INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY HYDERABAD

R&D SHOWCASE 2021

Technology, Social Impact

Analysis of similar weather conditions to improve reuse in weather-based decision support systems

Introduction:

- Weather-based decision support systems (DSSs) are being build to improve the efficiency of the production systems in the domains of **health, agriculture, livestock, transport, business, planning, governance and so on.**
- **About Weather:** It is represented by weather parameters Rainfall (RF), Minimum Temperature (Tmin), Maximum Temperature (Tmax), Cloud cover (CC), Minimum Relative Humidity (minRH), Maximum Relative Humidity (maxRH), Wind speed (WS), Wind direction (WD) etc
- The weather-based DSS provides appropriate suggestions based on the weather condition/prediction of the given period (year/season) for the selected domain.

Table 1: Sample daily (d=1) weather values Collected from Rajendra nagar weather station

Date	RF	Tmax	Tmin	Rhmax	Rhmin
01-01-2020	0.0	27.0	19.0	95	56
02-01-2020	10.6	28.0	20.0	91	60
03-01-2020	0.0	28.5	20.0	91	60
04-01-2020	0.0	29.0	19.0	91	63
05-01-2020	0.0	27.5	17.0	85	52

- **Weather Condition: WC(d, s, e):** Statistics of each weather variable for a duration 'd' from start date *'s'* to end date *'e'*.
- Example: WC(1, 1 Jan 2020, 1 Jan 2020) is given as <0.0, 27.0, 19.0, 95.0, 56.0>

Problem:

- **How to improve the performance of weather-based DSS ?**

Approach: Exploit Reuse

- **Basic idea**: The advice prepared for past weather condition, **can be reused** when the similar weather condition occurs in the future.
- **Question:** How to calculate the similarity among the weather conditions?
- **Issue**: Similarity among **numerical** weather conditions is difficult.
- **Opportunity**: Apply domain-specific categories to weather variables to form form a category-based weather condition, as a different suggestion or advice is not recommended for a small change, like 0.2 degree centigrade, in temperature value, for small change, like 2 per cent, in humidity value.

Proposed Approach:

(i) For the given domain and application, obtain Weather Category Table (WCT)

(ii) Form Category-based Weather Conditions (CWCs) for given period.

(iii) Extract similar CWCs by comparing the CWCs of the given period to subsequent periods.

Performance Metric:

- **Coverage percentage(CP(x/n)):** For a given period x we calculate the percentage of CWCs of x which are similar to CWCs of preceding n periods of x (n>=1).

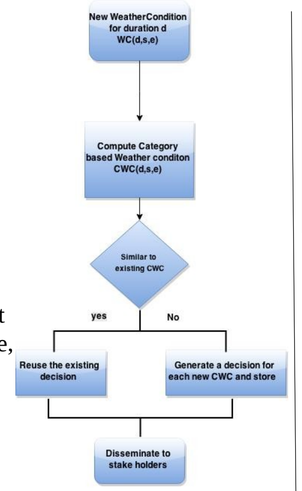


Fig. 1: Flow chart of the proposed approach

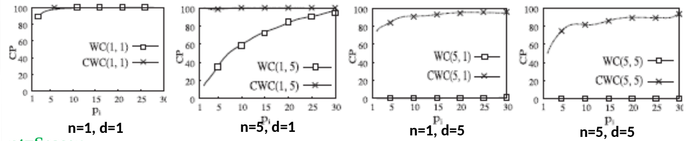
Table 2: Weather Category Table (WCT) defined by IMD

Weather Variable Name	Range	Description
Rain Fall (mm)	0 - 0	No Rain(NR)
	0.1 - 2.4	Very Light Rain(VLR)
	2.5 - 7.5	Light Rain(LR)
	7.6 - 35.5	Moderate Rain(MR)
	35.6 - 64.4	Rather Heavy Rain(RH)
	64.5 - 124.4	Heavy Rain(HR)
	124.4 - 244.4	Very Heavy Rain(VHR)
	> = 244.5	Extremely Heavy Rain(EHR)
Temperature(°C) deviation from normal	-1 ,0, 1	Little Change(LC)
	2 or -2	Rise/Fall(R/F)
	3 to 4	Appreciable Rise(AR)
	-3 to -4	Appreciable Fall(AF)
	5 to 6	Marked Rise(MR)
	-5 to -6	Marked Fall(MF)
	>= 7	Large Rise (LR)
	<= -7	Large Fall(LF)
Relative Humidity (%)	0 - 30	Low(L)
	31 - 60	Moderate(M)
	61 - 80	High(H)
	>= 81	Very High(VH)

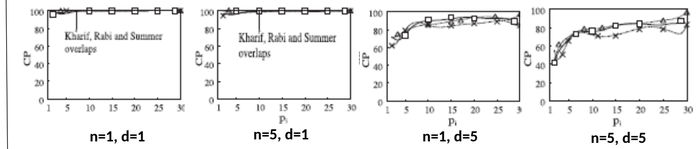
Table 3:Experimental Settings

Variable Name	Values
Dataset	30 years of weather data (1986-2015)
Period type (pt)	Year, Crop Seasons (Summer, Kharif, and Rabi), Phenophases of the Rice crop
Type of WCs and CWCs	WC(1,1), WC(1,5),CWC(1,1) and CWC(1,5)={Tmax} WC(2,1), WC(2,5),CWC(2,1) and CWC(2,5)={Tmax, Tmin} WC(3,1), WC(3,5),CWC(3,1) and CWC(3,5)={Tmax, Tmin, RHmax} WC(4,1), WC(4,5),CWC(4,1) and CWC(4,5)={Tmax, Tmin, RHmax, RHmin} WC(5,1), WC(5,5),CWC(5,1) and CWC(5,5)={Tmax, Tmin, RHmax, Rhmin, RF}

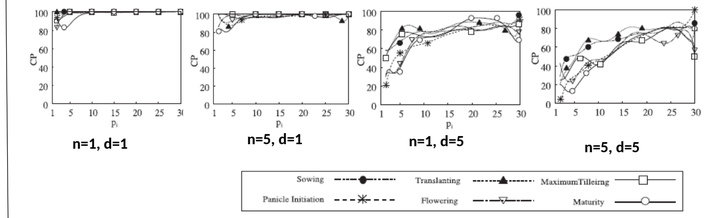
pt=Year



pt=Season



pt=Phenophase



Summary:

- Similarity of CWC shows the greater extent of **reuse** than the real values of weather.
- For 30 years period, results show that in season-based approach 80% of reuse is obtained in 15 years.

Publication: 1. Alugubelly Mamatha, Polepalli Krishna Reddy, Mittapally Kumara Swamy, G. Sreenivas, D. Raji Reddy:A Framework to Improve Reuse in Weather-Based Decision Support Systems. BDA 2014: 1-13. 2. Alugubelly Mamatha, Polepalli Krishna Reddy, Gade Sreenivas, Seishi Ninomiya: **Analysis of similar weather conditions to improve reuse in weather-based decision support systems.** Comput. Electron. Agric. 157: 154-165 (2019).

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