Locust Surveillance Using Geospatial Technology

No. 10
31st July, 2020

nrsc

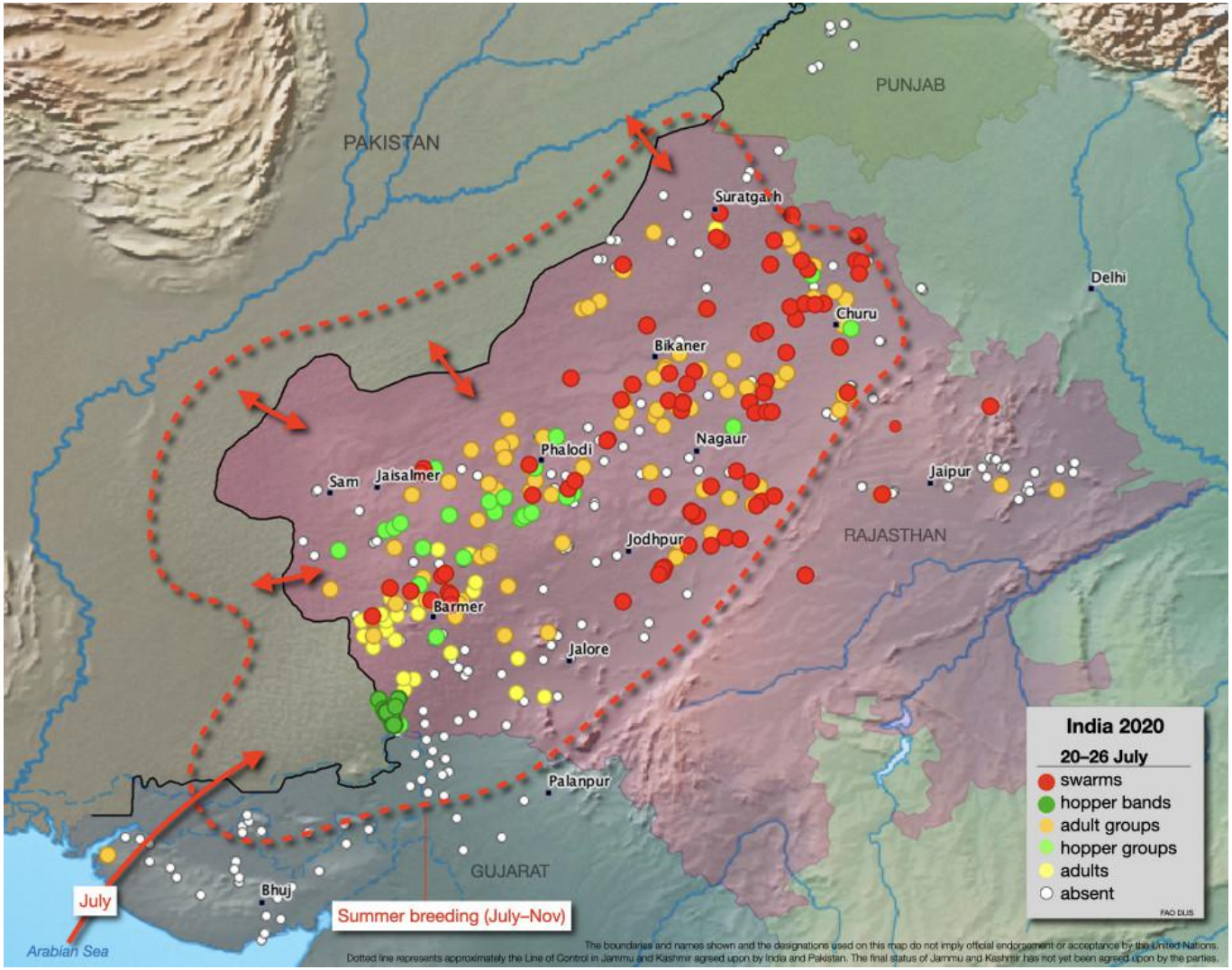
Image courtesy: FAO

Contents

Locust Surveillance Using Geospatial Technology Bulletin is issued weekly by Regional Remote Sensing Centre (West), NRSC/ISRO – Jodhpur. RRSC-W continuously monitors the weather and ecology to provide early warning based on survey and control results from Locust Warning Organisation (LWO), Jodhpur combined with remote sensing inputs.

Locust Update

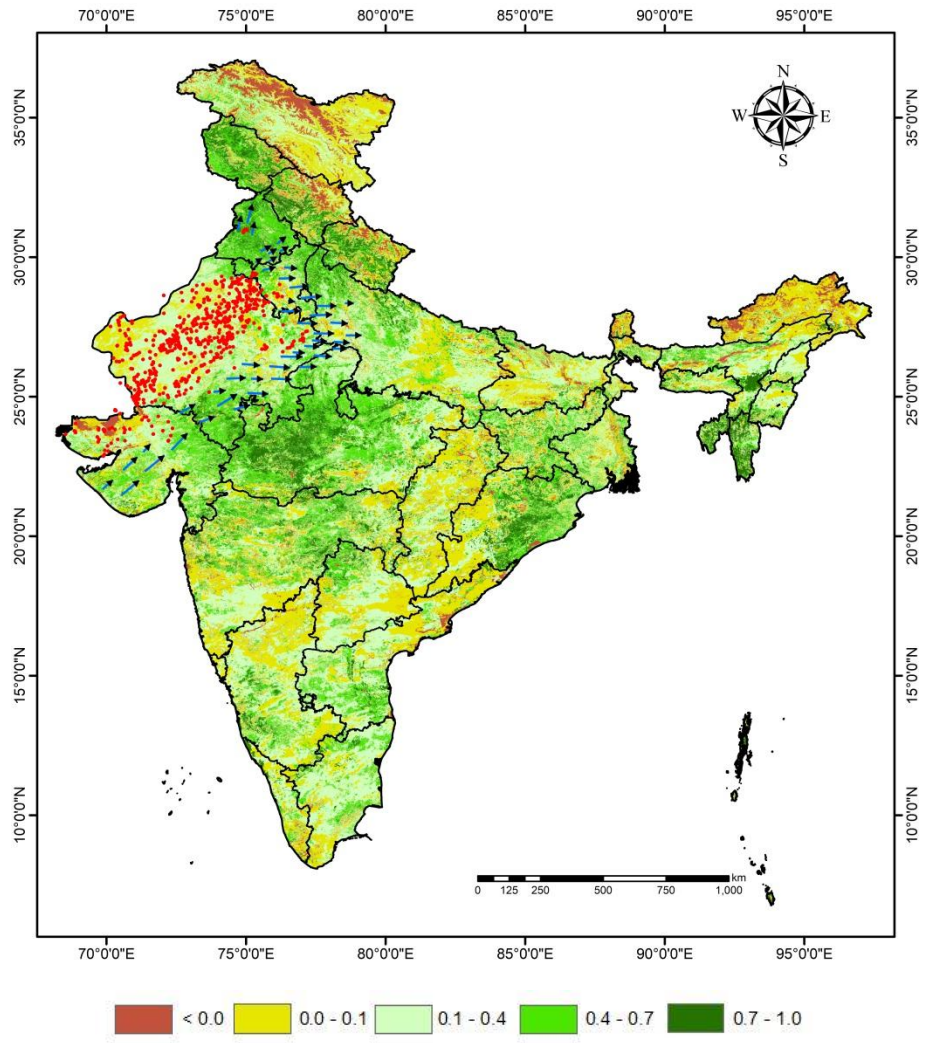
Swarms laying along Indo-Pakistan border



Summer breeding is underway along both sides of the Indo-Pakistan border. In India, numerous adult groups and swarms are laying eggs over a wide area of Rajasthan between Jodhpur and Churu while hatching and band formation from earlier laying have occurred further south from Phalodi to Gujarat. In Pakistan, hopper groups and bands are present in the Nagarparkar area in Tharparkar of southeast Sindh. Adult groups are scattered throughout Cholistan and other parts of Tharparkar that will lay eggs shortly. In Iran, locust numbers have declined, and the situation has improved. Survey and control operations are in progress in all countries

Source: Desert Locust situation update 29th July 2020 by Food and Agriculture Organisation, UN.

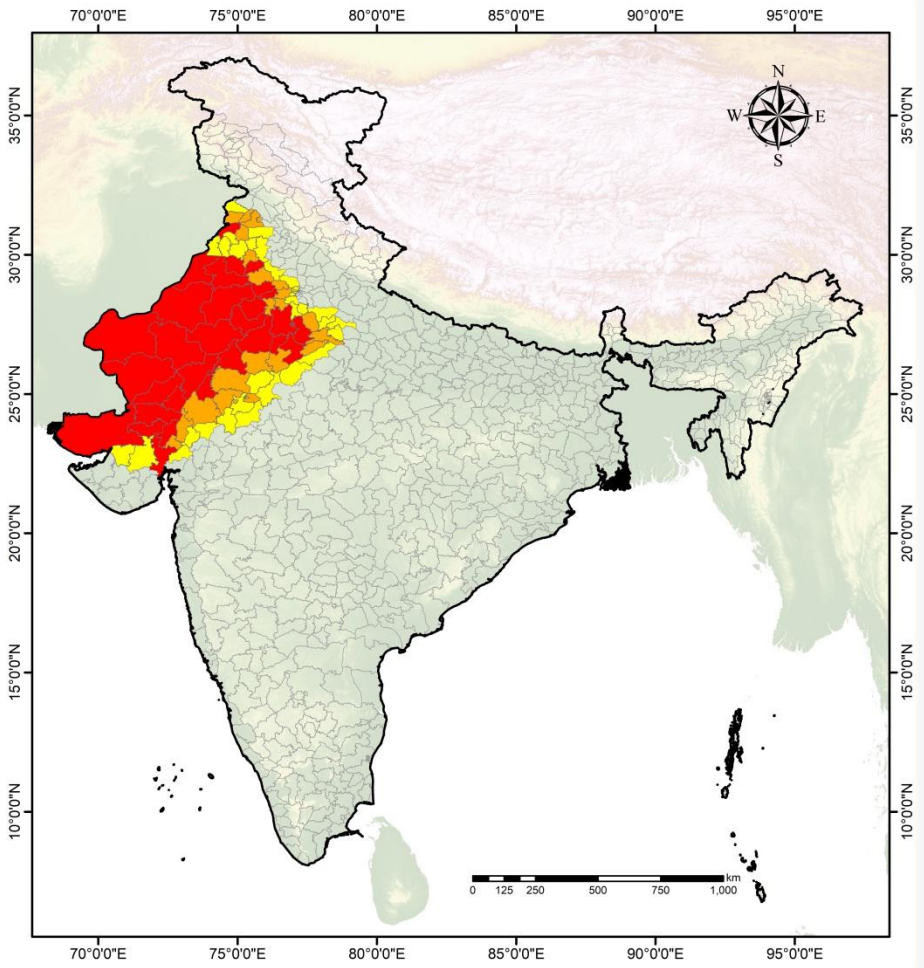
Location Map of Locust Infestation, Surrounding Wind Vectors and Vegetation Status



Source

- **Locust Infestation Point by LWO-Jodhpur**
- **NDVI – EMODIS Ver. 6**
- **Wind Vectors - MOSDAC**

