute  
of Tropical Meteorology (IITM), India Meteorological Society  
(IMS) and World Vision India

It gives me immense pleasure in presenting the Annual Lightning Report 2020-2021, the second annual report of Lightning Resilient India Campaign. The biggest achievement of this campaign is that today Lightning is a reckonable disaster and all including government at Central and state level are serious about lightning risk management. The reduction of deaths by more than 60% in Odisha, Andhra Pradesh and Nagaland are testimony to it. States like Bihar have gone on war to address lightning risk. The deaths recorded have reduced to 1697 during year 2020-2021. We still have one more year and our target till 2022 is to bring it down below 1200. Now with concerted efforts, we have reviewed our goal and we aim towards zero avoidable lightning deaths in near future.

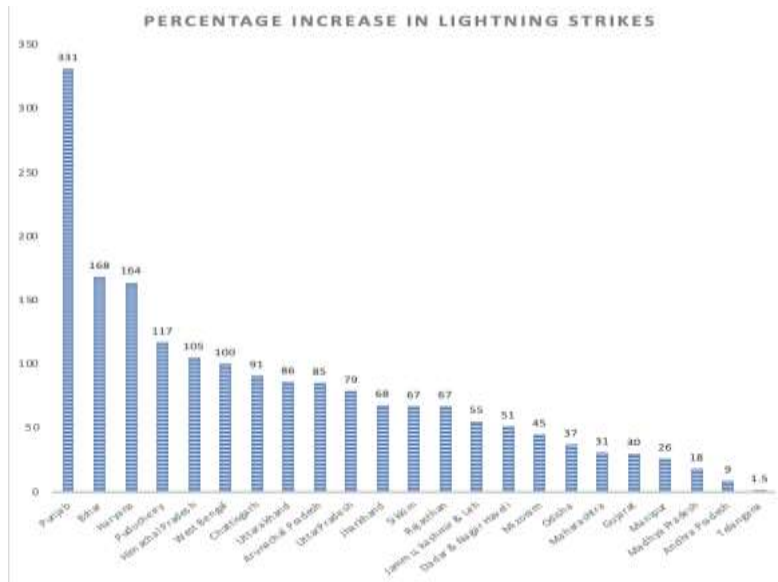
Annual Lightning Report 2020-2021 contains mapping of entire lightning strikes over India and all 37 states and union territories along with its impacts and detailed analysis. The report is of extremely high value and it is very useful for disaster management authorities/departments at National and state level that is NDMA and SDMA, all the scientific institutions involved in weather and lightning for understanding the hazard, generation of early warning and solutions to lightning, 'fulminologists, weather scientists, disaster management professionals, rural and urban development planners, land use planners', armed forces, communication and IT set ups, Industries,

Water management authorities specially Dam , tourism, Power industries, petrochemical industries , electrical industries , Bureau of Indian Standards, BMTPC, ministry of forest, environment and climate change, department of science and technology, academia, students and researchers. It's a collation of adverse impact of extreme weather phenomenon in the form of lightning and ways to reduce the extremities. We aim to develop climatology of lightning over a period of at least five years and de-mystify lightning complexities.

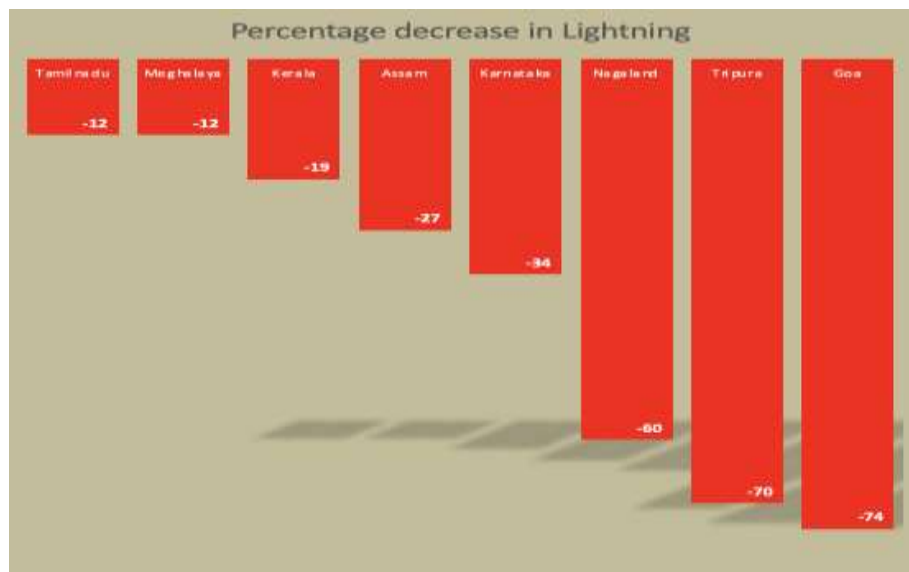
As we know till year 2018, there was apparent rise in lightning fatalities mainly due to rising frequency and intensity lightning strikes. To address the hazard, India Meteorological Department (IMD) started lightning forecasts from 01 April 2019. To enhance outreach of IMD's forecasts and comprehensive solutions to Lightning, Climate Resilient Observing Systems Promotion Council (CROPC) in collaboration with IMD, IMS and World Vision India and Red Cross , launched **lightning Resilient India Campaign** on 26 March 2019 with an aim to reduce lightning deaths by 80% in three years. The campaign, through multistakeholders engagement at National and state level with governments, academia, NGOs and communities, has been successful in bringing down deaths by more than 60% within two years. In addition, the scientific mapping of lightning in India as country and all 37 states and union territories and analysis of data with citizen centric approach has been key factor in scientifically endorsed addressal to lightning hazard.

Annual Lightning Report 2020-2021 contains mapping of lightning in real time and space which brings out the hotspots and comparison to the lightning strikes in 2019-2020. It also highlights critical communities and assets to be saved. The salient aspects of comparison of last two years data are as follows:-

1. There has been 34% rise in Lightning strikes in the country. It has advanced from 13800000 strikes in 2019-2020 to 18544367 strikes in 2020-2021, an increase of 4683989 strikes.
2. There are states with very high rise in lightning strikes upto 331 percent rise in Punjab. Bihar 168%, Haryana 164%, Puducherry 117%, Himachal Pradesh 105% and West Bengal 100% are leading states. States like Arunachal Pradesh, Rajasthan, Chhattisgarh, Jharkhand, Odisha need to take cognizance of it.



