

Original Research Article

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Spatial and Temporal Rainfall Variability of Sub Watershed in Deccan Plateau, India

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ABSTRACT

The local hydrological, agricultural and economic activities heavily depend on micro-level rainfall. Therefore, this study examines the variability of rain fall in Wargal sub watershed in Siddipet district, Telangana state of India. To study the rainfall variability within the study area of 15 sq km, 15 rain gauges were installed at different locations and data was collected during July and August months, 2009. The rainfall variability map was generated by using GIS software. The weather data was collected by installing the related instruments at Nagarjuna Innovation Centre, Wargal during Sep 2008. It was observed that relatively higher rainfall (310 to 340 mm) was received in areas around lower reach (*Kothakunta* and *Bitcherla kunta* tanks) and relatively lower rainfall (250 – 280 mm) was received in areas around upper reach (*Melakunta* and *Kadelakunta* tanks). The areas around middle of watershed (*Ausoloni kunta* and *Ayamgori kunta*) received relatively moderate rainfall (280 – 310 mm). The rain fall variation was greater in August than July months. During August month most of the rain fed crops of 90-110 days was in reproductive stage and any deficit cause variability yield in the same sub watershed as that observed in *Kothakunta* sub watershed.

Keywords

Rainfall, Rainfall intensity, Rain gauge, Rainfall variability, Sub watershed

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Introduction

Agriculture sector in India uses more than 80% of water. In India, of the total cultivated area only 34.5 % of the area is irrigated

contributing 60 % of food grain production. On the other hand, the rain fed area occupies 52 % of cropped area and contributing 40 % of food grain production. This is mainly due to variation in rain fall both time and space.

The water allocations towards agriculture will decrease as it has to compete with other sectors where returns are more. Hence, it becomes imperative to produce more food with less water, and to higher productivity from rain fed areas. That is, to increase agricultural water productivity particularly rainwater. There is a consensus that climate change has impacted agriculture (FAO, 2007; Mearns and Norton, 2009; Field, 2014 and Solomon *et al.*, 2007) and water is considered as a major means by which climate change affect the Earth's ecosystems. Further, the most important source of water for crop production and animal rearing is rainfall (FAO, 2007; Mearns and Norton, 2009).

In peninsular India, farmers cultivate cereals (maize, bajra, sorghum, finger millets, pulses (redgram, green gram, black gram and cowpea), oil seeds (sunflower, groundnut, til, castor) and vegetables (bhendi, brinjal, beans, potato, ridge guard, onion, bitter guard, and pea), cotton, fruit crops and other commercial crops. Precipitation shows spatio temporal differences at a regional and country level. Further, even in small water shed, the rainfall pattern may be different. Due to variability in rainfall the yield of same crop will be different from one part of village to the other part. This creates difficulty in developing local level recommendations. If the rainfall variability is known, it helps to identify agro-ecosystem-specific climate change adaptation strategies. Keeping this in view, an effort has been made to analyze the variability of rain fall in Wargal sub watershed in Siddipet district having 482 ha area near Hyderabad in Telangana state of India.

Materials and Methods

The Wargal village of Wargal mandal (administrative unit containing 18 villages) is located at latitude 17^o 41'19.4'' N, longitude 78^o 29'24.0'' E, and is 55 km from

Hyderabad at an elevation of 576-590 m above sea level in Siddipet district of Telangana. The geographical area of Wargal village is 2,618 ha with 2,522 ha cultivable land, of which 1,460 ha is rainfed, 167 ha under tank irrigation and 235 ha under bore wells. The soils of the village is mostly red chalka (Red sandy/sandy clay loams – Alfisols, 2,336 ha) and black cotton soils (Vertisols, 280 ha). The watershed area (about 15 sq km) selected for the study consists of mostly red soil. The physiography of the area is undulating having a slope of 1-5%, slight erosion, and moderately drained. The depth of the soil is shallow to medium having coarse to medium texture with a pH range of 6.5 to 7.5. The nitrogen and phosphorus content of the soil is low and potassium content is medium to high. The major amount of rainfall is received during the South-West monsoon and the normal rainfall is 773 mm.

The village is a cluster of 7 hamlets with one big village; there are 23 small to big tanks locally called as *kuntas* with a command area of 0.4 ha to 18.0 ha. Further, there are three big *kuntas* with an area of 21.42 – 27.32 ha. There are two tanks irrigating 47.2 and 119.04 ha. These small *kuntas* and tanks are interconnected one and another through drains forming water conservation structures. Further, most of the cultivated as well as waste land is draining into *kunta* or a tank.