Alert Map of Locust Infestation

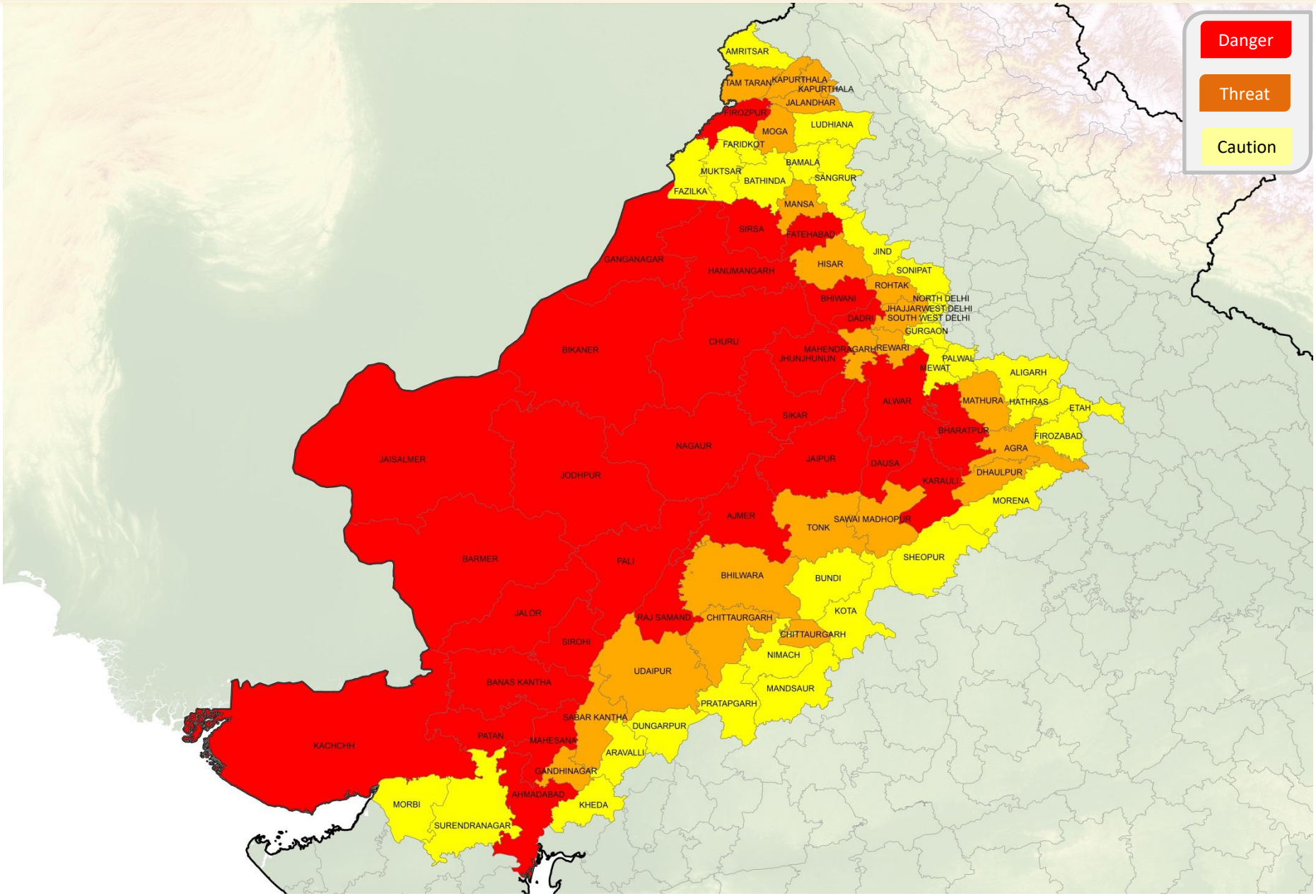


Alert for 31st July - 06th August, 2020

Warning Levels

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

Alert Map of Locust Infestation



Alert for 31st July - 06th August, 2020

Details of Locust Alert

Warning Level			
States	**Danger**	**Threat**	**Caution**
Rajasthan	Bikaner, Churu, Jhunjhunun, Jaisalmer, Sikar,Bharatpur, Jodhpur, Nagaur, Karauli, Ajmer, Barmer, Pali, Jalor, Sirohi, Rajsamand, Alwar, Ganganagar, Hanumangarh, Dausa, Jaipur	Chittaurgarh, Dhaulpur, Tonk, Bhilwara, Udaipur, Sawai Madhopur	Bundi, Dungarpur, Kota, Pratapgarh
Gujarat	Banaskanta, Ahmedabad, Kuchh, Patan, Mehsana	Sabarakanta, Gandhinagar	Kheda, Surdernagar, Morbi, Aravali
Haryana	Sirsa, Fatehabad, Bhiwani, Dadri	Mahendragarh, Hisar, Rohat, Jhajjar, Riwari	Jind, Sonipat, Mewat, Gurgaon, Palwal
Punjab	Firozpur	Kapurthala, Mansa, Jalandhar, Moga, Taran Taran	Amritsar, Fazilka, Ludhiana, Sangrur, Faridkot, Muktsar, Bhatinda, Barnala
Uttar Pradesh	--	Mathura, Agra	Etah, Aligarh, Ferozabad, Hatras
Madhya Pradesh	--	--	Morena, Shivpur, Neemuch, Mandsar
NCR	--	--	NCR

Districts with Locust Alert				
Warning Level	**No. of Districts**			
	11th – 17rd July	**18th – 24rd July**	**25th – 30th July**	**31st July – 06th August**
Danger	**35**	**45**	**36**	**40**
Threat	**31**	**48**	**38**	**20**
Caution	**49**	**45**	**69**	**33**

Biology and Ecology of the Desert Locust (Schistocerca Gregaria)

Efficient management of any pest is based on the thorough knowledge of its biology and ecology. The key event in the biology of locust is the change from a single-living and sedentary solitaries' phase to a gregarious phase in which they live in dense bands or swarms, actively migrate, and may devastate crops and rangeland well beyond their breeding sites. This phenomenon is known as locust phase transformation. It requires suitable environmental conditions and takes several consecutive generations to complete the density-dependent process of phase transformation from a solitaries' to a gregarious phase. As a general rule, locust aggregation and eventual phase transformation are favoured by habitat discontinuity or patchiness, which can result from a variety of meteorological events.

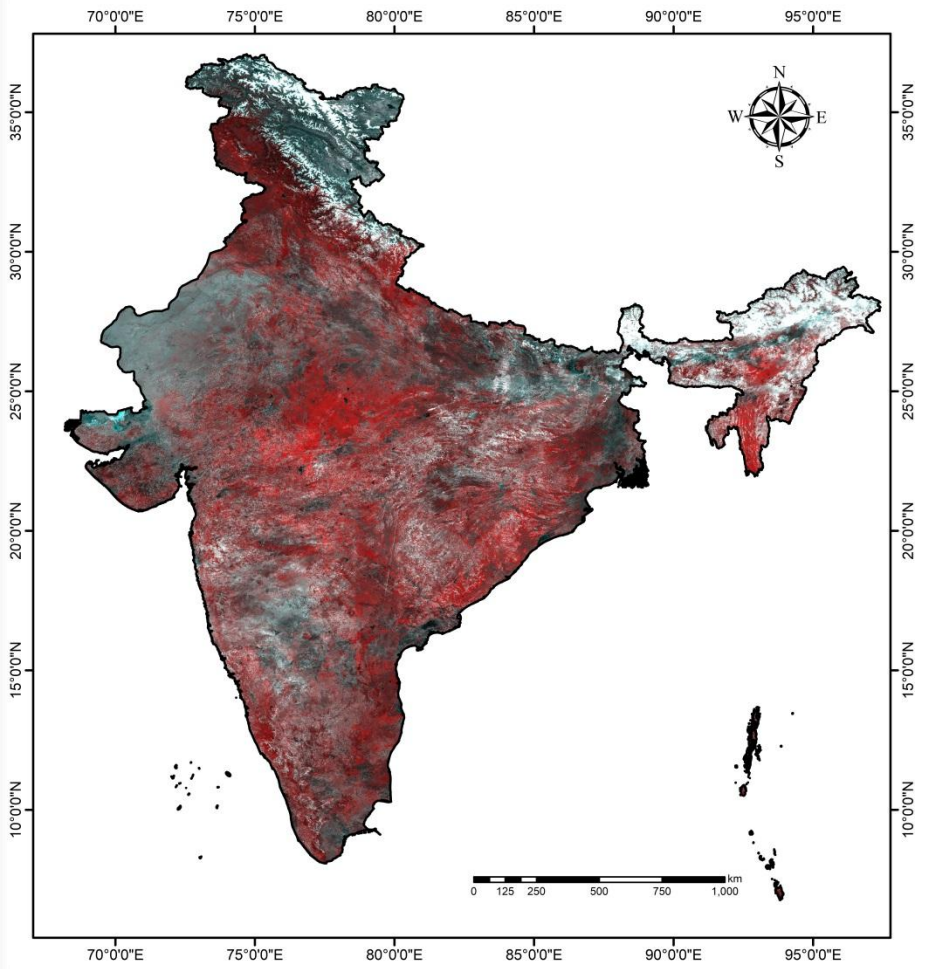
The recession area of the desert locust occupies arid and semi-arid lands covering 16 million km^2 from the Atlantic Ocean to Northwest India. Breeding occurs in the areas that receive 20–25 mm direct rainfall, and preferred oviposition sites are in sandy soils with a mosaic of grasses, herbs, and shrubs. Although rain over the area is largely erratic, it tends to fall seasonally. Consequently locust breeding also occurs seasonally in different geographic locations. The summer breeding zones include the Sahel, West Africa, Sudan, Eritrea, Ethiopia, and the India-Pakistan border. The winter/spring breeding zones include NW Africa, Iran, Pakistan, the Red Sea and the Gulf of Aden coasts, and the interior of Saudi Arabia and Yemen.

Seasonal rains in the deserts trigger the growth of green vegetation, which attracts the desert locusts. The oviposition habitat is a mosaic of bare ground and patches of emerging perennial and annual herbaceous vegetation. For successful incubation, eggs of the desert locust must absorb their own weight of water from the soil. In case the soil is moist enough, the eggs may hatch in about two weeks. Hopper development includes five or six instars and takes between 22 (hot conditions) and 70 (cool conditions) days. During this period hoppers form cohesive bands that can march up to several km per day. Immature adults are colured in pink; they pack in swarms that fly up to 200 km per day in search for areas suitable for egg-laying and successive hopper development. Once such habitat is found, the swarms settle, sexual maturation starts, and adults turn yellow and copulate. Several days' later females start laying egg-pods at intervals of 7 to 10 days.

Under conditions of high temperatures, egg development is more rapid. Hopper development is also a function of temperature. The hopper development period decreases with increasing daily air temperature from 24°C to 32°C. Band movement is stimulated by air temperature. Adults take off in temperatures above 20°C–22°C and fly with the wind (i.e. downwind).

Source: "Locusts and remote sensing: a review". Alexandre V. Latchininsky. Journal of Applied Remote Sensing, 7(1), 075099 (2013).

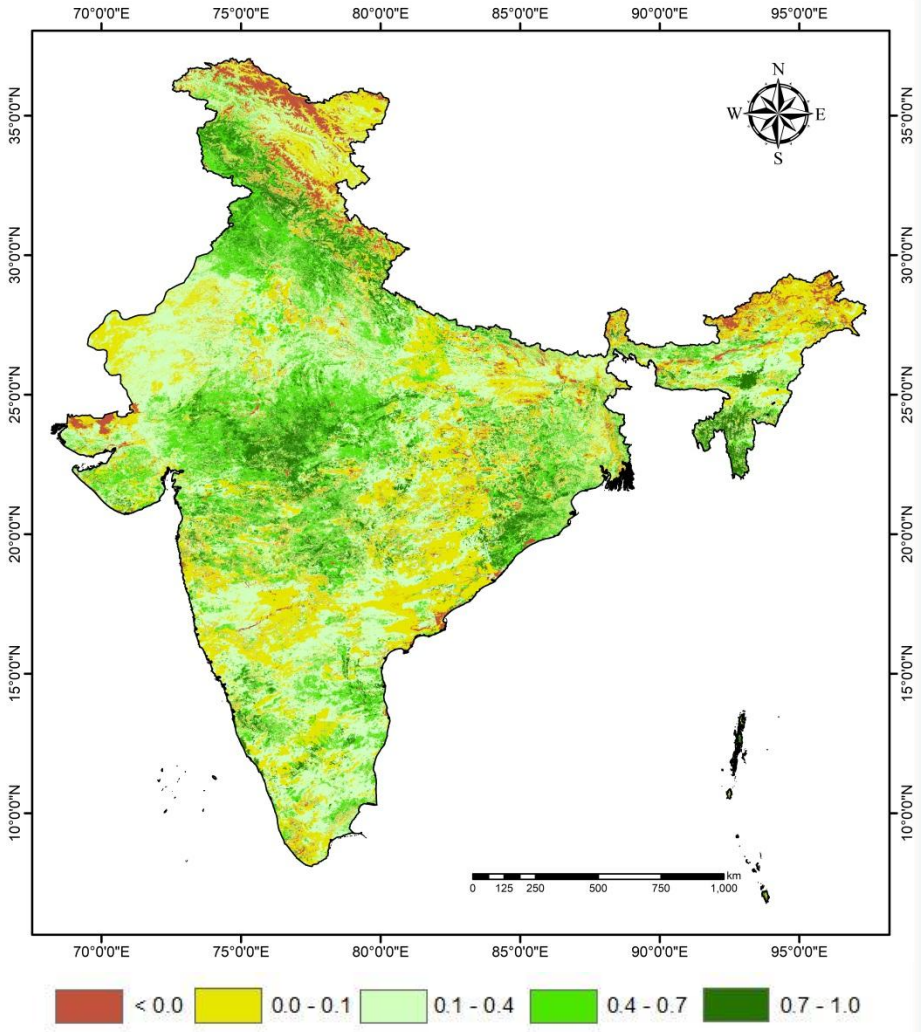
False Colour Composite (FCC)