3. There are a number of states where lightning strikes were observed to be reduced during the period 01 April 2020 to 31 March 2021. Goa, Daman & Diu, Dadar & Nagar Haveli received more than minus 74% lightning strikes followed by Tripura minus 70%, Nagaland minus 60%, Karnataka minus 34%, Assam minus 27%, Kerala minus 19%, Meghalaya minus 12% and Tamil Nadu minus 12%.



4. The above changes in the pattern of lightning is now core of our further research and we intend developing climatology of lightning, specially climatology of cloud to ground lightning.

5. Cloud to Ground(CG)Lightning. There has been significant variability. Noted in cloud to ground lightning. Coastal state like Andhra Pradesh had less than 20% conversion of lightning from Inter Cloud lightning to ground lightning whereas other coastal states like

Odisha and Gujarat had conversion ration more than 35-40% . The climatology of CG lightning needs to be researched more .

#### 5. Lightning Early Warning

There has been phenomenal improvement in early warning. IMD issues forecasts Medium range for 3-5 days, short range 1-3 days , nowcast 2-3 hours and Damini app 40 minues location specific. Yet there is lack of protocol and mechanism for last mile public notification and interventions. CROPC is dedicated to it and has developed

Public notification device  
Last mile intervention signals  
Sound and visual signals

Annual lightning Report 2020-2021 is a compilation of scientific products of Ministry of Earth Science institutions and ISRO's observations packed up in a citizen science format have yielded encouraging results . The outcome of Lightning resilient India Campaign is tribute to the scientific community and an exemplary practice to seed science amongst stakeholders for saving life, livestock and livelihood.

The major scientific outcomes are as follows:-

1. **Mapping of lightning flashes-** India has had first ever mapping of complete lightning strikes for that is total lightning, Intra or Inter Cloud (IC) lightning and Cloud to Ground (CG) lightning for two consecutive years . Its good effort to develop climatology of lightning. We have also mapped for entire country and individually for all 37 states and union territories. The Lightning strikes map of CG lightning for India prepared is given below in Table 3.

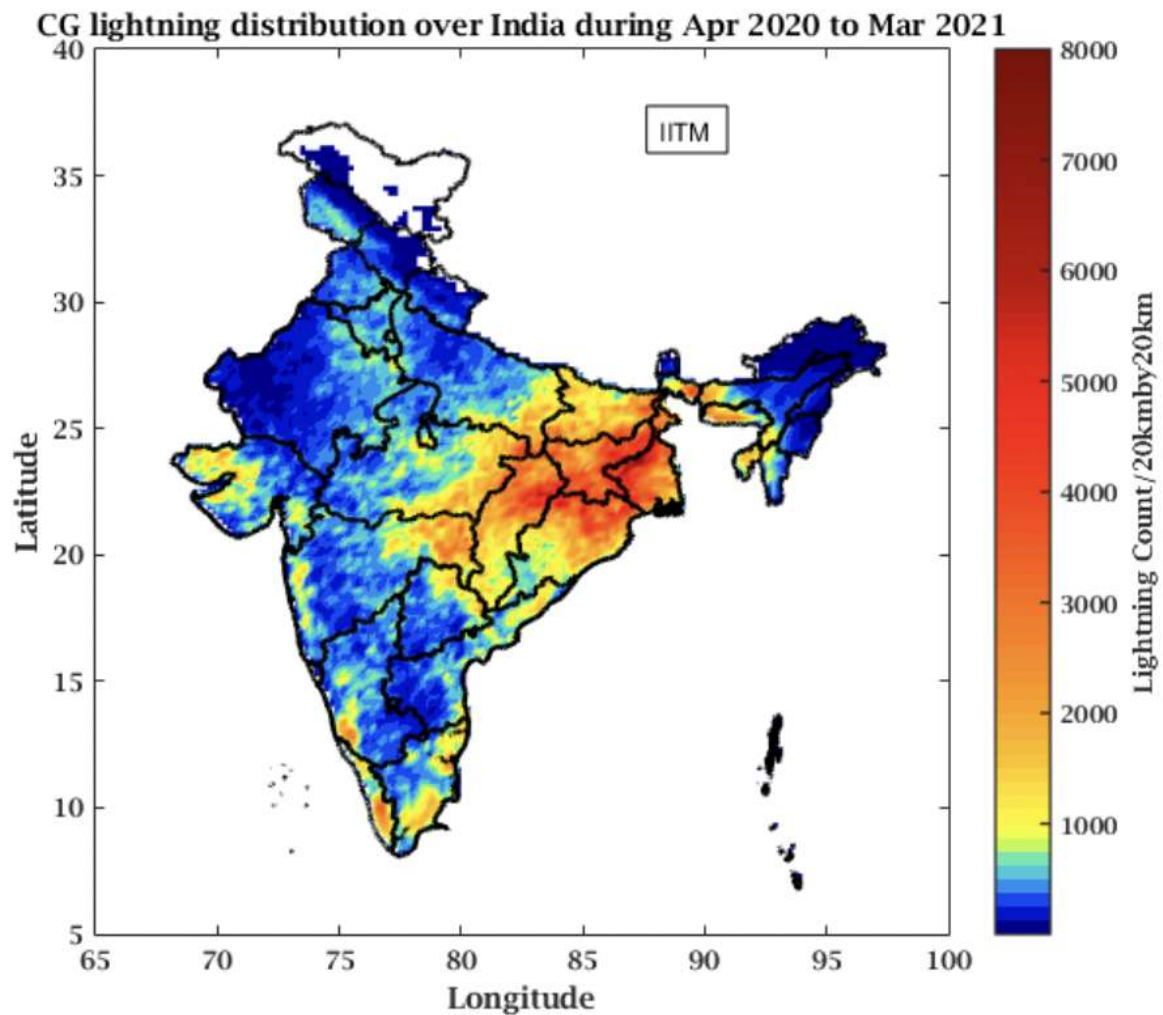
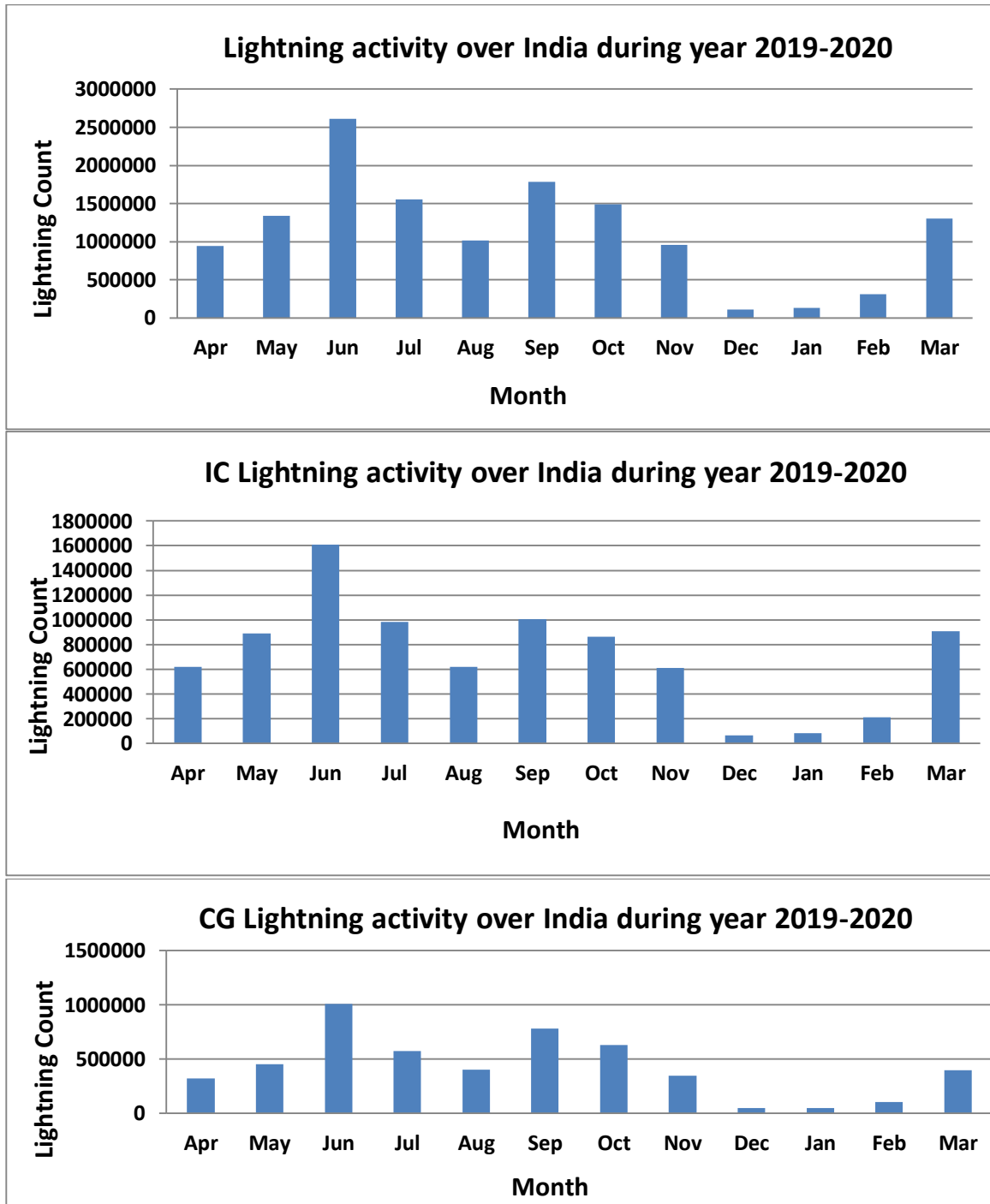


