***Report***

***of***

***Climate Services for Resilient Development (CSRD)***

***project***

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**1. Introduction**

An analysis of crop suitability was conducted and presented in this report. For each crop and their given optimum temperature threshold, the calculation of cumulative distribution function was conducted. From the probability of exceedance of the thresholds, interpolated surfaces were generated using the best-fitted kriging method. Some suitability maps were masked to identify the zone of risk corresponding to different crops. Finally, the difference between two selected climate periods was identified which give us the idea of changes in the suitability for each selected crop.

Table 1 of the document represents the input crops that were selected for this analysis. The maximum temperature is considered as the prime driver of the threshold analysis. However, cold temperature exceedance was also evaluated and showed in the appendix section.

**2. Method**

2.1 Input Data

In this study, we used the meteorological data such as maximum and minimum temperature from the Bangladesh Meteorological Department (BMD). The agricultural data such as crop threshold were collected from a previous comprehensive analysis.

2.2 Workflow:

From the previous analysis, we first defined a stress threshold for terminal heat stress for individual types of crops (details are provided in Table 1). Now, for each phonological phase, we made a subset of the meteorological information. For each of the weather stations of Bangladesh, we utilized the data from 1987 to 2016. Two analysis period were selected (1987-2001 and 2002-2016) to analyze the spatial changes between the two periods. In both periods, we constructed cumulative density functions for each category for the maximum and minimum temperature for each pixel of the data. From the threshold values that are provided in Table 1, we determined the probability of exceedance in percentage. From this probability of exceedance, we have generated an interpolated surface for entire Bangladesh for each phonological period for each type of crops. The spatial interpolation is conducted using an ordinary spherical kriging algorithm. Best fitted variogram was utilized for the kriging technique. The changes between two periods, later presented in the spatial plots. Each spatial plots were generated in a 0.5km by 0.5 km spatial resolution.

The code to generate CDF are provided in GitHub.

Table 1: The selected crops and its period for the threshold analysis

| Crop | Susceptible Stage of Growth and Development | Stage Reached | High Temperature Thresholds (°C) | Low Temperature Thresholds (°C) | Comments on Tmax | Comments on Tmin |
| --- | --- | --- | --- | --- | --- | --- |
| Boro Rice (early) | Germination | November 10-20 | 45 | 10 | Tmax Out of threshold range | Tmin map produced |
| Boro Rice (early) | Flowering | February 28 - March 15 | 35 | 22 | Tmax map produced | Tmin map produced |
| Boro Rice (early) | Anthesis | March 10 - March 25 | 34 | 22 | Tmax map produced | Tmin map produced |
| Boro Rice (late) | Flowering | February 18 - March 19 | 35 | 22 | Tmax map produced | Tmin map produced |
| Boro Rice (late) | Anthesis | February 28 -March 29 | 34 | 22 | Tmax map produced | Tmin map produced |
| Boro Rice (all) | Flowering | February 13 - March 28 | 35 | 22 | Tmax Out of threshold range | Tmin map produced |
| Boro Rice (all) | Anthesis | February 23 - April 7 | 34 | 22 | Tmax map produced | Tmin map produced |
| Aus-BR26 | Flowering | June 18- July 9 | 38 | 16 | Tmax map produced | Tmin Out of threshold range |
| Aus-BR26 | Anthesis | June 28- July 19 | 38 | 16 | Tmax map produced | Tmin Out of threshold range |
| Aus-BR26 | Ripening | July 28- August 18 |  | 20 | NA | Tmin Out of threshold range |
| Aman | Flowering | September 23 -November 2 | 38 | 16 | Tmax map produced | Tmin map produced |
| Aman | Anthesis | November 2 - November 12 | 38 | 16 | Tmax map produced | Tmin map produced |
| Aman | Ripening | December 2 - December 12 |  | 20 | NA | Tmin map produced |
| Aman-BR11 | Flowering | September 23 -November 2 | 38 | 16 | Tmax map produced | Tmin map produced |
| Aman-BR11 | Anthesis | October 3 - November 12 | 38 | 16 | Tmax map produced | Tmin map produced |
| Aman-BR11 | Ripening | November 2 - December 11 |  | 20 | NA | Tmin map produced |
| Aman-BRRI52 | Flowering | September 22 -October 18 | 38 | 16 | Tmax map produced | Tmin map produced |
| Aman-BRRI52 | Anthesis | October 2 - October 28 | 38 | 16 | Tmax map produced | Tmin map produced |
| Aman-BRRI52 | Ripening | November 5 -November 27 |  | 20 | NA | Tmin map produced |
| Wheat-BARI-GOM26 | Anthesis | January 29 - February 12 | 30.3 | <10 | Tmax map produced | Tmin map produced |
| Wheat-BARI-GOM26 | Grain Filling | February 8-February 22 | 32.1 | 10 | Tmax map produced | Tmin map produced |
| Maize | Flowering | February 8 - March 10 | 37.3 | 7.7 | Tmax map produced | Tmin map produced |
| Maize | Anthesis | February 18 - March 20 | 37.3 | 7.7 | Tmax map produced | Tmin map produced |
| Maize | Grain Filling | March 5 - April 4 | 36 | 8 | Tmax map produced | Tmin Out of threshold range |

**3. Results from the figures**

Results are provided in the shared google drive.