From the 2618 ha of Wargal village, 482 ha sub-watershed under *Kothakunta* was selected as the study area. In the study area, there are 206 bore wells, the only source irrigating 192.91 ha. The major crops cultivated under bore wells include paddy, maize, vegetables (bhendi, brinjal, beans, potato, ridge guard, onion, bitter guard, and cowpea), cotton and sunflower. To study the rainfall variability within the study area, 15 rain guages were installed at different locations in farmers fields (Fig. 2) and data was collected during

July and August months, 2009. The rainfall variability map (Fig. 2) was generated using Arc GIS version 9.3 using simple kriging functions under spatial analyst tools.

The weather data was collected by installing the related instruments at Nagarjuna Innovation Centre, Wargal during Sept. 2008 and mean monthly data on maximum and minimum temperatures, evaporation, relative humidity and total rainfall. The rain fall data for the months of January to Sep 2008 were collected from the mandal office, Wargal. The *Kothakunta* tank was totally filled during *kharif* 2008 after a gap of nearly ten years. Rainfall distribution in different months during 2008 to 2011 at *Kothakunta* sub watershed, Wargal, was recorded. Peak rainfall was received during August month in first two years (2008 and 2009), whereas during 2010 and 2011 peak rainfall was recorded in July (Fig. 1).

Results and Discussion

Rainfall variability

The total rainfall received was 662.26, 489.03, 1081.5 and 579.2 mm during 2008, 2009, 2010 and 2011 respectively (Fig. 1). The rainfall data located at different places in the watershed from 15 rain gauges for two months during July and August months, 2009 ranged from 270 mm to 323 mm with a standard deviation of +/- 21.89 mm. The rainfall variability map (Fig. 2) indicated that rainfall received in July and August months ranged from 250 mm to 340 mm. The area was divided into three rainfall zones. It was observed that relatively higher rainfall (310 to 340 mm) was received in areas around *Kothakunta* and *Bitcherla kunta* tanks (lower reach) and relatively lower rainfall (250 – 280 mm) was received in areas around *Melakunta* and *Kadelakunta* tanks (Upper reach). The areas around *Ausoloni kunta* and *Ayamgori kunta* (middle of watershed) received

relatively moderate rainfall (280 – 310 mm). Kumar *et al.*, (2010) reported a declining trend of annual rainfall over central India and north-east India, and an increase in annual rainfall in other parts of India while analyzing rainfall data for the period 1871–2005.

In July the rainfall ranged from 52.4 - 64.75 mm with S.Ed+/- of 2.98 while in August it varied between 195.55 - 266.45 mm and a standard deviation of 21.34 (Table 1). It shows that rain fall variation was greater in August than July months. During August month, most of the rain fed crops of 90-110 days was in reproductive stage and any deficit cause variability yield in the same sub watershed as that observed in *Kothakunta* sub watershed.

Francis Ndamani and Tsunemi Watanab (2015) reported that in the Lawra district of the Upper West Region of Ghana there was moderate seasonal and irregular annual rainfall concentration and the annual rainfall and crop production were negative for all the crops studied. The seasonal rainfall was negatively correlated in case of sorghum, millet and groundnut. Our results indicate that identifying and implementing appropriate adaptation techniques at farm level is essential for obtaining higher production of crops.

In conclusion, the analysis of the rainfall data collected at different places in the watershed from 15 rains during July and August months, 2009 shows that the monsoon season received a good amount of rainfall due to the south-west monsoon. There was variation in rainfall within the village of 15 km² and it ranged from 250 mm to 340 mm in July and August months. The rain fall variation was greater in August than that in July months. These results indicate the need for adoption of proper cropping system within the watershed by taking in to consideration of rainfall variation in different farms.

