Changes of South west monsoon in Western Ghats and its environmental impacts in Devala, Pandalur Taluk, Nilgiris District, Tamil Nadu, India

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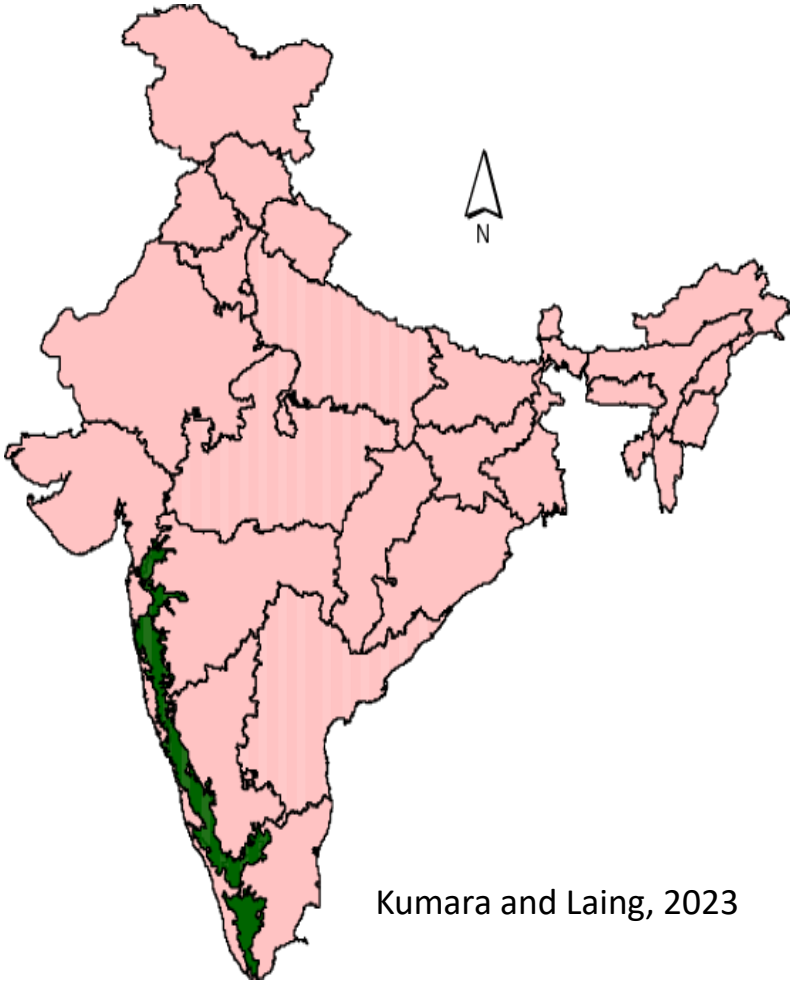
INTRODUCTION

- Western Ghats (WG) in India are internationally recognized as a world's eight 'hottest hotspots' of biological diversity along with Sri Lanka.
- The western Ghats covers approximately 1,600 km through the states of Gujarat, Maharashtra, Karnataka, Goa, Kerala and Tamil Nadu.
- The Western Ghats (WG) is a mountain range oriented north–south with a narrow zonal width and a steep rising western face.
- The Nilgiris from Tamil Nadu, Wayanad and Idukki from Kerala are fully in the Western Ghats region.



