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RESEARCH PAPER

Weather, crop interaction and land resource based management for groundnut crop in Shirur sub-watershed of Kundgol taluk in Dharwad district of Northern Karnataka

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Abstract: Weather plays a key role in determining groundnut productivity under rainfed conditions, as rainfall distribution, temperature, humidity, soil moisture and radiation strongly influence crop growth, pod development and yield stability. The present study assessed the effect of Land Resource Inventory (LRI)-based interventions on groundnut yield in the Shirur sub-watershed of Dharwad district, Karnataka, under four treatments: T1 (LRI farmers with cards, training and inputs), T2 (LRI farmers with cards and training), T3 (LRI farmers with cards only) and T4 (non-LRI farmers, control). Results showed that T1 outperformed all treatments, recording the highest pod yield (36.25 q/ha), kernel weight (116.90 g/plant) and total dry matter (56.00 g/plant), supported by favourable soil moisture and improved management. T2 and T3 recorded moderate yields (27.21 and 28.57 q/ha), reflecting partial benefits of training and advisories. In contrast, T4 produced the lowest yield (24.32 q/ha) due to poor management and terminal drought stress, which restricted kernel filling. T-test analysis revealed significant differences for most parameters, confirming the role of LRI interventions. Non-significant results for some traits indicated genetic buffering and environmental stability. Overall, LRI-based management enhanced adaptation to weather, stabilised yields and improved resilience of groundnut farming in semi-arid region of Northern Karnataka.

Key words: Groundnut, Land Resource, Weather

Introduction

Climate and weather strongly influence agricultural production, affecting crop growth, yield and quality through factors such as rainfall, temperature, humidity, sunshine, wind and evapotranspiration.Groundnut is majorly a rainfed crop highly influenced by weather conditions throughout its growth cycle. Well-distributed rainfall from sowing to pod filling is critical, with adequate soil moisture during flowering and pegging ensuring good pod initiation and development. Moist soil at harvest is desirable as it facilitates easy lifting and reduces pod loss. However, excess rainfall or waterlogging at any stage is highly detrimental, leading to poor germination, seed decay, root damage and increasing the risk of aflatoxin contamination (Girish *et al*., 2012). Dry spells during pegging and pod filling can drastically reduce yields by limiting peg penetration and kernel development (Reddy *et al*., 2013). In addition, weather-induced stresses such as high temperatures or prolonged humidity often predispose the crop to pest and disease outbreaks, further lowering productivity. Thus, groundnut performance is closely tied to prevailing weather, making timely rainfall and optimal soil moisture crucial for achieving higher yields and better quality.

To strengthen resource management, the Land Resource Portal was launched in 2019 under the World Bank–supported Sujala-III project, integrating spatial and non-spatial data on soil, water and socio-economic factors with GIS-based tools for crop planning, nutrient management, water budgeting and runoff analysis. Building on this, the Rejuvenating Watershed for Agricultural Resilience through Innovative Development (REWARD) project promotes Land Resource Inventory (LRI) for site-specific mapping of land and water resources, guiding farmers in adopting climate-resilient and sustainable practices. Land Resource Inventory (LRI) is an investigative assessment of the site-specific status and changing condition of soil, water, land use, weather and their related phenomena and features observed and measured at ground reality at cadastral level (Sathishkumar and Rajesh, 2021). Land resource inventory and mapping play a vital role in resource planning and management to assess its potential and limitations for wide range of land use options and formulate sustainable land use plans to meet the ever-increasing demand.

Material and methods

The Shirur sub-watershed is located in the northern part of Karnataka in Kundgol taluk of Dharwad district. It lies between $15^{0}10'30''$ to $15^{0}14'0''$ North latitudes and $75^{0}12'30''$ to$75^{0}19'30''$ East longitudes and covers an area of about 6446.14 ha bounded by Kundhagola, Bilebala, Shirura, Hireharakuni, Nelagudda, Kamadolli, Devanuru, Betadura villages. The Shirur sub watershed of Kundgol taluk in Dharwad district, is located in Northern Transition Zone (Zone 8) of Karnataka and having hot semi-arid climate. The average rainfall of Shirur sub watershed is 750 mm with an average of 62 rainy days. The region records an average of 31.4 ^{0}C maximum temperature, 19.2 ^{0}C minimum temperature with 83.8 per cent of morning relative humidity and 45.3 per cent of evening relative humidity. The experiment consists offour types of farmers treatments.

