Generation of weather windows to develop agro advisories for Tamil Nadu under automated weather forecast system

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ABSTRACT

With the objective of providing weather windows at block level of Tamil Nadu for developing agro advisories in respect of dominant crops, an exploratory research was conducted with four levels of rainfall, three levels of maximum temperature, three levels of minimum temperature, three levels of mean day relative humidity and three levels of wind speed. Adopting the permutation and combination methodology a total of 324 combinations from the identified levels of five weather elements were developed. Out of these combinations, 54 weather windows each with range of values for the identified weather elements were selected based on the validation of real-time weather data collected covering both temporal and spatial weather dimensions of the state.

Key words: Weather window, agro advisories, automated weather forecast system, generation

Management of monsoon rain for agricultural productivity is very critical for Tamil Nadu, since 45 per cent of the cultivable area is under dryland situation. Prof. M.S. Swaminathan used to spell out that under monsoon situation of limited water availability in India especially in Tamil Nadu, the role of climate/monsoon manager is very important. Tamil Nadu is the rain shadow area to Southwest monsoon (June-September) rainfall and hence the other monsoon namely the Northeast monsoon (October-December) is the life line monsoon for water resources of this geographical region. Though this is the fact that, the co-efficient of Southwest monsoon rainfall in India, considering it’s high and low values of CV across different regions of India, it is relatively lesser (34%) than the Northeast monsoon seasonal rainfall (45%) which is dominant in Tamil Nadu and costal parts of Seemandhra, Kerala and Karnataka.

The weather based risks (inherited geo-location risk, transferable risk and risk that can be minimized by technology introduction) to crop productivity in Tamil Nadu is something different from majority of the states in India, wherein, except Tamil Nadu, the Southwest monsoon is dominant with contribution of 80 per cent of seasonal (88 cm) rainfall to annual rainfall, while it is 42 cm for Northeast monsoon seasonal rainfall in Tamil Nadu. Its contribution to Tamil Nadu annual rainfall is 48 per cent. Niranjan Kumar et al. (2013)from their study on the observed variability of monsoon drought over India reported that there was general increase in the intensity and present area affected by moderate drought during the recent decades as a result of climate and weather variability and this highlights the need of weather based farming decisions.

Stewart (1991) recommended response farming to the farmers of Australia wherein response farming advocates framing of crop plan with technologies based on forthcoming seasonal rainfall and proved that this approach was successful in terms of reducing the crop and animal production risks under rainfall variability. In India, India Meteorological Department (IMD) started weather services for the farmers from 1945 onwards to reduce weather risks (V&A Programme, 2009). However it did not contain the relevant information as required by the farmers for practical applications and hence was not much useful to the farming community.

Huge wheat grain loss had been reported at harvest stage in the wheat belt region of India with occurrence of Western disturbance since there was no facility in place to forecast such weather system movement under medium range scale. This affected food production in India with greater financial loss. This was discussed as a policy matter in the Department of Science and Technology, Government of India and thus the National Centre for Medium Range Weather Forecast (NCMRWF) came into existence. The NCMRWF was mandated to develop...
medium range weather forecast over a resolution of agro-climate zonal level through supercomputers for three days from 1991 onwards and the same being communicated to different Agro Met Field Units (AMFU) to develop agro advisory for domain area farmers through mass media. Maini and Rathore (2011) from their study reported that farmers who adopted medium range agro advisories based on the weather forecast did accrue a net physical benefit of 10 to 15 per cent higher yield for the agricultural crops tested and also reduction in the cost of cultivation by 2 to 5 per cent as compared to the control farmers. Though, the medium range weather forecast at agro-climatic zone level had some advantages, still it was felt to down scale it to district level resolution so as to enhanced benefits to the farming community. Thus India Meteorological Department (IMD) started the district level weather forecast in association with the NCMRWF. The district level weather forecast for five days along with agro advisories are developed by IMD in association with different AMFU’s spread over India including Tamil Nadu. These agro advisories are issued bi-weekly (every Tuesday and Friday) and communicated to the farmers through mobile Short Message Service (SMS).

