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RESEARCH ARTICLE

Local rainfall fluctuations and their impact on crop production and gender roles in drought prone areas: Case of groundnut crop from Ananthpur district of Andhra Pradesh

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Abstract In the era of climate change, farmers to adapt to the changing climate, the policy makers need to understand this in a broader context of ecological, economical and socio-political processes and build support systems to facilitate adaptation. One of the key issue is bringing village-level weather variations centre-stage because climate variations are highly localized. Prioritize on ecological farming practices as they reduce the contribution to climate change and help in adopting to the change. Understanding, the weather variations and adaptation with a gender lens is very important as the impact of the variations is high on them.

Keywords climate change, women, drought, agriculture, groundnut, village

Introduction

Anantapur in the west of Andhra Pradesh is one of India's poorest districts, ravaged by frequent droughts, characterized by low human development, wide gender disparity and considered a major centre for human trafficking. Agriculture is the main economic activity, 85 per cent of it in rainfed areas, with groundnut being the main crop. About two out of three people (64%, according to Census, 2011) are farmers, with a much higher proportion among women workers (75%) than among male workers (56%). The economy and well-being of its people is tied to availability of sufficient water for their agriculture.

The district lies is in the arid agro-ecological zone and is marked by hot arid bioclimatic condition with dry summers and mild winters. The geographical location of Anantapur district is such that it does not get the full benefit of either of the monsoons. The south-west monsoon gets cut off by the Western Ghats, while the full benefit of the north-east monsoon is not derived, either, as the district lies far from the eastern coastline. The district is in the rainshadow area and the normal rainfall ranges from 400 to 550 mm. In the wake of climate change, the traditionally wetter months of June and July are expected to receive less rainfall with marginally increased amounts of rainfall projected for the dry months of May, September and October (Bapuji Rao *et al.*, 2011). An analysis of monthly rain fall over ninety-four years—from 1911 to 2004—indicates an annual mean rainfall of 568.5 mm with a coefficient of variation (CV) of 28 per cent. That the coefficient of variation of rainfall is higher than the threshold level of 25 per cent for annual rainfall suggests variability and lower degree of dependability on rainfall in the district. In more than one-half of the years studied, the actual rainfall is below the annual mean rainfall of 568.5 mm. That is, fifty-one out of ninety-four years have experienced below mean rainfall in Anantapur district. Further, on average once in every five years, the district experiences drought conditions. Eighteen out of ninety-four years are classified as drought years, as the annual actual rainfall in these years has been 75 per cent below the annual mean rainfall of 568.5 mm. Fourteen out of these 18 years are moderate-drought years while four may be classiûed as severe-drought years (Rukmani and Manjula, 2009).

Since mid-1960s, groundnut has replaced millets and other pulses which were normally grown in this region. All these crops are labour intensive but groundnut in particular is dependent on human labour for weeding and harvesting, including threshing (Govindraj and Mishra, 2011). The increased dry spells and shifts in the rainy days had a severe impact resulting in crop losses and distress out-migration, especially of male farmers and youth.

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The weather variations observed at the microlevel (village) have differential impacts on the crop growth, gender-differentiated impacts on men and women farmers, including their coping mechanisms. This calls for building the knowledge and skills of women and men farmers to understand, monitor these micro variations and change their production practices to adapt to the changing weather. It also calls for a sharper focus on gender-differentiated vulnerabilities because men and women farmers face different challenges though women farmers, like male farmers, are equally responsible for providing food and water to their family members, often to the young and the old, in addition to discharging care duties. In this background the current study was taken up to document the weather variations at the micro level (village level), their impact on groundnut production, practices helping in adapting to the change and gender-based capabilities and vulnerabilities.

Methodology

The study was taken up in five villages Palabavi, Yettigadda, Veerapallypeta, Baththalapalli, Muthyalachervu within a radius of 5 km in Ananthpur District. Standard Rain gauges were established in each village and data was collected on a daily basis (Figure 1 and 2). Maximum and Minimum temperatures and Relative humidity were also collected on a daily basis using standard instruments installed in Stevenson's Screen.

