# International Journal of Environmental Sciences

*(A peer reviewed International Journal)*


## Spatial and Temporal Changes in Rainfall Patterns in Coffee Landscape of Kodagu, India


*International Journal of Environmental Sciences, Vol. 1 No. 3. pp. 168-172. 2277-1948. 2012*

ISSN *2277 – 1948*

Article type *Full Length Research Article*

Submission date *01 May 2012*

Acceptance date *30 June 2012*

Publication date *15 July 2012*

Article URL *http://www.crdeep.org/category/ijes*



Authors *Sachin Kumar M.D.,* [i] ** Maruti Gurav,* [1] *Kushalappa C. G. .,* [1] *and Philippe Vaast* [2]





Center for Rural Development, Ecology and Environment Protection

CRDEEP Head Office:315/10, Kaulagarh Road, Rajendrnagar,

Inder Vihar, Dehradun, 248001, Uttrakhand, India.

***International Journal of Environmental Sciences Vol. 1 No. 3. 2012. Pp. 168-172***


***Full Length Research Paper***

# Spatial and Temporal Changes in Rainfall Patterns in Coffee Landscape of Kodagu, India

**Sachin Kumar M.D., [ii]* Maruti Gurav, [1] Kushalappa C. G. ., [1] and Philippe Vaast [2]**

[1]*Department of Forest Biology and Tree Improvement, College of Forestry Ponnampet, University of Agricultural Sciences Bangaolre, - 571216.*
[2]*General coordinator, CAFNET,CIRAD, 2 place Viala - Bât. 12, 34060 Montpellier cedex 2, France.*

****Corresponding Author: Sachin Kumar M.D***

**Abstract**
As Kodagu is dominated by agricultural land, essentially coffee agroforestry that cover around 30% of the total area of the district. Rainfall is very important factor for coffee flowering and production. Therefore, this study investigated the temporal dynamics of rainfall and its spatial distribution within Cauvery watershed area, in Kodagu, India, under the CAFNET project funded by European Union. The Cauvery watershed area was delineated using the Shutter Radar Topological Mission (SRTM) data in the district. The analysis was done based on the valuable data obtained from over 80 farmers that have registered rainfall data for decades in the Cauvery watershed of Kodagu, India, indicate that: There is a strong fluctuation of annual rainfall with an apparent cycle of 12-14 years. From this apparent cycle, it can be predicted that the rainfall is likely to be lower in the coming years to very low level in 2014 to 2016 in Kodagu district. The length of the rainy season has been decreasing by 12 days over the last 30 years.

***Keywords:*** *Monsoon, Coffee, Cauvery watershed, Western Ghats, Rainfall gradient and Rainfall Pattern.*

## Introduction

Kodagu district has 81.40 per cent of its landscape under tree cover, and is one of the densely forested districts in India (FSI, 2009). Kodagu is dominated by agricultural land, essentially coffee agroforestry that cover around 30% of the total area of the district. Kodagu district is the largest coffee growing region in India producing about 38% of India's coffee with the production area concentrated in the Western Ghats, one of the world's hot spot of biodiversity. Coffee is one of the most environmental friendly crop compared to many other plantation or agriculture crops since it is not only shade grown but also helps in protecting the forests around by providing fuelwood and timber which otherwise would have to be taken from natural forests. Over the last 30 years, in response to external market driven economies, intensification of coffee cultivation has led to the loss of 30 per cent tree cover in the district (Garcia *et al.,* 2007).

Western Ghats has typical tropical climate characterized by medium to high humidity, heavy rainfall and cool summer. The most important climate characteristics of Kodagu district is the strong rainfall gradient with annual rainfall decreasing in less than 50 km from over 5000 mm in the Evergreen Western part to 1200 mm in the Moist Deciduous Eastern part. A major part of the year consists of rainy season as the monsoon period starting in June lasts till the ends of September. Even during the post monsoon months of October and November certain parts of the district receive a significant amount of rainfall. Because of the cloudy weather, the day would be quite sultry during October and it is only during the second half of the November that the weather becomes brighter (Hunse, 2007).

Rainfall is a randomly distributed hydrologic event. It varies with space and time. The knowledge of total rainfall and its distribution pattern round the year of a place is very important for better crop planning, determining irrigation and drainage requirements of crops, design and construction of hydrologic structures etc. Some studies have suggested the use of daily, weekly, monthly, seasonal and annual rainfall distributions for crop planning.

