Desert Locust in India:
The 2020 invasion and associated risks

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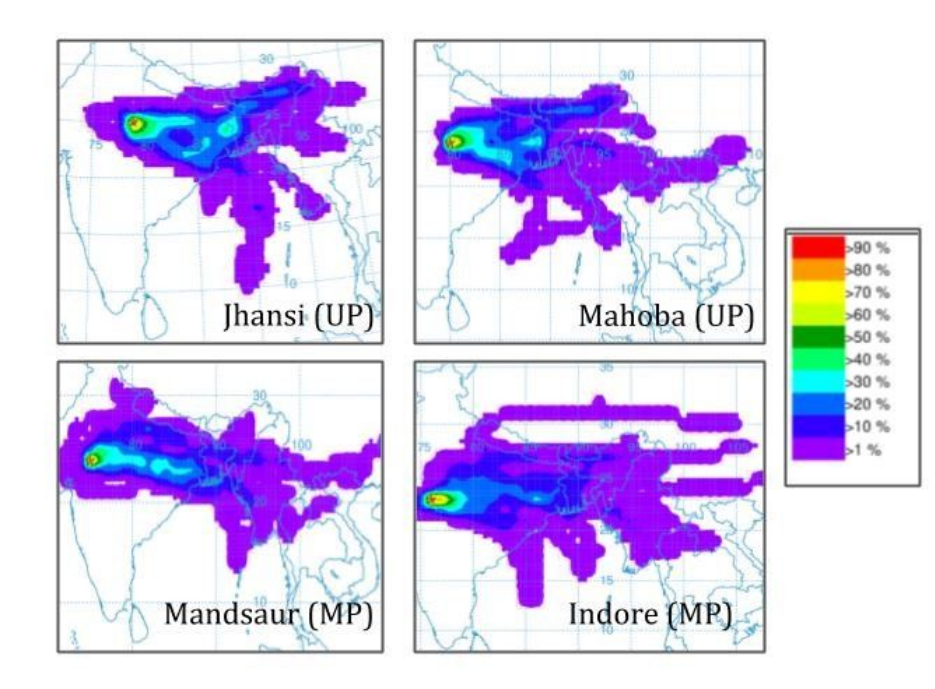

Fig 1: Forward forecasting trajectory till June 12, 2020 from the locust invaded region in May, 2020. The colorbar indicates the percentage between number of trajectory and total trajectory.

EXECUTIVE SUMMARY

Wind direction, often used in forecasting locust migration, indicates a non-zero probability of desert locust invasion in eastern Indian states. Apart from present controlling measures, we are additionally suggesting to be cautious about the eggs of locust as the rainfall associated with Super Cyclone Amphan has created a favourable breeding ground for the gregarious locust. Also reverse migration of these locusts might affect the Indian states for the second time. Long-term controlling policy (till Kharif season; June to October) is required to minimize the damage. Also, increasing the farmers awareness and sensitized local ecology groups might be helpful in desert locust reporting.

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CONTEXT

The eastward movement of the Desert Locust (*Schistocerca gregaria*[1]) swarm in the Indian states of Rajasthan, Uttar Pradesh and Madhya Pradesh has created an additional level of concern in the post-corona scenario[2] (Fig 1). FAO Locust Watch suggests that migration is driven by strong westerly wind associated with the cyclone Amphan originated at the Bay of Bengal[3]. The excessive rainfall (20 - 59%) in all central and northern Indian states might additionally create the favourable growth condition for the locust swarm (Fig 2). The first encounter with the swarm was reported in Jaisalmer, Rajasthan (Indo-Pak border region) in the second week of April[4]. Since then (May 31, 2020), six Indian states have been affected by the swarms namely; Rajasthan, Gujrat, Uttar Pradesh, Madhya Pradesh, Maharashtra and Tamilnadu.