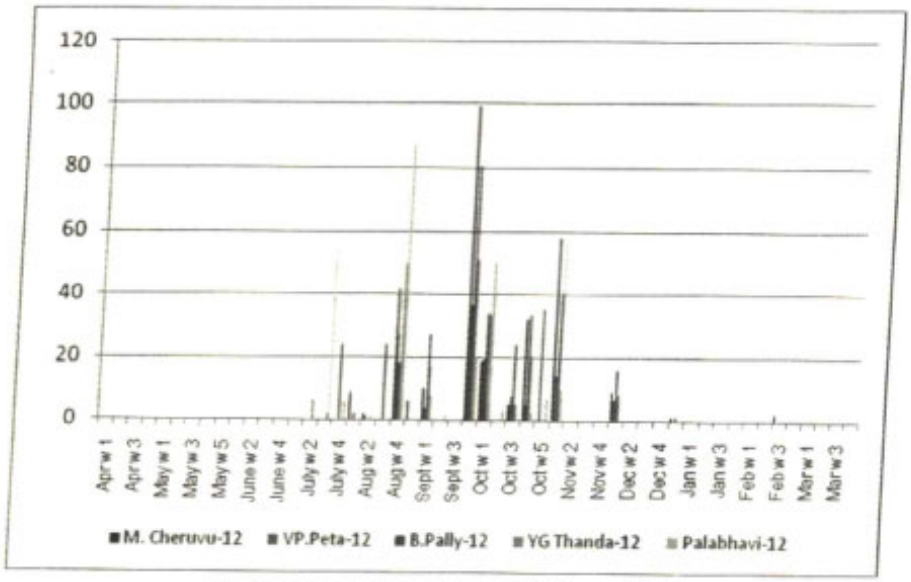

Figure 1 Rainfall analysis of all villages 2012
Source: Primary data collected for this study.

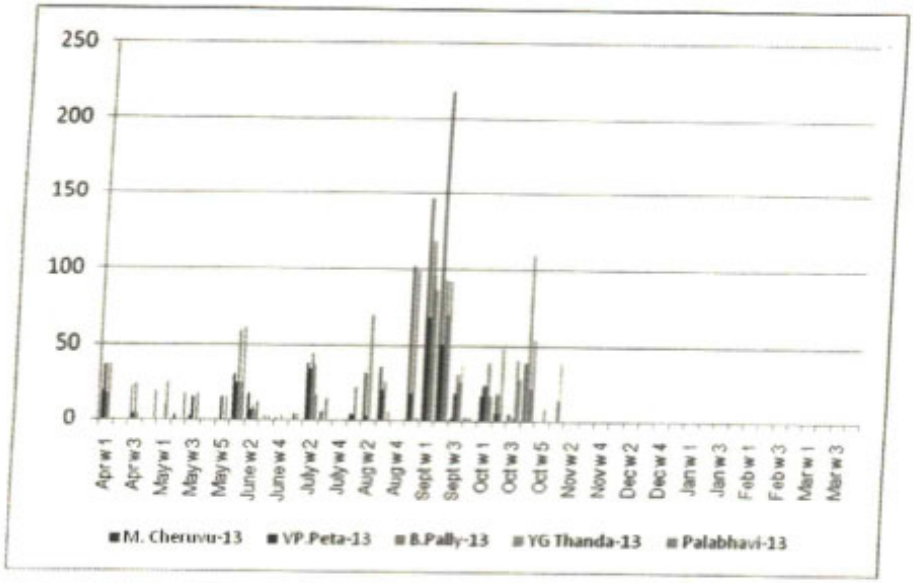

Figure 2 Rainfall Analysis of all villages 2013
Source: Primary data collected for this study.