Treatment one (1): LRI farmers with cards, training and inputs provided (Bhu Tharlaghatta), treatment two (T2): LRI farmers with cards and training provided (Kamdolli 2), treatment three (T3): LRI farmers with cards provided (Kamdolli 1) and treatment four (T4): Non LRI farmers (Control) (Bhu Koppa).Groundnut yield parameters were recorded to assess performance. Pods per plant were counted from randomly selected plants, while 100-seed weight was measured in grams. Pod yield was recorded quintal per hectare. Shelling percentage was calculated from kernel to pod weight ratio. Total dry matter was obtained by drying above-ground parts at 70°C and leaf area index was measured at harvest stage using a portable LAI meter.

Results and discussion

Groundnut growth and yield varied significantly across treatments, reflecting the combinedinfluence of weather and LRI interventions. In treatment one(T1) LRI farmers with cards, training and inputs provided (Bhu Tharlaghatta), timely rainfall, high humidity and optimum temperatures, supported by adequate soil moisture at both surface and deeper layers, ensured uniform germination, vigorous canopy growth, peg penetration and efficient kernel filling even under declining rainfall, resulting in the highest yield (36.25 q/ha), 24 pods/ plant, 116.90 g kernel weight, 69.35% shelling and low variability (CV: 7.06%), confirming stability under full support, consistent with earlier studies (Boote *et al*., 1986; Nautiyal *et al*., 2002; Reddy & Reddi, 2016). (Table 1). In treatment two (T2)LRI farmers with cards and training provided (Kamdolli 2), well-distributed rainfall (24–30 mm/week), cooler temperatures, high humidity and deep soil moisture (>59%) favoured establishment and reproductive growth, while moderate radiation sustained canopy function; later declines in rainfall were buffered by soil reserves, enabling stable kernel filling, yielding 27.21 q/ha, 18.80 pods/plant, 91.06 g kernel weight and 66.95% shelling, with low variability (CV: 9.75%), highlighting the role of knowledge-based support in aligning farm practices with weather cues (Reddy

Table 1. Groundnut yield parameters recorded under T1: LRI farmers with cards, training and inputs provided (Bhu Tharlaghatta), T2: LRI farmers with cards and training provided (Kamdolli 2)T3: LRI farmers with cards provided (Kamdolli 1) and T4:Non LRI farmers(Control) (Bhu Koppa)