Kumara and Laing, 2023

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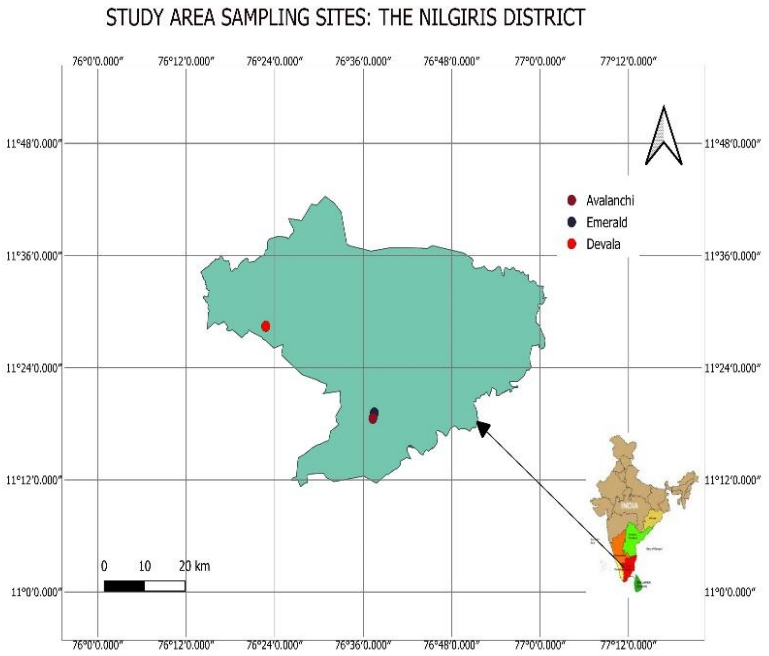
- The rainfall during the southwest monsoons months (June–September).
- The southwest monsoon in Indian subcontinent is characterized by significant rainfall that contributes about 850mm-925mm (75–90%) of the total annual rainfall in India (IMD, 2022).
- The peak rainfall occurs mostly in the side of upstream flow of westerlies, in the areas of low elevation, in particular below 200 m.

Species	No of Biodiversity
Flowering Plants	7402
Non flowering plants	1814
Insects	6000
Mammals	139
Amphibian	179
Reptile	227
Fresh water species	290

STUDY AREA SAMPLING SITE

- Daily gridded IMD (India Meteorological Department, Pune) rainfall data with a spatial resolution of 0.25° latitude × 0.25° longitude for a period from 1981 to 2022 are used for this study.
- Different location of rain gauge data of Devala (11.47235N- 76.381535 E), Avalanchi (11.30365N- 76.579926E), Emerald (11.32059N- 76.57992E) considered for making this gridded data (.
- NASA POWER precipitation data is utilized (https://power.larc.nasa.gov/data-access-viewer/) for the specific coordination for data validation.
- Missing data analysis and data gap filling is carried out using IBM SPSS statistical tool. (Rajeevan et al. 2006; Rajeevan and Bhate 2009; Pai et al. 2014).



INTEGRATED TREND ANALYSIS (ITA) FOR PRECIPITATION TREND (TIME SERIES)

- Sen (1968) slope estimator is a powerful tool to develop the linear relationships.
- Sen's slope has the advantage over the slope of regression, in the sense that gross data series errors and outliers do not affect in much.
- The slope of the Sen was determined to be the mean of all pair-wise slopes for any pair of points in the dataset.

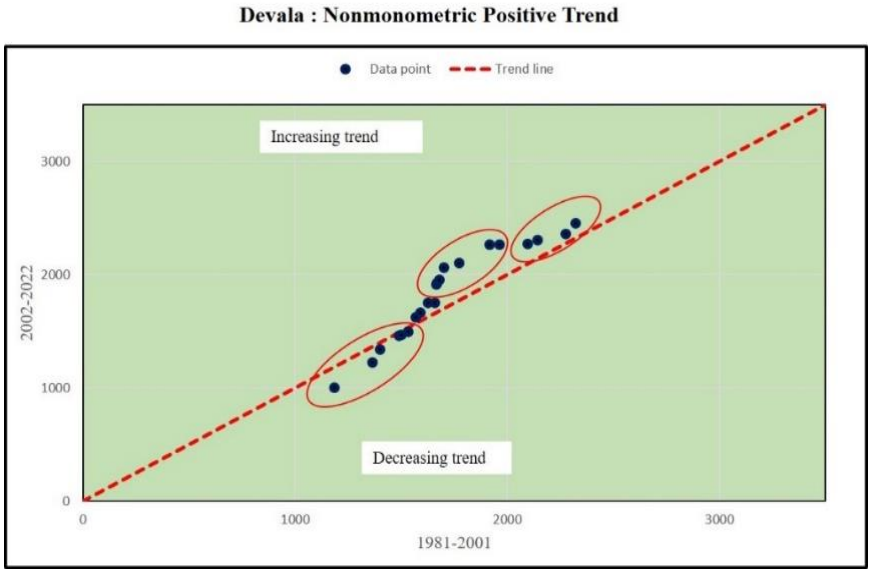
$$\text{Sen's Slope } (S_1) = \frac{2(m_2 - m_1)}{n} \qquad B = 1/n \sum_{i=1}^{n} 10\,(x_j - x_k)/x$$