Though the district level resolution is better than agroclimatic zonal level, issuing weather forecast at block level resolution with agro advisories for 6 days would be a better option to reduce the weather related risks in crop production. This approach of block level forecast would reduce the forecast error of topographic variability. With this in objective, the Government of Tamil Nadu has funded to Agro Climate Research Centre (ACRC) of Tamil Nadu Agricultural University (TNAU) under National Agricultural Technological Project (NATP) to install one Automatic Weather Station (AWS) each in all 385 blocks of the state. These blocks level AWSs will sense the weather information on day to day basis and communicate to the central server of Tamil Nadu Agricultural University. The block level weather forecast with a lead-time of 6 days will be developed using regional climate models (WRF) and stored in the server. The past 6 days observed weather and 6 days forecast developed will be integrated to develop weather based agro advisories at block level and communicated to the farmers through mobile SMS for the dominant crops.

This concept require generation of Weather Windows (WW) with ranges of important weather elements for Tamil Nadu covering both spatial and temporal dimensions, and for this exploratory research have been initiated by a team of Agro meteorologists at ACRC, TNAU.

**MATERIALS AND METHODS**

Considering the objective of developing weather windows for capturing the weather of Tamil Nadu across seasons covering temporal and spatial dimensions, four levels of rainfall, three levels of maximum temperature, three levels of minimum temperature, three levels of mean daily relative humidity (RH) and three levels of wind speed were taken for study as furnished in Table 1 and their permutations and combinations were generated (4x3x3x3x3).

Enough care was taken to identify each weather window from 324 combinations to capture the weather scenario of state more precisely. Based on the ground reality experiences in the field of daily weather situation of the state and also by validation with real-time weather data, the total 324 combinations were screened for short listing and thus 24 weather windows were selected. In addition caution was taken not to select more number of weather windows, since it will decrease the efficiency of agro advisories to be developed. For validating the initially developed 24 weather windows, weather data of 2013 from Agro met Observatory of Tamil Nadu Agricultural University were used as suggested by Mooley (1994). He recommended that for validation in respect of cold weather