Rainfall is of course very important for coffee flowering and production. Many farmers interviewed by the CAFNET team in Kodagu, India are certain that rainfall has changed over the last decades and that it is affecting their coffee production.

Local stakeholders are also becoming more and more aware of the importance of the Western Ghats region in terms of water provision as all the main rivers providing water for urban centres and agriculture in Southern India all originate from the coffee areas of this region.

In present study therefore, an attempt has been made to evaluate the rainfall distribution pattern of Cauvery watershed, in Kodagu. The prediction of rainfall distribution at different recurrence intervals was done in this study.

## Materials and Methods

Rainfall over Western Ghats region is governed by its tropical location as well as by the monsoonal regime and thus has a strong seasonal variation in the rainfall pattern. The rainy season is termed as south-west monsoon which

concentrates annual rainfall into a short period of 5-6 months (June to October).

The study was conducted during 2010 in Cauvery watershed, in Kodagu, India. The Shutter Radar Topological Mission (SRTM) data was used to delineate the Cauvery watersheds of the district under the CAFNET project funded by European Union (Fig. 1).

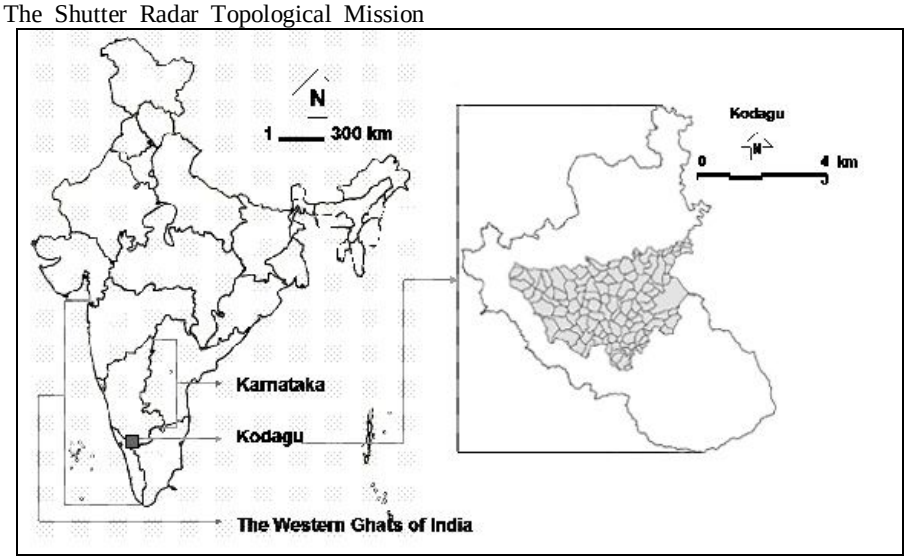


**Fig. 1.** Map showing Cauvery watershed, of the Kodagu, Karnataka, India.

Many farmers were thoroughly interviewed about the change in rainfall distribution pattern in the past decades, and the data was collected for about 60 years in collaboration of over 80 farmers spread all over Cauvery watershed of Kodagu. The geographic positions were recorded for places of rainfall data registered by farmers for decades were also recorded and used for analysis. It is important to emphasize that rainfall data were collected every rainy day for over 35 to 40 years in some of these farms.

## Results and Discussion

The data gathered from farmers for over decades showed that in general, the southwest monsoon sets during end of May to beginning of June. The June, July and August months are of heavy rainfall and the precipitation in July is incessant and very heavy. The average annual rainfall for the district (1975-2010) is 2528.92 mm and the number of rainy days ranges between 84 and 148, with an average of about 109 rainy days in a year. Results are similar to the previous analysis of the last 10 years (1997-2006) in Kodagu (Hunse, 2007).

Figure 2 shows the results of the data gathered from farmers, which shows the distribution of rainfall over the entire Cauvery watershed area of Kodagu. As indicated by Hunse (2007) there is an orographic influence on rainfall which is responsible for the spatial distribution pattern. Therefore, the rainfall is found to go on decreasing as one proceeds from the western part of the district to the eastern part. As shown in Figure 2 the rainfall shown that there is a very strong annual rainfall gradient in less than 50 km in the Cauvery watershed, the central watershed of the Kodagu district. Indeed, annual rainfall decreases very rapidly from the Evergreen Western zone (Zone 1), very wet with 5000-4000 mm/year to the West-Central Zone (Zone 2) with 4000-3000 mm/year to the West-Central Zone (Zone 3) with 3000-2000 mm/year and to the drier zone, the Moist Deciduous Eastern zone (Zone 4) with 2000-1200 mm/year.