Table.1 Rainfall variability at 15 locations during peak rainy months (July and August) in *kharif* 2009 Kothakunta subwatershed, Wargal

| S.No | Farmer Name | Latitude | Longitude | Rainfall (mm) | | Total rainfall (mm) |
|--------------|----------------|-----------|-----------|---------------|-----------------|---------------------|
| | | | | July, 2009 | August,2009 | |
| 1 | G.Bikshapathi | 17°45.374 | 78°37.84 | 59.75 | 248.00 | 307.75 |
| 2 | E.Sataiah | 17°45.307 | 78°37.999 | 58.95 | 221.75 | 280.70 |
| 3 | T.Yadagiri | 17°45.298 | 78°37.072 | 63.80 | 250.00 | 313.80 |
| 4 | G.Usaiah | 17°45.444 | 78°37.985 | 61.25 | 195.55 | 256.80 |
| 5 | Ch.Posaiah | 17°45.556 | 78°37.192 | 60.75 | 255.65 | 316.40 |
| 6 | T.Chandragiri | 17°45.457 | 78°37.429 | 60.00 | 251.15 | 311.15 |
| 7 | L.Yadaiah | 17°45.308 | 78°37.527 | 52.40 | 247.35 | 299.75 |
| 8 | Ch.Jahimgiri | 17°45.56 | 78°37.495 | 56.80 | 213.15 | 269.95 |
| 9 | Ch.Narsaiah | 17°45.828 | 78°37.692 | 64.75 | 275.00 | 339.75 |
| 10 | E.Kishtaiah | 17°45.712 | 78°37.783 | 57.00 | 241.10 | 298.10 |
| 11 | E.Ramachandran | 17°45.211 | 78°38.001 | 58.50 | 260.95 | 319.45 |
| 12 | G.kanakaraju | 17°45.438 | 78°37.834 | 57.50 | 266.45 | 323.95 |
| 13 | Kommusailu | 17°45.296 | 78°37.919 | 57.20 | 266.25 | 323.45 |
| 14 | G.Lingam | 17°45.282 | 78°37.857 | 58.25 | 240.20 | 298.45 |
| 15 | G.Yallaiah | 17°46.121 | 78°37.694 | 58.75 | 235.85 | 294.60 |
| Range | | | | 52.4 - 64.75 | 195.55 - 266.45 | 269.95 - 323.95 |
| SD+/- | | | | 2.98 | 21.34 | 21.89 |

Fig.1 Rainfall distribution in different months during 2008, 2009, 2010 and 2011 at *Kothakunta* sub watershed Wargal