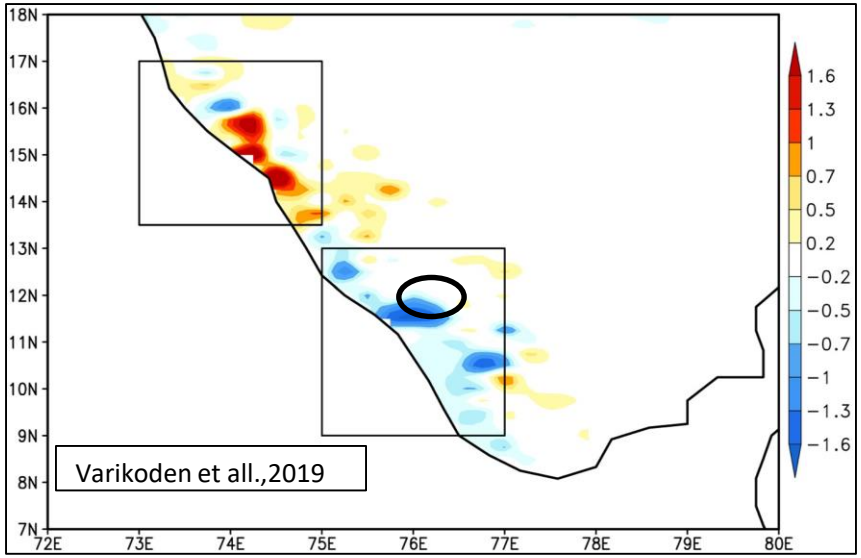
m_2 – Second half (2002-2022)

m_1 – First half (1981-2001)

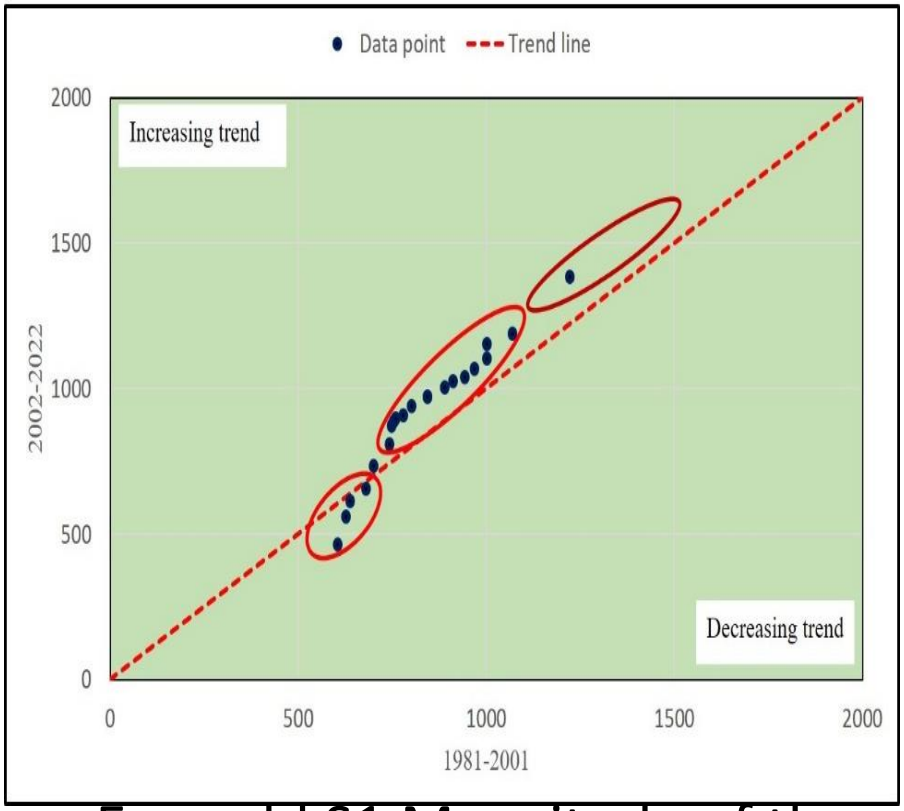
Changes of rainfall pattern and Intensity in Devala study area