Treatments	Sub treatments	Number of pods/plants	Pod weight (g/plant)	Kernel weight (g/ plant)	100 seeds weight (g)	Shell weight (g/plant)	Shelling Percentage	Pod yield (q/ha)	Totaldry matter (g/plant)	Total dry matter (kg/ha)	LAI
T 1	GNT1	24.00	151.80	119.60	42.30	33.20	58.87	45.00	61.74	205.78	1.36
	GNT2	28.00	123.70	118.60	38.90	23.30	73.89	30.00	89.24	297.46	1.39
	GNT3	23.00	148.40	106.10	37.10	26.40	71.42	35.00	48.50	161.67	1.75
	GNT4	21.00	147.80	123.30	41.60	28.40	73.21	35.00	24.52	81.71	2.01
	Mean	24.00	142.93	116.90	39.98	27.83	69.35	36.25	56.00	186.65	1.63
	SD	2.94	12.94	7.48	2.41	4.15	7.06	6.29	26.98	90.00	0.31
	CV (%)	12.25	9.05	6.40	6.03	14.91	10.18	17.36	48.17	48.21	19.05
	S.Em±	1.47	6.47	3.74	1.21	2.08	3.53	3.15	13.49	45.00	0.16
T2	GNT1	22.00	164.10	103.50	41.40	23.20	63.07	26.32	42.05	140.17	1.15
	GNT2	21.00	140.50	100.70	39.30	22.70	71.67	30.00	23.98	79.93	1.91
	GNT3	21.00	154.30	110.70	38.50	28.80	71.74	29.00	13.80	46.00	2.19
	GNT4	18.00	123.20	87.50	43.20	21.50	71.02	23.75	29.30	97.67	1.20
	GNT5	12.00	92.40	52.90	36.10	29.40	57.25	27.00	58.70	195.67	1.58
	Mean	18.80	134.90	91.06	39.70	25.12	66.95	27.21	33.56	111.89	1.61
	S D	4.08	28.29	22.92	2.72	3.69	6.53	2.44	17.35	57.87	0.44
	C.V (%)	21.7	20.97	25.17	6.85	14.68	9.75	8.96	51.68	51.73	27.40
	S.Em±	1.83	12.69	10.28	1.22	1.65	2.93	1.09	7.78	25.88	0.20
T3	GNT1	22.00	171.10	125.10	39.60	28.80	73.11	26.45	39.24	132.8	2.01
	GNT2	15.00	128.90	76.30	38.70	24.00	59.19	27.80	65.26	217.63	1.38
	GNT3	14.00	74.50	51.00	32.20	19.20	68.45	29.75	18.10	60.33	2.00
	GNT4	31.00	215.10	153.00	32.10	24.10	71.12	26.87	26.11	87.03	1.07
	GNT5	17.00	136.10	70.90	39.30	29.40	52.09	32.00	60.22	200.73	1.17
	Mean	19.80	145.14	95.26	36.38	25.10	64.79	28.57	41.91	139.70	1.53
	SD	6.79	52.21	42.23	3.87	4.16	8.87	2.30	20.63	68.77	0.45
	CV (%)	34.29	35.97	44.33	10.64	16.57	13.69	8.04	49.22	49.21	29.49
	S.Em±	3.04	23.41	18.94	1.74	1.86	3.98	1.03	9.25	30.75	0.20
T4	GNT1	12.00	75.00	54.20	32.50	16.10	72.26	25.75	28.00	93.33	2.58
	GNT2	15.00	89.10	62.70	37.10	21.80	70.37	23.50	14.90	49.67	2.81
	GNT3	29.00	162.90	95.30	57.30	25.60	58.50	25.62	22.00	73.33	1.19
	GNT4	16.00	113.30	73.90	39.10	21.30	65.22	24.25	25.18	83.93	2.15
	GNT5	24.00	160.70	109.30	36.60	24.90	68.01	22.50	27.54	91.8	2.46
	Mean	19.20	120.20	79.08	40.52	21.94	66.87	24.32	23.52	78.41	2.24
	S D	7.05	40.37	22.86	9.68	3.77	5.37	1.39	5.37	17.91	0.63
	CV (%)	36.71	33.59	28.91	23.89	17.16	8.03	5.71	22.82	22.84	28.15
	S.Em±	3.16	18.10	10.25	4.34	1.68	2.41	0.62	2.41	8.01	0.28

Table 2. T test of Groundnut yield parameters for all four treatments

Treatment	Number of pods/plants	Pod weight (g/plant)	Kernel weight (g/plant)	100 Seeds Weight (g)	Shell weight (g/plant)	Shelling Percentage	Pod yield (q/ha)	TDM (g/plant)	TDM (kg/ha)	LAI
	Average									
T1	24.00	142.93	116.90	39.98	27.83	69.35	36.25	56.00	186.65	1.63
T2	18.80	134.90	91.06	39.70	25.12	66.95	27.21	33.56	111.88	1.60
T3	19.80	145.14	95.26	36.38	25.10	64.79	28.57	41.91	139.70	1.52
T4	19.20	120.20	79.08	40.52	21.94	66.87	24.32	23.52	78.41	2.23

T-Test

Treatment	Number of pods/plants		Pod weight (g/plant)		Kernel weight (g/plant)		100 Seeds weight (g)		Shell weight (g/plant)		Shelling percentage		Pod yield (q/ha)		TDM (g/plant)		TDM (kg/ha)		LAI	
	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R
T1 vs T2	7.16	S	3.36	S	4.31	S	4.47	S	2.59	S	4.83	S	4.59	S	2.48	S	2.48	S	3.42	S
T1 vs T3	5.06	S	2.16	NS	3.13	S	4.03	S	1.78	NS	5.35	S	3.84	S	2.43	S	2.43	S	4.67	S
T1 vs T4	3.82	S	1.73	NS	1.99	NS	4.4	S	2.1	NS	3.96	S	5.47	S	3.76	S	3.76	S	2.01	NS
T2 vs T3	10.28	S	10.65	S	8.82	S	32.57	S	13.74	S	22.9	S	24.94	S	4.32	S	4.32	S	7.99	S
T2 vs T4	10.28	S	10.65	S	8.82	S	32.57	S	13.74	S	22.9	S	24.94	S	4.32	S	4.32	S	7.99	S
T3 vs T4	6.34	S	6.26	S	5.04	S	20.99	S	6.62	S	16.31	S	27.79	S	4.52	S	4.54	S	7.56	S