| Weather factor / level | Rainfall (mm) | Maximum temperature(°C) | Minimum temperature(°C) | Day mean RH (%) | Wind speed (kmph) |
|------------------------|--------------|------------------------|------------------------|----------------|------------------|
| L0                     | 0            | 20-30                  | <15                    | 20-40          | <5               |
| L1                     | 0.1-20       | 30.1-35                | 15.1-20                | 40.1-70        | 5-15             |
| L2                     | 20.1-30      | >35.0                  | 20.1-30                | >70.0          | >15              |
| L3                     | >30.0        | -                      | -                      | -              | -                |
| WWNo | Rainfall (mm) | Maximum temperature (°C) | Minimum temperature (°C) | Mean RH (%) | Wind speed (kmph) | Name of the weather windows |
|------|---------------|--------------------------|--------------------------|-------------|------------------|-----------------------------|
| 1    | 0             | 20-30                    | <15                      | 40-70 & >70 | <5               | Dry cool humid weather      |
| 2    | 0             | 30.1-35                  | 15.1-20                  | 40-70 & >70 | <5               | Dry warm humid weather      |
| 3    | 0             | 30.1-35                  | 15.1-20                  | 20-40       | <5               | Dry warm weather            |
| 4    | 0             | >35.0                    | 20.1-30                  | 40-70 & >70 | <5               | Dry hot humid weather       |
| 5    | 0.1-30        | 20-30                    | <15                      | 40-70 & >70 | <5               | Moist cool humid weather    |
| 6    | 0.1-30        | 30.1-35                  | 15.1-20                  | 40-70 & >70 | <5               | Moist warm humid weather    |
| 7    | 0.1-30        | 30.1-35                  | 15.1-20                  | 20-40       | <5               | Moist warm weather          |
| 8    | 0.1-30        | >35.0                    | 20.1-30                  | 40-70 & >70 | <5               | Moist hot humid weather     |
| 9    | >30           | 20-30                    | <15                      | 40-70 & >70 | <5               | Wet cool humid weather      |
| 10   | >30           | 30.1-35                  | 15.1-20                  | 40-70 & >70 | <5               | Wet warm humid weather      |
| 11   | >30           | 30.1-35                  | 15.1-20                  | 20-40       | <5               | Wet warm weather            |
| 12   | >30           | >35.0                    | 20.1-30                  | 40-70 & >70 | <5               | Wet hot humid weather       |
| 13   | 0             | 20-30                    | <15                      | 40-70 & >70 | >5               | Dry cool humid weather with wind |
| 14   | 0             | 30.1-35                  | 15.1-20                  | 40-70 & >70 | >5               | Dry warm humid weather with wind |
| 15   | 0             | 30.1-35                  | 15.1-20                  | 20-40       | >5               | Dry warm weather with wind   |
| 16   | 0             | >35.0                    | 20.1-30                  | 40-70 & >70 | >5               | Dry hot humid weather with wind |
| 17   | 0.1-30        | 20-30                    | <15                      | 40-70 & >70 | >5               | Moist cool humid weather with wind |
| 18   | 0.1-30        | 30.1-35                  | 15.1-20                  | 40-70 & >70 | >5               | Moist warm humid weather with wind |
| 19   | 0.1-30        | 30.1-35                  | 15.1-20                  | 20-40       | >5               | Moist warm weather with wind |
| 20   | 0.1-30        | >35.0                    | 20.1-30                  | 40-70 & >70 | >5               | Moist hot humid weather with wind |
| 21   | >30           | 20-30                    | <15                      | 40-70 & >70 | >5               | Wet cool humid weather with wind |
| 22   | >30           | 30.1-35                  | 15.1-20                  | 40-70 & >70 | >5               | Wet warm humid weather with wind |
| 23   | >30           | 30.1-35                  | 15.1-20                  | 20-40       | >5               | Wet warm weather with wind   |
| 24   | >30           | >35.0                    | 20.1-30                  | 40-70 & >70 | >5               | Wet hot humid weather with wind |
Table 3: Validation of weather for different seasons of 2013.

| Date       | Rainfall (mm) | Maximum temperature (°C) | Minimum temperature (°C) | Daily mean RH (%) | Wind speed at 10 feet height (kmph) | WW No. |
|------------|---------------|--------------------------|--------------------------|------------------|-------------------------------------|--------|
|            |               |                          |                          |                  |                                     |        |
| (a) Cold weather period |               |                          |                          |                  |                                     |        |
| 15.1.2013  | 0             | 31.2                     | 16.7                     | 61.0             | 6.4                                 | 14     |
| 16.1.2013  | 0             | 31.2                     | 19.0                     | 66.0             | 8.3                                 | 14     |
| 17.1 2013  | 0             | 30.2                     | 20.2                     | 59.0             | 7.8                                 | NA     |
| 18.1.2013  | 0             | 29.5                     | 18.5                     | 62.0             | 6.0                                 | NA     |
| 19.1.2013  | 0             | 30.4                     | 16.8                     | 65.0             | 4.7                                 | 2      |
| 20.1.2013  | 0             | 31.5                     | 17.6                     | 61.5             | 3.9                                 | 2      |
| Total/mean | 0*            | 30.7**                   | 18.1**                   | 62.4**           | 6.2**                               | 14     |
| (b) Hot weather period |               |                          |                          |                  |                                     |        |
| 15.4.2013  | 0             | 37.0                     | 25.7                     | 63.0             | 5.0                                 | 16     |
| 16.4.2013  | 0             | 35.6                     | 24.5                     | 66.0             | 7.3                                 | 16     |
| 17.4 2013  | 0             | 36.0                     | 25.4                     | 62.5             | 6.1                                 | 16     |
| 18.4.2013  | 0             | 37.0                     | 25.0                     | 63.5             | 5.2                                 | 16     |
| 19.4.2013  | 0             | 35.5                     | 23.4                     | 60.0             | 5.0                                 | 16     |
| 20.4.2013  | 0             | 36.0                     | 23.6                     | 56.5             | 4.5                                 | 4      |
| Total/mean | 0*            | 36.2**                   | 24.6**                   | 61.9**           | 5.5**                               | 16     |
| (c) Sowthwest monsoon period |           |                          |                          |                  |                                     |        |
| 15.7.2013  | 0             | 32.0                     | 24.2                     | 67.0             | 12.1                                | NA     |
| 16.7.2013  | 0             | 31.0                     | 25.2                     | 68.5             | 13.9                                | NA     |
| 17.7 2013  | 0.8           | 30.0                     | 23.4                     | 67.5             | 16.6                                | NA     |
| 18.7.2013  | 0             | 30.5                     | 24.6                     | 70.0             | 15.6                                | NA     |
| 19.7.2013  | 1.2           | 29.5                     | 23.4                     | 80.0             | 16.7                                | NA     |
| 20.7.2013  | 7.6           | 26.0                     | 22.5                     | 75.0             | 15.0                                | NA     |
| Total/mean | 9.6*          | 32.0**                   | 24.2**                   | 67.0**           | 12.1**                              | 20     |
| (d) Northeast monsoon period |           |                          |                          |                  |                                     |        |
| 15.10.2013 | 0             | 32.8                     | 23.2                     | 70.5             | 4.8                                 | NA     |
| 16.10.2013 | 22.6          | 32.8                     | 22.4                     | 78.0             | 5.3                                 | NA     |
| 17.10.2013 | 17.2          | 31.6                     | 21.7                     | 79.5             | 5.0                                 | NA     |
| 18.10.2013 | 0             | 31.0                     | 21.7                     | 75.0             | 2.6                                 | NA     |
| 19.10.2013 | 10.6          | 32.6                     | 21.2                     | 76.5             | 4.7                                 | NA     |
| 20.10.2013 | 42.4          | 31.0                     | 20.8                     | 83.0             | 3.4                                 | NA     |
| Total/mean | 92.8*         | 32.0**                   | 21.8**                   | 77.1**           | 4.3**                               | 12     |