Source: MODIS 8 day Composite

20th - 27th July, 2020

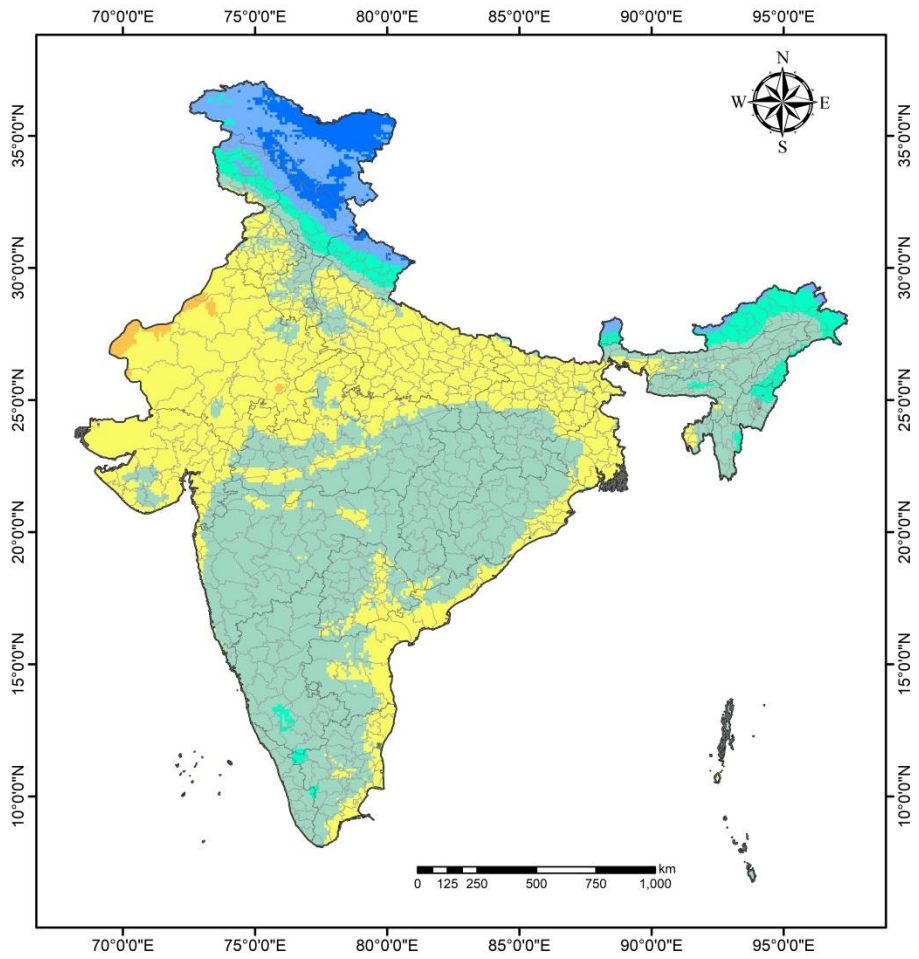
Normalized Difference Vegetation Index (NDVI)



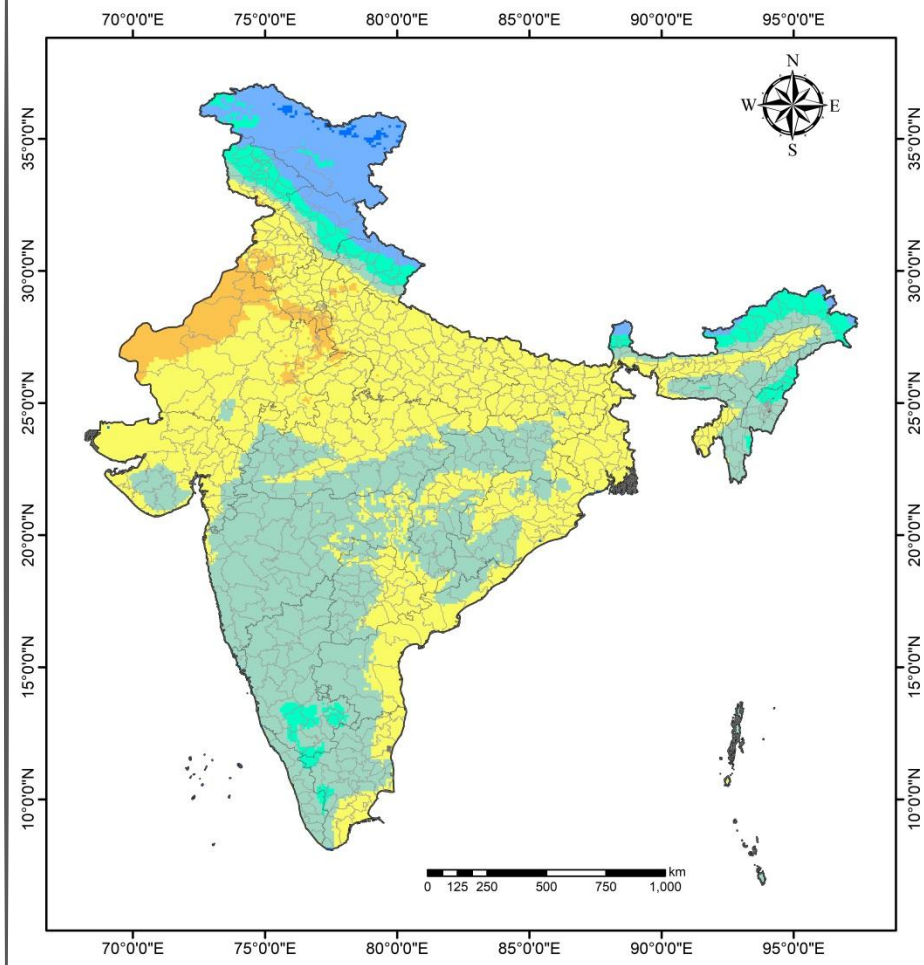
Source: eMODIS Ver. 6

16th - 25th July, 2020

Land Surface Temperature (⁰C)



19:30 Hrs. of 22nd July 2020

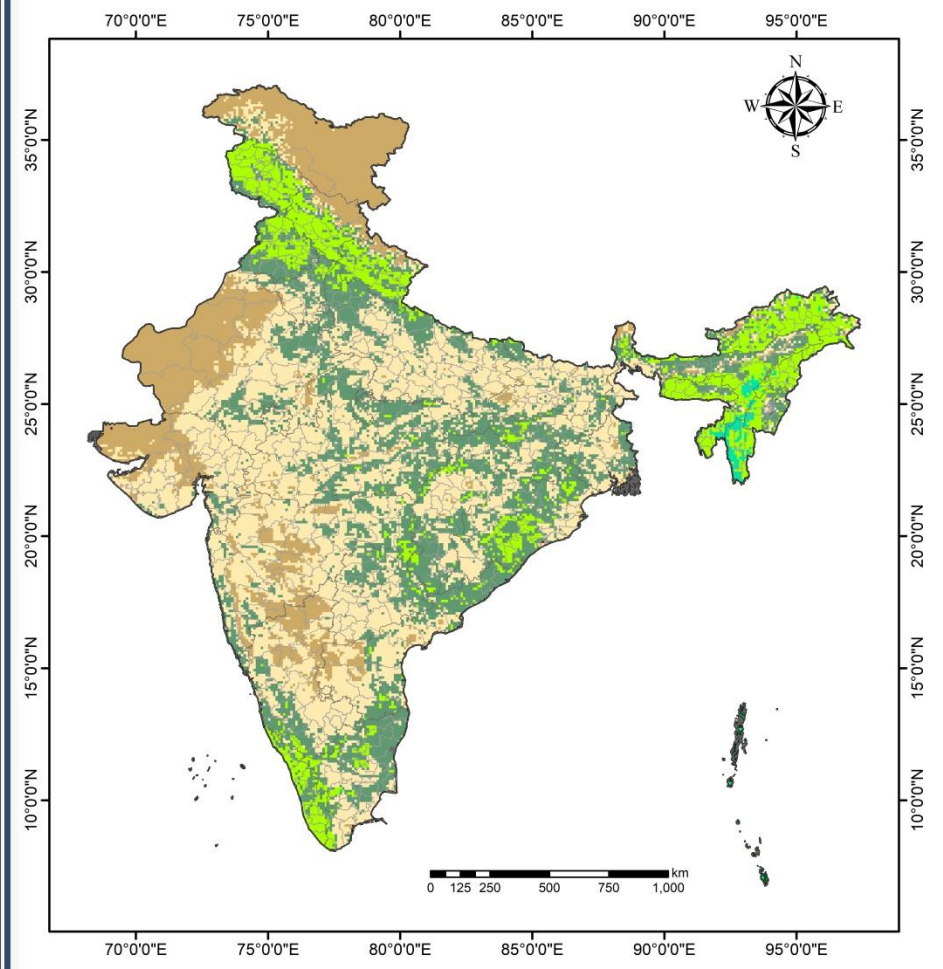


19:30 Hrs. of 27th July 2020.

< 0 | 0 - 10 | 10 - 20 | 20 - 25 | 25 - 30 | 30 - 35 | 35 - 40 | 40 - 45 | 45 - 50

Source: SMAP Enhanced L4 Global 3 Hourly 9 km Product

Leaf Area Index (LAI)