Table 3: India's Lightning strike flashes plotted for period 01 April 2020 to 31 March 2021

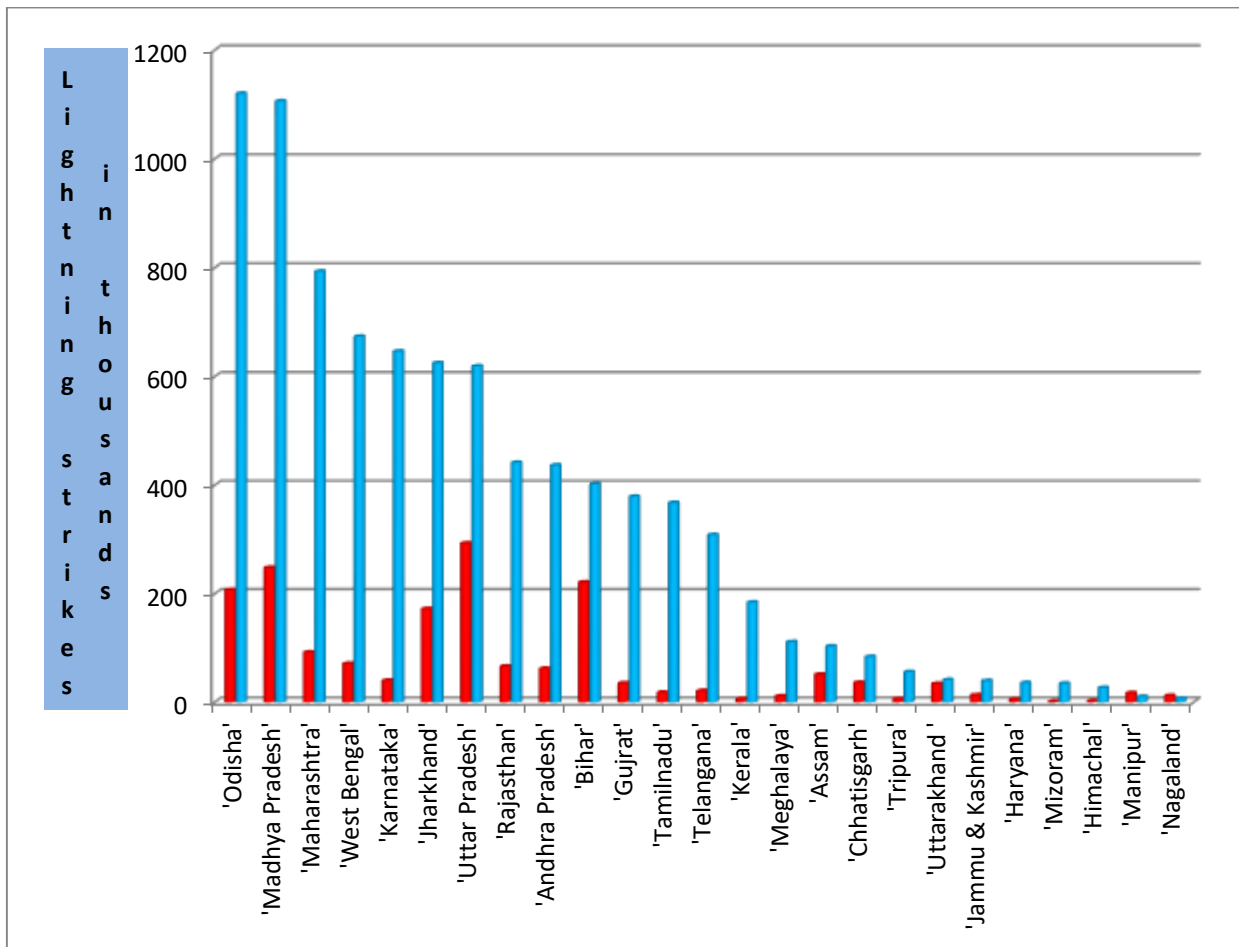
This map reveals lightning prone zones , also called as lightning hotspots. This is going to be important map for strategizing lightning risk management by both national and state governments. It has critical bearing on land use pattern and development of infrastructures.