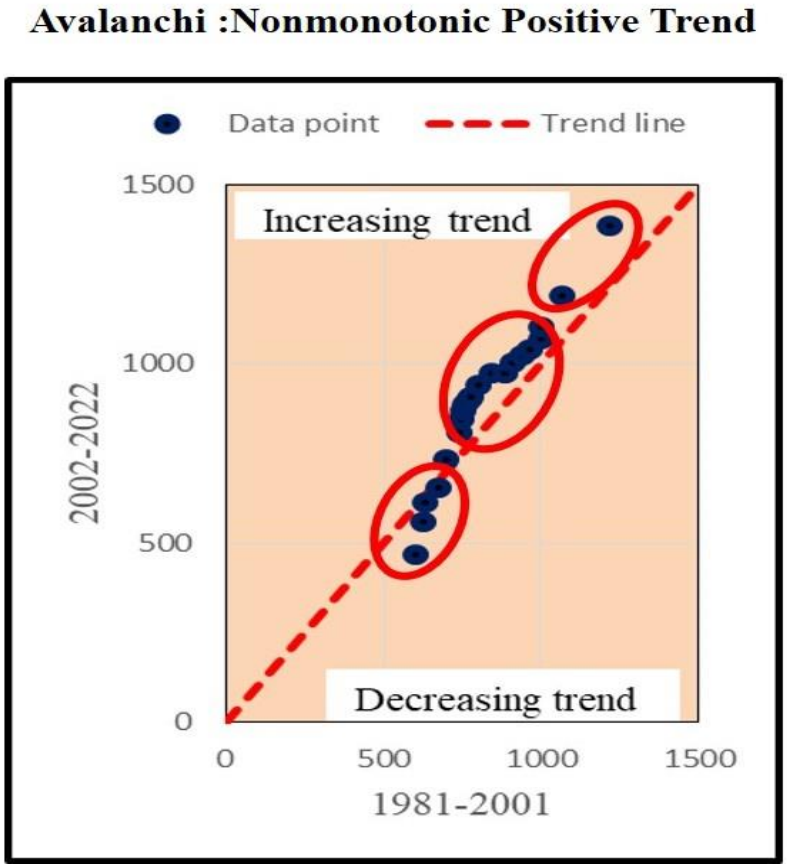
- According to Varikden (2019) the trends in Indian monsoon trend in the WG region for the 1931–2015 period showed a negative trend in the southern and positive trend in the northern regions during the period.
- Innovative trend analysis (ITA) : Sen's slope Magnitude of the slope (S_1) : 10.95 mm of rain per year increased over the period and B=0.36 mm per year.