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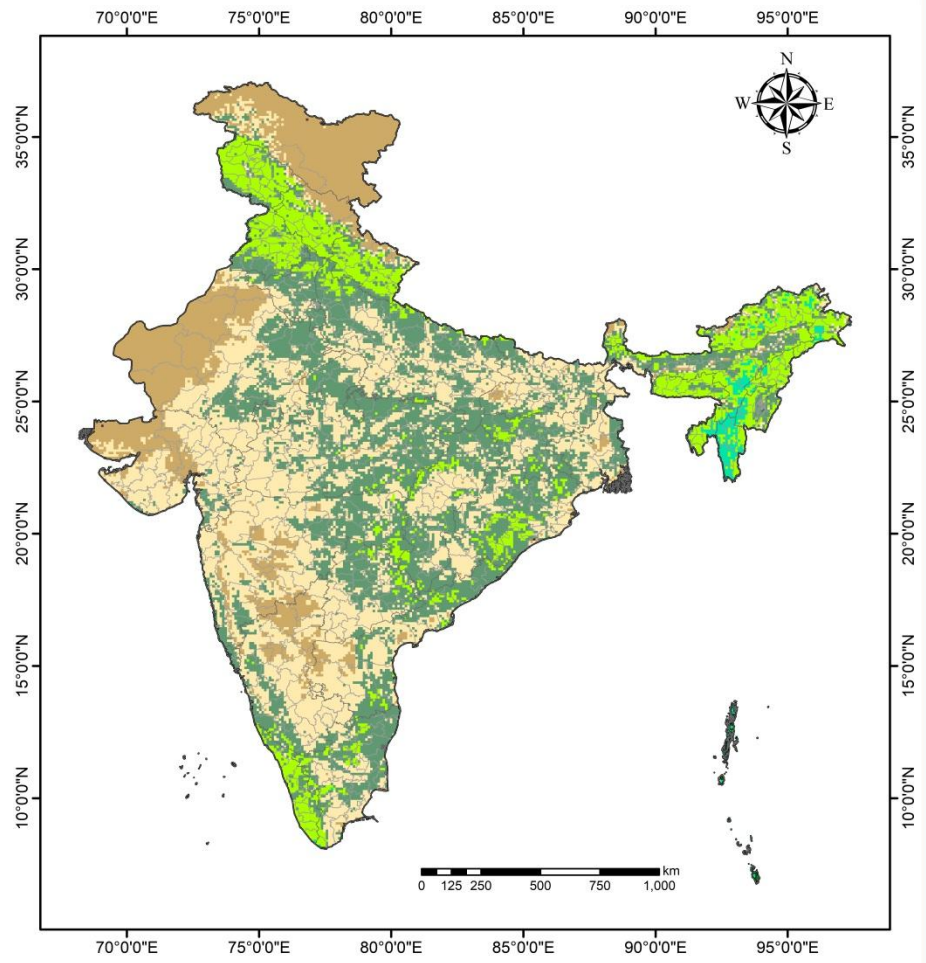
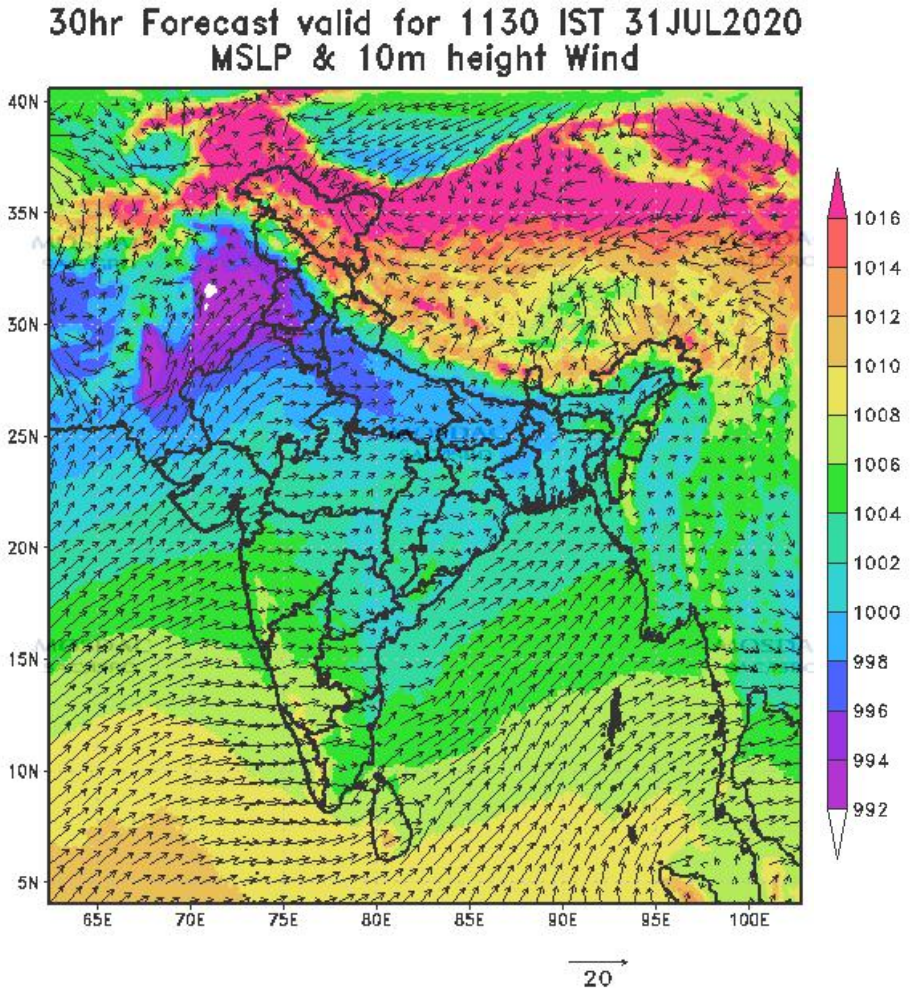


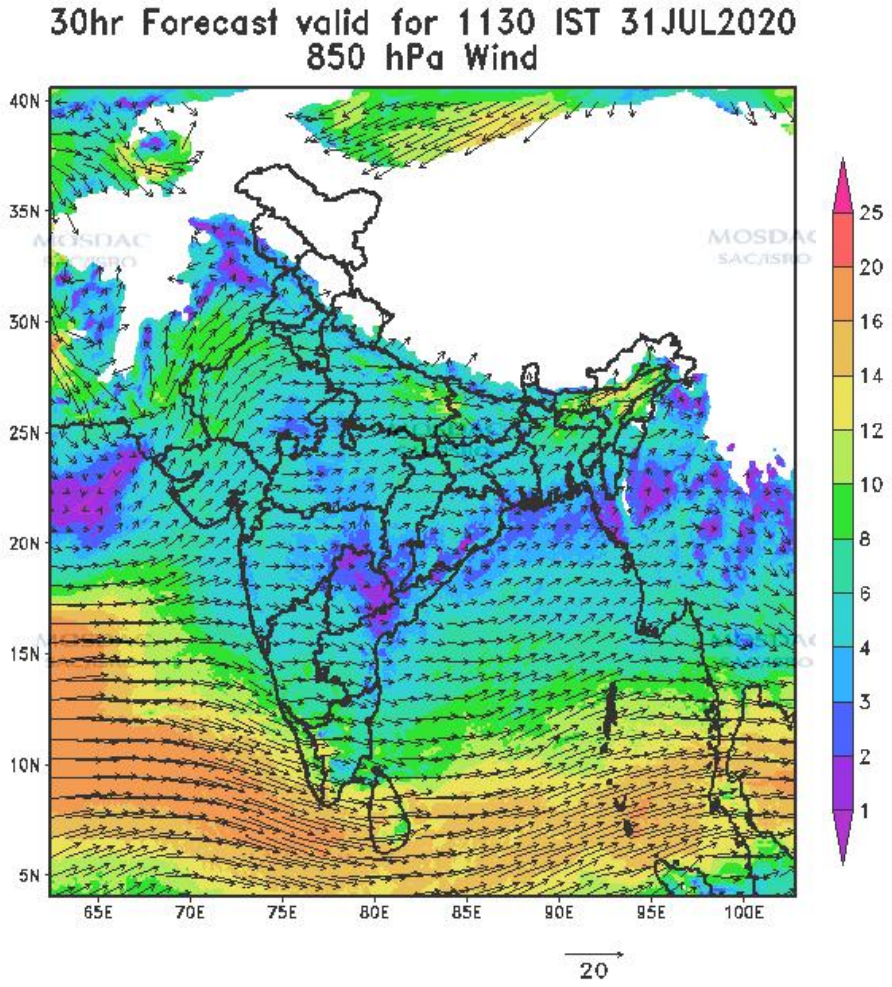
19:30 Hrs of 27th July 2020.

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

Source: SMAP Enhanced L4 Global 3 Hourly 9 km Product

Wind Vectors

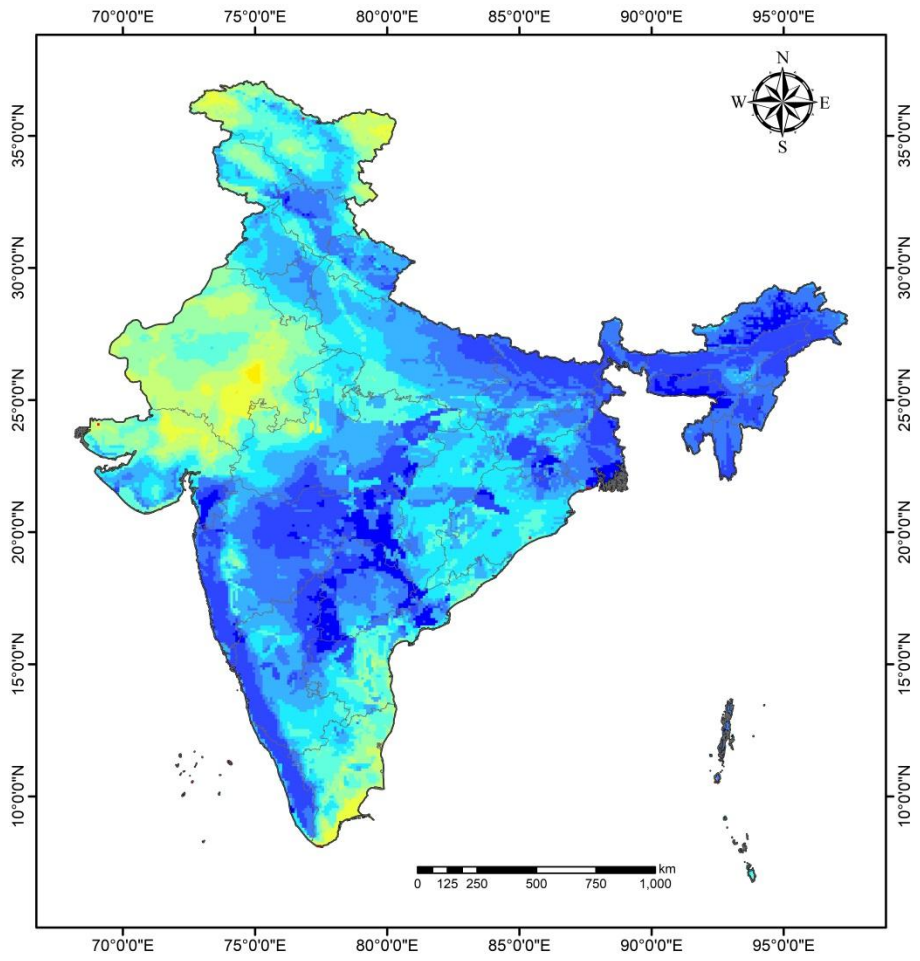




Source: MOSDAC web portal

Wind speed @ 1.46 km from msl.

Surface Soil Moisture Map (%)