**2. Climatology of IC and CG Lightning strikes** – The strikes recorded during the period have been collated with an aim to develop climatology of IC and CG clouds . The first ever such plots also reveal the intensity of CG clouds during various months . Thus seasonality of CG clouds is going to be most critical in planning the lightning safety prevention and mitigations at local level.



3. **Variability of Lightning strikes with special reference to CG strikes** – The lightning strikes were plotted for each quarter. It was found that the lightning strikes were different for different quarters. The same has been depicted below in Table 4.

4. **Impacts of Lightning strikes with special reference to deaths** – There was extensive mapping of deaths and data collection of fatalities through the volunteers network. This gave out the impact of lightning strikes in various states. It shows the preparedness of states and the particular areas and time interval where they need to work to prevent the losses. Odisha with highest strikes of 14.20 lakhs plus has recorded 207 deaths whereas states like Uttar Pradesh and Bihar incur double the losses with half the strikes. The comparative analysis of lightning strikes vis a vis deaths in states has been depicted below in Table 5.



**Table 5: Comparative analysis lightning strikes vs deaths**

5. **States Lightning Risk Management Analysis** – A comprehensive mapping of Lightning phenomena in states along with the vulnerability of population including special groups like tribal, PVTG, children, women, industries, economic assets was assessed and shared. This assisted states proper identification of risks and precise. States like Odisha and

Andhra Pradesh could bring down deaths by almost 70% within a short period. A sample of Odisha is depicted below in Table 6.

### Lightning Strikes counts over Andhra Pradesh for period 01 April 2020 to 31 March 2021

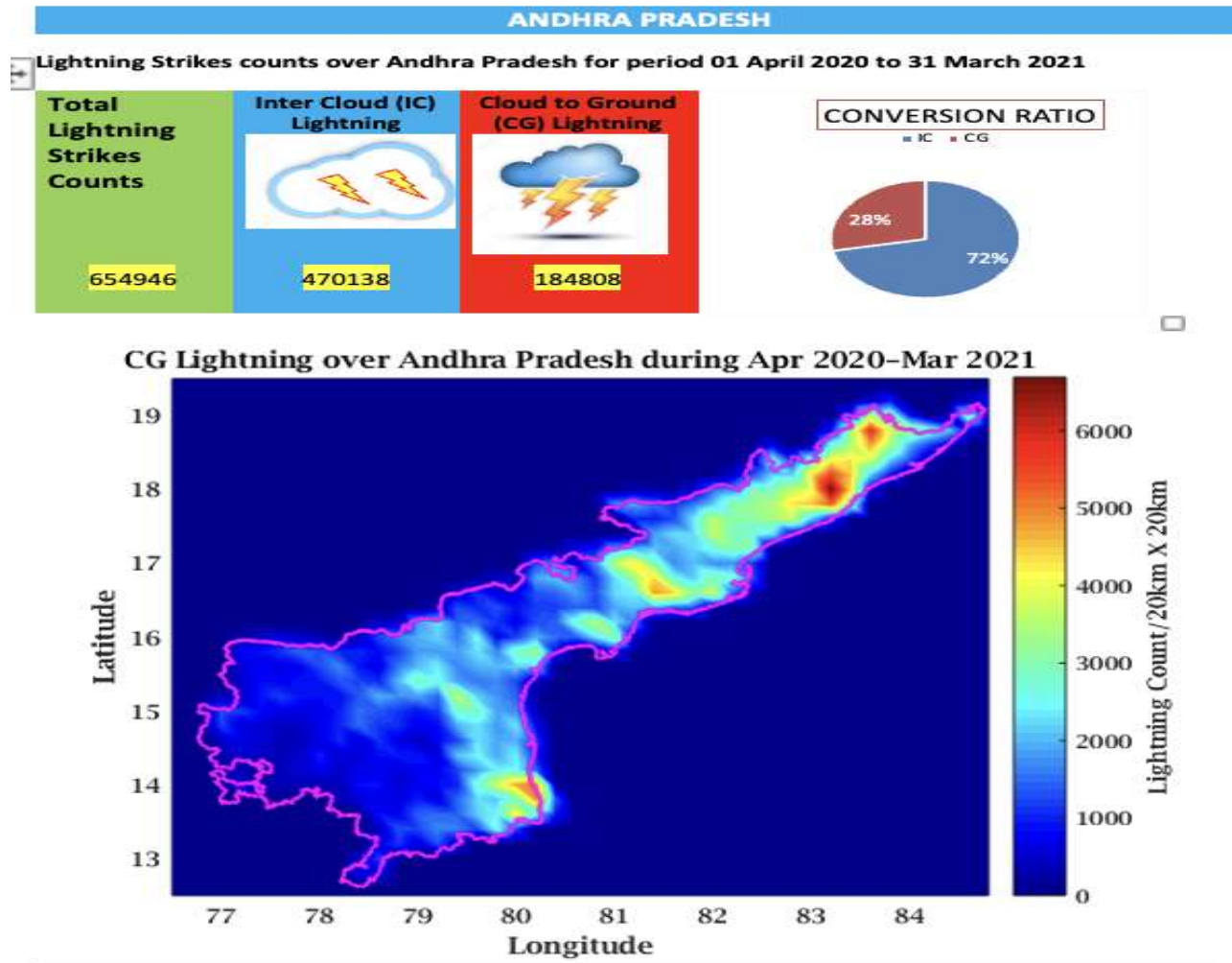
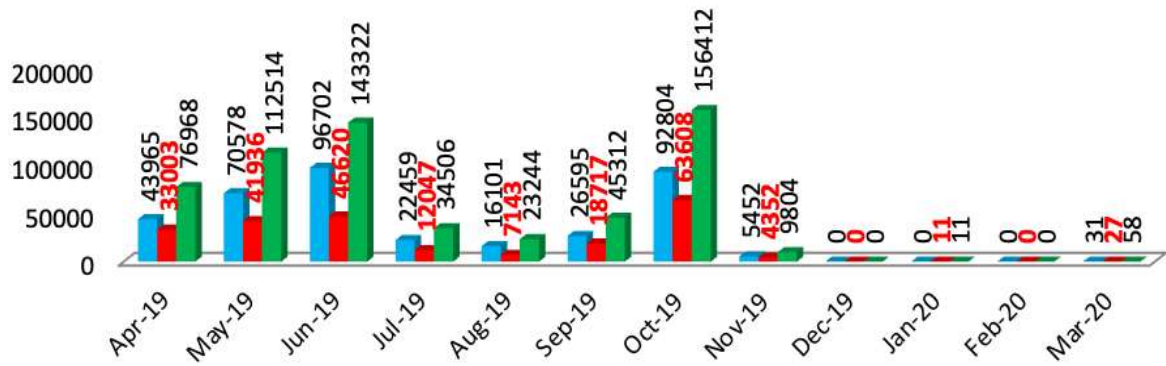