V: T table value R: Result S: Significant NS: Non-significant

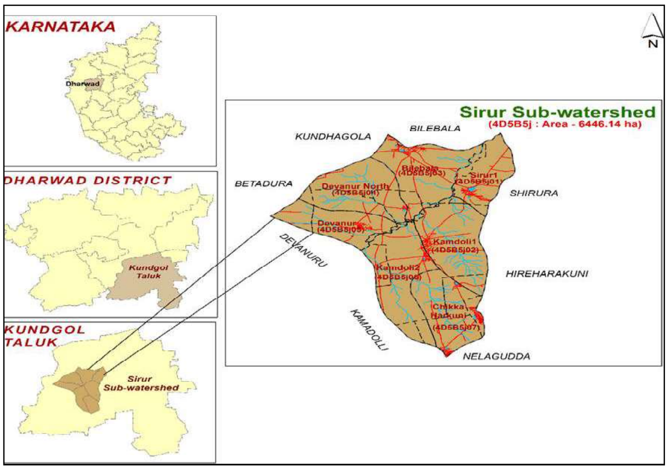

Fig 1. Location map of the study area

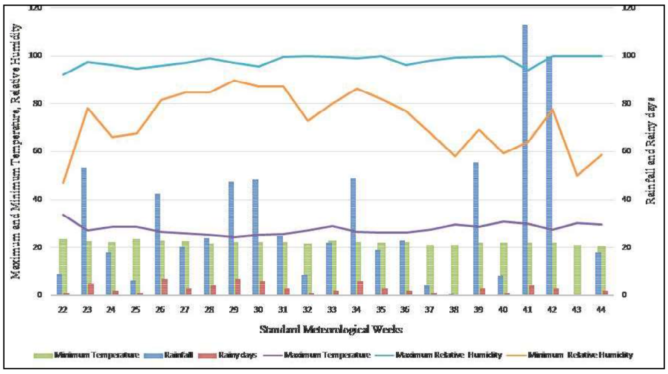

Fig 2. Standard meteorological week wise rainfall (mm), rainy days (days),maximum temperature (⁰C), minimum temperature (⁰C), maximum relative humidity (%) and minimum relative humidity (%) recorded at the study area during crop growing period (2024)

et al., 2018). (Table 1). In treatment three (T3)LRI farmers with cards provided (Kamdolli 1), weather remained favourable for germination and vegetative growth, but absence of timely agronomic interventions restricted peg-to-pod conversion and declining soil moisture (<57%) combined with rising radiation (>130 W/m²) induced mild terminal stress, lowering kernel filling efficiency; yield averaged 28.57 q/ha with 19.80 pods/plant, 95.26 g kernel weight, 64.79% shelling and higher variability (CV: 13.69%), showing that access to advisories without training reduced yield stability (Jat *et al*., 2017). (Table 1). In treatment four (T4)Non LRI farmers (Control) (Bhu Koppa), early growth benefitted from favourable rainfall, humidity and temperatures, but lack of structured guidance, uneven germination and poor canopy management reduced efficiency, while declining rainfall, reduced RH II and high radiation (>130 W/m²) during the terminal phase intensified stress, causing incomplete kernel filling and the lowest yield (24.32 q/ha), with 19.20 pods/plant, 79.08 g kernel weight, 66.87% shelling and high variability (CV: 8.03%), consistent with earlier reports that terminal drought and weak adaptive management reduce productivity (Srinivas *et al*., 1996; Williams *et al*., 1984). (Table 1)