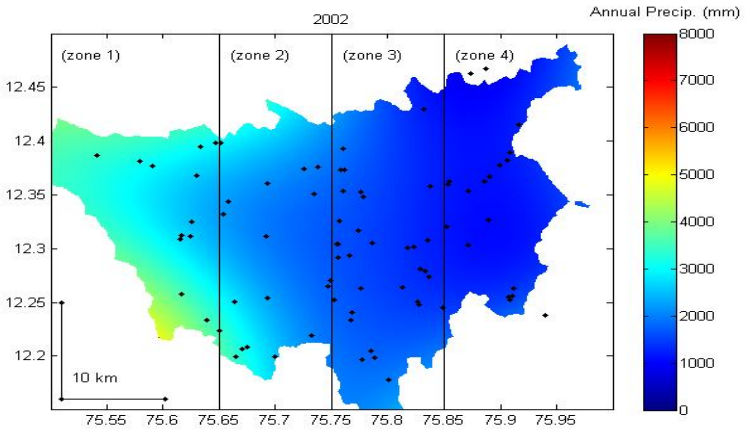


**Fig. 2:** Geographic position of the farms where daily rainfall data were collected by farmers for 60 years and map of rainfall distribution generated with these data as an example for the year 2002.

The results also shows that there is a strong fluctuation of annual rainfall with an apparent cycle of 12-14 years (Fig.3A & B) and with the 4 zones behaving similarly (Fig.3C) similarly Suresh, *et al.* (2004.) have observed the strong fluctuation of annual rainfall at 25 years recurrence intervals in Patna, Bihar. When the monsoon is very strong, all 4 zones have heavy rainfall like in the years 1982, 1994 & 2008. When the monsoon is weaker, all 4 zones have lower rainfall like in the years 1986 & 2002. Similarly Hunse, (2007) have also observer the lower rainfall during the years 2001, 2002 and 2003 in Kodagu. Figure 3A & B shows that there are years of heavy rainfalls such as 1997 where annual rainfall goes up to 7000 mm/year in the West and 2500 mm/year in the East, but there are also years of low rainfall such as 2002 where annual rainfall goes down to 3500 mm/year in the West and less than 1000 mm/year in the East. From this apparent cycle, it can be predicted that the rainfall is likely to be lower in the coming years to a very low level in 2014 to 2016.

