Locust Surveillance Using Geospatial Technology

No. 8
17th July, 2020

nrsc

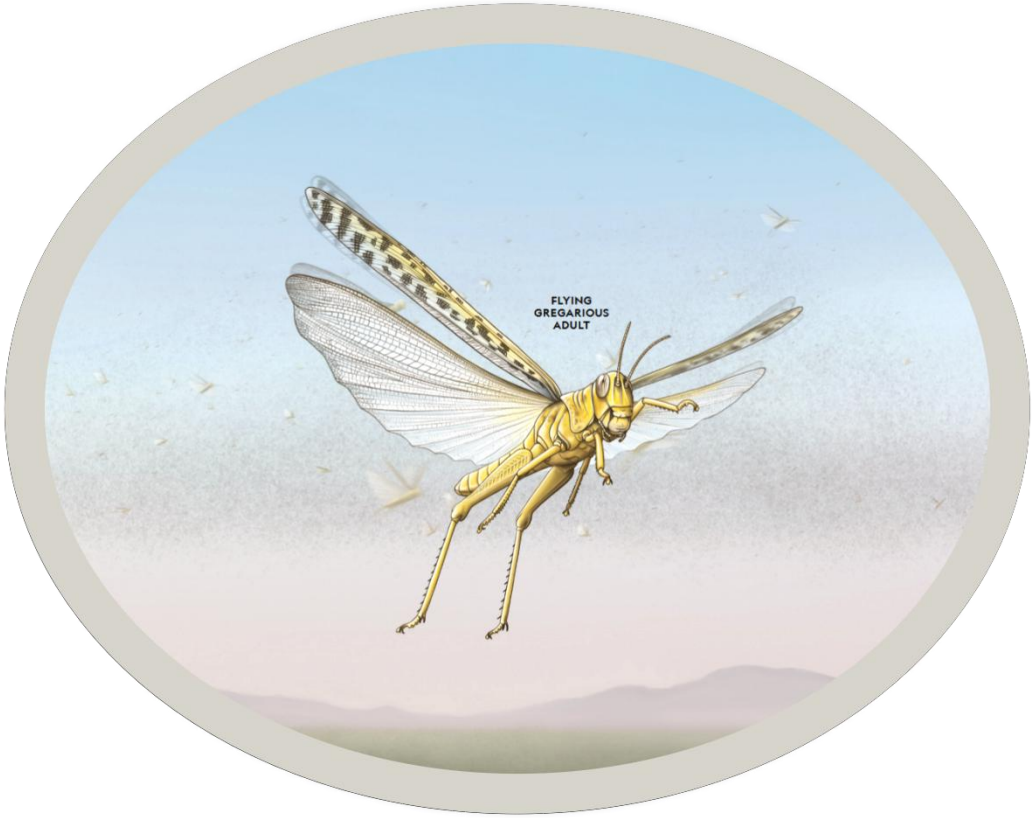


Image courtesy: National Geographic

Contents

Regional Remote Sensing Centre (West), NRSC/ISRO - Jodhpur

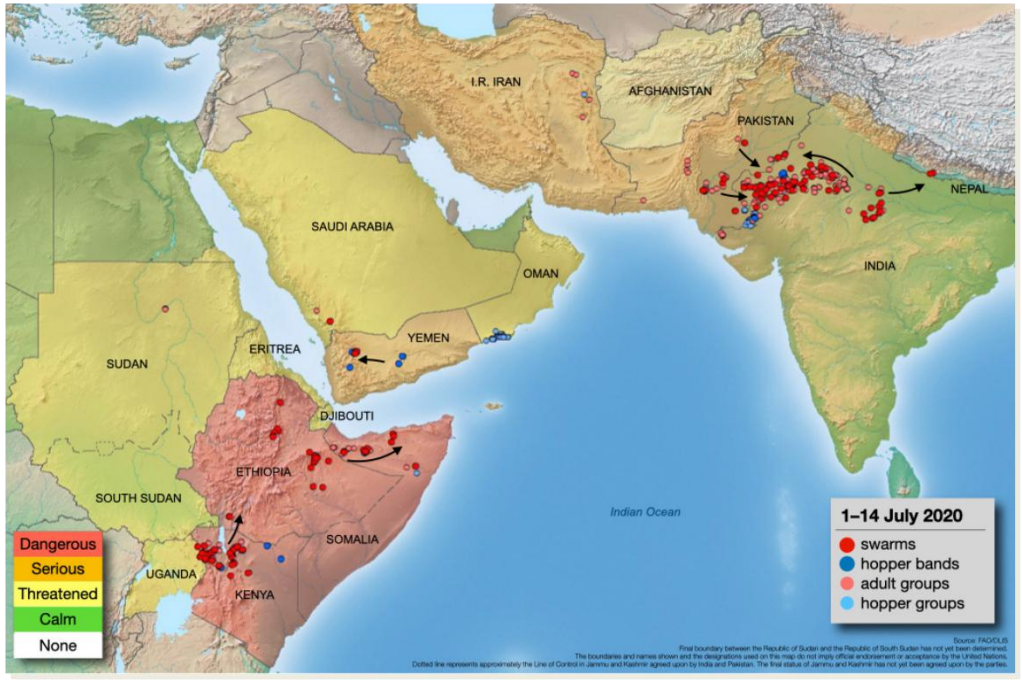
Risk of swarm migration from Horn of Africa to Indo-Pakistan increases

New reports of Desert Locust swarms further east in northern Somalia suggest that migration from northeast Somalia across the Indian Ocean to the summer breeding areas along both sides of the Indo-Pakistan border could be imminent. More swarms are likely to form in northern Somalia in the coming weeks. India and Pakistan have been warned accordingly and they continue to take preparatory actions. During the migration, a few swarms could briefly appear in transit along the eastern coast of Oman.

Current Status in Southwest Asia

Summer breeding has commenced along both sides of the Indo-Pakistan border where numerous swarms are present mainly in Rajasthan, India. Hatching and band formation will increase during this month in Rajasthan and northern Gujarat, India as well as adjacent areas of Tharparkar, Nara and Cholistan deserts in Pakistan. A few swarms continue to be seen further east in Uttar Pradesh, India and at least one swarm let reached the central plains of Nepal on 12 July where they are likely to disperse or return towards Rajasthan without causing significant damage or breeding. A few residual populations remain in the spring breeding areas of southeast Iran and southwest Pakistan.

Copulation process in progress



Source: FAO, Desert Locust Brief, 13 July 2020

Current status of Locust

Egg-pods in sandy soils

Weather and Desert Locust biology

All the different phases in the life cycle of a locust require ideal meteorological conditions for it to develop and cause the widespread damage that is often associated with locust plagues. Meteorological data, such as temperature, pressure and wind, are important for both assessing the current locust situation and forecasting its development. Information on meteorological and ecological parameters such as rainfall, soil moisture, soil and air temperatures, surface and boundary winds, synoptic-scale patterns and the convective state of the atmosphere are needed to understand and forecast swarm movement and the various developmental stages. These stages include egg-laying, egg development, hopper development, moulting, hardening of the wings, adult maturity, rate of movement of hopper bands and adult swarms, and transition from the solitarious phase to the gregarious phase.

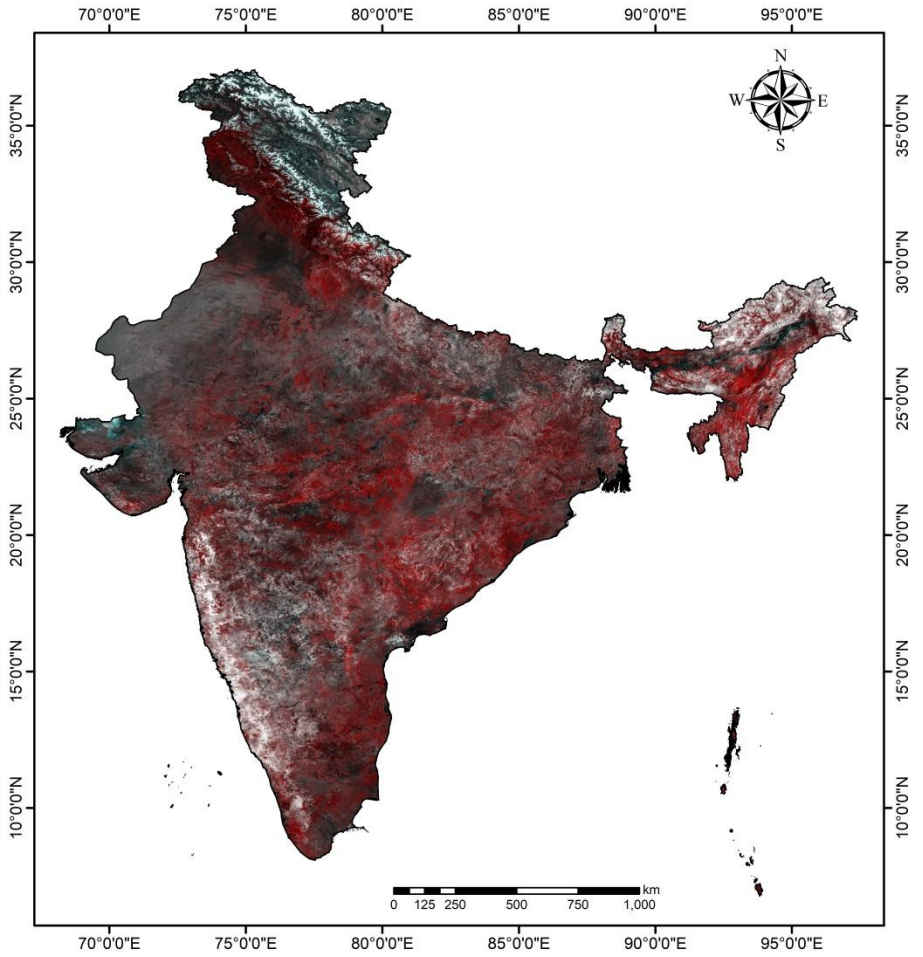
Rainfall: Rainfall data consist of rainfall location, date and amount to date. Because of the sparse coverage of the measurement network and the variable nature of rainfall, such data can be inaccurate or missing altogether. Rainfall estimates can also be derived from satellite observations. Eggs require moist soil conditions after laying as they need to absorb moisture to complete their development. They can be destroyed by flooding if extreme rainfall occurs after the laying takes place. Hopper development from the first instar to fledging (the final moult from the wingless fifth or sixth instar to winged adult) indirectly requires rainy conditions, since the hoppers require edible vegetation for survival. Adults start to mature when they arrive in an area that received significant rains recently. After fledging, the hardening of the soft wings of the locust is stimulated by rainfall.

Temperature: Egg development in the female depends on air temperature. The rate of development of the laid eggs is a function of the soil temperature. Under conditions of high temperatures, egg development is more rapid. Egg mortality may occur when soil temperatures are above 35°C. Hopper development is also a function of temperature. The hopper development period decreases with increasing daily air temperature from 24°C to 32°C. On warm, sunny days, the bands march throughout the day while, on overcast days, they do not move very far. Exceptionally high night temperatures can also facilitate some movement. Adults take off in temperatures above 20°–22°C and fly with the wind (i.e. downwind). Swarms usually take off about 2–3 hours after sunrise. In sunny conditions, they can take off in temperatures of at least 15°C–17°C. Under cloudy conditions, take-off occurs when temperatures reach 23°–26°C.

Wind: Wind is the main transportation mechanism of locusts and also concentrates them by convergence. Eggs can dry up if exposed to wind. Hopper band movement is usually downwind. Adult migration occurs at night when the air temperature is above 20°C–22°C. Swarms land about an hour before sunset as convection dies away. The structure of swarms depends on weather conditions, governed by convective winds and low pressure systems. Cool, overcast weather favours strati form swarms, while convective updrafts on hot afternoons promote cumuliform swarms. Thus, swarms are usually strati form in the morning and become cumuliform in the heat of the day, when convection takes place from the hot ground.