Changes of rainfall pattern and Intensity in Emerald and Avalanchi



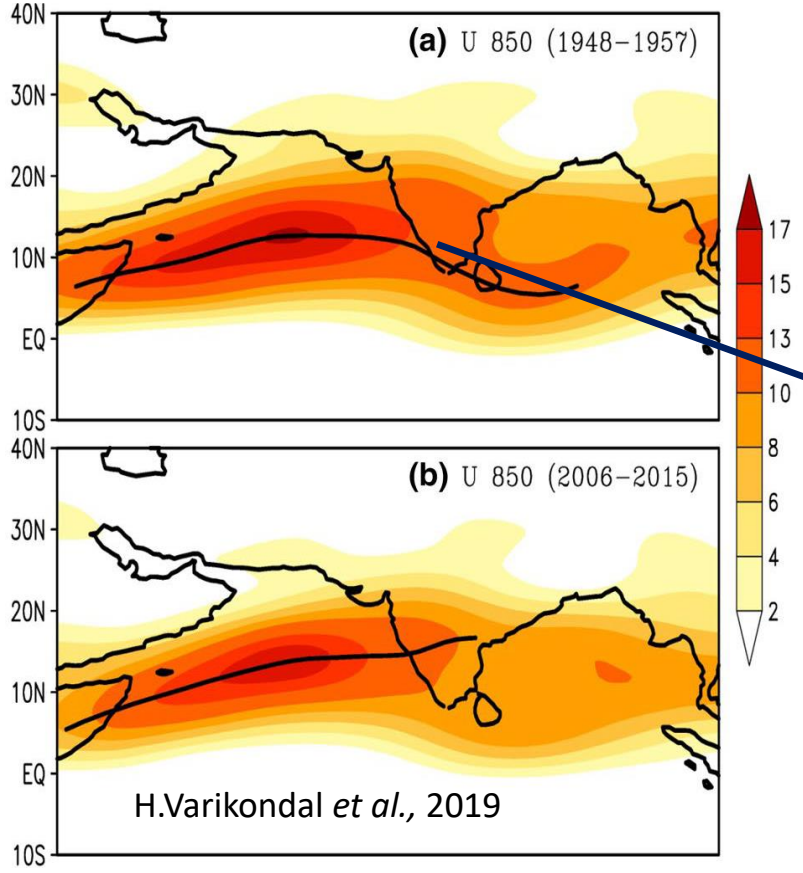


- Emerald S1 Magnitude of the slope (S_1)= 10.95 mm per year
- B=0.36 mm per year

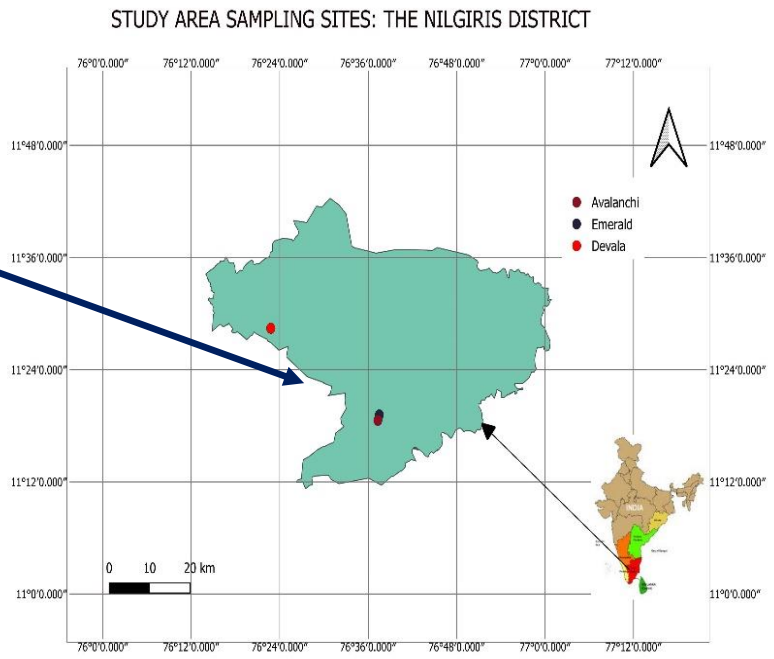
Avalanchi Magnitude of slope (S1)= 6.5 mm per year

B= 0.43mm per year

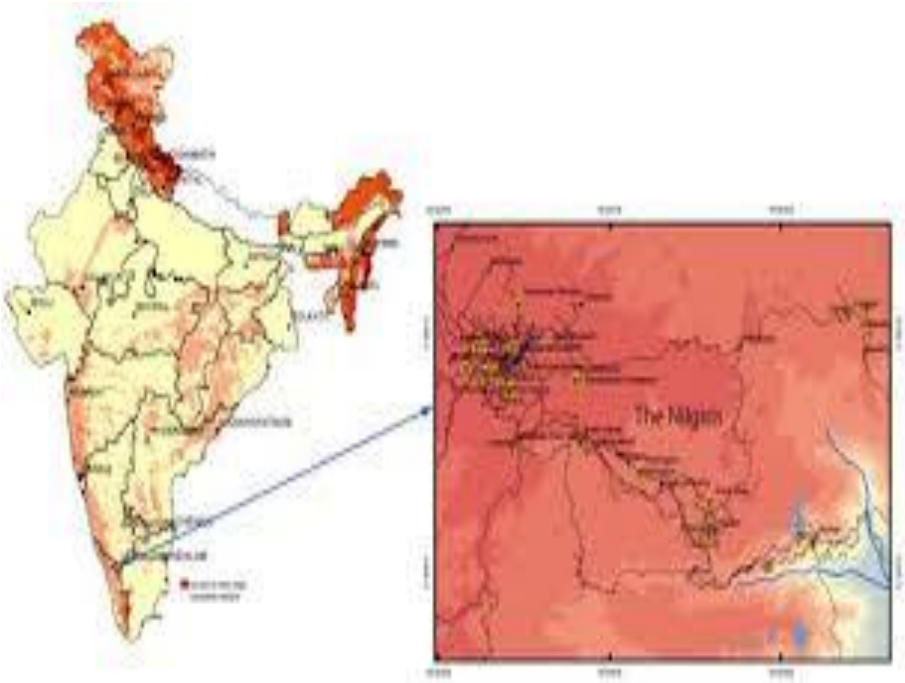
WIND PATTERN OF WESTERN GHATS (1948-1957, 2006-2015)