Table : Andhra Pradesh- Precise view of lightning strikes during year 2020-2020 and its seasonality

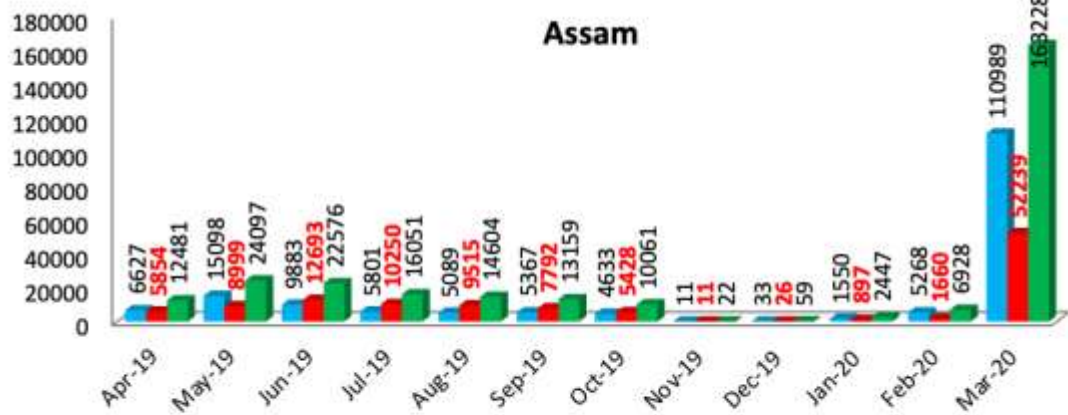
5. **Seasonality of Lightning different among states** – There was a pre-set concept of fixed seasonality of lightning in India. The lightning recorded during the period reveals that seasonality of lightning is different for different states. Table 7 below shows month wise lightning strikes in each state . It makes amply clear that the Lightning Risk Management programme for each state has to be customised as per seasonality, intensity and frequency of lightning. It has also revealed that lightning is highly localised phenomena and it varies at different geographical areas . Thus m, within a state , the seasonality and severity may vary for different areas viz coastal, hilly, river basin, urban and industrial areas. , It is recommended that states should undertake lightning micro zonation for geographical region wise precise handling of the risk .