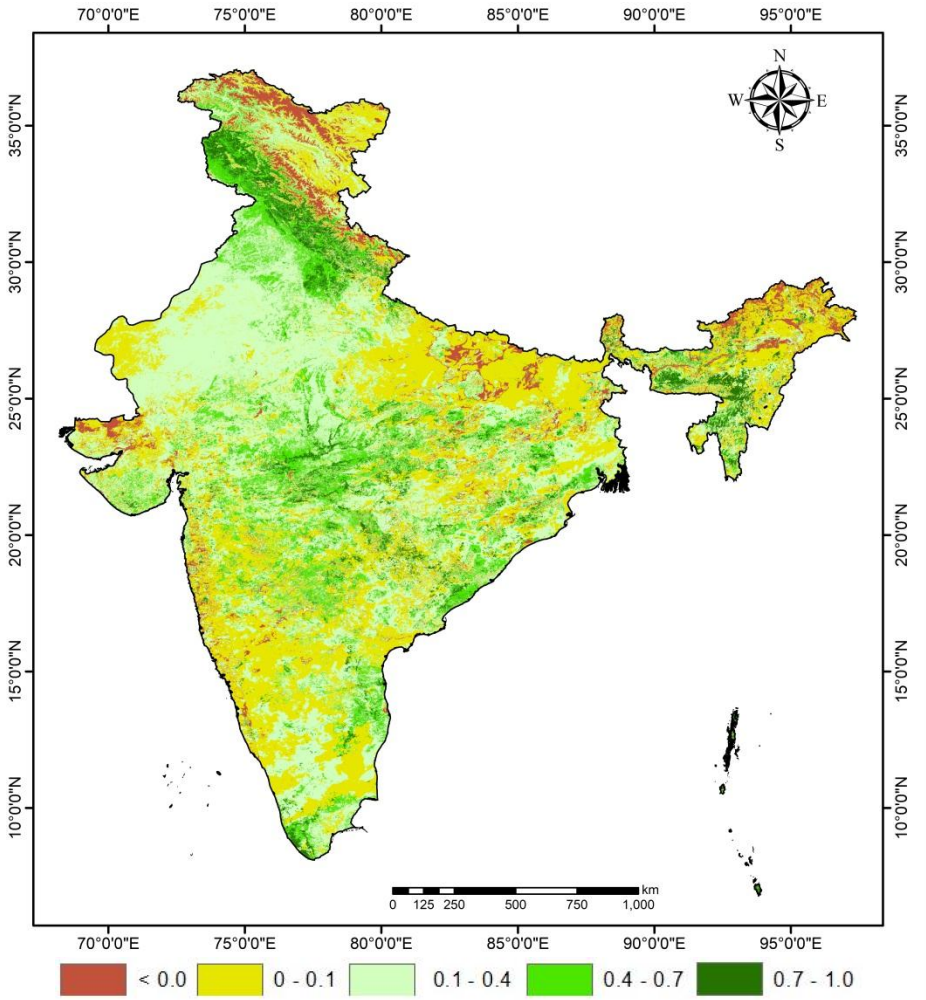
(Source: Weather and Desert Locusts, WMO- No. 1175, WMO & FAO, 2016)

False Color Composite of India



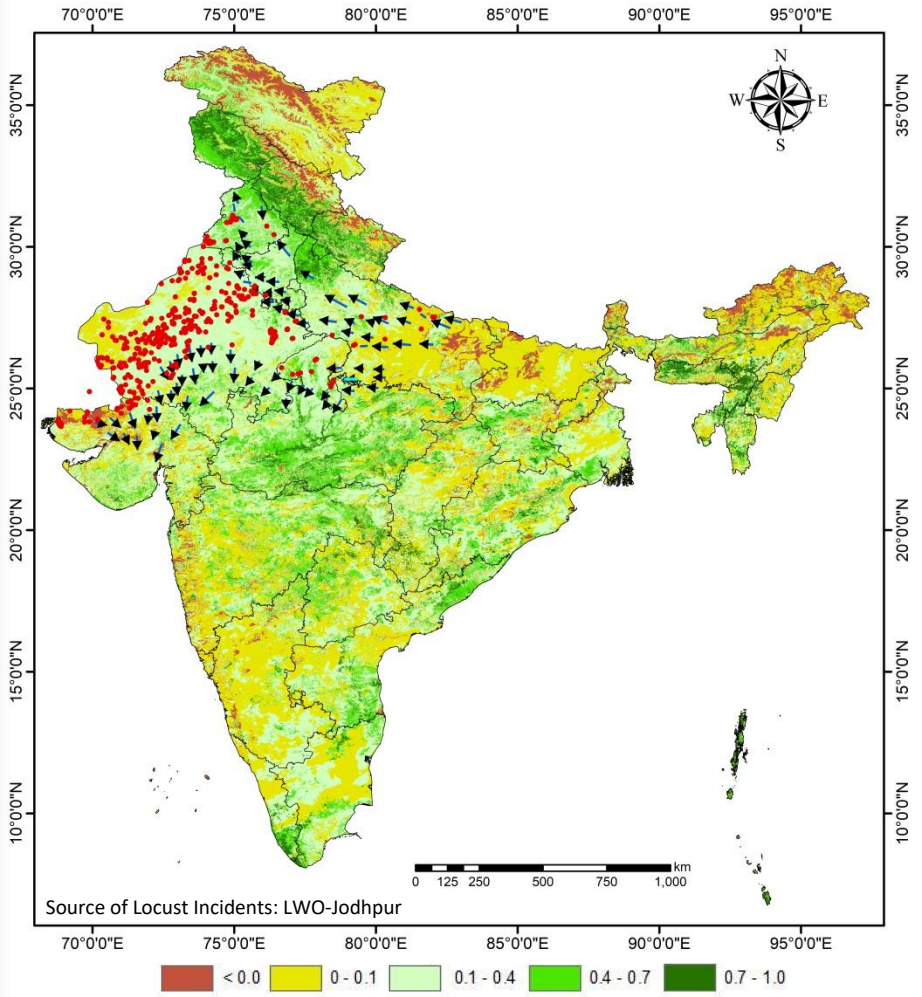
MODIS 8 day Composite Data (3rd July - 10th July, 2020)

Normalized Difference Vegetation Index



Proba V8 day Composite (4th July - 11th July, 2020)

Probable Direction of Locust Migration



Source of Locust Incidents: LWO-Jodhpur

Threat Map of Locust Infestation (18th – 23rd July, 2020)

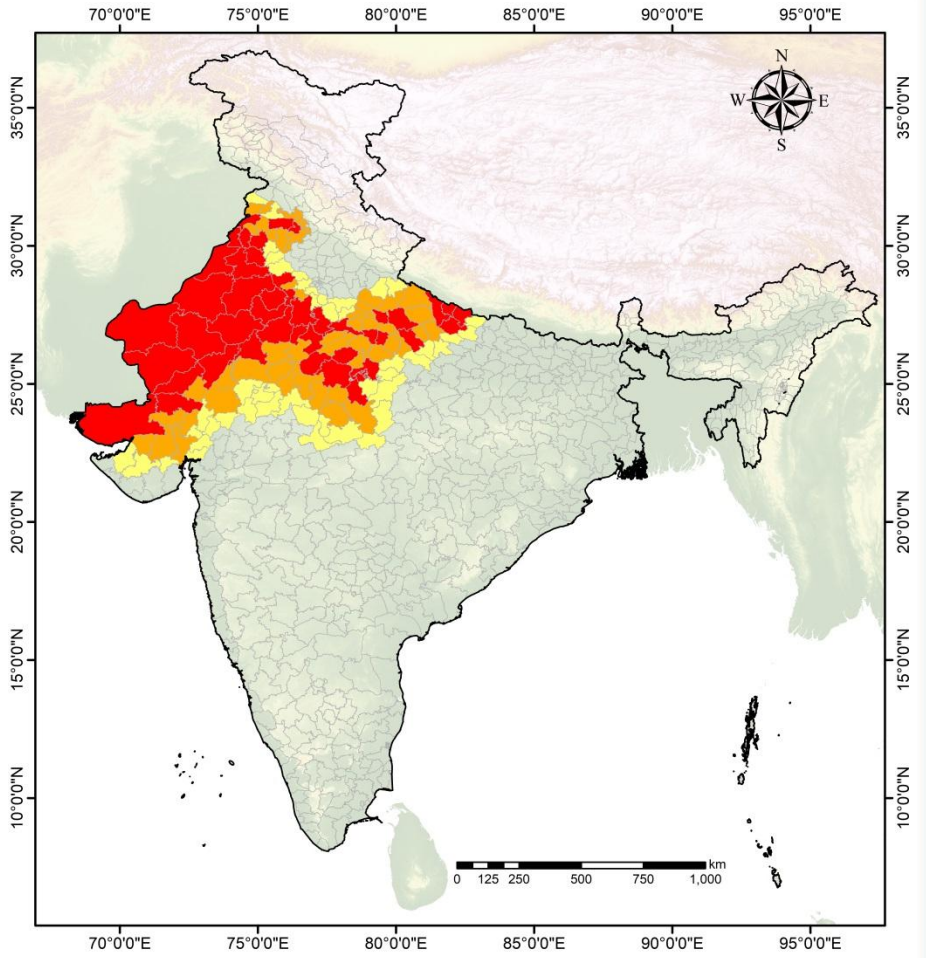
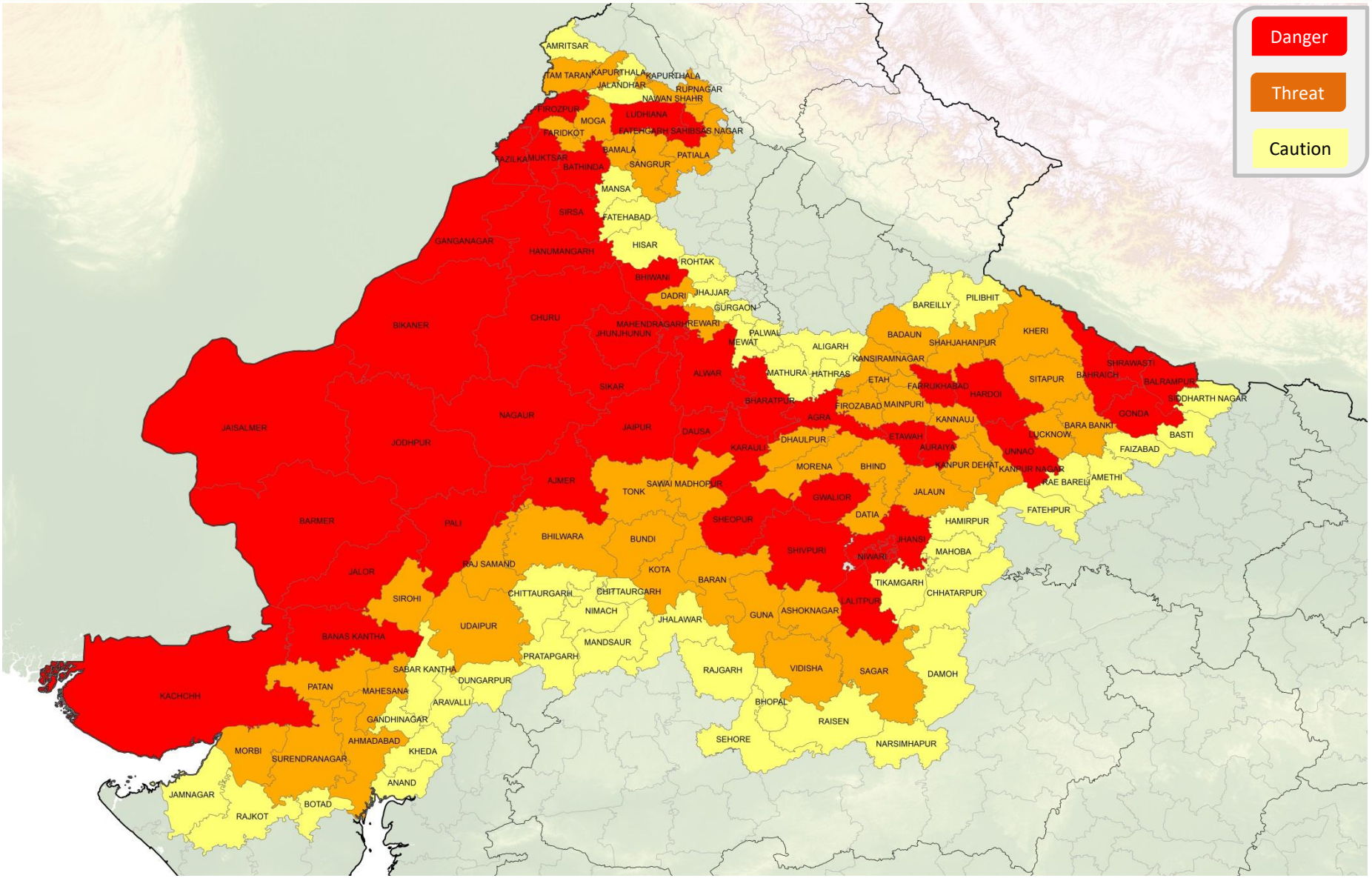


Table 1: Districts with Locust Threat

Threat Level	No. of Districts	
	11th – 17rd July	18th – 24rd July
Danger	35	45
Threat	31	48
Caution	49	45

Red : Danger	Significant threat to crops; intensive survey and control operations must be undertaken.
Orange: Threat	Threat to crops; survey and control operations must be undertaken
Yellow : Caution	Potential threat to crops; increased vigilance is required; control operations may be needed