Overall, treatment oneLRI farmers with cards, training and inputs provided (Bhu Tharlaghatta) (T1) clearly demonstrated the benefits of integrated management with inputs, training and advisories, treatment two LRI farmers with cards and training provided (Kamdolli 2) (T2) showed the effectiveness of capacity building in improving weather-responsive farming even without full input support, treatment three LRI farmers with cards provided (Kamdolli 1) (T3) reflected moderate performance but highlighted the limitations of partial interventions andNon LRI farmers (Control) (Bhu Koppa) (T4) confirmed the vulnerability of non-LRI farmers to weather stresswithout structured support, emphasizing that a combination of technical guidance, timely inputs and adaptive management is essential for stabilizing groundnut yields under variable semi-arid weather.

The t-test analysis of groundnut yield parameters revealed significant variation among treatments (T1 to T4). T1 recorded the highest pods/plant (24.00), kernel weight (116.90 g), pod yield (36.25 q/ha) and TDM (56.00 g/plant), while T4 (control) showed the lowest values. Significant differences were observed for most parameters, including pods/plant, kernel weight, pod

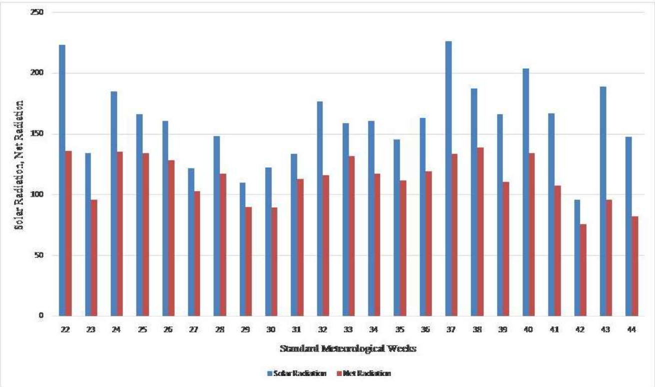

Fig 3. Standard meteorological week wise Solar Radiation (W/m^2) and Net Radiation(W/m^2) recorded at the study area during crop growing period (2024)

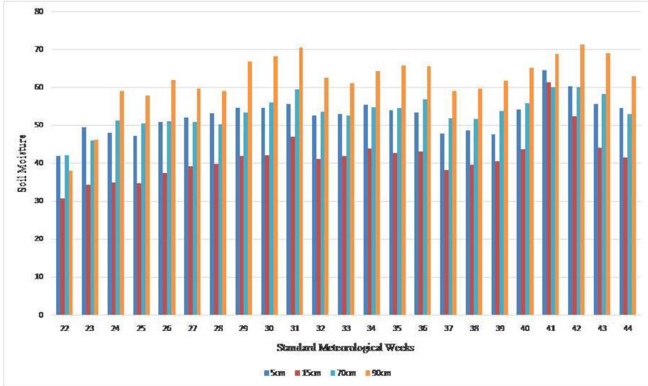

Fig 4. Standard meteorological week wise Soil moisture at different depths (5, 15, 30, 50,70, 90 cm) recorded at the study area during crop growing period (2024)

yield, 100-seed weight and LAI, indicating the positive influence of LRI interventions. Pod weight and kernel weight differences in T1 vs T2 and T2 vs T3 reflected improved input efficiency under LRI. However, traits like pod weight (T1 vs T3) and kernel weight (T1 vs T4) were non-significant, suggesting genetic buffering. These results agree with Patil *et al*. (2019), Reddy *et al*. (2020), Kumar *et al*. (2021) and Gowda *et al.* (2018), confirming that LRI practices enhance groundnut productivity, though varietal stability moderates certain traits. (Table 2)

Conclusion

The study clearly demonstrated that groundnut performance is highly influenced by weather parameters and management practices. LRI-based interventions significantly improved yield stability and efficiency through timely inputs, training and site-specific guidance. Among treatments, T1 recorded the highest productivity due to optimal resource use, favourable soil moisture and balanced weather conditions, while T4 showed the lowest yields under conventional practices. Statistical analysis confirmed significant differences for most yield traits, highlighting the role of capacity building and input support in mitigating weather stress. Thus, integrating LRI with farmer training and inputs ensures sustainable, weather-resilient groundnut production in semi-arid regions.

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