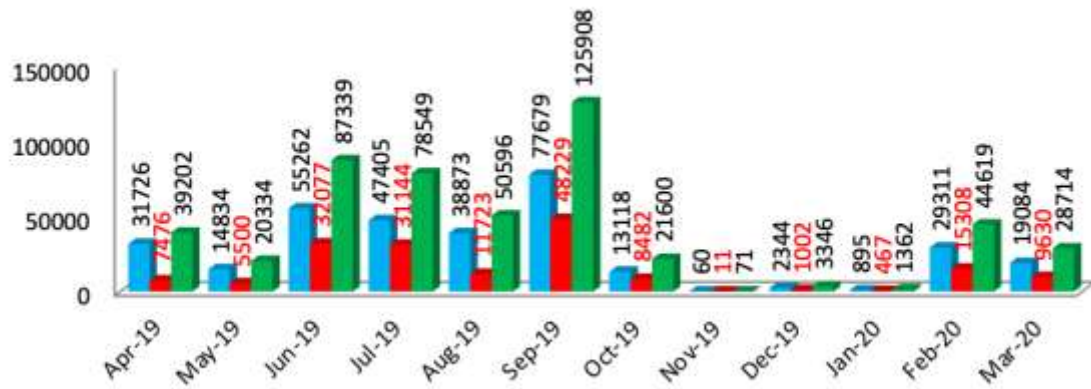
### Andhra Pradesh

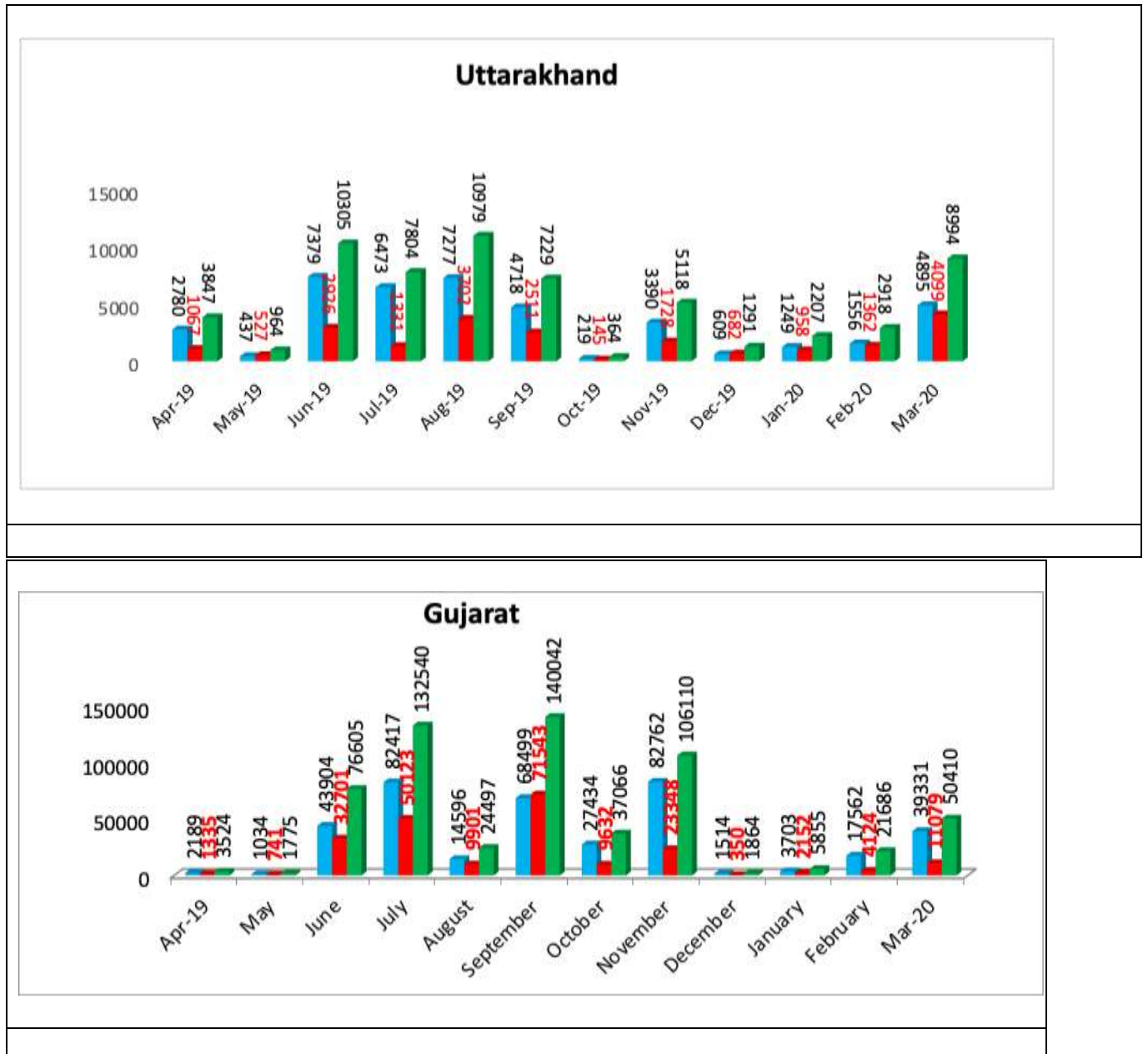


### Assam

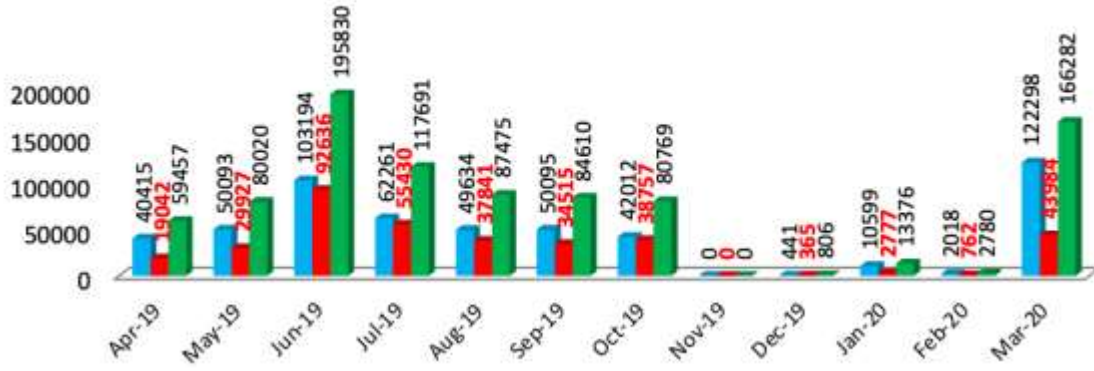


### Bihar

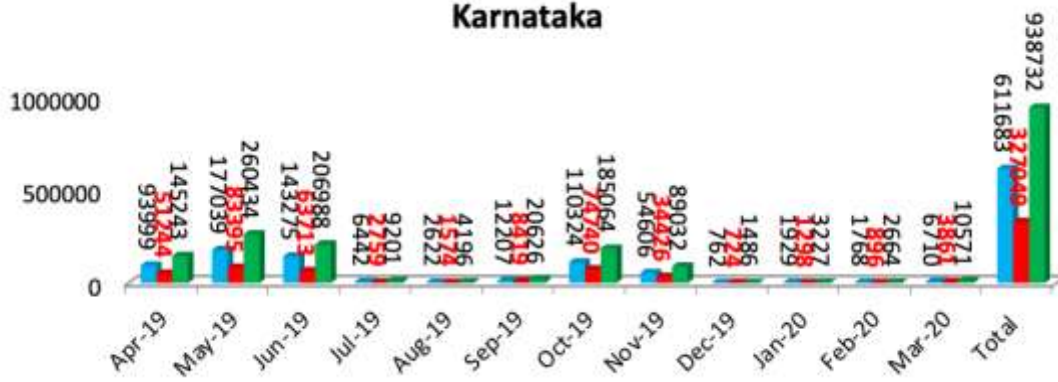




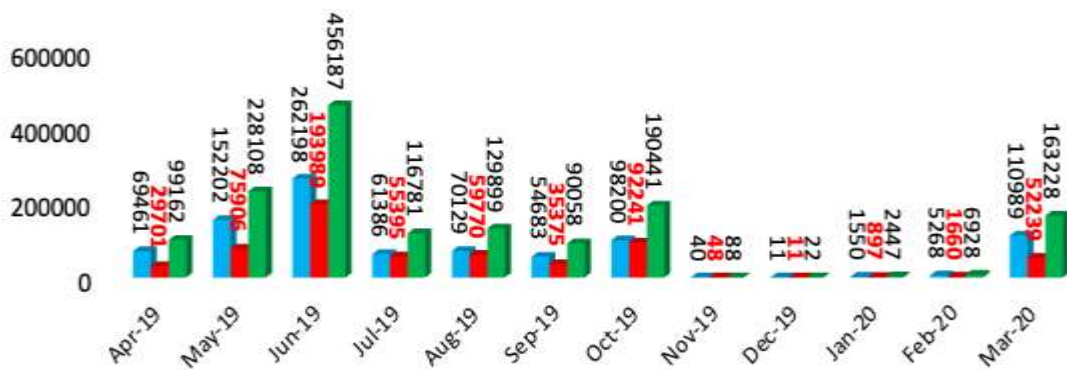
### Jharkhand



### Karnataka



### Odisha



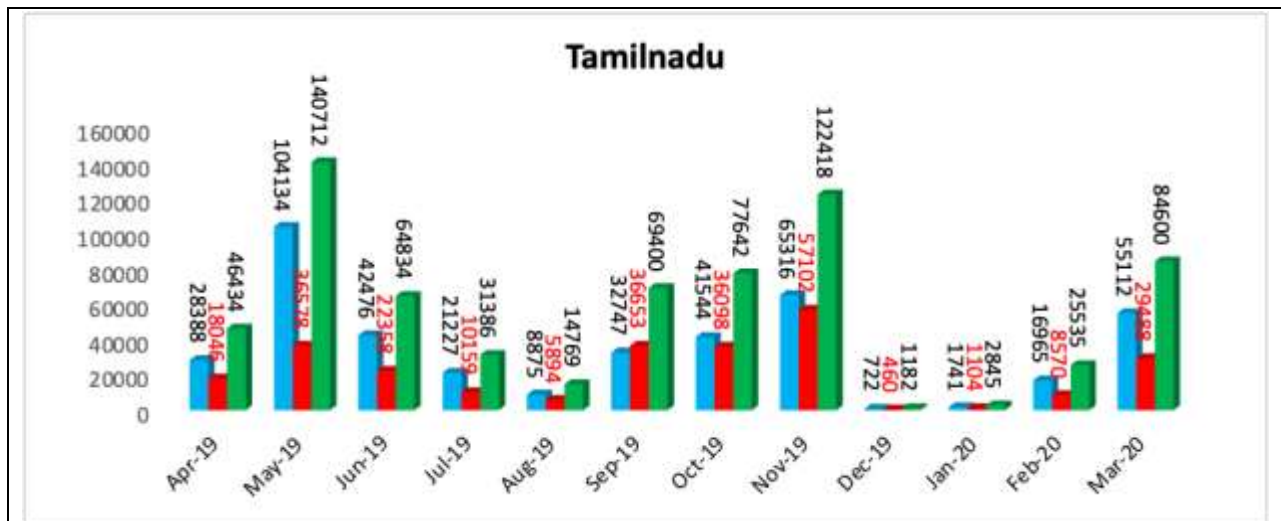


Table 7: State wise seasonality of lightning strikes during year 2019-2020

6. **Time wise comparison based on occurrence of lightning** – Lightning has been generally observed in most of the part during second half of the day. However, during intense cloud movement with high wind speed, especially during monsoon and cyclonic activities, lightning may occur anytime. Lightning also depends on local geographical conditions like its different in coastal region, hilly areas and river basins. Recent lightning strikes in Bihar and UP on 25-26 June 2020 as the cloud moved from north Bihar to south Bihar, the lightning started from morning till late evening as per the movement of the cloud and so was the fatal impact felt on ground.

Similarly, vulnerability of population and geographical area was deduced out the scientific mapping . This has given a scientific strategy to states and hence there was sudden fall in the number of fatalities in many sincere states.