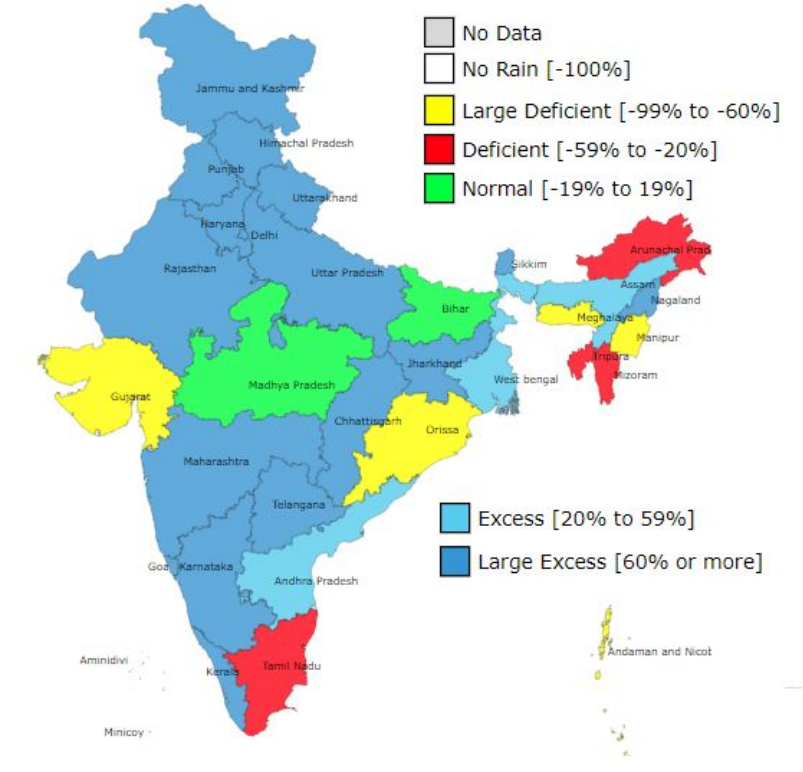

Fig 2: State-wise cumulative rainfall during March to May; Image taken from Mausam-IMD (on 1st Jun, 2020).

Previous studies on behaviour of desert locust have suggested wind, temperature and vegetation have a definite role in its migration[5]. The migration stalled after reaching an area with recent widespread heavy rainfall and a temperature range of 20-35°C. The female probes the soil and senses the presence of adequate soil moisture (0.1 - 0.2 m^3/m^3) to deposit egg-pods containing hundreds of eggs[6,7]. After depositing, the swarm resumes the migration and continues the second and third waves of eggs laying hundreds of kilometers away from the first site. Depending on the temperature and soil moisture, the eggs may undergo dormant stages

and stay for three months[8]. The higher temperature (>20°C) and moisture content (>0.1 m^3/m^3) lowered the incubation period.

METHODS AND RESULTS

We simulate the HYSPLIT[9] (Hybrid Single Particle Lagrangian Integrated Trajectory) air parcel trajectory model over four central India locations (Jhansi, Mahoba, Mandsaur and Indore) where the locust swarm invasion was reported in the last two weeks of May (Fig 1, 20th -30th May, 2020). We have run the trajectory model at 100m amsl using the GFS (Global Forecast System) model output produced by the National Centre for Environmental Prediction. The result indicates the wind is moving towards eastern Indian states from all four desert locust invasion sites (Fig 1). As the reported invasion area of desert locust is extended from Canary island (West Africa) to Assam (India)[5], therefore an alert for all the eastern Indian states is necessary.