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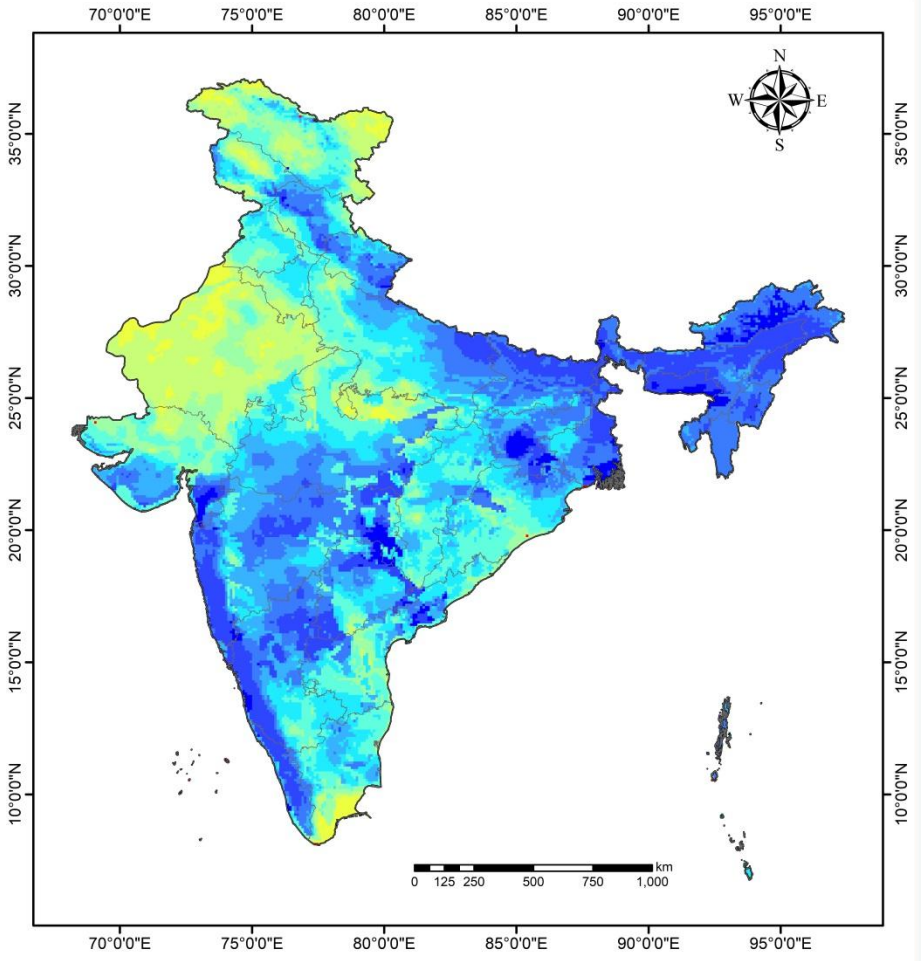
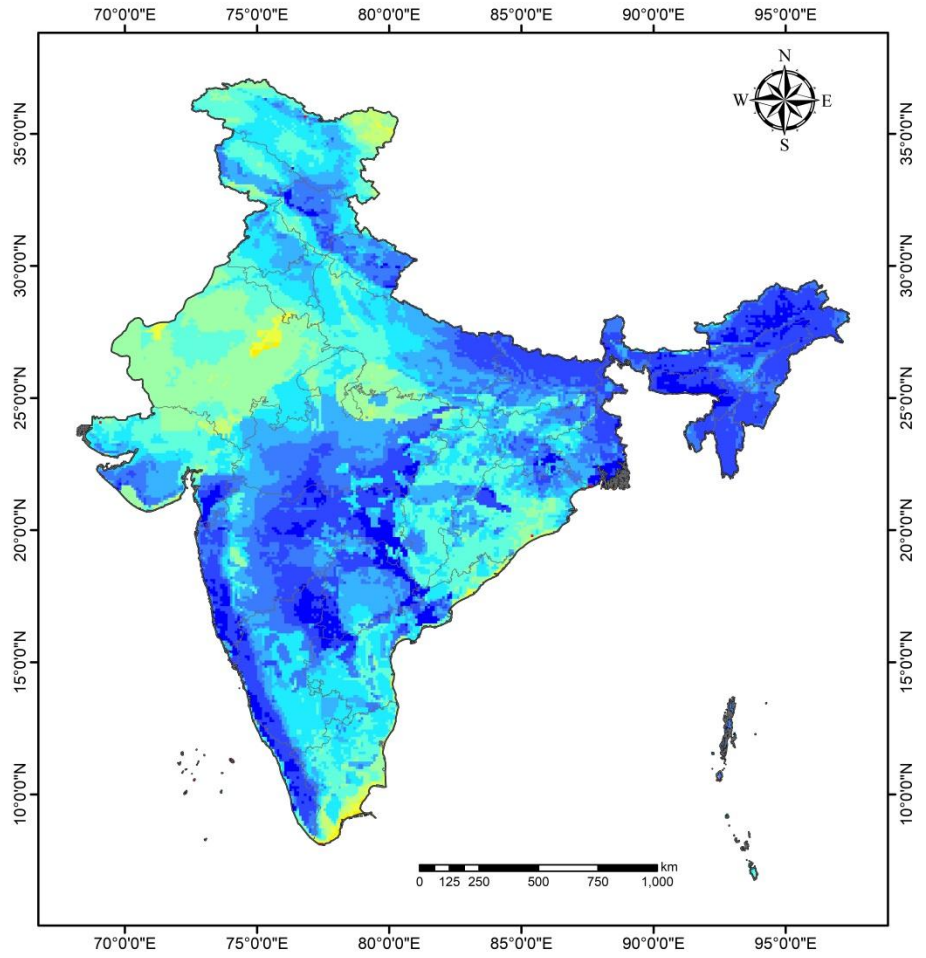


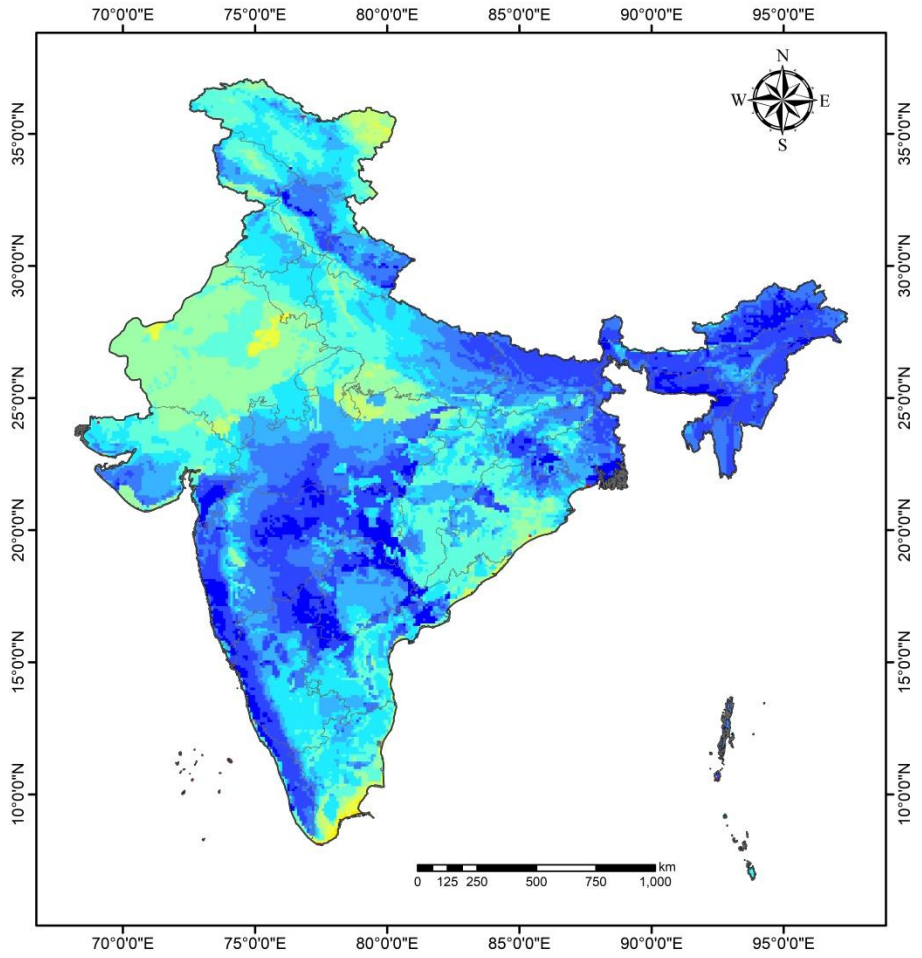
19:30 Hrs. of 27th July 2020.

Source: SMAP Enhanced L4 Global 3 Hourly 9 km Product

Root-Zone Soil Moisture Map (%)



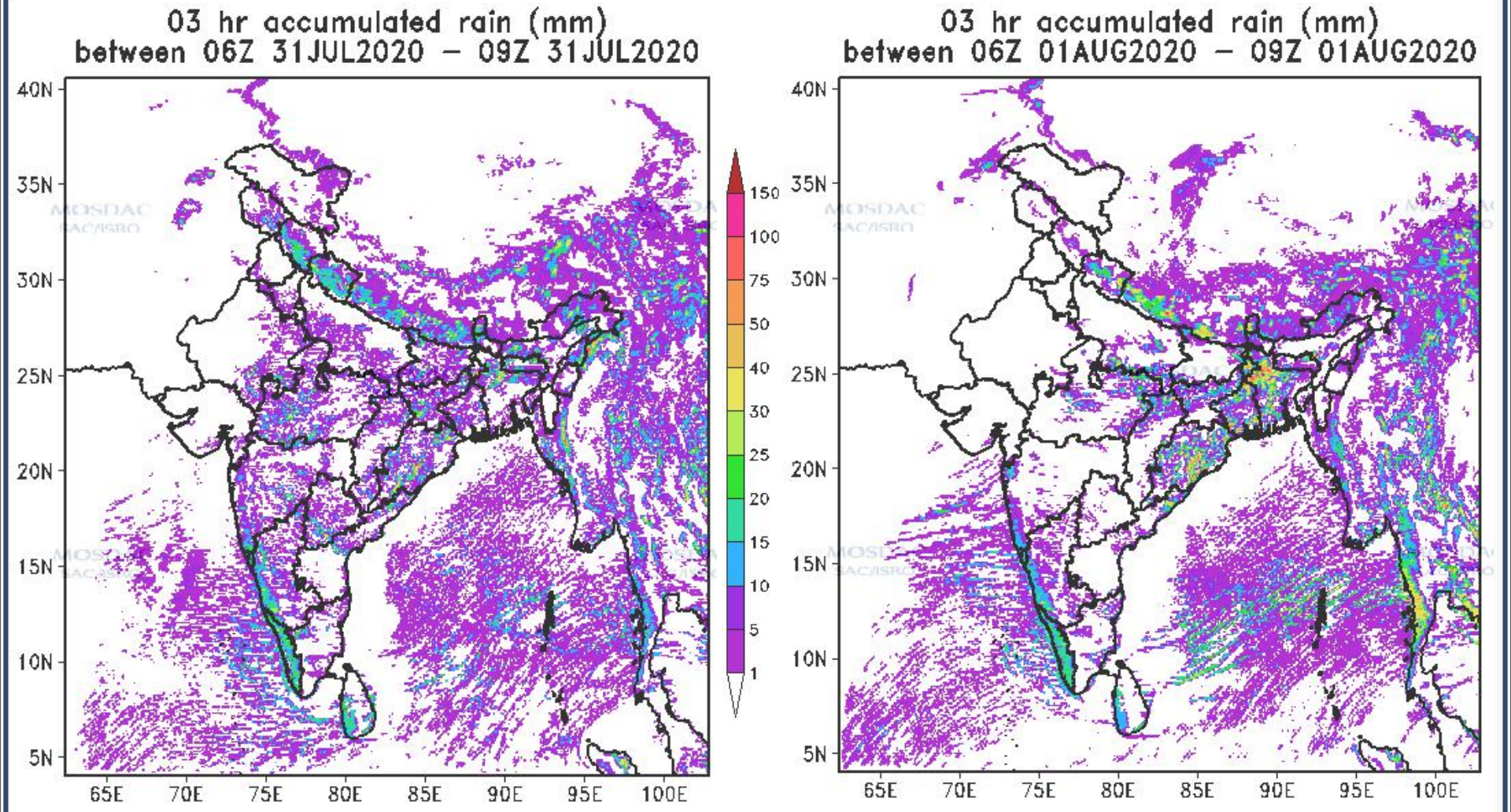
19:30 Hrs. of 22nd July 2020.



19:30 Hrs. of 27th July 2020.

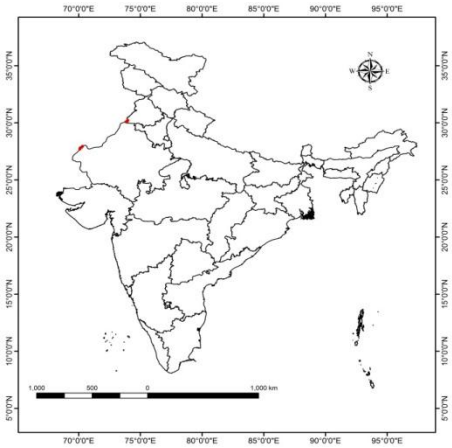
Source: SMAP Enhanced L4 Global 3 Hourly 9 km Product

Accumulated Rainfall

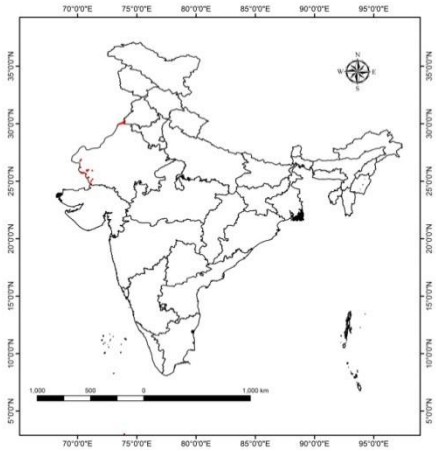


Source: MOSDAC web portal

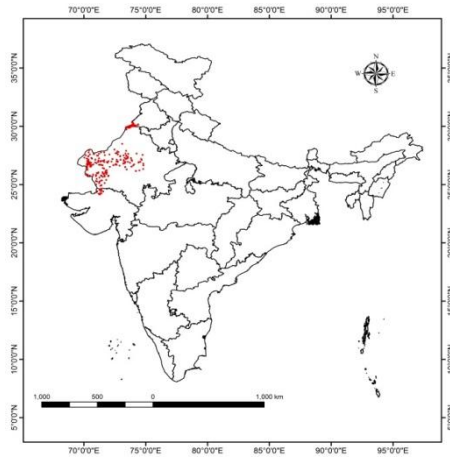
Monitoring of Locust Infestation (April – July, 2020)



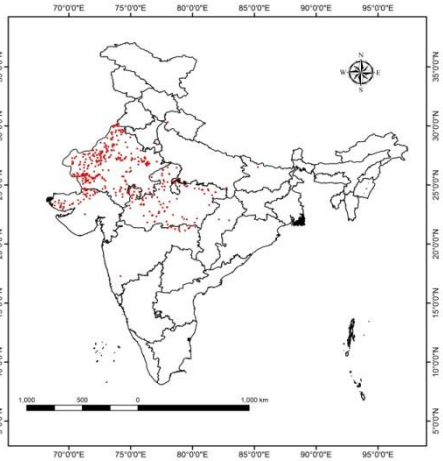
1st – 15th April, 2020: 74 sq.km.