**4. Appendix**

Table 2: Temperature statistics for the duration of the threshold analysis.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Crop | Susceptible Stage of Growth and Development | Tmax Mean  (1987-2001) | Tmax Mean  (2002-2016) | Tmax Max (1987-2001) | Tmax Max (2002-2016) | Tmin Mean  (1987-2001) | Tmin Mean  (2002-2016) | Tmin Min (1987-2001) | Tmin Min (2002-2016) |
| Boro Rice (early) | Germinatio | 30.7 | 31.4 | 36.2 | 35.9 | 19.4 | 18.8 | 12.8 | 11.8 |
| Boro Rice (early) | Flowering | 31.6 | 32.1 | 38.3 | 37.9 | 18.3 | 18.8 | 12.2 | 11.5 |
| Boro Rice (early) | Anthesis | 30.2 | 31.0 | 36.8 | 36.3 | 19.7 | 20.1 | 12.1 | 11.5 |
| Boro Rice (late) | Flowering | 31.5 | 32.0 | 37.8 | 37.7 | 17.8 | 18.3 | 10.3 | 10.5 |
| Boro Rice (late) | Anthesis | 30.5 | 31.1 | 37.5 | 37.6 | 19.5 | 19.9 | 11.9 | 11.5 |
| Boro Rice (all) | Flowering | 31.0 | 31.7 | 37.9 | 37.3 | 18.3 | 18.7 | 9.8 | 8.1 |
| Boro Rice (all) | Anthesis | 31.3 | 31.8 | 36.0 | 36.8 | 19.5 | 20.3 | 10.8 | 11.8 |
| Aus-BR26 | Flowering | 31.3 | 31.7 | 35.8 | 35.9 | NA | NA | NA | NA |
| Aus-BR26 | Anthesis | NA | NA | NA | NA | NA | NA | NA | NA |
| Aus-BR26 | Ripening | NA | NA | NA | NA | NA | NA | NA | NA |
| Aman | Flowering | NA | NA | NA | NA | 24.4 | 24.7 | 18.3 | 17.9 |
| Aman | Anthesis | NA | NA | NA | NA | 19.4 | 18.8 | 12.8 | 11.8 |
| Aman | Ripening | NA | NA | NA | NA | 14.3 | 14.6 | 8.9 | 8.2 |
| Aman-BR11 | Flowering | 31.3 | 31.5 | 36.0 | 36.3 | 24.4 | 24.7 | 18.3 | 17.9 |
| Aman-BR11 | Anthesis | NA | NA | NA | NA | 22.8 | 22.8 | 15.5 | 14.1 |
| Aman-BR11 | Ripening | 31.8 | 32.2 | 36.2 | 36.6 | 18.2 | 18.0 | 10.9 | 11.3 |
| Aman-BRRI52 | Flowering | 31.6 | 31.9 | 36.0 | 36.4 | 24.6 | 25.0 | 19.2 | 20.8 |
| Aman-BRRI52 | Anthesis | NA | NA | NA | NA | 23.6 | 23.8 | 17.2 | 17.5 |
| Aman-BRRI52 | Ripening | 27.2 | 27.4 | 32.2 | 32.2 | 19.4 | 18.8 | 12.8 | 11.8 |
| Wheat-BARI-GOM26 | Anthesis | 28.0 | 28.6 | 34.2 | 34.9 | 14.2 | 13.9 | 8.8 | 8.3 |
| Wheat-BARI-GOM26 | Grain Filling | 29.0 | 29.8 | 35.9 | 35.9 | 15.4 | 15.6 | 9.0 | 7.8 |
| Maize | Flowering | 30.3 | 31.1 | 37.0 | 36.5 | 16.4 | 17.0 | 9.1 | 8.1 |
| Maize | Anthesis | 32.0 | 32.3 | 38.3 | 38.0 | 17.9 | 18.4 | 10.3 | 10.5 |
| Maize | Grain Filling | NA | NA | NA | NA | NA | NA | NA | NA |

* Figures are provide in the output folder.