Threat Map of Locust Infestation



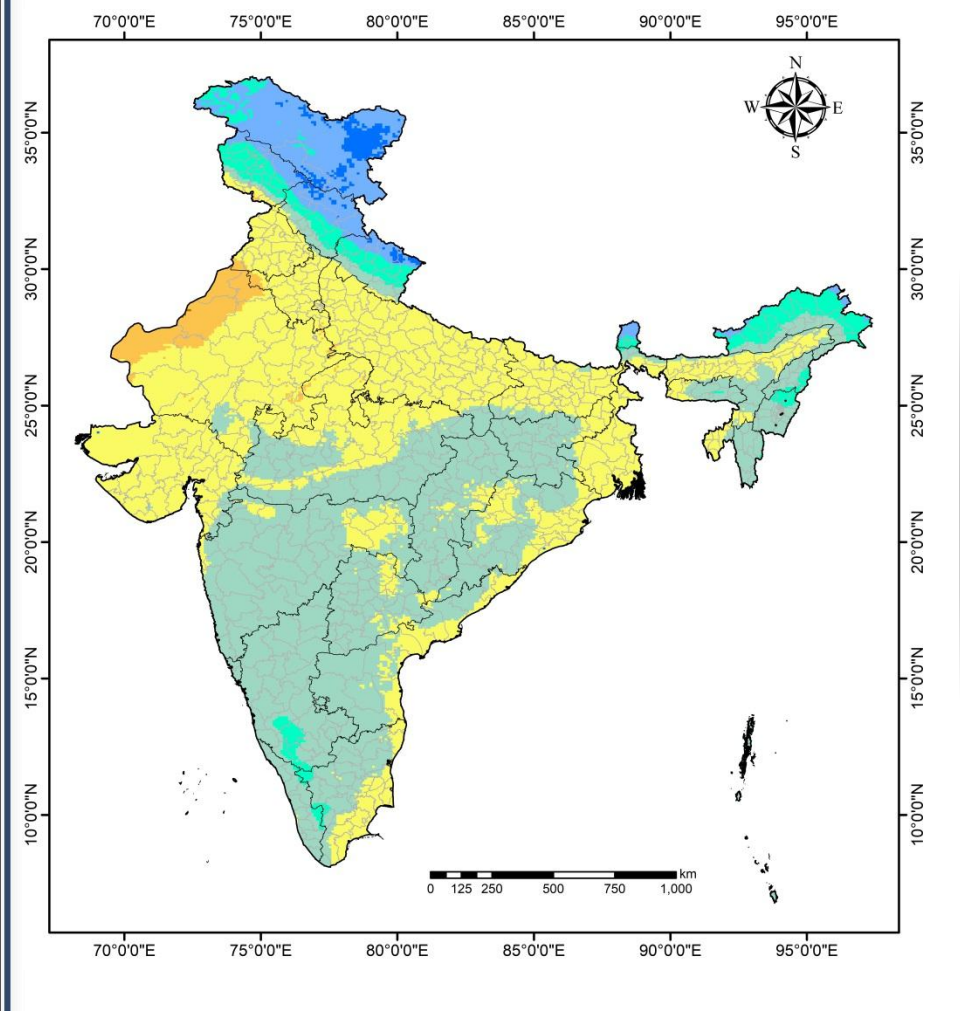
18th July 2020 ... 23rd July, 2020

Table 2. State-wise Threat Details of Locust Infestation

State	Districts Under Threat		
	Danger	**Threat**	**Caution**
Rajasthan	Bikaner, Churu, Jhunjhunun, Jaisalmer, Sikar, Bharatpur, Jodhpur, Nagour, Karauli, Ajmer, Barmer, Pali, Jalore, Alwar, Sri Ganganagar, Hanumangarh, Dausa, Jaipur	Dhaulpur, Tonk, Bhilwara, Bhundi, Sirohi, Kota, Udaipur, Rajsamand, Baran, Sawai Madhavpur	Chittorgarh, Jalawar, Dungarpur, Pratapgarh
Gujarat	Banaskanta, Kachh	Surendranagar, Ahmedabad, Patan, Mehsana, Morbi	Kedha, Sabarakanta, Gandhinagar, Rajkot, Jamnagar, Anand, Botad, Aravalli
Haryana	Sirsa, Mahendragarh, Bhiwani,	Rewari, Dadri	Newat, Fatehabad, Hisar, Gurugram, Rotak, Jhajjar, Palwal
Punjab	Fazilka,Ludhiana, Fatehgarh Sahib, Muktsar Bhathinda, Ferozpur	Kapurthala, Roopnagar,Sangrur, Faridkot, Nawanshahr, Patiala, Moga, Tarantaran, Baranala, SAS Nagar	Amritsar, Mansa, Jalandhar
Uttar Pradesh	Auriya, Etawah, Balrampur, Hardoi, Agra, Unnao, Gonda, Jhansi, Lalitpur, Shrawasti, Bahraich, Farukhabad	Kheri, Badaun, Shahjahanpur, Etah, Sitapur, Ferozabad, Mainpuri,Bara Banki, Lucknow, Kanpur Dehat, Kanpur Nagar, Jalaun, Kannauj, Kansiramnagar,	Pilibhit, Bareilly, Aligarh, Mathura, Sidharthnagar,Basti,Raebareli, Fatehpur, Hathras, Hamirpur, Mahoba, Faizabad, Amethi
Madhya Pradesh	Sheopur, Gwalior, Shivpuri, Niwari	Morena, Bhind, Datia, Guna, Sagar, Vidisha, Ashoknagar	Neemach, Mandsaur, Tikamgarh, Damoh, Rajgarh, Bhopal, Raisen, Seehore, Narsimhanpur, Chatarpur

Land Surface Temperature (⁰C)

Generated from SMAP Enhanced L4 Global 3 Hourly daily 9 km Product



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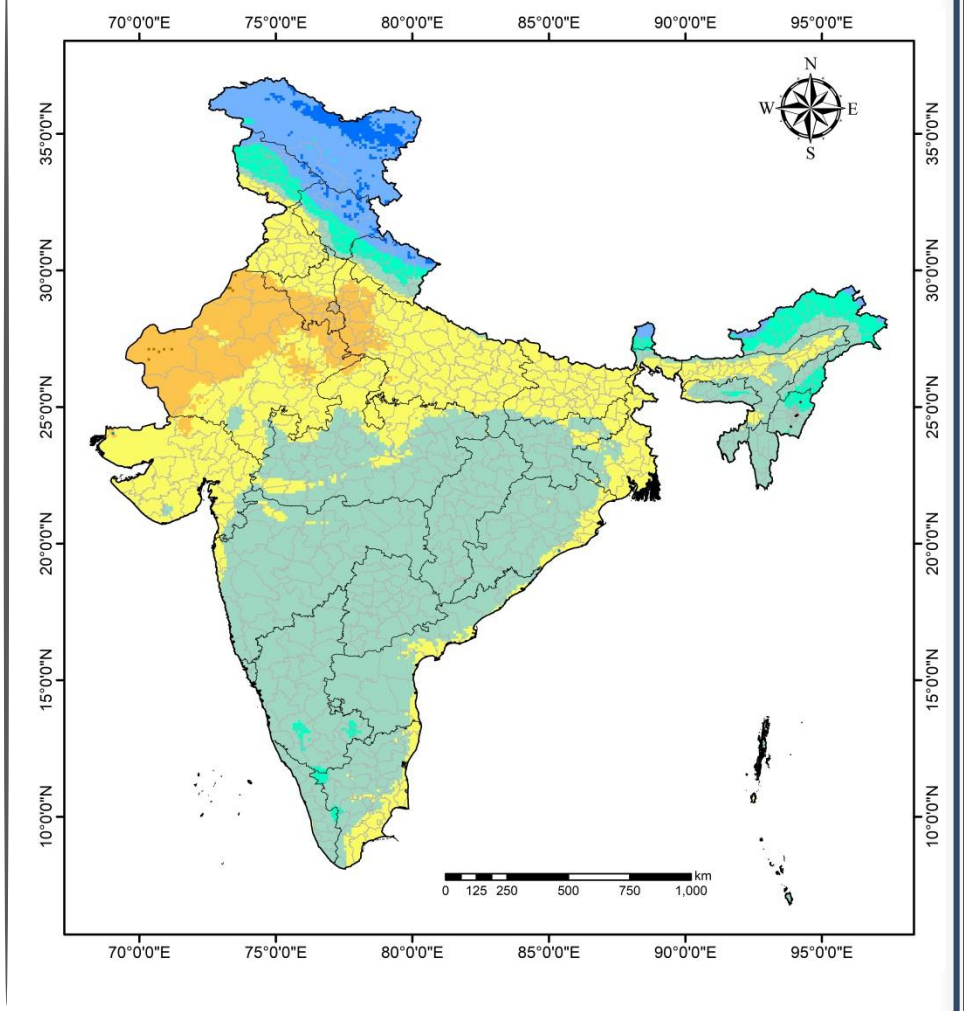
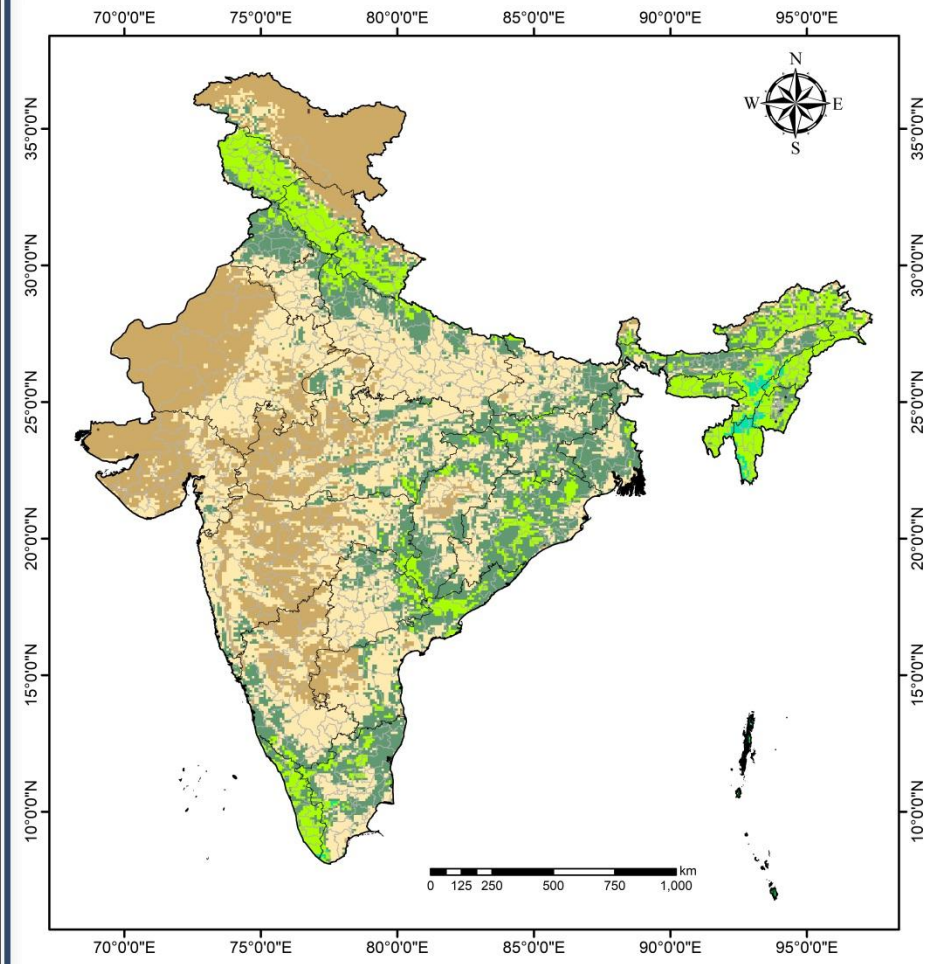


19:30 Hrs of 14th July 2020.

< 0 | 1 - 10 | 11 - 20 | 21 - 25 | 26 - 30 | 31 - 35 | 36 - 40 | 41 - 45 | 46 - 52

Leaf Area Index (LAI)