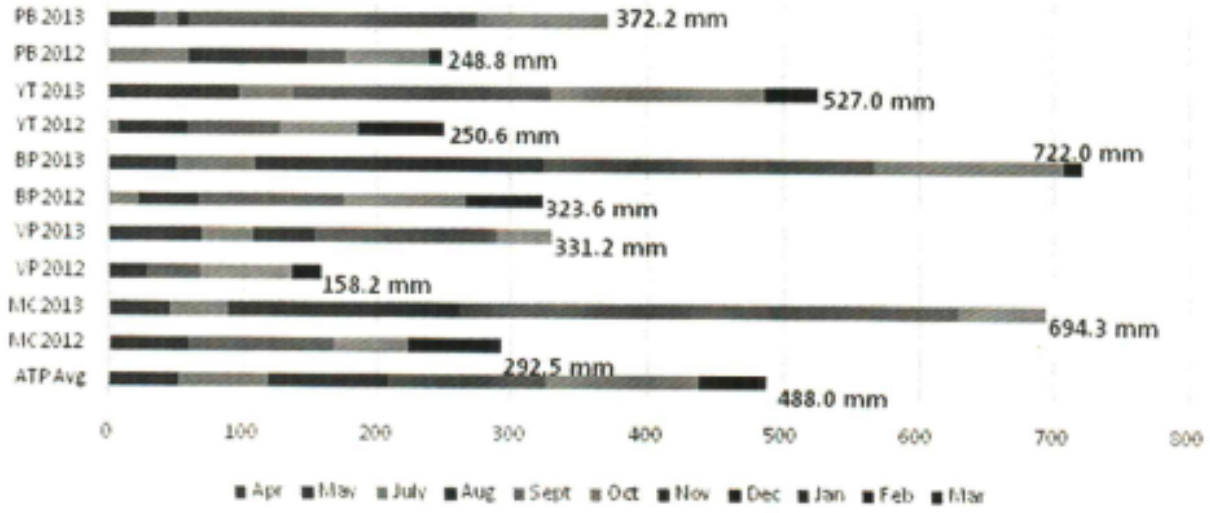

Figure 3 Rainfall Distribution across villages
Source: Primary data collected for this study.

The data on crop production practices, yields, pest and disease incidence were collected regularly with give farmers in each village.

The data was collected for three seasons Kharif 2013 and 2014 and Rabi 2013 and is analysed using simple statistical tools like means and represented through graphs.

A survey based on face-to-face interviews and group discussions was used to gather information regarding gender-based farming activities, income, decision-making, coping mechanisms and access to government benefits. Data was collected for 50 farmers, including 25 women farmers.

Results and Discussion

Wide temporal and spatial variation is observed in the rainfall. Rainfall variation is highly variable between villages and over time in the same village. As can be observed in the following graphs.

When compared with district average rainfall, variations were observed both in total rainfall and distribution of rainfall from Fig. 3 we can observe that the variation is very high between the villages.

The total average rainfall during 2012 and 2013 in Ananthpur District was 488 mm. The rainfall across villages varied from 158.2 mm to 323.6 mm during 2012 while during 2013 it ranged from 331.2 mm to 722.0 mm. In addition the distribution of rainfall during the season also varies widely between villages and seasons.

Table 1 shows the monthly distribution of rainfall. The data shows that rainfall is getting concentrated in September October. Delays in rainfall during 2012 in most of the villages has delayed the sowing of the crop. Reduction in yields were reported by farmers when the sowings were reported beyond 2nd week of July.

Reddy *et al.* (1984) noted much reduction in pod yields of groundnut due to delayed sowings (15th July, 30th July to August) due to reduction in number of pods per plant, 100 kernel weight and shelling percentage and also observed that the difference in pod yield of first and second fortnight sowings in the month of July was not much as compared to late sowing in August. Similar observations were reported by Usha Rani *et al* (1985) Freire *et al.* (1987) and Reddy *et al.* (1990).

Variations in Rainfall Distribution between Villages and Impact on Groundnut Crop

The rainfall distribution is also varying between seasons and villages. Figures 4 a–e show the variation in the rainfall observed during 2012 and 2013 in the five selected villages.

1. During 2012 rainfall was delayed in all the villages and the crop sowings were delayed till mid of July and the yields were slightly affected.
2. During 2013 the rainfall was normal but in Yetigaddathanda, the crop there was a prolonged dry spell (7 weeks) between July 3rd week to August 5th week (Fig 4b). The crop sown in the June 2nd and 3rd weeks got caught in severe dry spell. It was one of the most sensitive stages of the crop and impact on yields was very high. The pod yield reduced by more than 50 per cent. Kulkarni *et al.* (1988) also reported that plant biomass in groundnut was reduced to 50 per cent when stress was created after 30 and 45 days growth. Groundnut pod yield was severely reduced due to moisture stress at flowering than at other stages (Reddy *et al.*, 1980). Yield was drastically reduced in groundnut due to moisture stress at 9 to 13 weeks after sowing coinciding with peg and pod development (Balasubramanian and Yayock, 1981).

Table 1 Monthly rainfall (in mm) recorded across the villages 2012 and 2013

Month	ATP Normal rainfall	Muthyala Cheruvu		Veerepallypeta		Bathalapally		Yetigadda Thanda		Palabavi	
		2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Apr	12.0	0.0	40.3	0.0	40.0	0.0	40.2	0.0	40.0	0.0	19.20
May	40.0	0.0	5.0	0.0	30.4	0.0	10.4	0.0	57.0	0.0	17.00
July	67.0	0.0	43.0	0.0	37.6	23.8	58.8	8.2	41.0	60.8	16.20
Aug	89.0	58.5	173.4	28.4	45.4	43.8	214.2	51.2	0.0	86.6	8.40
Sept	118.0	109.0	368.0	40.4	136.4	107.4	243.4	68.0	191.4	29.0	213.60
Oct	111.0	56.0	64.6	68.2	41.4	91.2	140.8	59.0	157.6	62.6	97.80
Nov	35.0	58.0	0.0	14.2	0.0	40.4	14.2	56.0	40.0	9.8	0.00
Dec	10.0	9.0	0.0	7.0	0.0	17.0	0.0	8.2	0.0	0.0	0.00
Jan	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
Feb	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Mar	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
	488.0	292.5	694.3	158.2	331.2	323.6	722.0	250.6	527.0	248.8	372.20

Source: Primary data collected for this study.