* 6 days total; NA not available, mean of 6 days.
| WNWNo | Rainfall (mm) | Absolute range values of weather elements | Daily Mean RH (%) | Minimum temperature (°C) | Maximum temperature (°C) | Wind speed (kmph) |
|-------|--------------|------------------------------------------|-------------------|--------------------------|--------------------------|-------------------|
| 1     | 0            | $<$20                                     | $>$40             | $<$15                    | $<$15                    | $<$5              |
| 2     | 0            | 20-30                                    | $>$40             | $<$15                    | 15.1-20                  | $<$5              |
| 3     | 0            | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 4     | 0            | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 5     | 0            | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 6     | 0            | 20-30                                    | $>$40             | $<$15                    | 15.1-20                  | $<$5              |
| 7     | 0            | 20-30                                    | $>$40             | $<$15                    | 15.1-20                  | $<$5              |
| 8     | 0            | 20-30                                    | $>$40             | $<$15                    | 15.1-20                  | $<$5              |
| 9     | 0            | 20-30                                    | $>$40             | $<$15                    | 15.1-20                  | $<$5              |
| 10    | 0            | 20-30                                    | $>$40             | $<$15                    | 15.1-20                  | $<$5              |
| 11    | 0.1-30       | $<$35.0                                  | $>$40             | $<$15                    | 15.1-20                  | $<$5              |
| 12    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 15.1-20                  | $<$5              |
| 13    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 15.1-20                  | $<$5              |
| 14    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 15.1-20                  | $<$5              |
| 15    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 15.1-20                  | $<$5              |
| 16    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 17    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 18    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 19    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 20    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 21    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 22    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 23    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 24    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 25    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |
| 26    | 0.1-30       | 20-30                                    | $>$40             | $<$15                    | 20.1-30                  | $<$5              |