Generated from SMAP Enhanced L4 Global 3 hourly daily 9 km product



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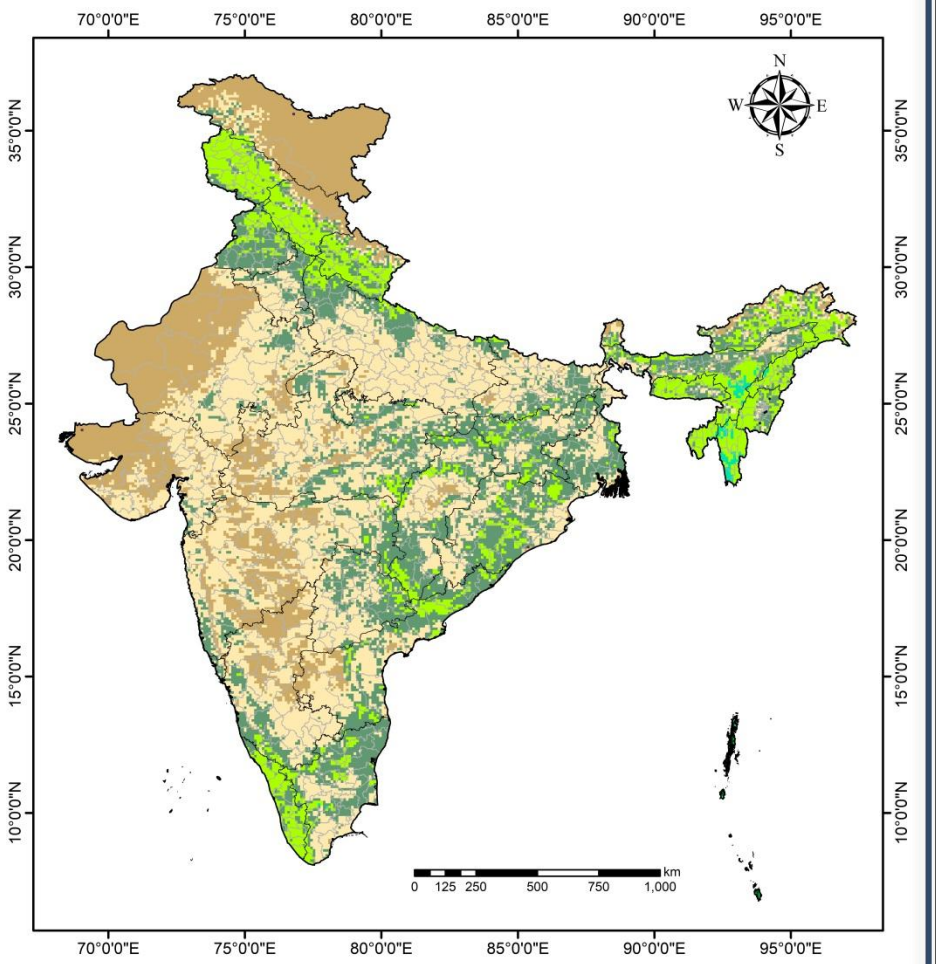
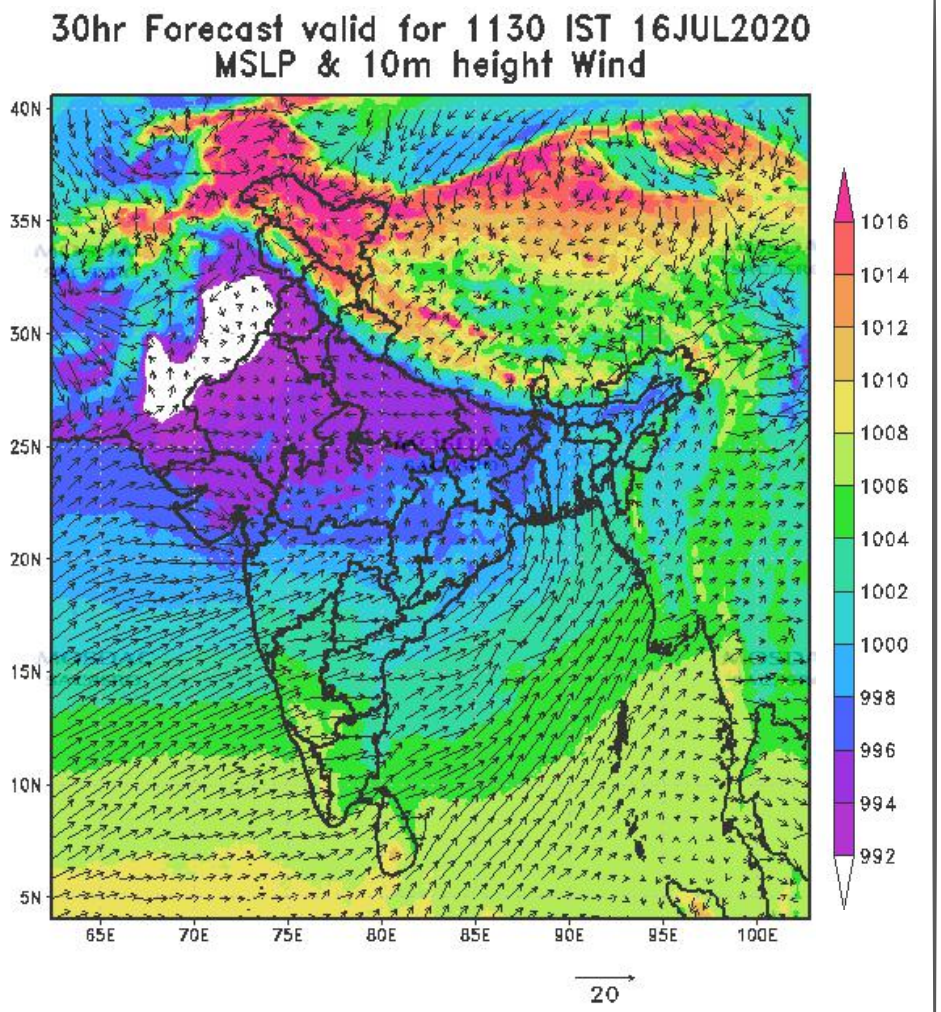
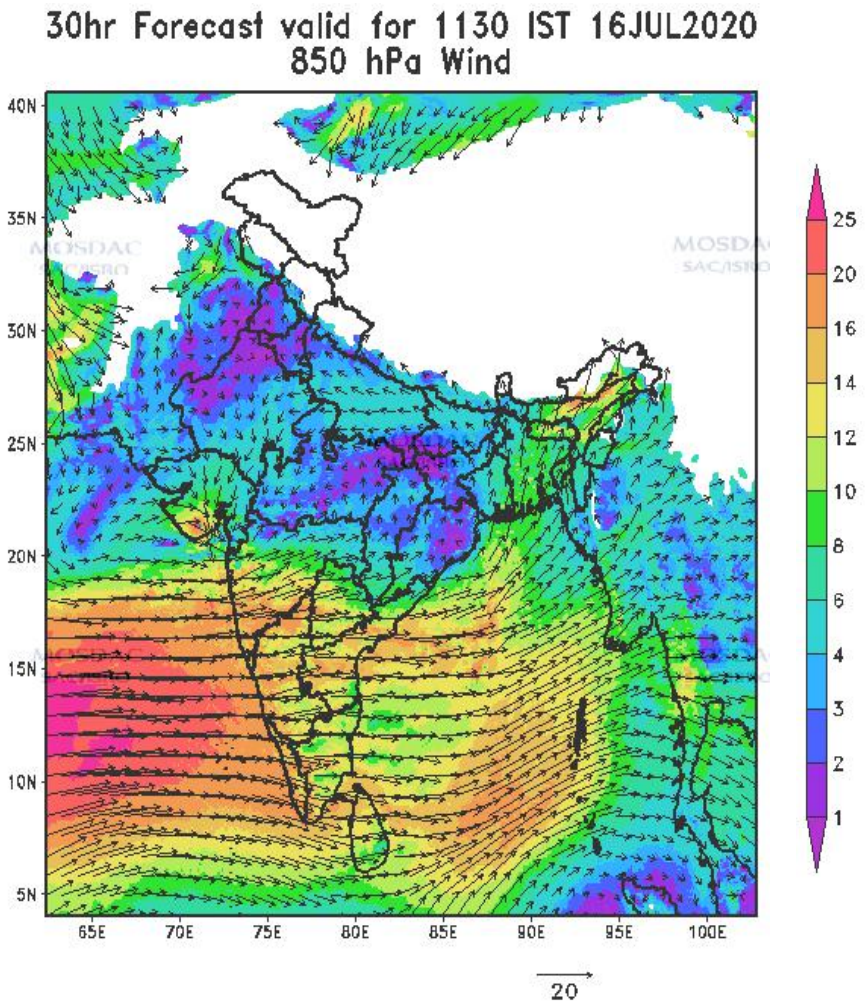


19:30 Hrs of 14th July 2020.

< 0 | 0.00 - 0.25 | 0.25 - 0.50 | 0.50 - 1.00 | 1.00 - 3.00 | 3.00 - 5.00 | 5.00 - 7.00

Wind Parameters



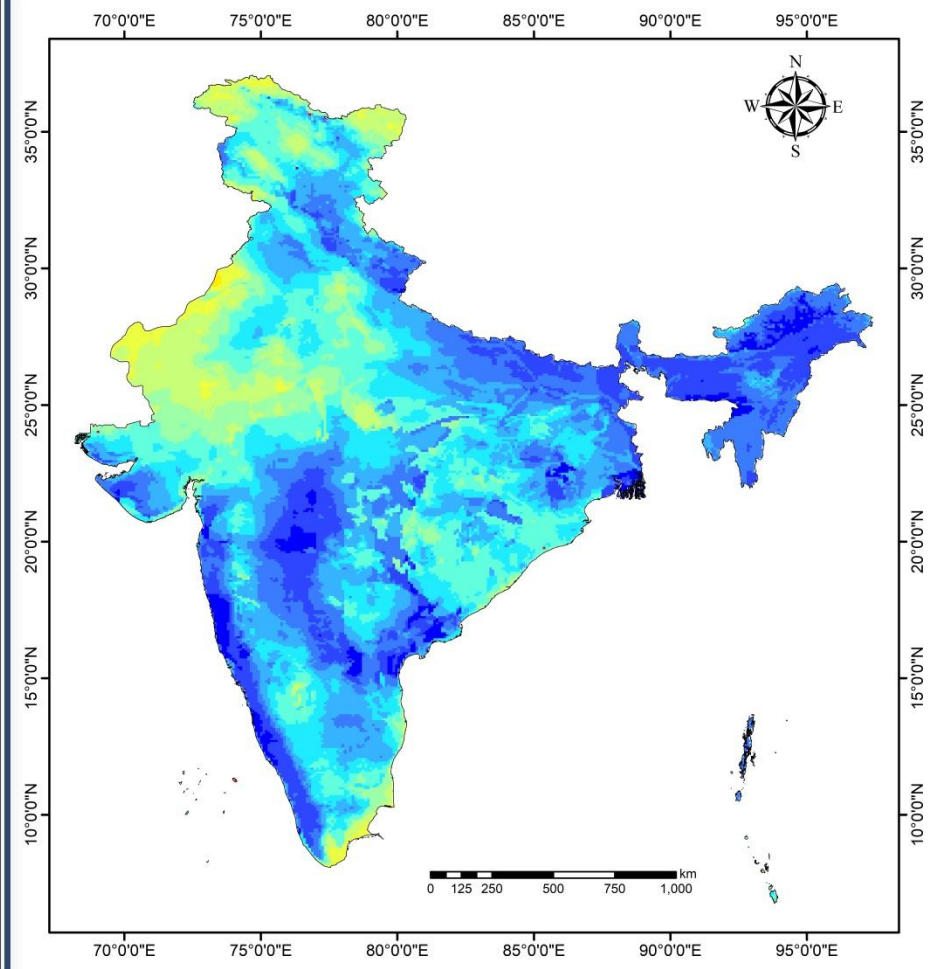


Wind speed @ 1.46 km from msl.

Source: MOSDAC web portal

Surface Soil Moisture Map (%)

Generated from SMAP Enhanced L4 Global 3 hourly daily 9km product



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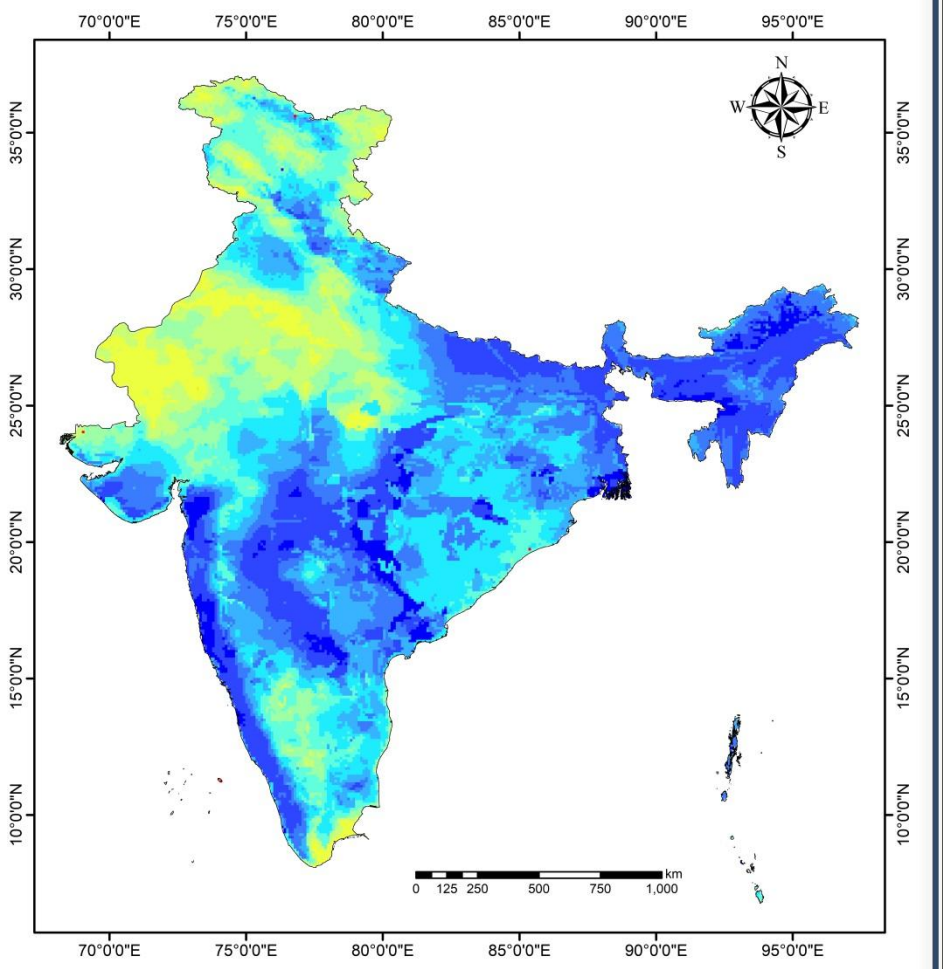