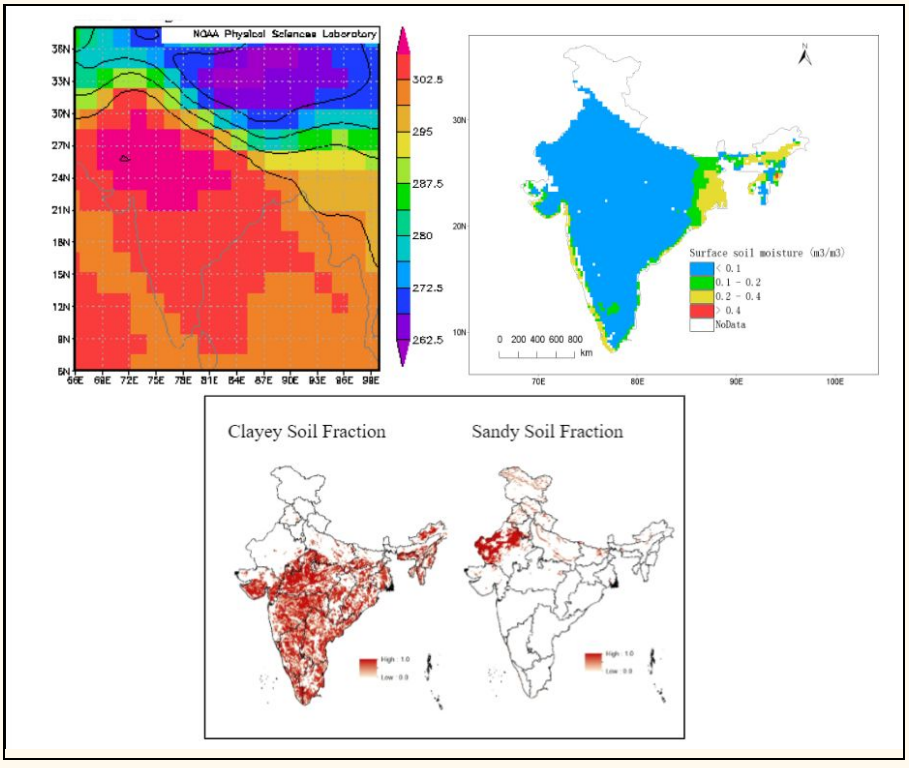

Fig 3: Temperature (in K) , soil moisture and soil types in May fourth week over India.

The surface soil moisture data and soil type were collected from the National Information System for Climate and Environment Studies (NICES) during post-Amphan times and the 2m temperature data for the fourth week of May were taken from NCEP/NCAR reanalysis (Fig 3). The present swarms over India consist of immature locusts which may start reproducing if certain criterias are met. For ideal mating conditions, they require sandy/clayey soil; adequate moisture; bare area and green vegetation. The data indicates a certain probability of emergence of favorable conditions for the mating and egg deposition of desert locust over some scattered locations in the central and eastern parts of the country.

POLICY RECOMMENDATION

- Locust Warning Organization (LWO) of India has field and circle offices in the northern Indian states. However, as the risk of locust invasion in other states has emerged, training of the state-level agricultural field workers in the risk-prone states to identify locust and its swarming behavioural stages is extremely important. During the lockdown scenario, online training to the field staff might be one easiest solution. Groups of amateur ecologists, bird watchers and wildlife photographers might be of immense value for reporting any kind of desert locust activity in their respective area.
- There might be a second and third wave of invasion from the reverse migration of these locusts during monsoonal wind reversal in the affected states. Therefore, the locust monitoring and controlling methods need to be continued till the end of the Kharif season. In addition, there is also a possibility of coupling and subsequent egg-laying in the migratory path and therefore long-term regular observation in the area of locust invasion is also highly recommended.
- The farmers of affected states and at-risk states might be panic-stricken to start monsoonal farming at full capacity due to the chances of desert locust attack. Respective departments must initiate awareness among the farmers about the locust and its control procedure to bring back their confidence.
- The driving force behind the present invasion can be backtraced to the changing climate which has accelerated the extended migration. Considering the increasing number of extreme events and other weather phenomenon, an insurance on locust infection for the farmers can be implemented in the affected region in near future.

LIMITATIONS

The migration of desert locusts does not completely depend upon wind trajectory[10]. Although a number of studies have used the air-parcel model to forecast locust migration[11,12,13], the incredibly complex phenomenon relies on multiple factors. Controlling locust population in the upwind region also significantly reduces the downwind migration impact. Therefore, it is impossible to conclude exactly the next movement of the migratory swarm. The Locust Warning Organization (LWO) has deployed all their resources in terms of manpower and cutting edge controlling technologies in the field and getting success in controlling the huge swarms of locust. The present policy note focused on the if/else scenario which might be helpful for formulating real-time contingency planning in near future.

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