7. **Identification of Vulnerable groups** – The mapping of lightning strike based hotspots and the analysis of its impact, revealed the circumstances of deaths and cross sections of population loosing life. This was immensely helpful in focussed approach towards targeted vulnerable community.

Interestingly , it was revealed that the lightning strikes map matched with the tribal map of India. There used to be 60-70% deaths of tribal due to lightning in Jharkhand , Odisha, Madhya Pradesh, West Bengal and others. The lightning strikes based mapping for tribal area could diagnose the reasons for their fatalities in terms of tinned housing pattern and their nature of livelihood that is living off the land.

The above findings have been depicted in Table below:-

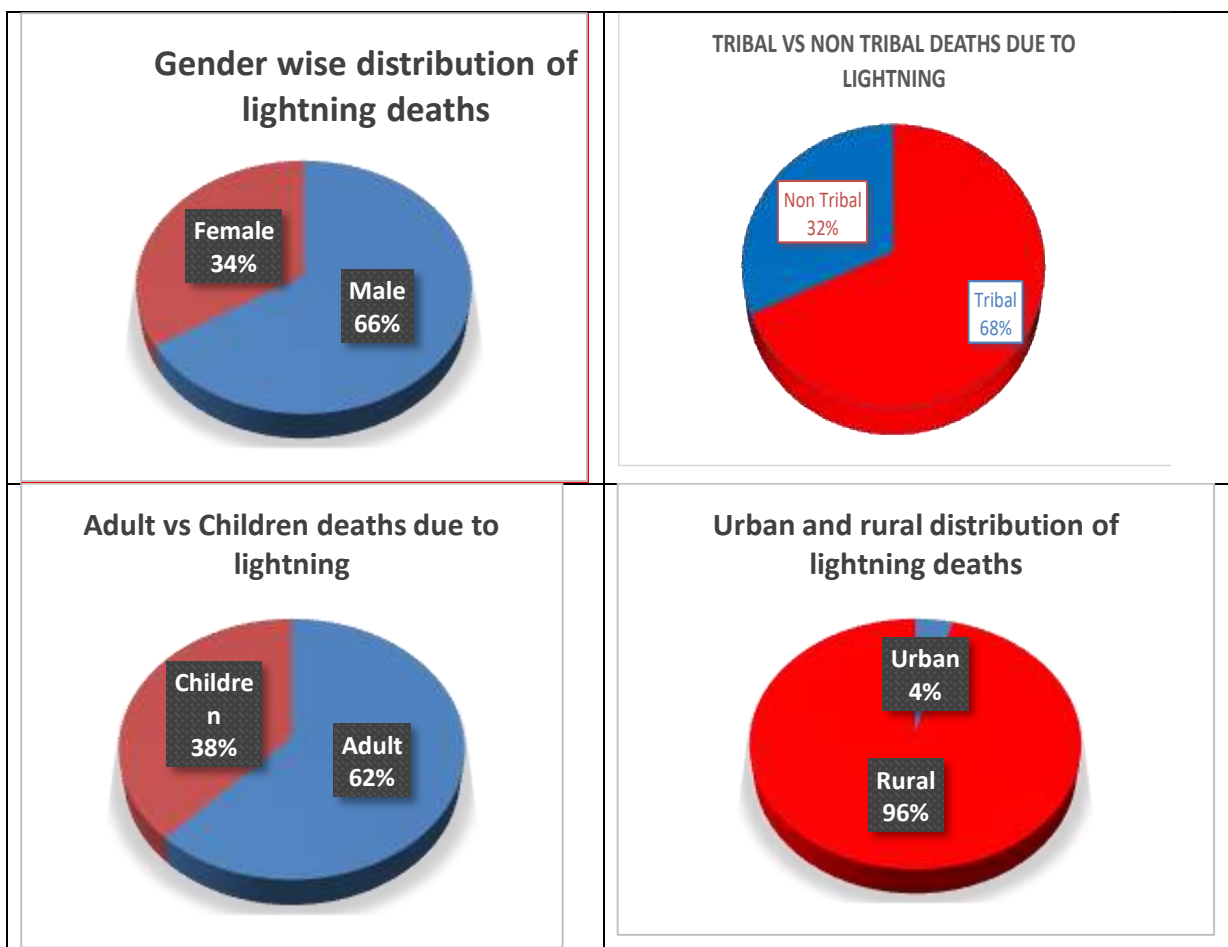


Table 8: Identification of vulnerable groups

8. **Circumstances of lightning victims during struck by lightning-** The recent fatalities and even same during previous year has , it has been observed that during pre-monsoon to initial monsoon are more due to farmers being in agriculture field or in orchards as well as strikes over their huts . Later part of the year that is September of other months, majority die due to standing under tall tree on inside their huts .Lightning deaths categorised

circumstances wise given below in Table 9 reveals the capacity building needs in terms of awareness, education and training .