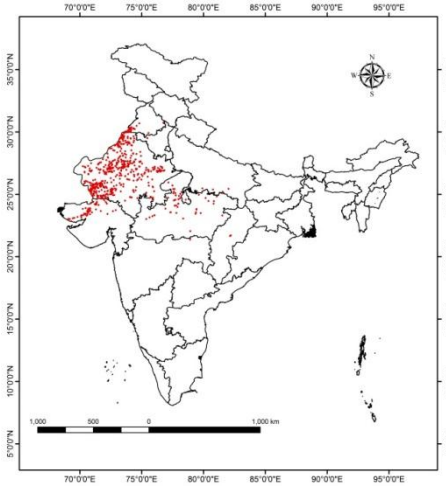
16th – 30th April, 2020: 13604 sq.km.



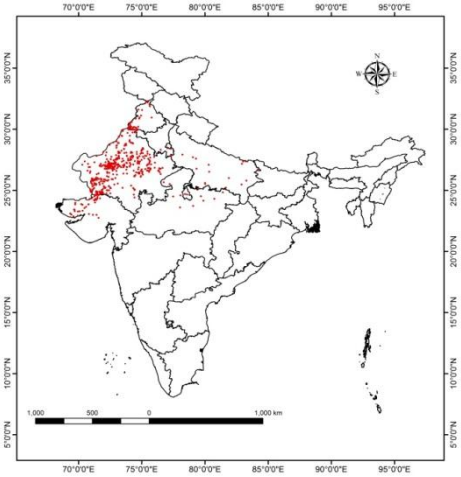
1st – 15th May, 2020: 1,32,315 sq.km.



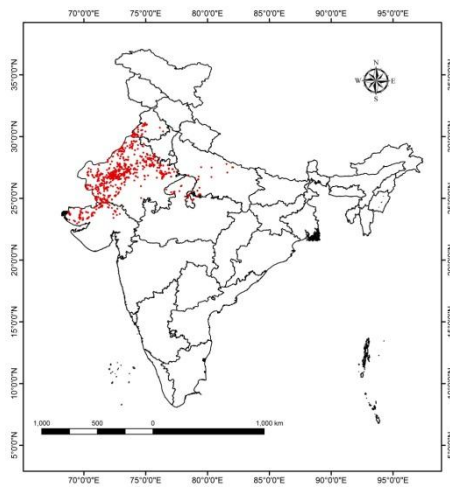
15th – 31st May, 2020: 6,45,723 sq.km.



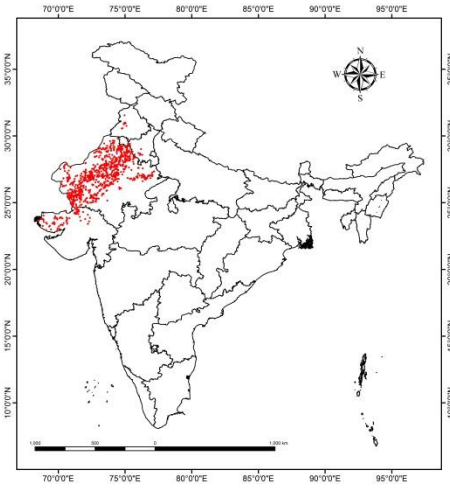
1st – 15th June, 2020: 5,10,991 sq.km.



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



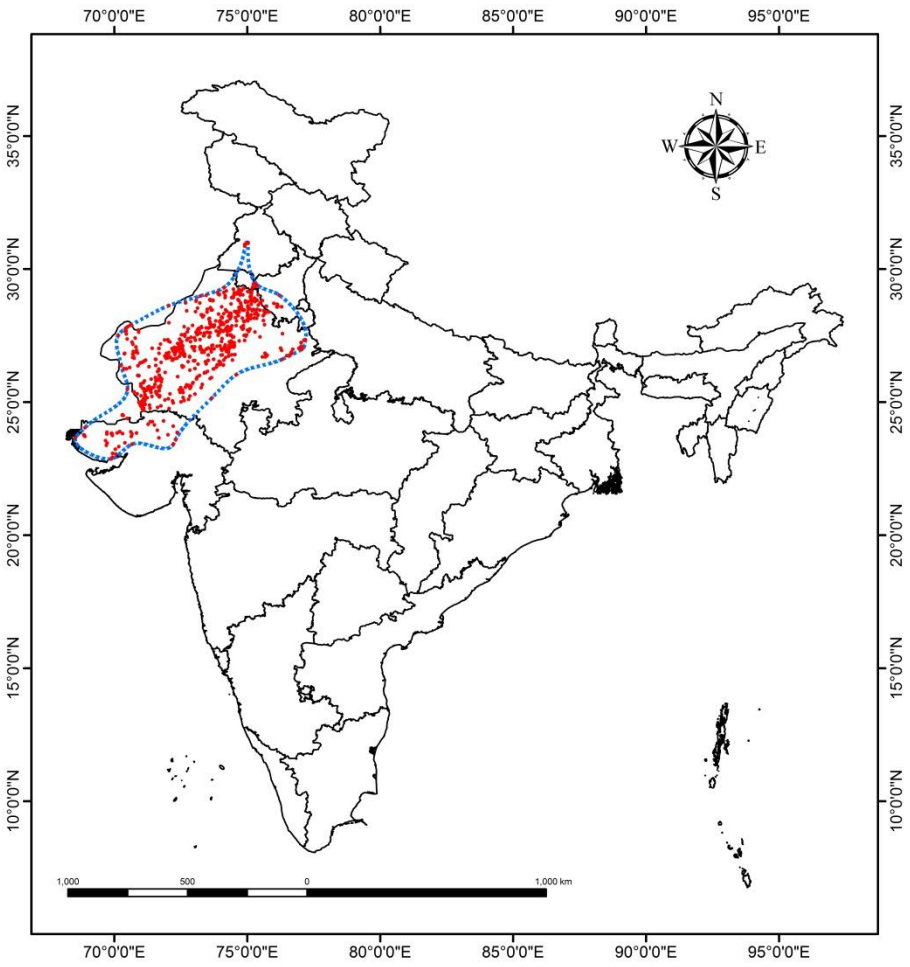
1st – 15th July, 2020: 4,77,391 sq.km.



16th – 30th July, 2020: 3,20,240 sq.km.

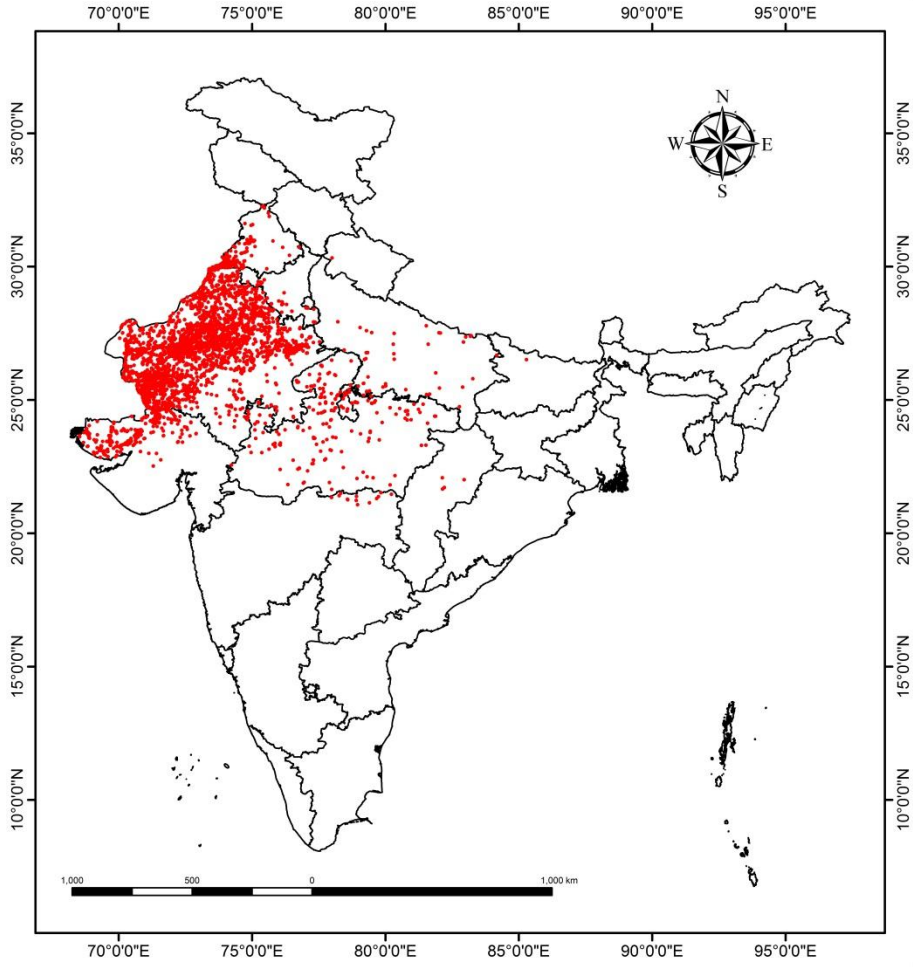
Source of Locust Incidents: LWO-Jodhpur

Monitoring of Locust Infestation (July 2020)



24th – 30th July, 2020: 3,19,277 sq.km.

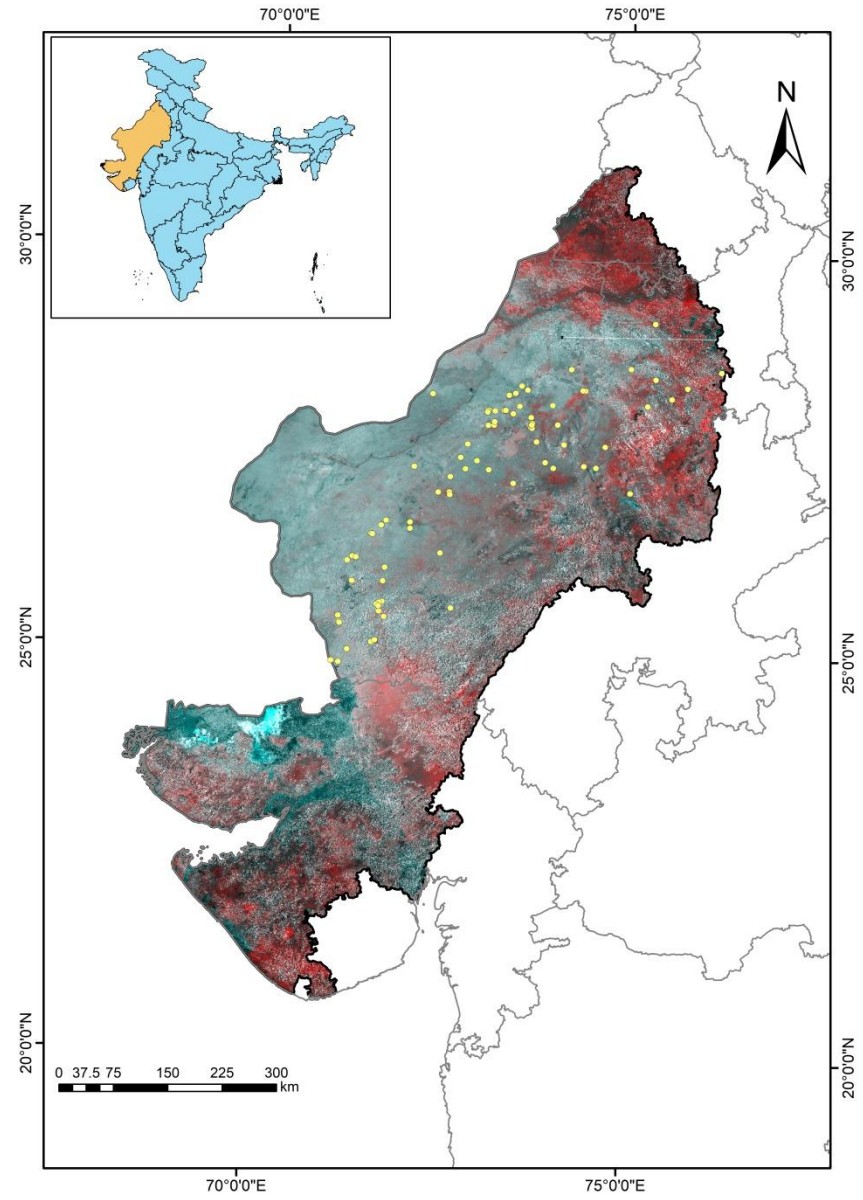
Monitoring of Locust Infestation (April - July 2020)