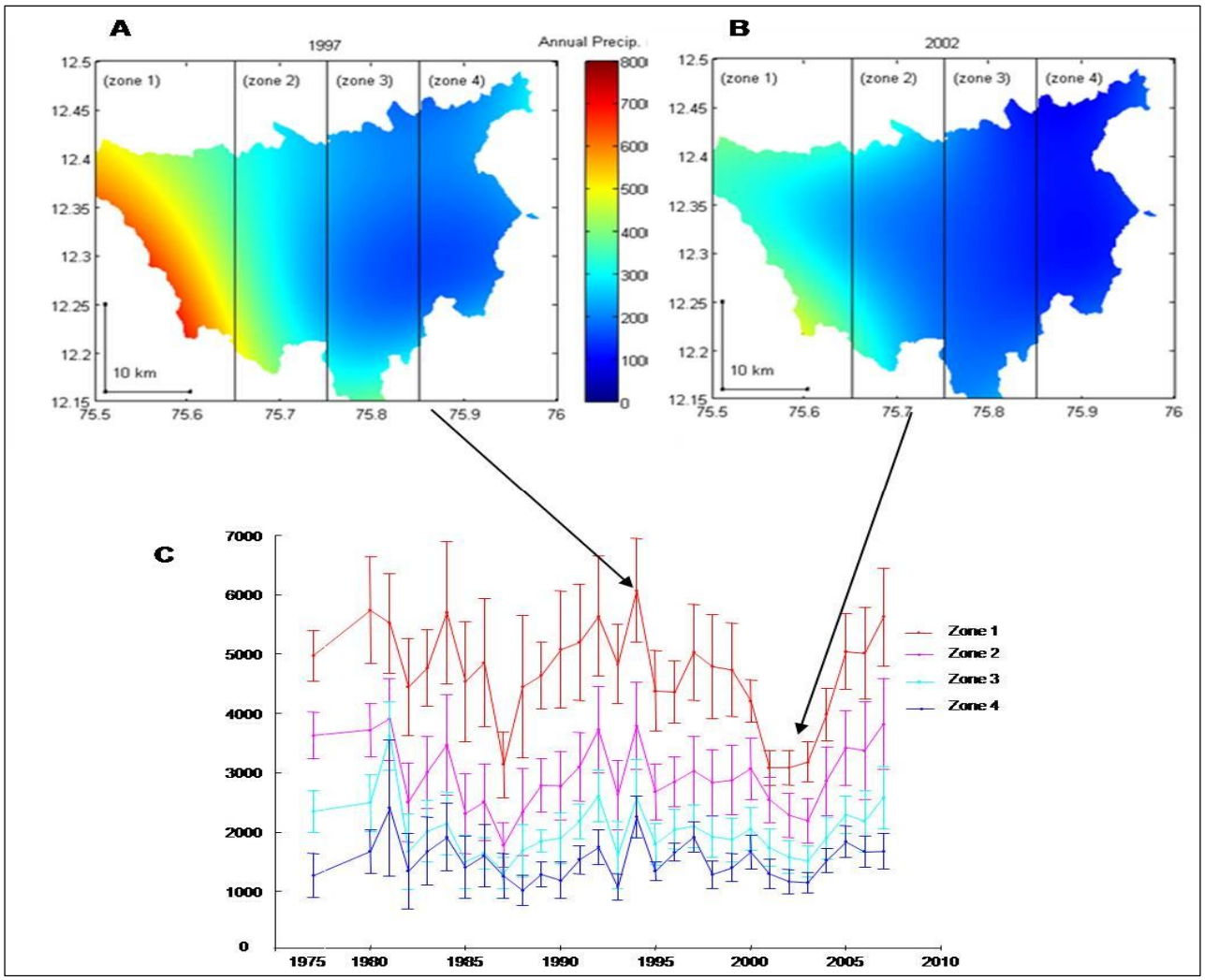


**Fig. 3:** Rainfall distribution in the Cauvery watershed for a year of (A) heavy rainfall (1997) versus a year of (B) low rainfall (2002) and (C) Annual rainfall pattern of the 4 zones of the Cauvery watershed over the last 30 years.

The southwest monsoon sets in usually during the early part of June (Hunse, 2007). But our results show that the day of the beginning of the rainy season is fluctuating a lot from one year to the next and is situated at around day 145 (i.e. May 25$^{th}$). The analysis shows that on average the start of the rainy season has changed very little since 1975 at the rate of 0.05 day per year, and hence the rainy season starts on average only by one day late after 20 years (Fig 4A).

The persual of results showed that the last day of the rainy season is also fluctuating a lot from one year to the next and situated around day 315 (November 10$^{th}$). More importantly, the analysis shows that the last day of rain is coming earlier year after year since 1975 at the rate of 0.35 day per year, and hence 10 days earlier after 30 years (Fig 4B).

Though Indian monsoon rainfall as a whole does not show any significant trend, significant rainfall trends are observed over some specific areas (Guhathakurta and Rajeevan, 2006).

Present study brings out one of the interesting and also important changes in the rainfall pattern of the district. The results showed that the average length of the rainy season has been decreasing over the last 35 years (1975-2010) at the rate of 0.4 day per year, and hence the rainy season has shortened on average by 12 days over the last 30 years (Fig 4C).

## Conclusion

The analysis done based on the valuable data obtained from over 80 farmers that have registered rainfall data for decades in the Cauvery watershed of Kodagu, India, indicates that:

There is a strong fluctuation of annual rainfall with an apparent cycle of 12-14 years. From this apparent cycle, it can be predicted that the rainfall is likely to be lower in the coming years to very low level in 2014 to 2016. The length of the rainy season has been decreasing by 12 days over the last 30 years