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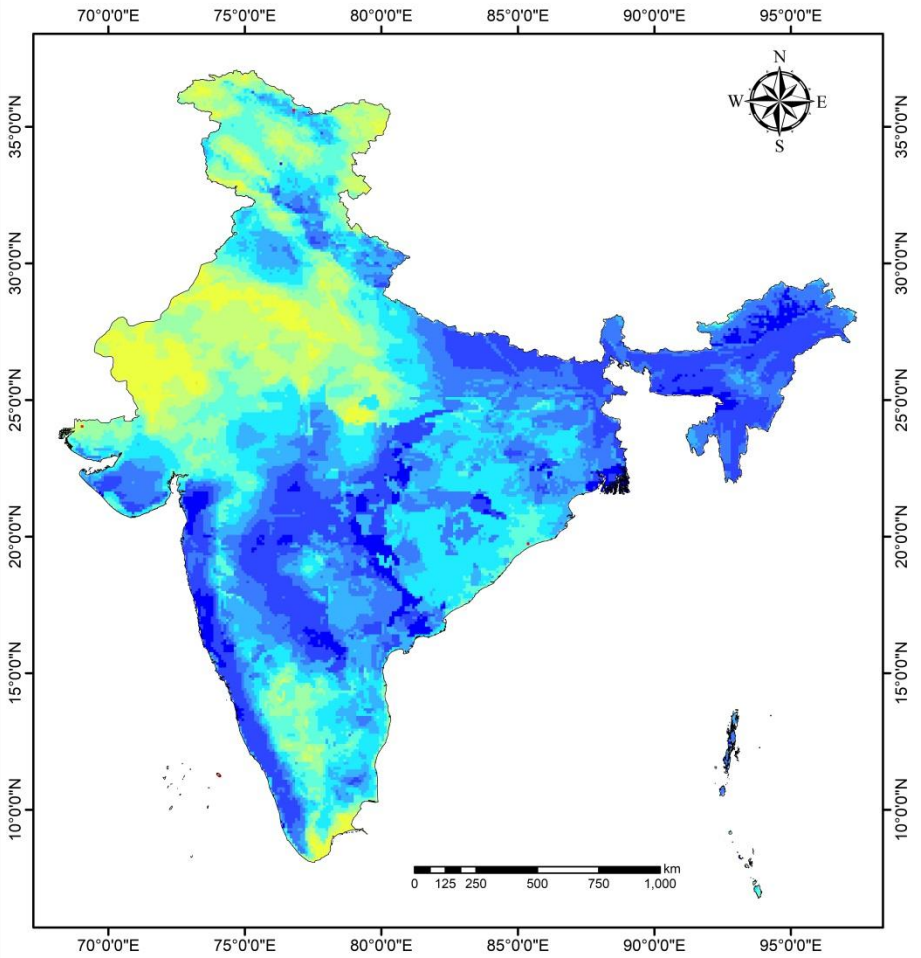
Root-Zone Soil Moisture Map (%)

Generated from SMAP Enhanced L4 Global 3 hourly daily 9km product



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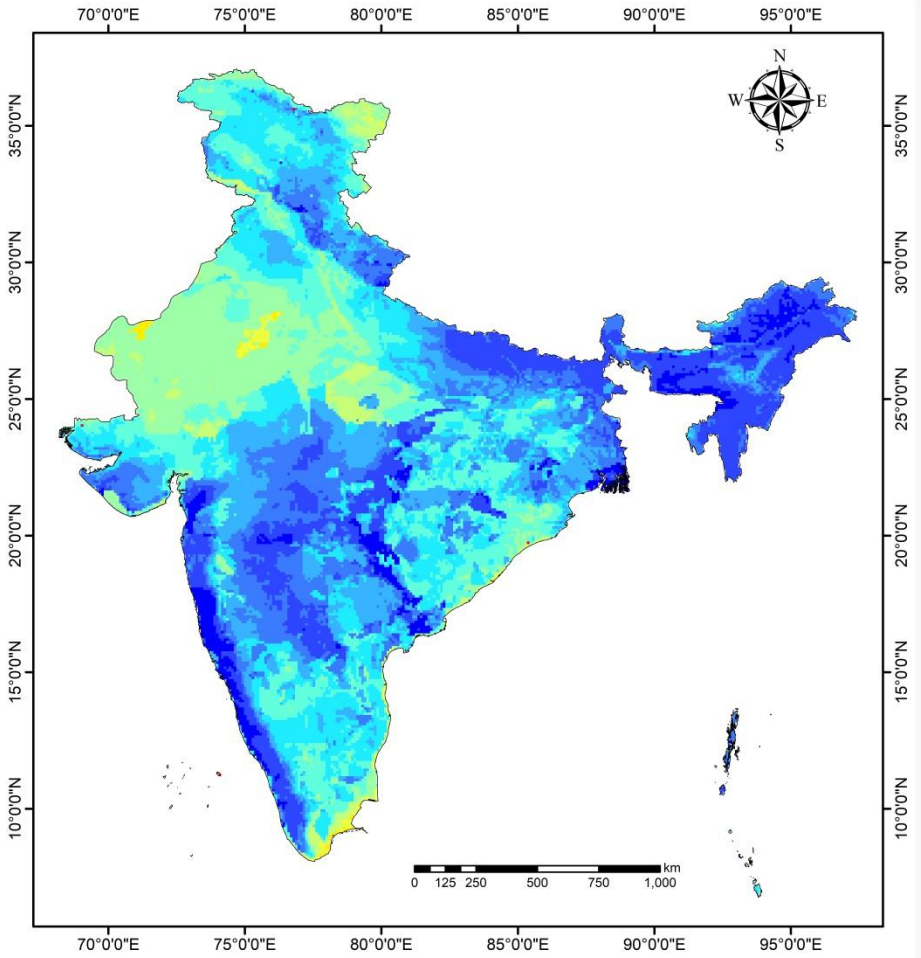

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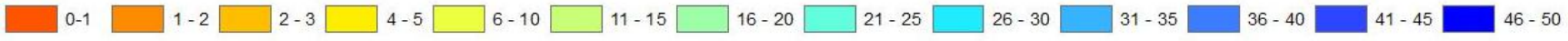
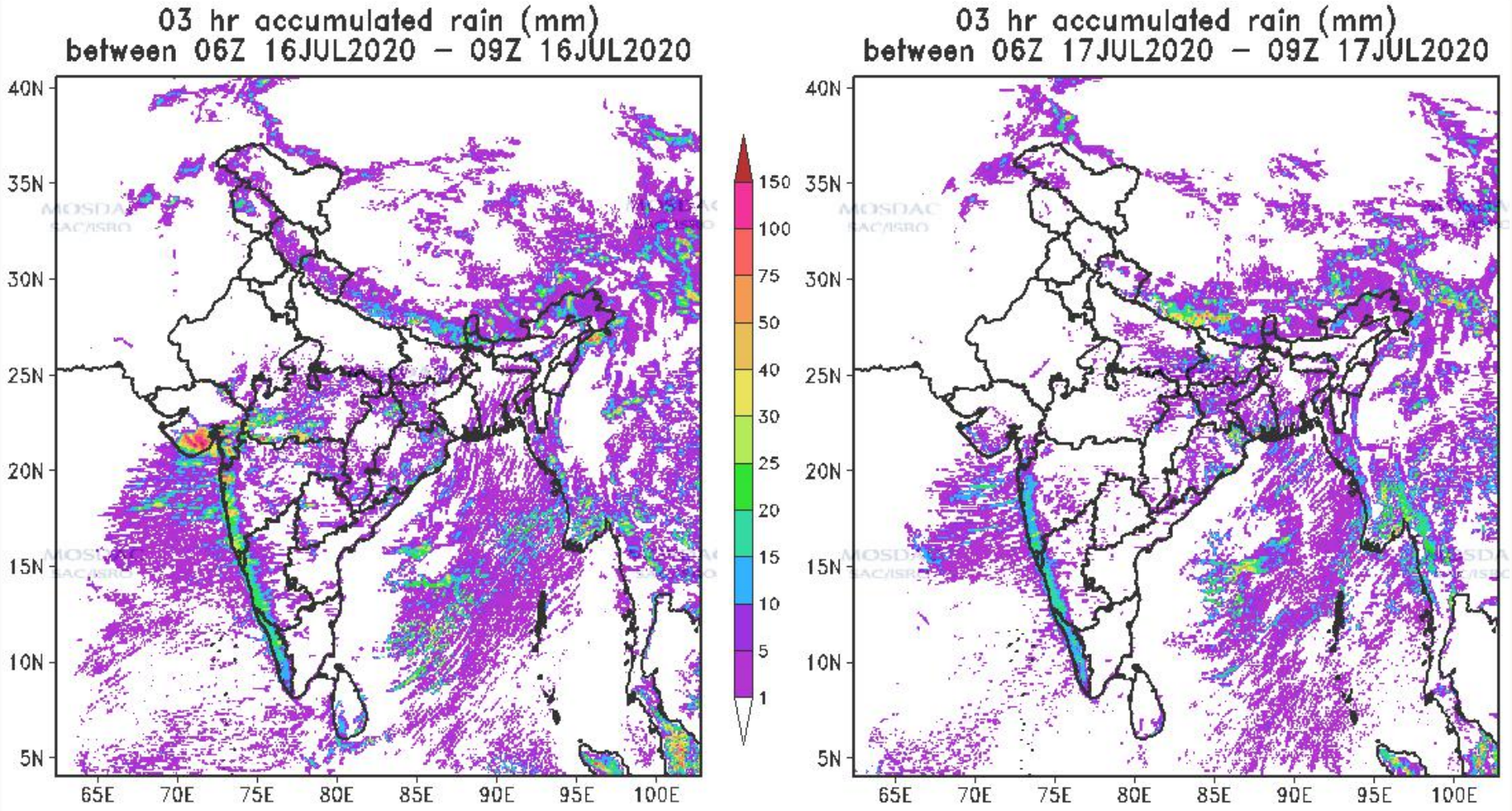
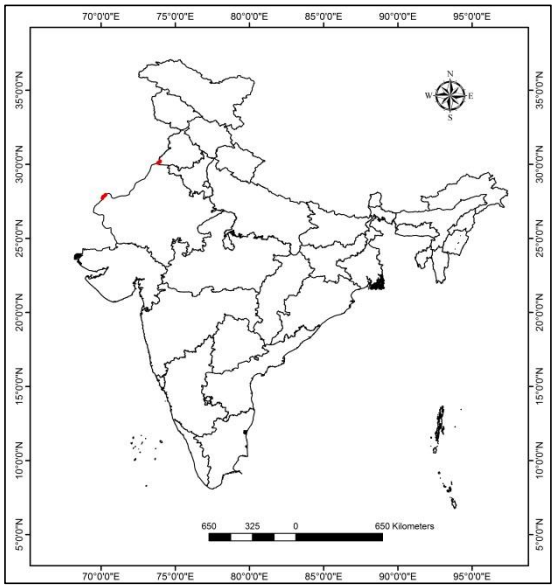


Accumulated Rainfall

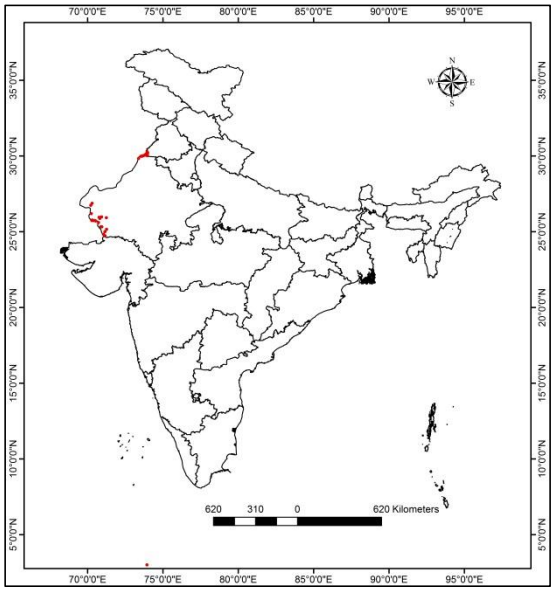


Source: MOSDAC web portal

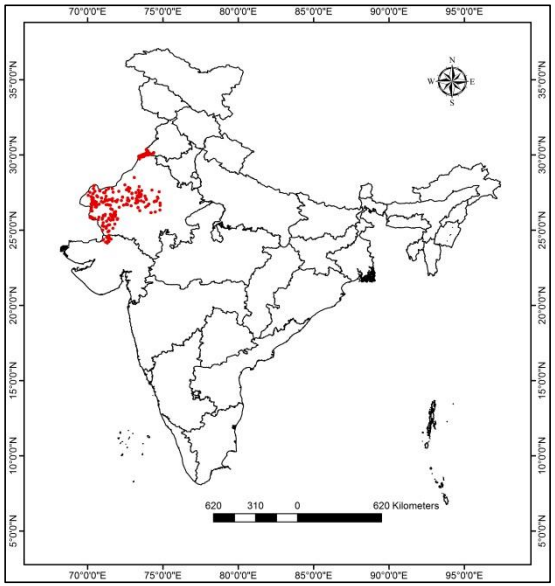
Fortnightly Progression of Locust Swarms in India



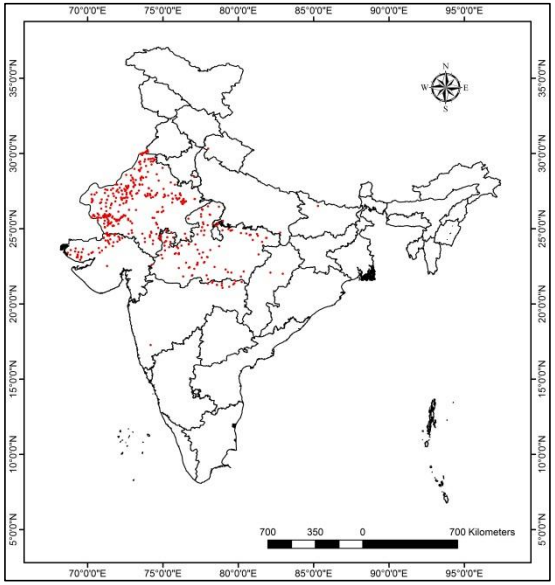
1st – 15th April, 2020: 74 sq.km.