Table 4: Revised weather windows (absolute range values)
|   |   |   |   |   |
|---|---|---|---|---|
|   |   |   |   |   |
| 27 | >30 | 0 | 0 | 30.1-35 |
| 28 | >30 | 0 | 0 | 30.1-35 |
| 29 | >30 | 0 | 0 | 30.1-35 |
| 30 | >30 | 0 | 0 | 30.1-35 |
| 31 | >30 | 0 | 0 | 30.1-35 |
| 32 | >30 | 0 | 0 | 30.1-35 |
| 33 | >30 | 0 | 0 | 30.1-35 |
| 34 | >30 | 0 | 0 | 30.1-35 |
| 35 | >30 | 0 | 0 | 30.1-35 |
| 36 | >30 | 0 | 0 | 30.1-35 |
| 37 | >30 | 0 | 0 | 30.1-35 |
| 38 | >30 | 0 | 0 | 30.1-35 |
| 39 | >30 | 0 | 0 | 30.1-35 |
| 40 | >30 | 0 | 0 | 30.1-35 |
| 41 | >30 | 0 | 0 | 30.1-35 |
| 42 | >30 | 0 | 0 | 30.1-35 |
| 43 | >30 | 0 | 0 | 30.1-35 |
| 44 | >30 | 0 | 0 | 30.1-35 |
| 45 | >30 | 0 | 0 | 30.1-35 |
| 46 | >30 | 0 | 0 | 30.1-35 |
| 47 | >30 | 0 | 0 | 30.1-35 |
| 48 | >30 | 0 | 0 | 30.1-35 |
| 49 | >30 | 0 | 0 | 30.1-35 |
| 50 | >30 | 0 | 0 | 30.1-35 |
| 51 | >30 | 0 | 0 | 30.1-35 |
| 52 | >30 | 0 | 0 | 30.1-35 |
| 53 | >30 | 0 | 0 | 30.1-35 |
| 54 | >30 | 0 | 0 | 30.1-35 |

|   |   |   |   |
|---|---|---|---|
| Wet hot humid weather | Windy dry cool humid weather | Windy dry cool humid weather | Windy dry cool humid weather |
| Windy dry warm humid weather | Windy dry warm humid weather | Windy dry warm humid weather | Windy dry warm humid weather |
| Windy moist cool humid weather | Windy moist cool humid weather | Windy moist cool humid weather | Windy moist cool humid weather |
| Windy moist warm humid weather | Windy moist warm humid weather | Windy moist warm humid weather | Windy moist warm humid weather |
| Windy moist hot humid weather | Windy moist hot humid weather | Windy moist hot humid weather | Windy moist hot humid weather |
| Windy wet cool humid weather | Windy wet cool humid weather | Windy wet cool humid weather | Windy wet cool humid weather |
| Windy wet warm humid weather | Windy wet warm humid weather | Windy wet warm humid weather | Windy wet hot humid weather |
| Windy wet hot humid weather | Windy wet hot humid weather | Windy wet hot humid weather | Windy wet hot humid weather |
Table 5: Validation of weather windows of Table 4 with block level AWS mean real-time data of six days