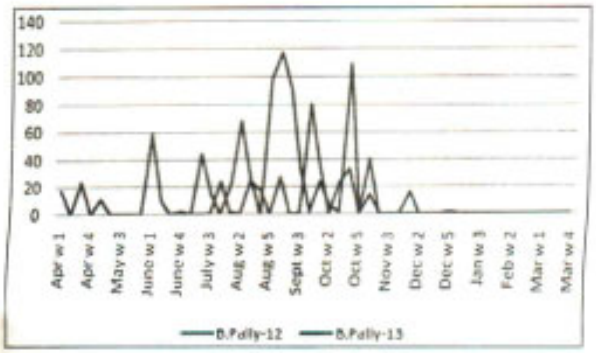

Figure 4a Bathalapally Village Rainfall analysis 2012 & 2013

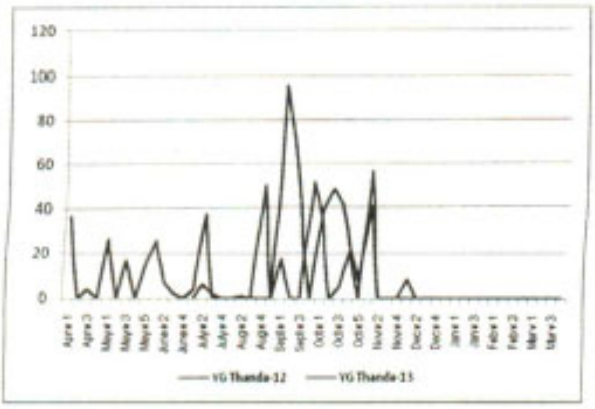

Figure 4c Y Gaddathanda Village Rainfall Analysis 2012 & 2013

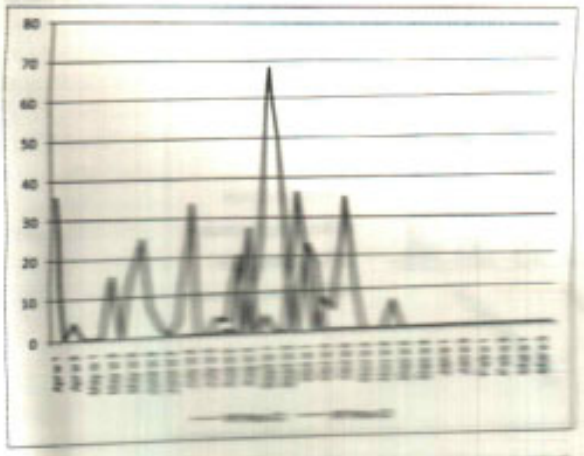

Figure 4b

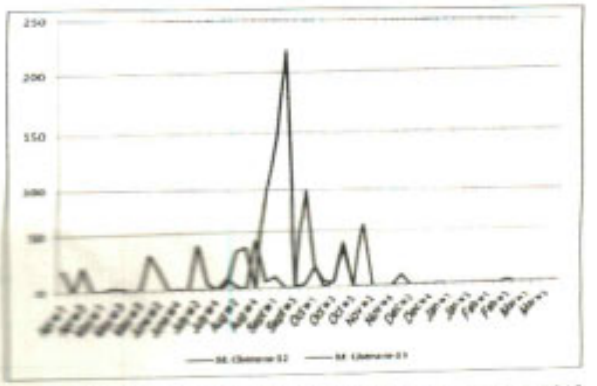

Figure 4d Mutyalacheruvu Village Rainfall Analysis 2012 & 2013

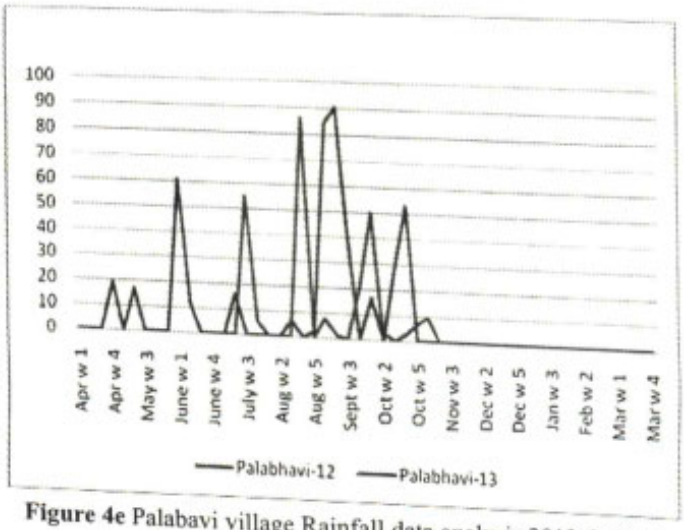

Figure 4e Palabavi village Rainfall data analysis 2012 & 2013

Gender-differentiated roles and impacts

In all the five villages, Fig. 5 shows that women's labour is dominant in the two key farming activities of weeding and threshing. Both weeding and threshing are highly dependent on rainfall patterns and the chart also shows the gender-based contrast in each of the five villages for these two main activities. In village Palabhavi, for instance, the initial dry months and then the onslaught of late rains led to a huge investment of women's labour in weeding. In Yetigaddathanda and Mutyalacheruvu, the poor yield led to higher male migration, resulting in a sharp increase in the proportion of women who undertook the threshing task. These links between women's work and erratic rainfall are seldom established by technical studies which only take into account crop yields.

Rainfall variations also lead to gender-differentiated coping strategies. Women constitute a larger proportion of farmers taking up farm-based wage labour in their village and in neighbouring villages and among those taking loans (Lambrou and Nelson, 2013). Male migration is higher, leading to an increase in resource-poor female-headed households trying to eke out a farm-based living. This study revealed that many women farmers took up work under the government's Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) for the first time following late rains, crop loss and male migration. While this gave them alternative means to earn a livelihoods, it also increased their workload. Domestic burden also increased with women needing to walk much longer, up to 3–4 km, for water in villages like Palabavi.