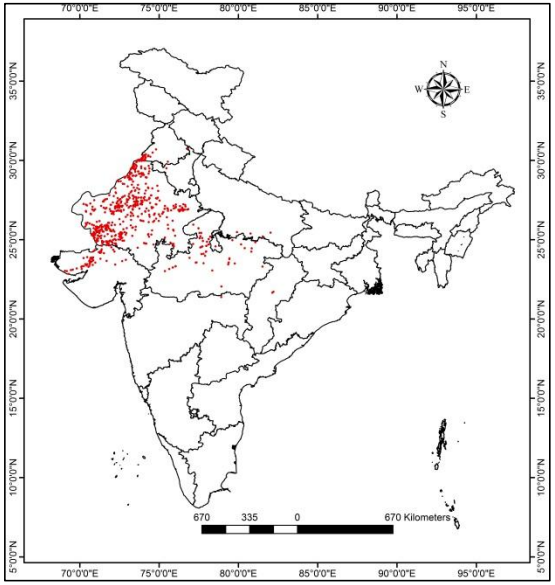
16th – 30th April, 2020: 13604 sq.km.



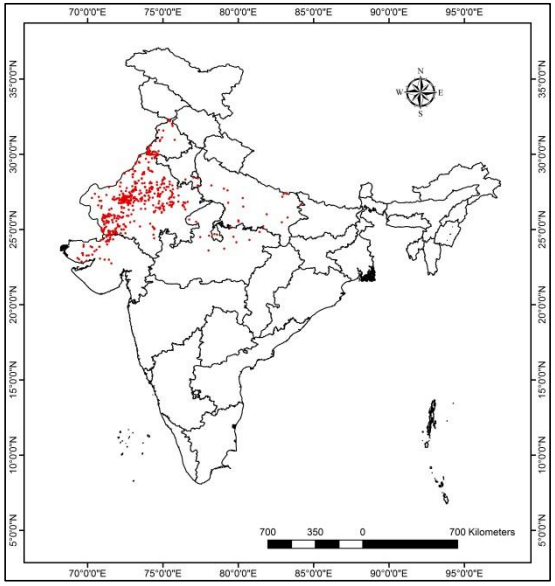
1st – 15th May, 2020: 1,32,315 sq.km.



15th – 31st May, 2020: 6,45,723 sq.km.



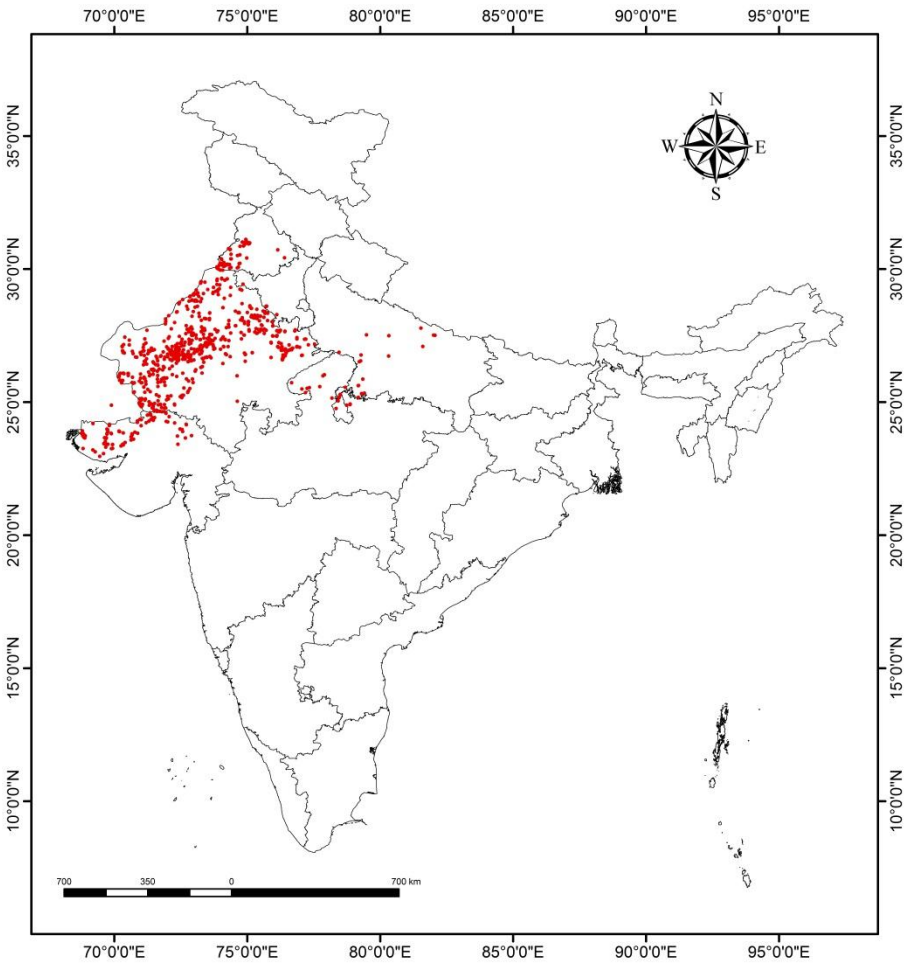
1st – 15th June, 2020: 5,10,991 sq.km.



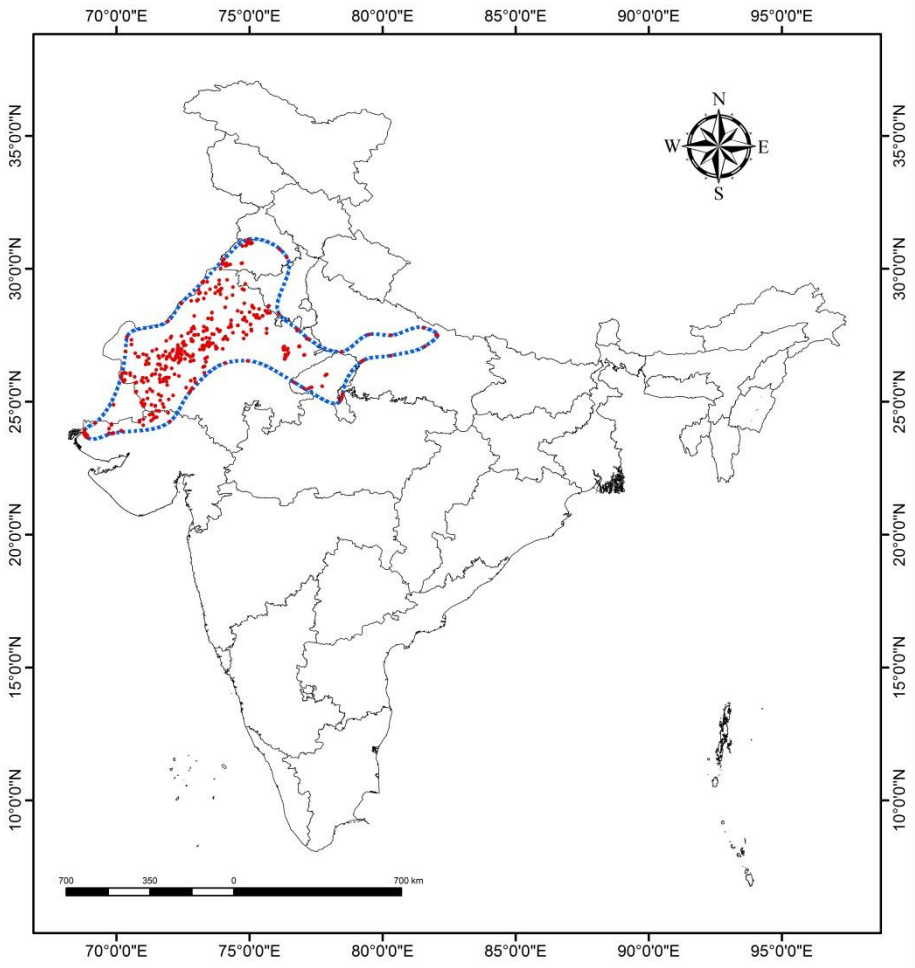
16th – 30th June, 2020: 5,36,348 sq.km.

Source of Locust Incidents: LWO-Jodhpur

Current Incidents of Locust Swarms in India (July 2020)



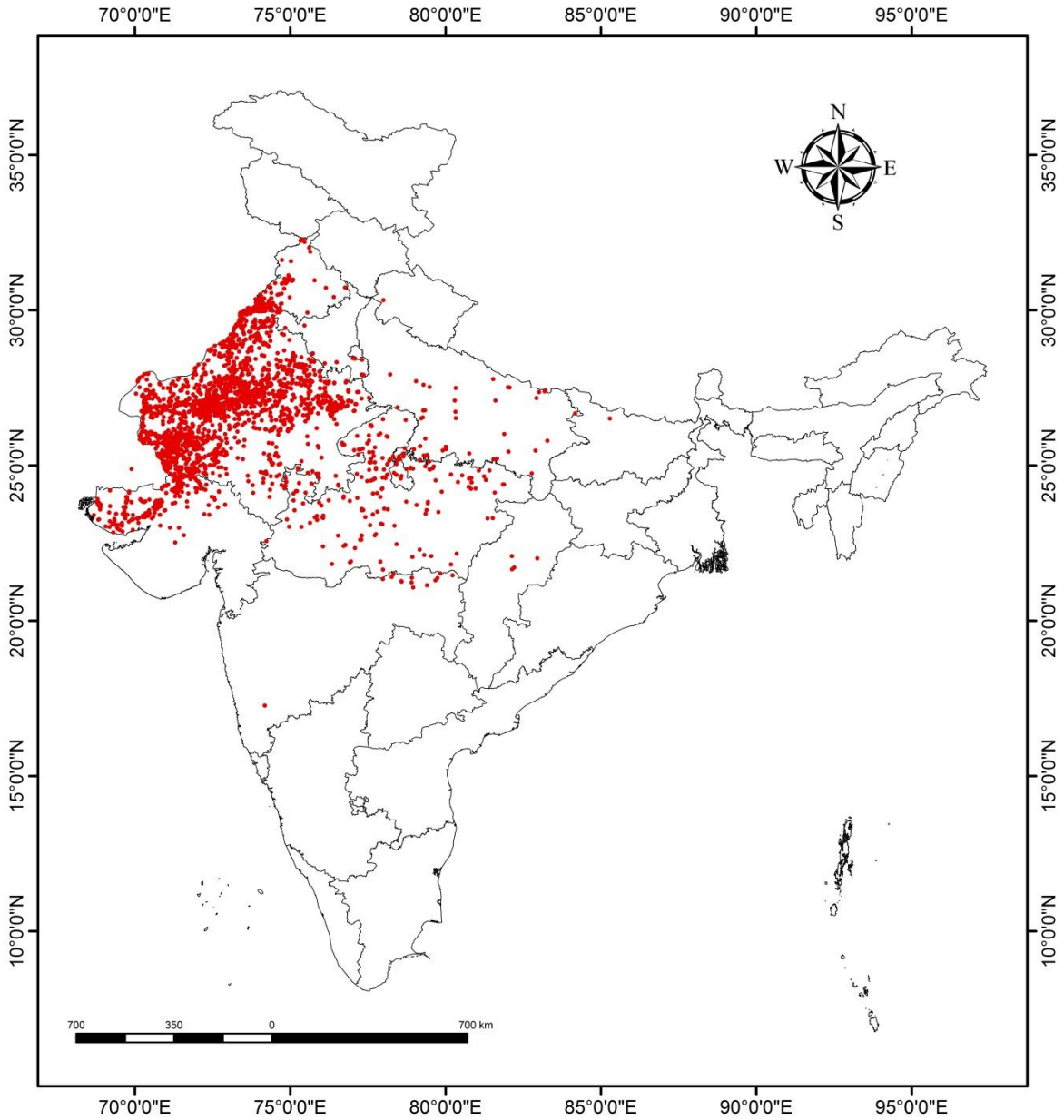
1st – 15th July, 2020: 4,77,391 sq.km.



8th – 15th July, 2020: 3,62,454 sq.km.