| District    | Block          | Observation dates | Rainfall* (mm) | Maximum temperature** (°C) | Minimum temperature** (°C) | Daily mean RH** (%) | Wind speed** (kmph) | WW No. |
|-------------|----------------|-------------------|--------------|---------------------------|---------------------------|--------------------|---------------------|--------|
| Ariyalur    | Andimadam      | 1.1.12 to 6.1.12  | 0            | 31.1                      | 23.3                      | 84.8               | 2.2                 | 7      |
| Coimbatore  | Anamalai       | 2.3.12 to 7.3.12  | 0            | 35.6                      | 22.9                      | 73.9               | 2.6                 | 9      |
| Cuddalore   | Annagramam     | 4.6.12 to 9.6.12  | 0            | 39.4                      | 27.0                      | 57.3               | 7.6                 | 36     |
| Dharmapuri  | Dharmapuri     | 11.8.12 to 16.8.12| 0            | 33.1                      | 23.5                      | 61.2               | 6.1                 | 34     |
| Dindugal    | Dindugal       | 4.10.12 to 9.10.12| 66.5         | 35.7                      | 22.9                      | 65.2               | 4.6                 | 27     |
| Erode       | Bhavanisagar   | 8.12.12 to 13.12.12| 0           | 32.1                      | 18.9                      | 78.0               | 2.5                 | 5      |
| Kanchepuram | Kanchepuram    | 1.12.12 to 6.12.12| 0            | 29.1                      | 18.8                      | 85.3               | 4.09                | 3      |
| Kanyakumari | Agasteesvaram  | 20.9.12 to 25.9.12| 0            | 33.6                      | 25.5                      | 78.5               | 5.78                | 34     |
| Krishnagiri | Bargur         | 4.4.12 to 9.4.12  | 0            | 37.15                     | 21.5                      | 53.8               | 4.2                 | 9      |
| Karur       | Paramathi      | 10.5.12 to 15.5.12| 0            | 35.8                      | 25.5                      | 62.0               | 3.0                 | 9      |
| Madurai     | Alanganallur   | 19.7.12 to 24.7.12| 0            | 35.6                      | 25.3                      | 52.7               | 5.4                 | 36     |
| Nagapattinam| Nagapattinam   | 1.11.12 to 6.11.12| 0            | 29.8                      | 24.7                      | 79.3               | 6.9                 | 31     |
| Namakkal    | Pallipalayam   | 23.2.12 to 28.2.12| 0            | 37.1                      | 17.9                      | 60.0               | 2.9                 | 8      |
| Perambalur  | Perambalur     | 15.3.12 to 20.3.12| 0            | 36.4                      | 21.9                      | 61.1               | 4.35                | 9      |
| Pudukkotai  | Annavasal      | 1.7.12 to 6.7.12  | 0            | 37.5                      | 25.5                      | 80.0               | 5.9                 | 36     |
| Ramanathapuram | Ramanathapuram | 1.10.12 to 6.10.12| 0           | 34.5                      | 27.3                      | 65.2               | 5.6                 | 34     |
| Salem       | Salem          | 2.5.12 to 7.5.12  | 1.0          | 36.5                      | 25.9                      | 65.4               | 4.7                 | 18     |
| Sivaganga   | Kalaiyarkoil   | 5.12.12 to 10.12.12| 0           | 32.1                      | 22.1                      | 60.0               | 3.03                | 7      |
| Thanjovur   | Kumbakonam     | 7.8.12 to 12.8.12 | 19.0         | 35.8                      | 25.4                      | 69.7               | 6.98                | 45     |
| The Nilgiris| Ooty           | 30.7.12 to 4.8.12 | 1.5          | 19.1                      | 13.3                      | 75.9               | 7.8                 | 37     |
| Theni       | Andipatti      | 28.10.12 to 2.11.12| 7.5         | 29.0                      | 22.3                      | 57.08              | 2.2                 | 13     |
| Thiruvarall | Ellapuram      | 10.4.12 to 15.4.12| 0            | 37.3                      | 25.6                      | 65.0               | 9.1                 | 36     |
| Tuticorin   | Alvarthirunagari| 8.11.12 to 13.11.12| 74.0        | 31.6                      | 24.2                      | 81.0               | 3.7                 | 25     |
| Thiruvannamalai | Arani       | 3.4.12 to 8.4.12  | 0            | 37.0                      | 22.1                      | 68.3               | 0.78                | 9      |
| Thiruvurur  | Kodavasal      | 12.6.12 to 17.6.12| 0            | 36.6                      | 26.4                      | 66.9               | 8.4                 | 36     |
| Thiruchirapalli | Manigandam   | 7.8.12 to 12.8.12 | 0            | 40.0                      | 27.8                      | 61.9               | 7.96                | 36     |
| Thiruneveli | Thengasi       | 18.10.12 to 23.10.12| 165.5      | 29.7                      | 23.1                      | 90.4               | 9.5                 | 52     |
| Thiruppur   | Dharapuram     | 4.5.12 to 9.5.12  | 2.5          | 36.0                      | 25.1                      | 66.0               | 9.68                | 45     |
| Vellore     | Katpadi        | 20.7.12 to 25.7.12| 1.0          | 33.3                      | 25.2                      | 70.2               | 3.72                | 16     |
| Villupuram  | Chinnasalem    | 30.1.12 to 4.2.12 | 0            | 29.4                      | 20.2                      | 72.6               | 5.2                 | 31     |
| Virudhunagar| Aruppukottai   | 21.9.12 to 26.9.12| 0            | 35.8                      | 23.4                      | 61.8               | 4.2                 | 9      |