Conclusion

The rainfall variations and workloads of women farmers are wider even between villages which are in a radius of 5 km. Therefore, village level monitoring of weather variations becomes very important to manage the crops without being effected by the extremities. Village or hamlet has to be considered as a unit for monitoring the weather. This is very crucial for support systems like weather insurance. Currently weather stations and rain gauges are present only at the Mandal (blocks in Andhra Pradesh) level. The weather monitoring can be taken up by the community institutions at the village level. Weather insurance should especially target women farmers who invest much more of their labour in farming activities but cannot access insurance because they do not own the land they till. Rainfall variation is also observed within the same village between years. Therefore, one set of production practices or a single cropping pattern is not advisable. Women and men farmers must be trained to monitor the weather variations, plan the cropping patterns accordingly and take up some of the more resilient traditional crops like ragi and jowar, pulses like red gram and vegetables like tomatoes which farmers in this study grew as part of their coping strategies. Knowledge of critical stages of crop growth moisture conservation by building soil organic matter and/or planning for life saving irrigation would help farmers to adapt to the wild fluctuations in the rainfall.

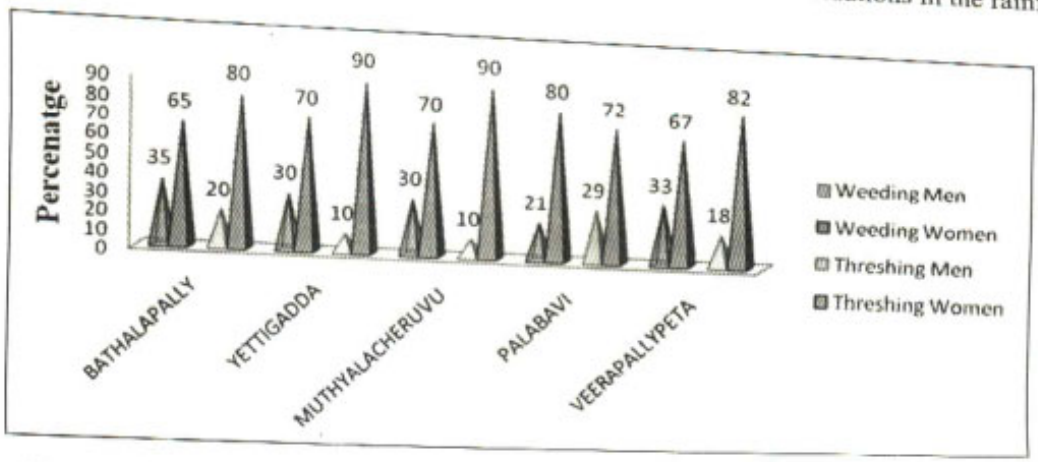

Figure 5 Village level gender segregation of gender roles in weeding and threshing for all farmers

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