Source of Locust Incidents: LWO-Jodhpur

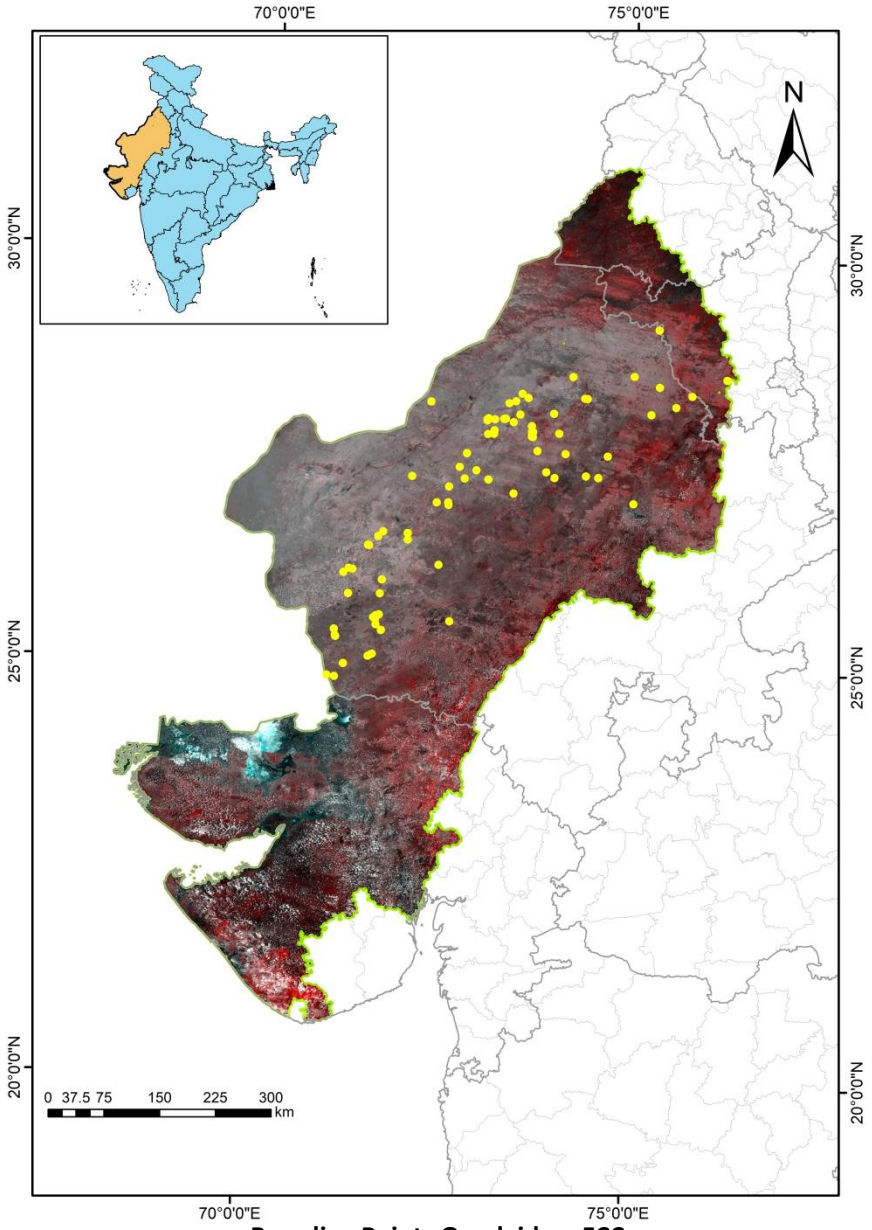
Cumulative Incidents of Locust Swarms in India



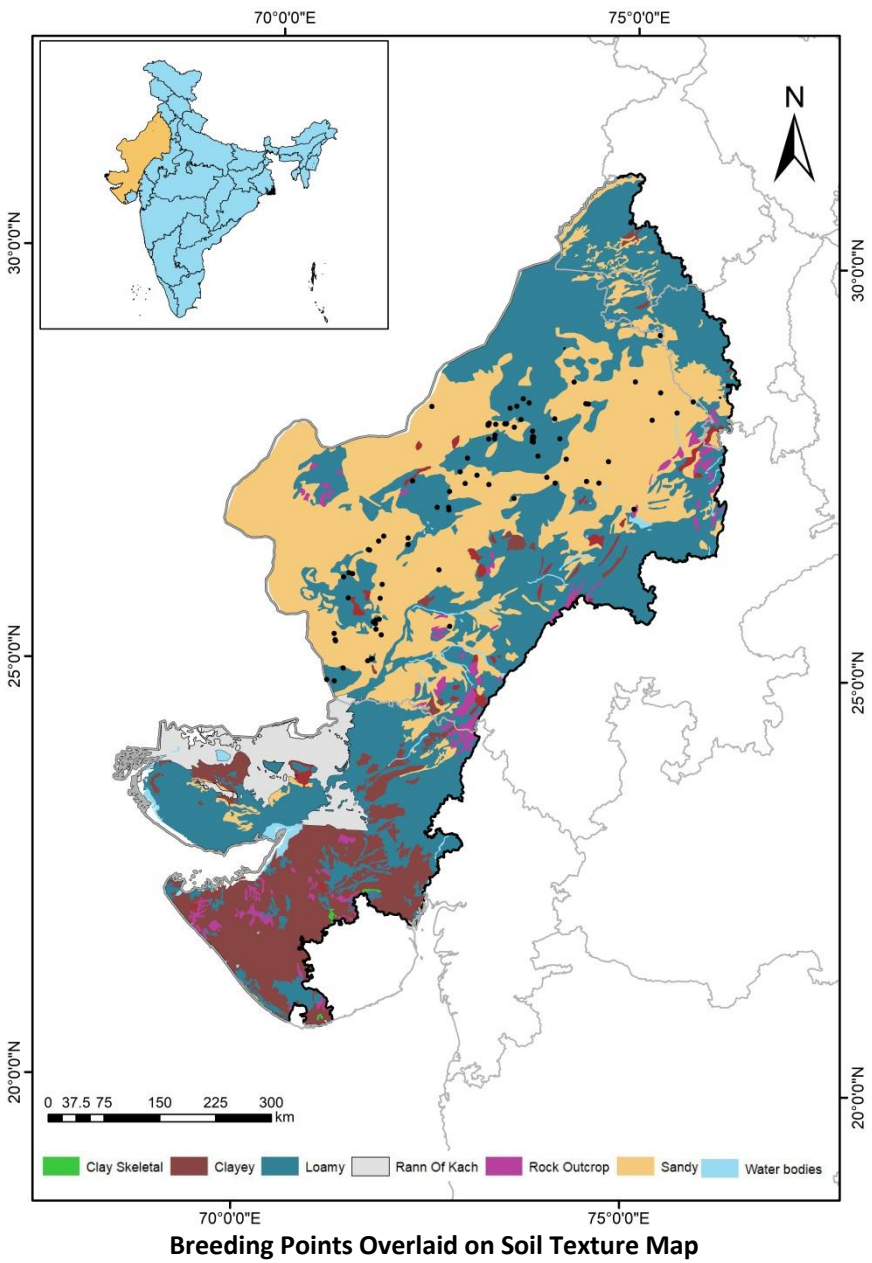
Source of Locust Incidents: LWO-Jodhpur

1st April – 15th July, 2020: 10,26,427 sq.km.

Locust Breeding Points in Thar Desert Region



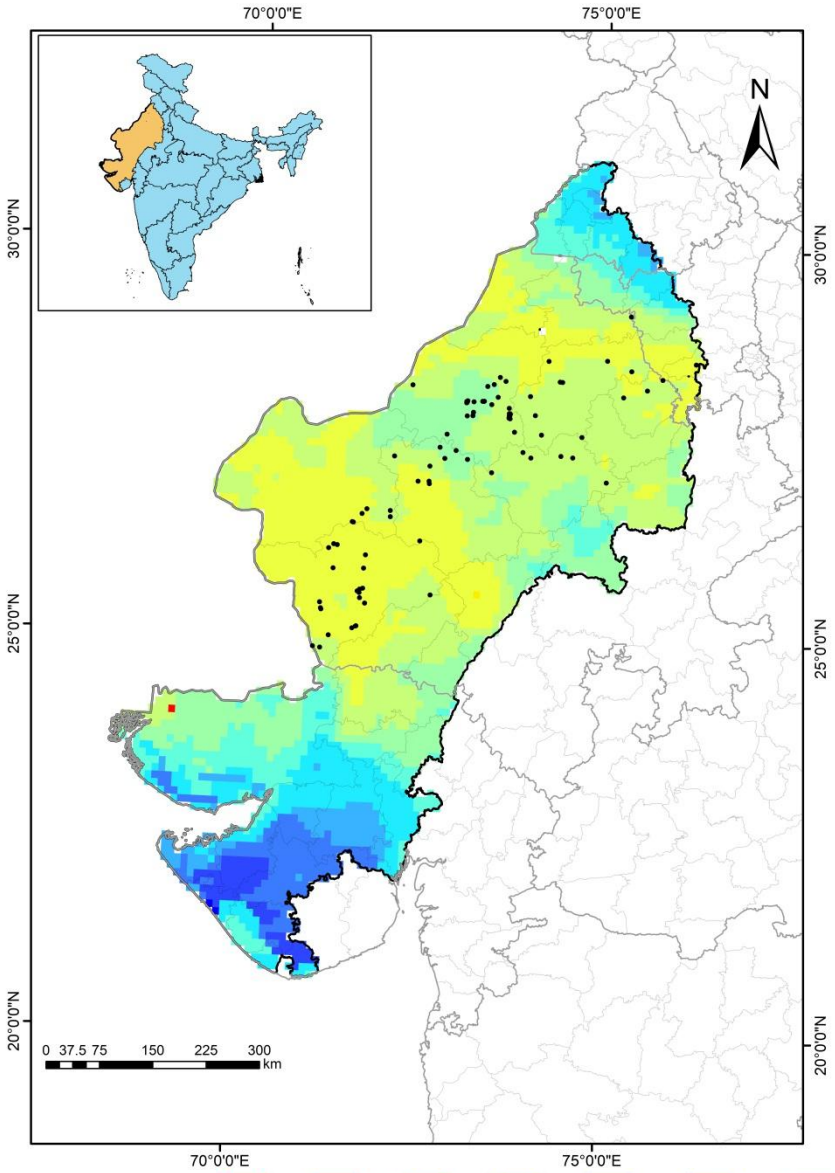
Breeding Points Overlaid on FCC

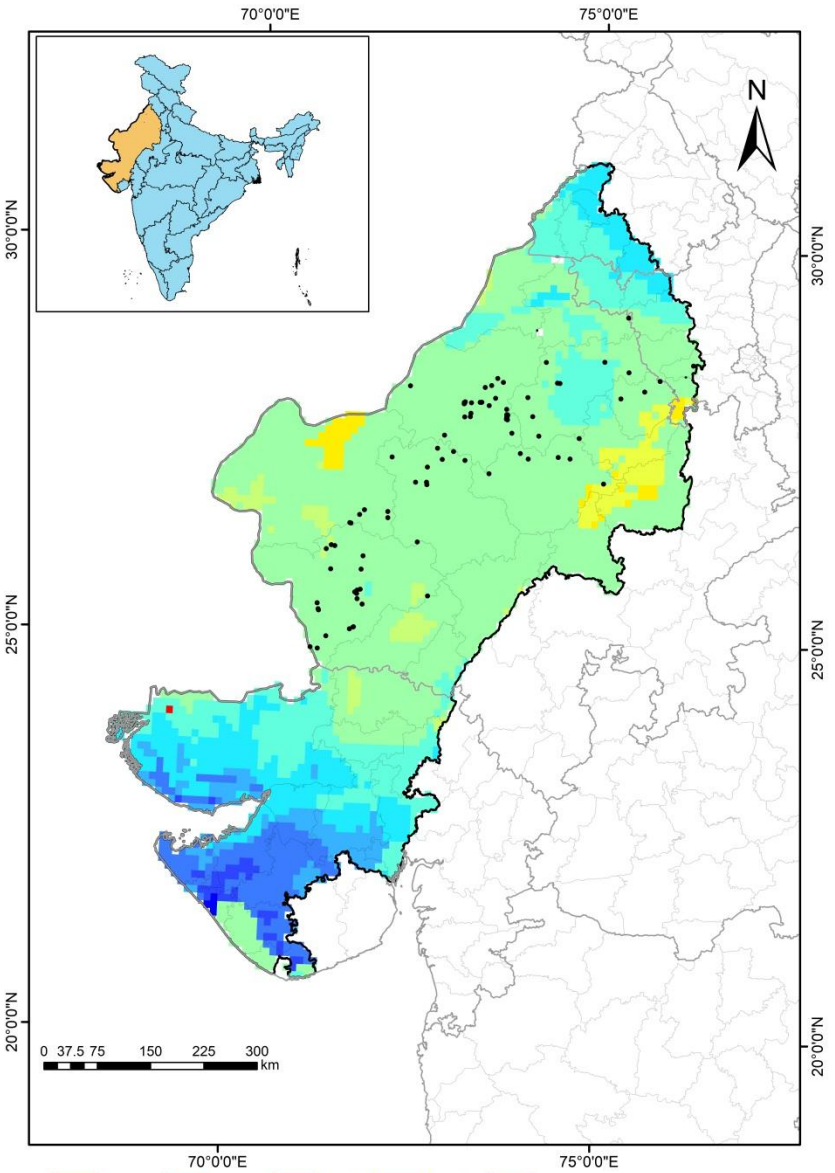


Breeding Points Overlaid on Soil Texture Map

Source of Locust Incidents: LWO-Jodhpur

Locust Breeding Points in Thar Desert Region





0-1 | 1 - 2 | 2 - 3 | 4 - 5 | 6 - 10 | 11 - 15 | 16 - 20 | 21 - 25 | 26 - 30 | 31 - 35 | 36 - 40 | 41 - 45 | 46 - 50