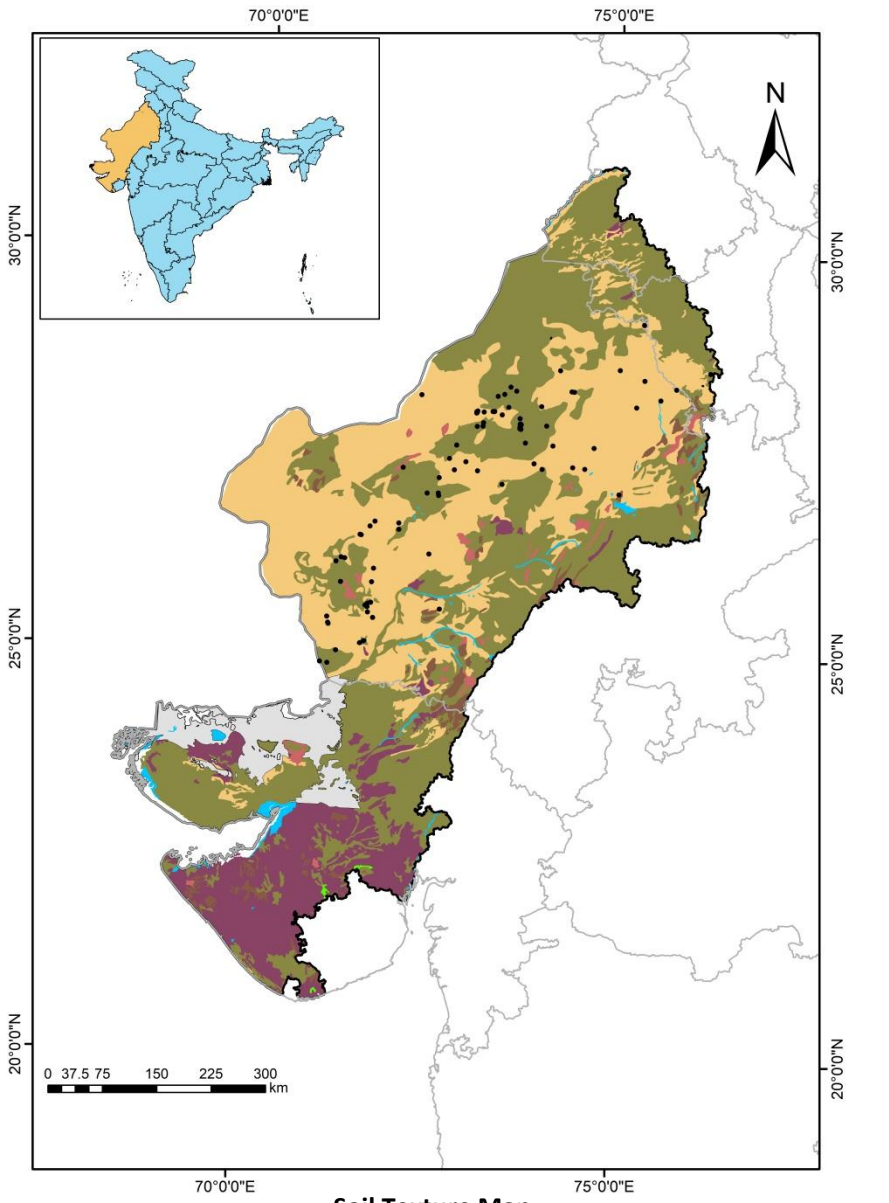
01 April – 30 July, 2020: 10, 28, 232 sq.km.

Source of Locust Incidents: LWO-Jodhpur

Locust Breeding Sites in Thar Desert Region



False Color Composite

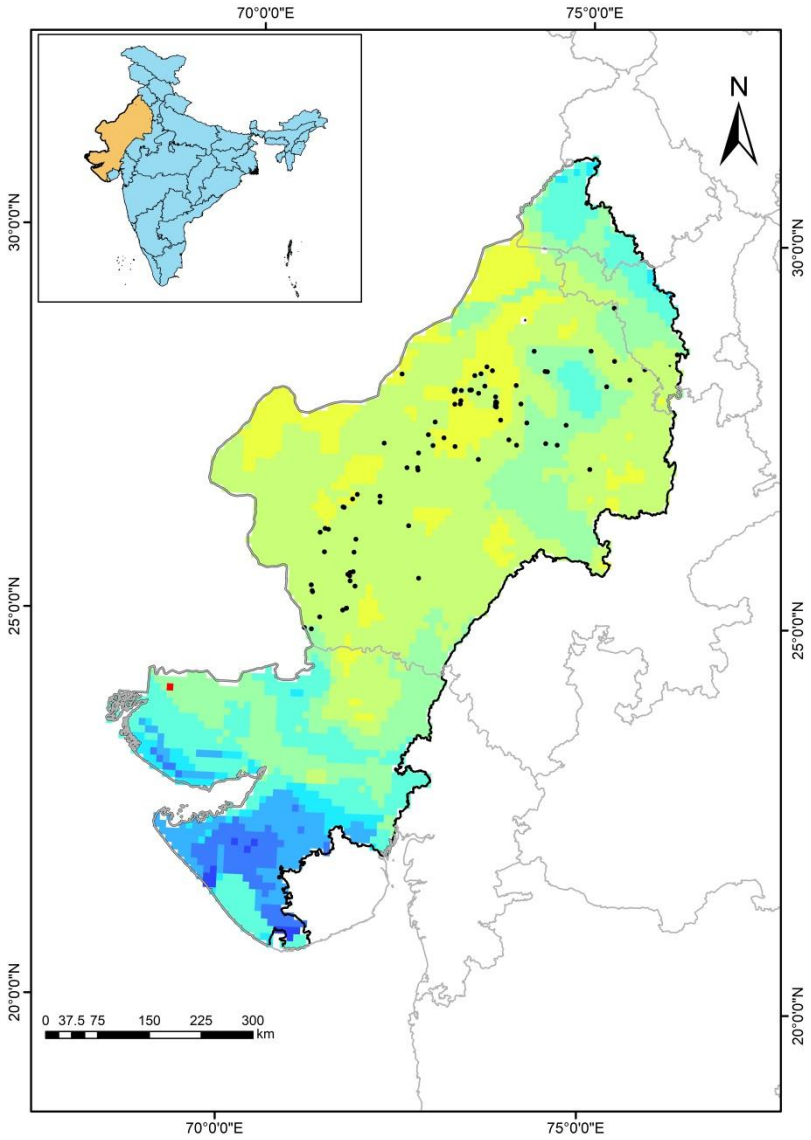


Soil Texture Map

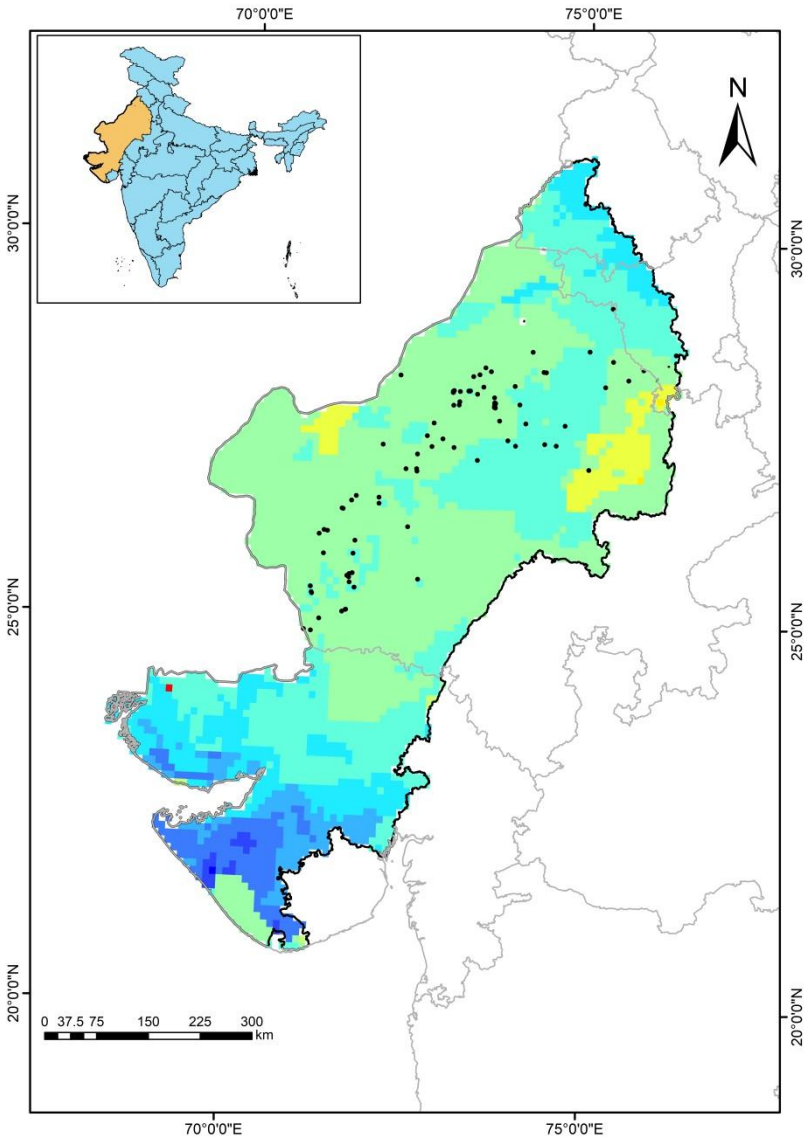
Clay Skeletal | Clayey | Loamy | Rann Of Kach | Rock Outcrop | Sandy | Water bodies