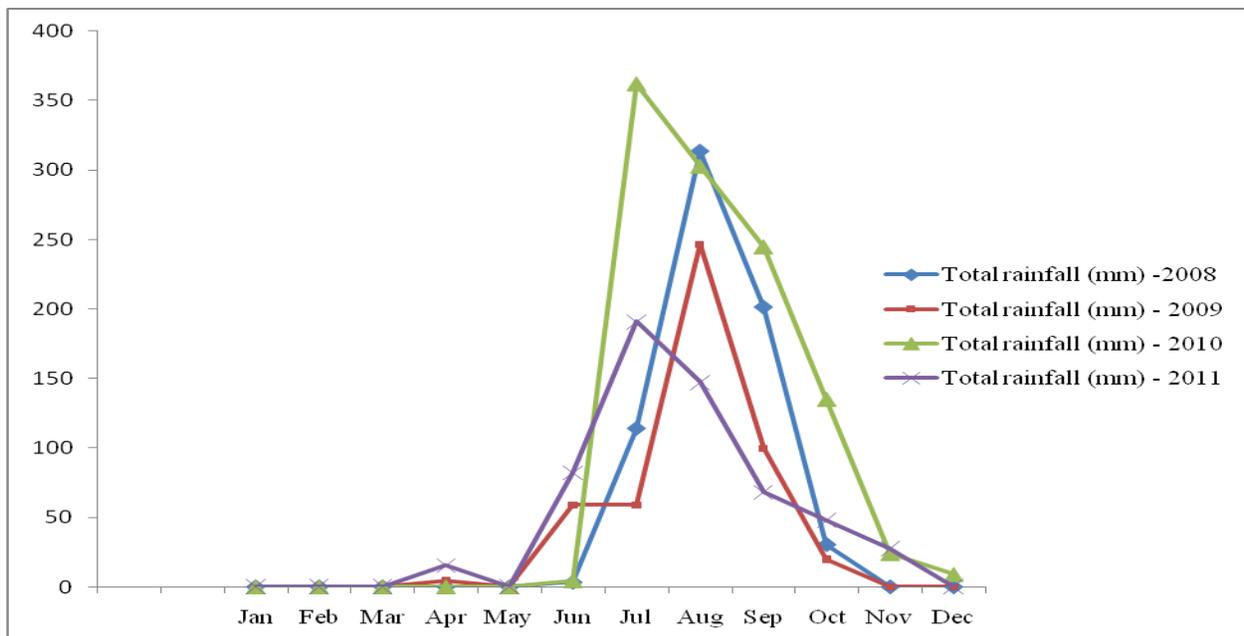
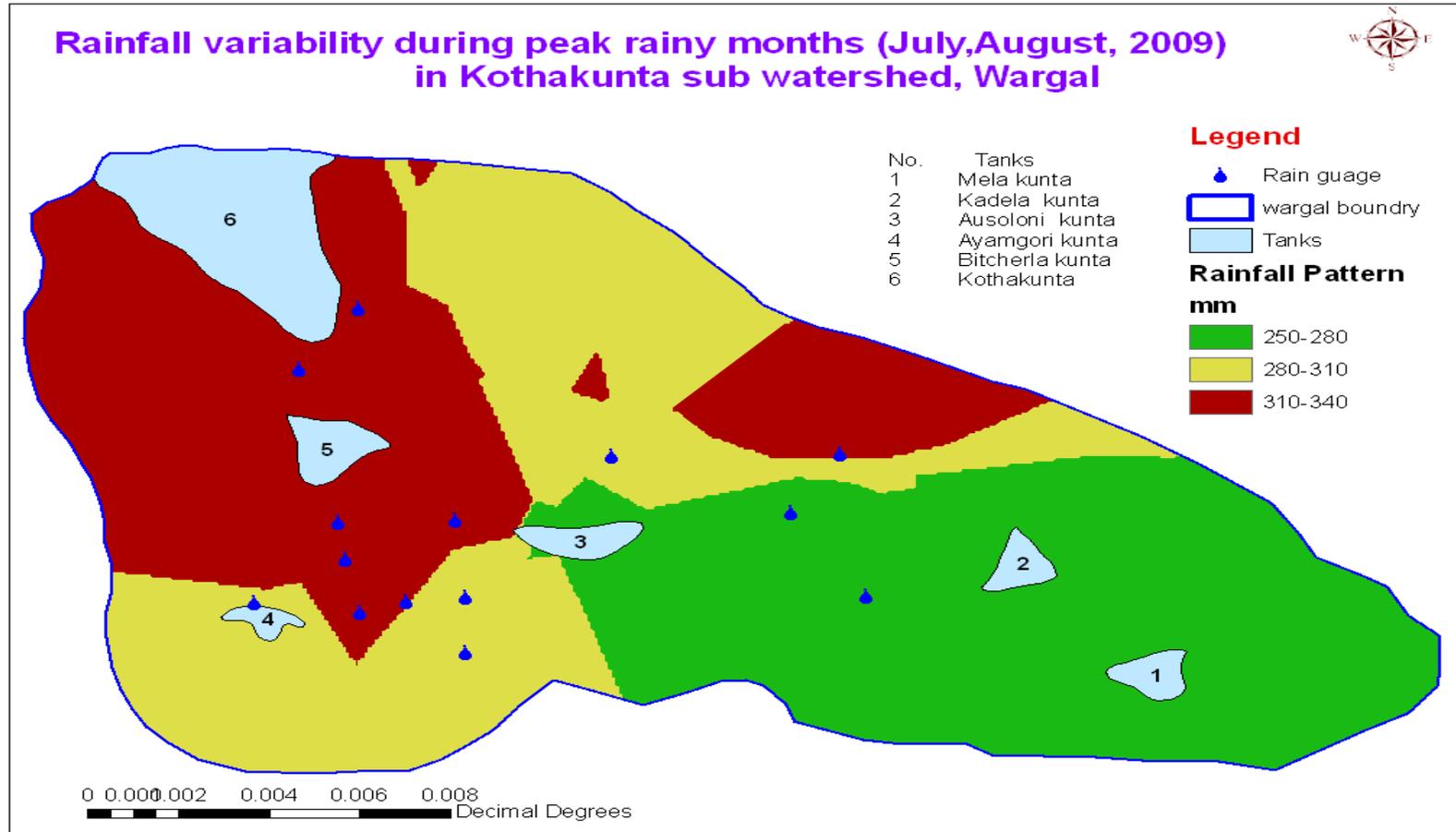


Fig.2 Rain fall variability (Range) during peak rainy months in *Kothakunta* Sub watershed, Wargal



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