*6 days total; **mean of 6 days
period, 6 days of January month can be taken, while it is 6 days from April for summer month, 6 days from July for Southwest monsoon season and 6 days from October for Northeast monsoon. While validating the Coimbatore weather it was realized that the identified 24 weather windows need further revision. Hence re-exercise was done by addition of another 30 weather windows from the pool of 324 combinations to the strength of 24 weather windows selected already after careful examination, the number of weather windows was brought to 54 so as to capture the entire weather situations of Tamil Nadu across seasons without any miss. These 54 weather windows were validated again with weather data collected from AWS installed in each block of the state.

RESULTS AND DISCUSSIONS

Out of 324 permutations and combinations, with knowledge of Tamil Nadu daily weather scenario, initially 24 weather windows were shortlisted as given in Table 2. Each weather element in the weather window has range of absolute values so as to capture the weather scenario precisely without any miss and also to reduce the number of weather windows to be used for providing agro advisories. For example, in case of weather window (WW1) in Table 2, the absolute value of rainfall is 0 mm, combined with maximum temperature range of 20–30°C, minimum temperature of less than 15°C, mean day relative humidity between 40-70% greater than 70 per cent and wind speed ranging between 0 to 5 kmph.

Validation of the weather windows given in Table 2 was done with real-time weather data of year 2013 collected from Agro met Observatories of TNAU and the season-wise results are presented in Table 3.

From Table 3 with reference to weather windows in Table 2 it may be noted that the mean 6 days for cold weather period matched with the weather window 14 (WW14), likewise for hot weather period with WW16, for Southwest weather period with WW20 and for Northeast monsoon period with WW12 indicating that the each weather element’s absolute value varied with seasons and this said to be the natural variability arising due to variation in falling of sun’s rays on Earth with its rotation around Sun. While, scanning the daily values of each six days of hot weather period the weather values recorded in each date and 6 days mean were accurate at 90 per cent level to indicate the weather window 16 (Table 2). However, for Southwest and Northeast monsoon periods it emerged that daily values did not fall into any of the 24 weather window identified although the mean of the 6 days weather elements indicated weather window 20 and 12, respectively. Likewise, the accuracy for the cold weather period was also poor (33 per cent). Considering the limitations of the values of weather elements in Table 2 and anomalies noted for different seasons a need was felt for inclusion of some more windows from the pool to the weather windows in Table 2. Based on the revisit made, another 30 weather windows were added to the already identified 24 weather window making the total to 54 and presented in Table 4.

The sample data for validation were so chosen that for each district, one block was selected. From AWS of the block, daily data for six days at random were collected, mean arrived for all weather elements except rainfall, where six days total were considered and used for validation of weather windows given in Table 4. Validation was done for both mean values and individual data values of the data collected from AWS of each block for year 2012 and the results are given in Table 5.

The validation results given in Table 5 indicated that the mean 6 days weather data of all the blocks taken for the study (different dates) fell within the 54 weather windows given in Table 4. The daily weather data for five weather elements was also validated with the weather windows given in Table 4. The result endorses the validity of the weather windows chosen in Table 4 indicating thereby that these 54 weather windows are able to capture the weather scenarios of Tamil Nadu both spatially and temporally and hence can be used to provide agro advisories under automated weather forecast system in Tamil Nadu. If at all any climate change situation arises in future, the absolute values given in the Table 5 may require some micro-level adjustments.

CONCLUSION

The objective of developing weather windows for Tamil Nadu covering both spatial and temporal dimension of weather system was achieved through identification of 54 weather windows by employing permutation and combination methodology followed by validation of 54 weather windows with real-time weather data. These 54 weather windows can be employed with confidence for developing agro advisories for individual crops for
dissemination to the farmers in domain area under automated agro advisory services.

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