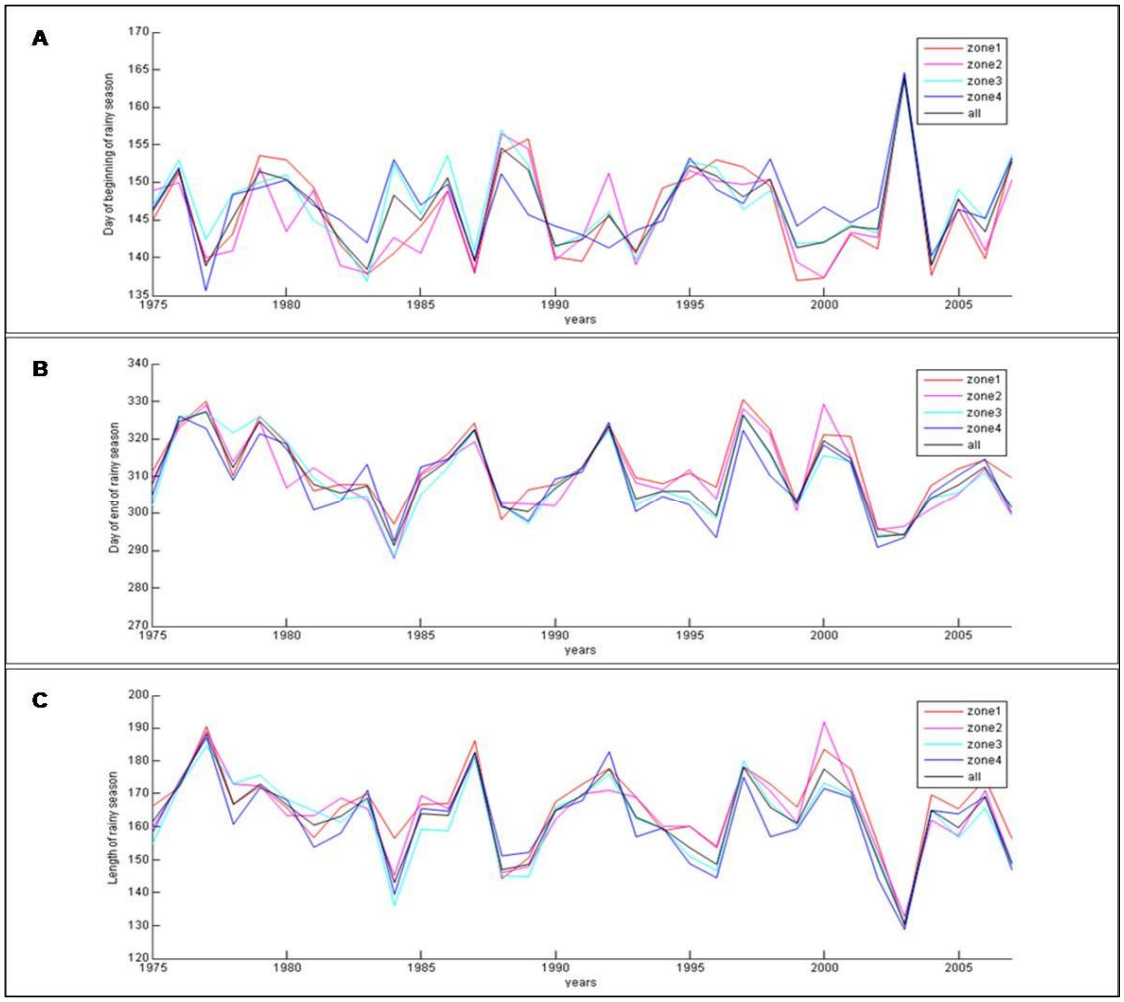


**Fig. 4:** Fluctuation in (A) the date of the beginning of the rainy season, (B) the date of the end of the rainy season and (C) the length of the rainy season over the last 3 decades in the Cauvery watershed, of Kodagu, Karnataka, India.

## Acknowledgements

We are thankful to collaboration of over 80 farmers from Cauvery watershed of Kodagu, for sharing there valuable rainfall data for this study and also we are thankful to the CAFNET project, India, funded by European Union, for the financial assistance in conducting this study.

## References

FSI. (2009) Forest Survey of India, *India State of Forest Report*. Ministry of Environment & Forests, Government of India, Dehradun. www.envfor.nic.in. accessed on 22.01.2010.

Garcia, C., Marie-Vivien, D., Kushalappa, C. G., Chengappa, P. G. and Nanaya, K.M. (2007) Geographical Indications and Biodiversity in the Western Ghats: Can labelling benefit producers and the environment in a mountain agroforestry landscape?. *Mountain Research and Development*, **27** (3): 206-210.

Guhathakurta, P. and Rajeevan, M. (2006) Trends in the rainfall pattern over India National Climate Centre India Meteorological Department PUNE. INDIA.

Hunse, T.M. (2007) *Ground water information booklet kodagu district, Karnataka*. Government of India

Ministry of Water Resources Central Ground Water Board.

Suresh, R., Mishra, V.K. and Singh, S.N. (2004) Evaluation of Rainfall Distribution Pattern of Patna, Bihar. *Indian Journal of Agriculture Research.* **38** (2): 139 – 142.