Breeding points overlaid on surface soil moisture map

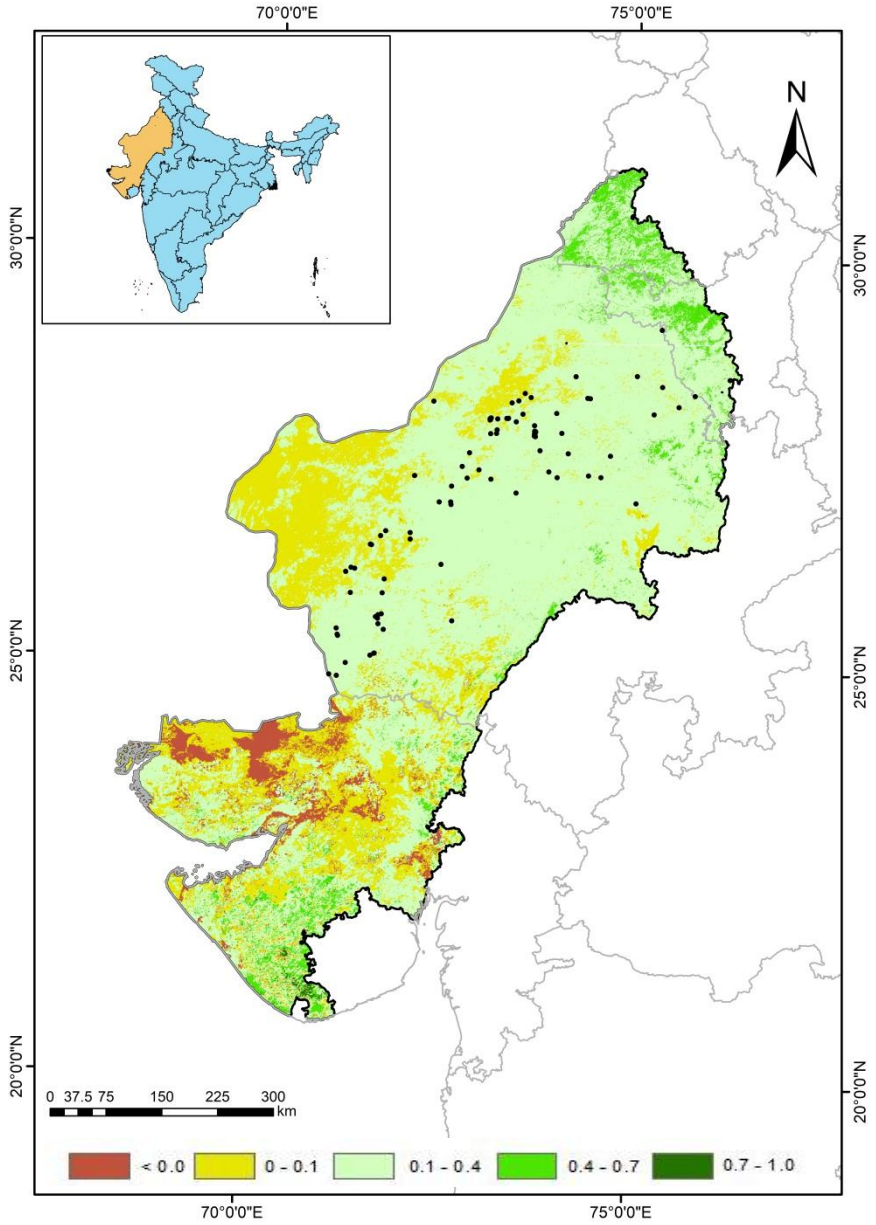
19:30 Hrs of 14th July 2020

Source of Locust Incidents: LWO-Jodhpur

Breeding points overlaid on root-zone soil moisture map

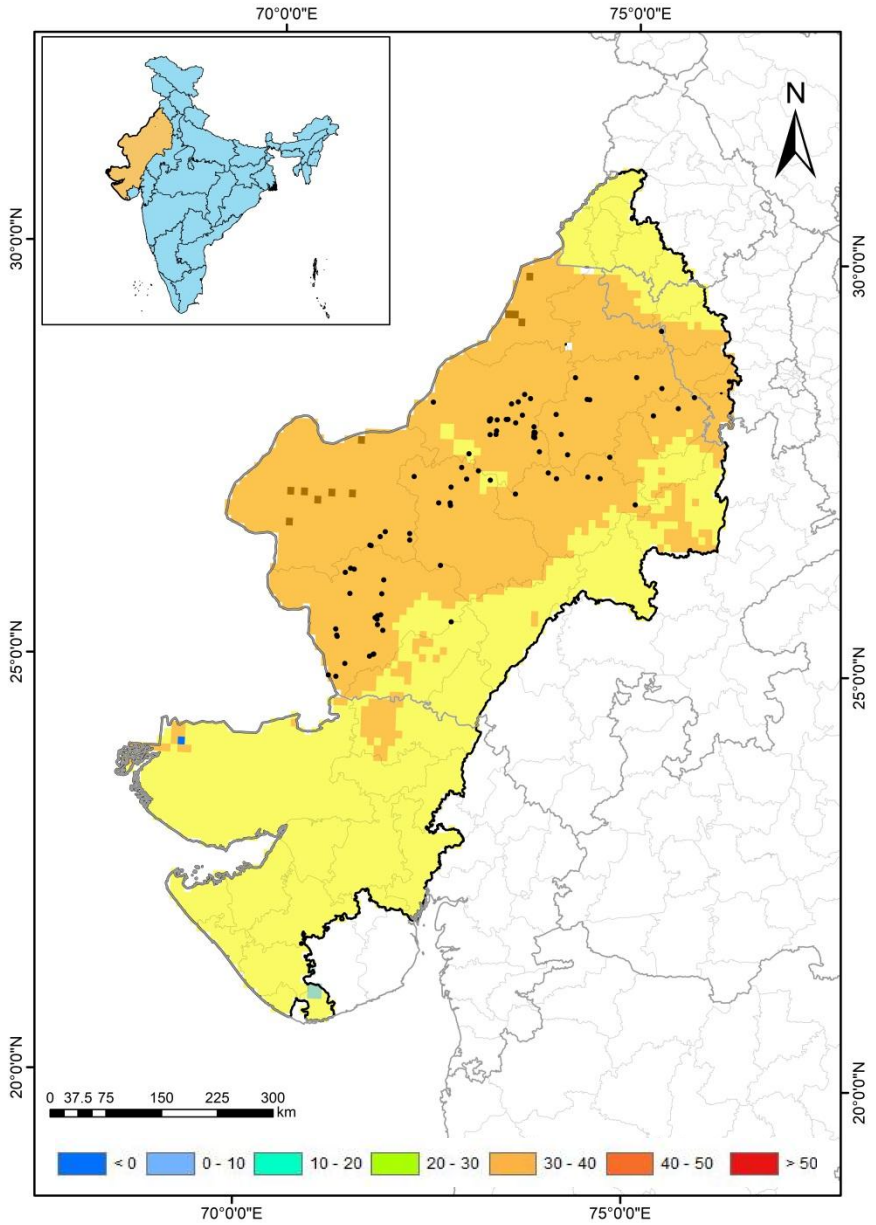
19:30 Hrs of 14th July 2020

Locust Breeding Points in Thar Desert Region



Breeding points overlaid on NDVI map

19:30 Hrs of 14th July 2020



Breeding points overlaid on Land Surface Temperature map

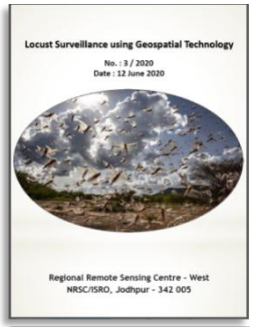
19:30 Hrs of 14th July 2020

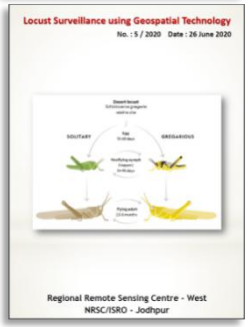
Source of Locust Incidents: LWO-Jodhpur

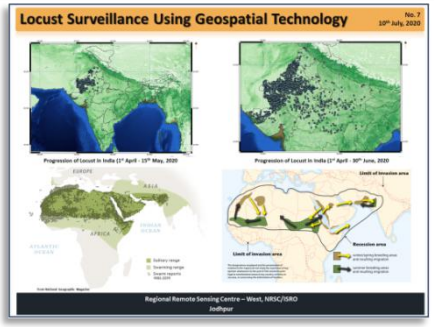
Locust Swarm Sightings Reported by NEWS Media

Source	Headlines	Date	Reported Areas
Navbharat Times	सीतापुर: टिड्डियों के समूह ने आधा दर्जन इलाकों में मचाई तबाही, फसलों को भारी नुकसान	11 July 2020	सीतापुर के मिश्रिख,खैराबाद,मछरेहटा और सिधौली क्षेत्र (उत्तर प्रदेश)
Navbharat Times	टिड्डी नियंत्रण अभियान जारी, केंद्र ने 1.5 लाख , राज्यों ने 1.33 लाख हेक्टेयर में छिड़काव किया	11 July 2020	राजस्थान, मध्य प्रदेश, पंजाब, गुजरात, उत्तर प्रदेश, महाराष्ट्र, छत्तीसगढ़, हरियाणा और बिहार
India Today	Locust swarms attack Haryana districts, anti-insect drive conducted	12 July 2020	Bhiwani, Jhajjar, Sirsa, Charkhi, Dadri in Haryana
The Indian Express	Locust swarms along border spur mock drills in Bathinda, Fazilka	12 July 2020	Mangla and Malika villages of Sirsa district of Haryana and Sri Ganganagar, Hanumangarh districts of Rajasthan
News 18	'Return of Tiddis': Lucknow Residents Swarm Twitter with Photos as Locusts Darken Skies	12 July 2020	Sitapur, Nishatganj, Daliganj and Vikas Nagar (Lucknow)
Livemint	Locusts enter Haryana districts; agriculture minister says necessary action take	12 July 2020	Sirsa, Bhiwani, Charkhi Dadri and Mahendragarh districts of Haryana
Navbharat Times	टिड्डी दल का आतंक: रात भर में चट कर दीं फसलें, केमिकल स्प्रे भी रहा बेअसर	13 July 2020	सिरसा जिले का ऐलानाबाद क़स्बा
Jagran	हरियाणा में टिड्डी दलों ने किया भारी नुकसान, सिरसा में 900 एकड़ में लगीं फसलें चट कीं	14 July 2020	चिकलनी ढाब, रंगड़ी, शहीदांवाली, मंगाला, चौबुर्जा, ङ्घधगतानिया, नटार, उमेदपुरा, केसुपुरा, माधोसिंघाना, कोटली (सिरसा)
Jagran	Locusts Attack: टिड्डियों से युद्धस्तर पर निपट रही सरकार, भारत को इस महीने सतर्क रहने की सलाह	15 July 2020	राजस्थान के बाड़मेर, जैसलमेर, जोधपुर, बीकानेर, झंझनू, श्रीगंगानगर, अलवर और चुरु, उत्तर प्रदेश और बिहार
Jagran	गांव खावा में दिखी टिड्डियां, ग्रामीणों में हड़कंप	15 July 2020	गांव खावा (उत्तर प्रदेश)
Hindustan Times	Locusts arrive in Gujarat from Somalia via Pakistan	16 July 2020	Bhuj, Gujarat
Rajasthan Patrika	देश में जोधपुर बना टिड्डी का हॉट स्पॉट	16 July 2020	फलोदी, शेरगढ़, लोहावट, देचू, सेखला, पीपाड, ओसियां, भोपालगढ़, बालेसर, तिंवरी (जोधपुर)

Feedback and Suggestions







Bringing together multiple parameters derived from different satellite platforms and are also able to put them together with information that would be useful for the decision making processes for Locust

P. G. Diwakar, ISRO Hq.

Very informative Locust Bulletin. Congratulations.

Dr. Prakash Chouhan, IIRS.

Thanks for sharing the locust bulletin. It has been brought out very nicely. In fact, the locust menace is a serious concern in agriculture in the current and rabi seasons also. Any such assessment using space and collateral data is really appreciable.

Dr. Bimal K Bhattacharya, SAC, Ahmedabad.

Congratulations to the Team RRSC-West for bringing out an informative bulletin on Locust.

Prof. Siva Ram Krishna, Indian Agriculture Research Institute.

Very informative and exhaust study. Thank you for sharing this bulletin

Dr. P. Krishnan, Indian Agriculture Research Institute.

Congratulations to the Team RRSC-West for bringing out an informative bulletin on Locust.

Dr. S. K. Srivastava, IIRS.

Excellent efforts by RRSC-W team. Compliments to you and your team

Dr. G. Sreenivasan, RRSC- C, Nagpur.

Please send your feedback to
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