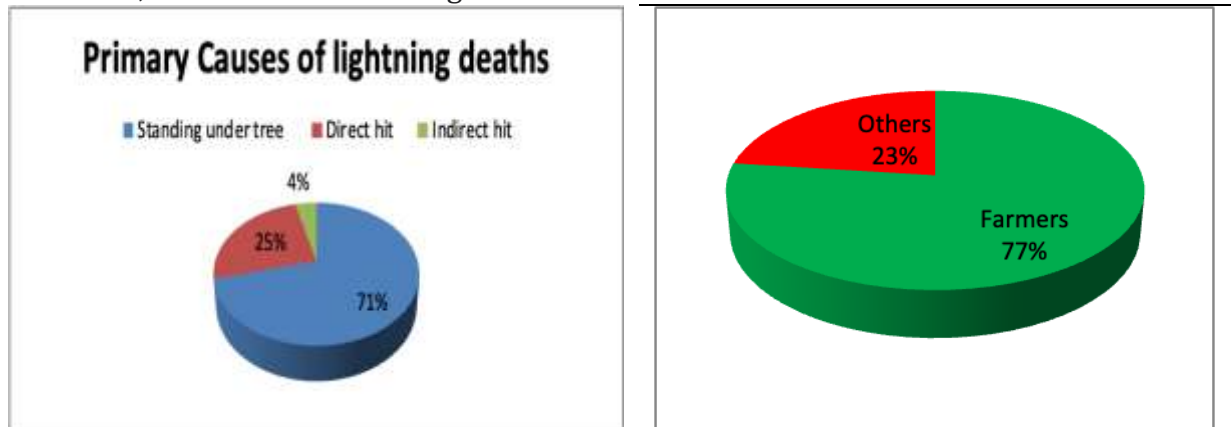


Table 9: Primary causes of deaths due to lightning

**10.** Citizen science approach towards lightning resilience has effected governments at national and state levels , decision makers, academia and community. The findings establish the fact that lightning is not state specific but a national disaster. The recommendation of the campaign has brought in significant policy level interventions by most of the states. Various tools envisaged for dissemination of IMD's lightning forecast have been adopted greatly. The high level of awareness generated towards lightning resilience, policy and community level interventions have enhanced aspirations of Lightning Resilient India Campaign to ambitious goal of zero lightning deaths. The success of campaign is real tribute to Ministry of Earth Science- its scientists, institutions specially India Meteorological Department, Indian Institute of Tropical Meteorology, Pune and Indian Meteorology Society. The journey continues and its aimed to develop climatology of lightning in India and utilise science for humanity.

The Lightning Resilient India Campaign has been a collective efforts of organisations and individuals. I would like to acknowledge support of IMD , IITM and other MoES institutions ,IMS, NDMA, SDMA of Nagaland, Odisha, Gujarat and others states, World Vision India, IITM, IMS , NRSC, NESAC, IIT Delhi, SCDR JNU, CUJ and media – both print and electronic. Mr. M. Rajeevan Nair, Secretary, Ministry of Earth Science and Mr C.V.V. Sarma , IAS , Former Member Secretary NDMA have been two most inspiring personalities without whose support the campaign would not have been successful. NDMA Members Lt Gen NC Marwaha, Mr Kamal Kishore and Mr Rajinder Singh have been guiding factor. Mr V Thorough, IAS Additional Secretary has been a mentor. Mr Anup Kumar Srivastava, Senior Consultant has immense contribution in Lightning Resilient India Campaign and in preparation of this report .Gen Naik and Brig Ajay Gangwar from NDMA are part of great support., Maj Gen MK Bindal ED NIDM has been an inspiration in this campaign. I would also like to mention support from Dr Akhilesh Gupta, Head SPLICE, DST. I must express my gratitude of patrons of Lightning Resilient India Campaign that is Mr. P.P. Shrivastav, I.A.S., Member NDMA Advisory Board , Mr Anil Kumar Sinha, IAS , Former VC BSDMA, Dr. K.J. Ramesh, Member, National Commission for monitoring AAQ in NCR and former DGM, Dr. Mrutyunjay Mohapatra DGM, IMD, Prof. S.K.Dash, Past President IMS, Prof AK Gosain IIT Delhi, Mr NM



Prusty, President Humanitarian Aid International, Dr Aditi Kapoor. Advisor IFRC, Mr RK Jain IAS, Secretary General Indian Red Cross Society, Prof PK Joshi, Chairman SCDR JNU, Prof Janki Andharia, TISS Mumbai, Dr Akhilesh Gupta, Head Splice DST, Dr. PK Taneja, IAS, DG, GIDM Gujarat, Dr. PLN Raju, Director NESAC, Mr SS Kundu, NESAC, Dr .Alok Tauri NRSC Hyderabad, Dr. Parvez Hayat, IPS, Mr. Vinson Kurian, Editor Hindu business line, Mr Johnny Ashin Reingungmai, Nagaland SDMA, Mr Blesson Samuel, World Vision India and many more volunteers and weather enthusiasts. IITM has huge contribution and the blessings of Prof Ravi Shankar Nanjundiah and his team Dr SD Pawar, Dr Gopalakrishnan and Mr Manoj Domkawale Scientist has been incredible. It has been a collective effort and it would not have been possible without everyone's support.

I dedicate the Annual Lightning Report 2020-2021 to Dr Thomas Prasad, founder Director CROPC.

I am sanguine that with the collective efforts of everybody, we shall be able to make a Lightning Resilient India.

Place : New Delhi  
Date : 30 June 2021

Sanjay Kumar Srivastava  
Convener  
Lightning Resilient India Campaign