Source: Locust Incidents - LWO-Jodhpur; FCC – MODIS 8 day Composite

Locust Breeding Sites in Thar Desert Region



Surface Soil moisture map 19:30 Hrs of 27th July 2020

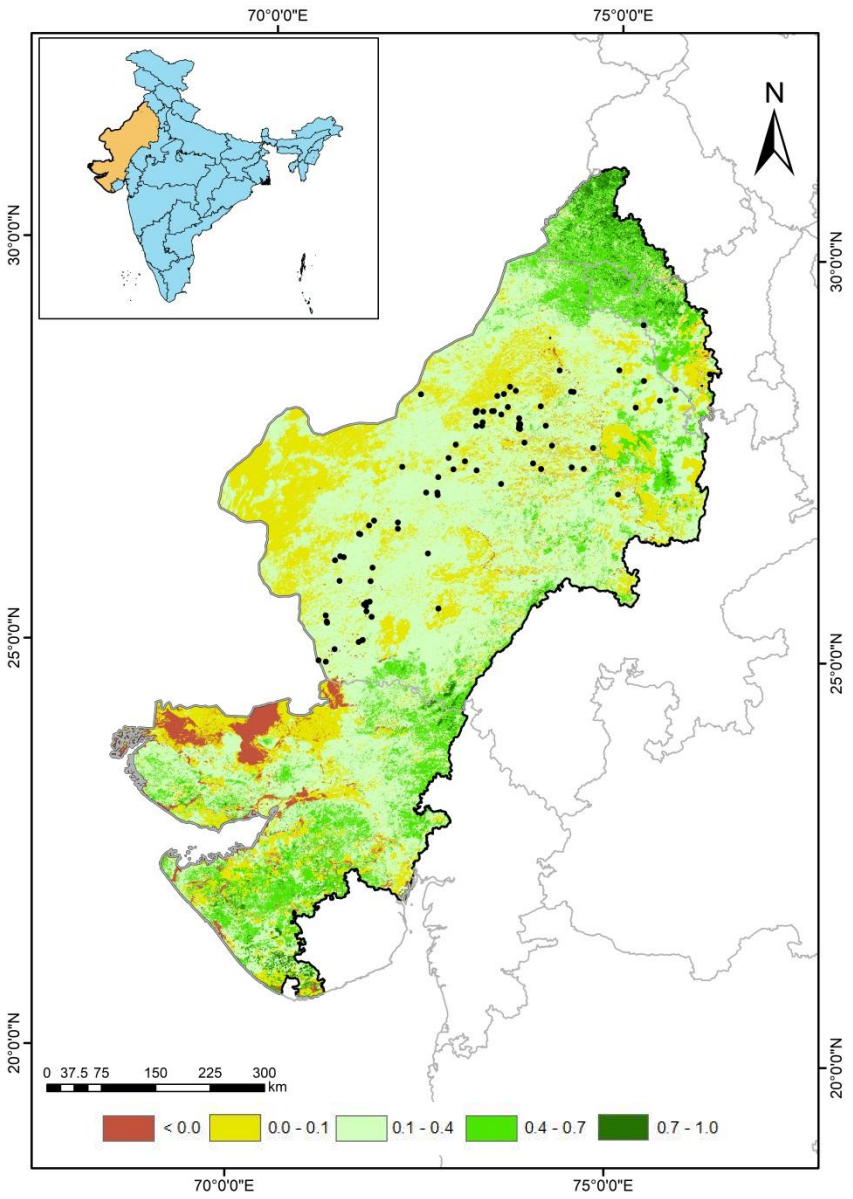


Root-zone soil moisture map 19:30 Hrs of 27thJuly 2020

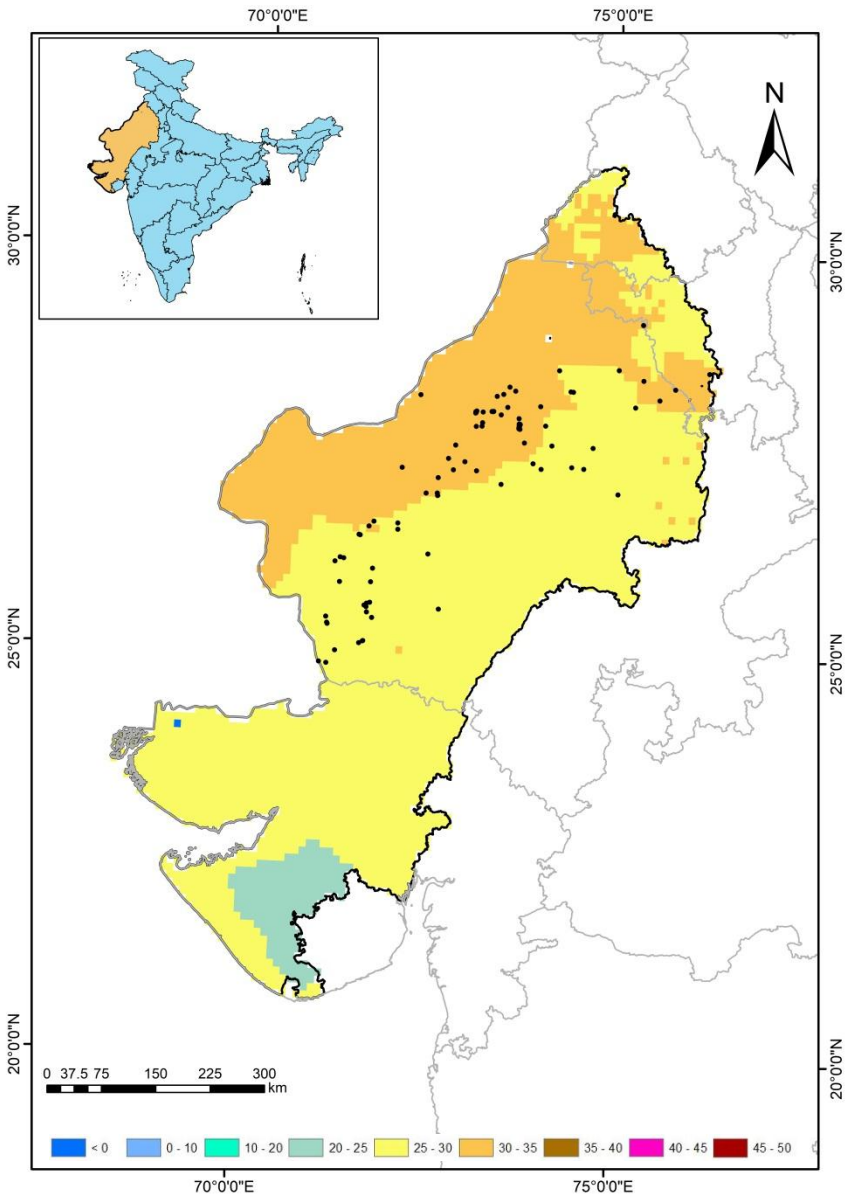
0-1 | 1 - 2 | 2 - 3 | 3 - 4 | 4 - 5 | 5 - 10 | 10 - 15 | 15 - 20 | 20 - 25 | 25 - 30 | 30 - 35 | 35 - 40 | 40 - 45 | 45 - 50

Source: Locust Incidents - LWO-Jodhpur; Surface/Root-zone Soil Moisture - SMAP Enhanced L4 Global 3 Hourly 9 km Product

Locust Breeding Sites in Thar Desert Region



Normalized Difference Vegetation Index



Land Surface Temperature map

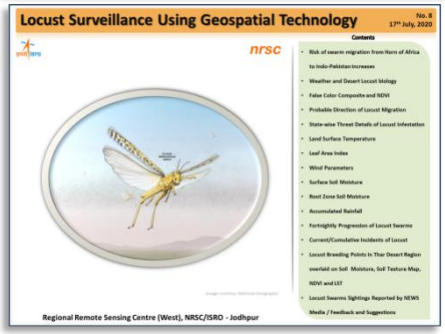
19:30 Hrs. of 27th July 2020

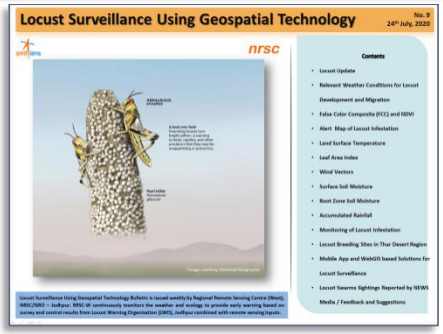
Source: Locust Incidents - LWO-Jodhpur; NDVI – EMODIV Ver. 6; Land Surface Temperature - SMAP Enhanced L4 Global 3 Hourly 9 km Product

Locust Swarm Sightings Reported by NEWS Media

Source	Headlines	Date	Reported Areas
The Times of India	Locust swarms from South Africa to enter Rajasthan	25 July 2020	Jaisalmer, Barmer, Indo-Pakistan border.
Rajasthan Patrika	3 लाख लीटर पेस्टीसाइड से मारी 445 करोड टिड्डी	27 July 2020	श्रीगंगानगर, चुरू, बीकानेर, जैसलमेर, जोधपुर, बाड़मेर, नागौर, सीकर, झुंझुनूं
Navbharat Times	एलसीओ ने राजस्थान, गुजरात के 10 जिलों में टिड्डियों के नियंत्रण अभियान चलाया	27 July 2020	राजस्थान के जैसलमेर, बाड़मेर, जोधपुर, बीकानेर, चूरू, नागौर, झुंझुनू, हनुमानगढ़ और श्रीगंगानगर जिले तथा गुजरात का कच्छ जिला
Dainik Jagran	हिसार में भी टिड्डी दल ने दी दस्तक, भिवानी में टिड्डियों के असंख्य बच्चे कभी भी भर सकते हैं उड़ान	28 July 2020	गावड़, गोरछी, बासड़ा (हिसार), सिरसा, बिठण, चैहड़, नकीपुर, अमीरवास और बुढेड़ा गांव (भिवानी)
Dainik bhaskar	पनप गई टिड्डी कि नई पीढ़ी	28 July 2020	देचू के पास कलाऊ, भीवसागर के राजस्व गाँव हेमनगर, राणासर, केसरगढ़, इन्द्रानगर
Amar Ujala	राजस्थान की ओर से जिले में टिड्डी दल की दस्तक, किसान लगातार शोर करके उड़ा रहे टिड्डियों को	29 July 2020	पनिहार चक्क, गोरछी और रावलवास खुर्द गांव रावतखेड़ा सिवानी क्षेत्र के गांव लीलस, सैनीवास, देवसर, हिसार
The Tribune	Another locust attack puts 6 district on alert	29 July 2020	Gawar and Basra villages in Hisar district; Jhuppa, Gurera and Khera villages in Bhiwani district and Chopta in Sirsa district
Dainik bhaskar	राजस्थान से बिखरा टिड्डी दल हिसार जिले में घुसा:प्रशासन ने 10 टीमें बनाईं, रात को फायर ब्रिगेड की गाड़ियों से किया छिड़काव	29 July 2020	तलवंडी बादशाहपुर के अलावा बासड़ा और मुकलान, पनिहार, गोरछी., चौधरीवास, गांवड़, सरसाना आदि गांव
Rajasthan Patrika	यमन में हॉपर बेंड की भरमार, भारत में नए टिड्डी दलों का खतरा	29 July 2020	यमन, भारत-पाक बोर्डर

Feedback and Suggestions





The bulletins are very well focussed conveying important information. It is now important to get the feedback from the stakeholders. Publishing the multi-sensor data in geoportal will be of high use in all the aspects of locust monitoring.

P. G. Diwakar, ISRO Hq. Bengaluru.

On behalf of NESAC, I complement entire team of your centre for nicely bringing out the Locust early warning Bulletins integrating different parameters in geospatial domain.

P.L.N. Raju, NESAC, Shillong

Good work by the team in locust monitoring. Lot of satellite, model and ground truth data have been effectively analysed for the monitoring. It is also good to see the 3-level alert map of the possible locust infested regions.

Dr. Raj Kumar, SAC, Ahmedabad.

Good to see the regular flow of these useful information services provided by the Centre to the users. Congratulations for the sincere job done by the Team even in the current not-so-conducive Covid environment. Keep it up.

Dr. V. Jayaraman, ISRO Hq.

Congratulations to you and your team for brining out this very useful and elaborative article on locust menace. All the best

Dr. Shashikant A Sharma, SAC, Ahmedabad.

Thanks for very comprehensive report. I would like to congratulate you and your team for the studies undertaken and reporting.

Vinod Bothale, NRSC.

The bulletin No 9 has very useful information, improved a lot from earlier versions; Kudos to you and your team..

Dr. K. Ganesh Raj, RRSC-South, Bengaluru.

Please send your feedback to rrsc_w@nrsc.gov.in or ssrao@nrsc.gov.in

Announcement

- A Standing Committee for Locust Surveillance, Alerts and Monitoring has been constituted by Department of Space, Govt. of India with a task of developing an operational locust monitoring system, by integrating inputs from GEO, LEO and field based observations.
- The committee consists of scientists from RRSC-West - Jodhpur, Space Application Centre – Ahmedabad, ISRO Hq. – Bengaluru, Mahalanobis National Crop Forecasting Centre – New Delhi and National Remote Sensing Centre – Hyderabad.
- The main objective of this committee is to evolve and setting up a locust monitoring system, including early warning and surveillance mechanism and provide regular alerts and forecasts of possible locust infested areas to the stakeholders.