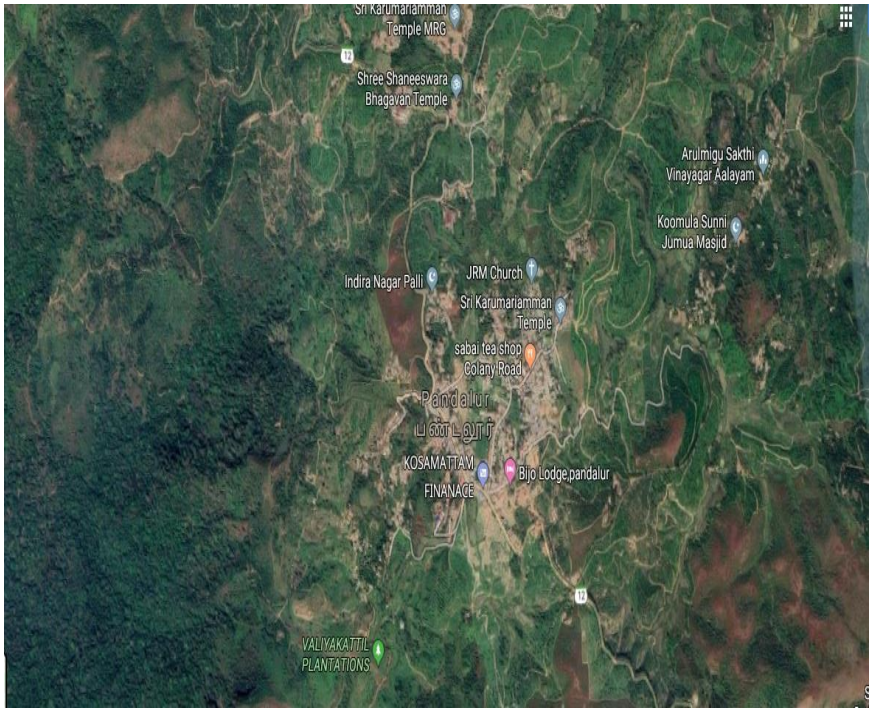


H.Varikondal *et al.,* 2019



PANDALUR TALUK-STUDY AREA





- Pandalur taluk is located at 11° 29' 0" N, 76° 20' 0" E, at an altitude of 1100 meters with an Nelliyalam municipality and 4 villages (Cherangode, Erumad, Kolapally, Munnanad)

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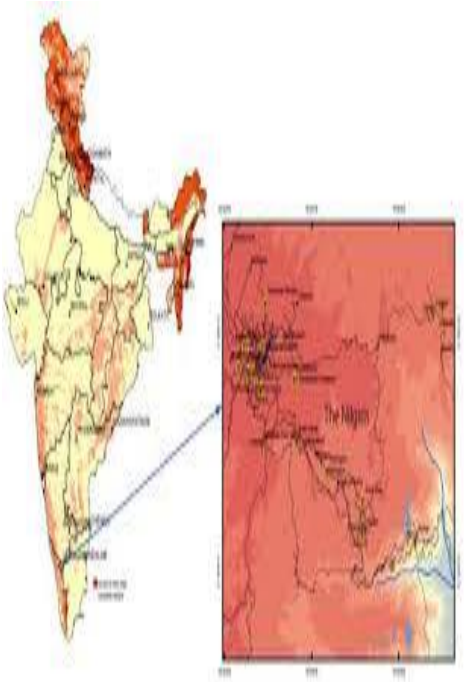
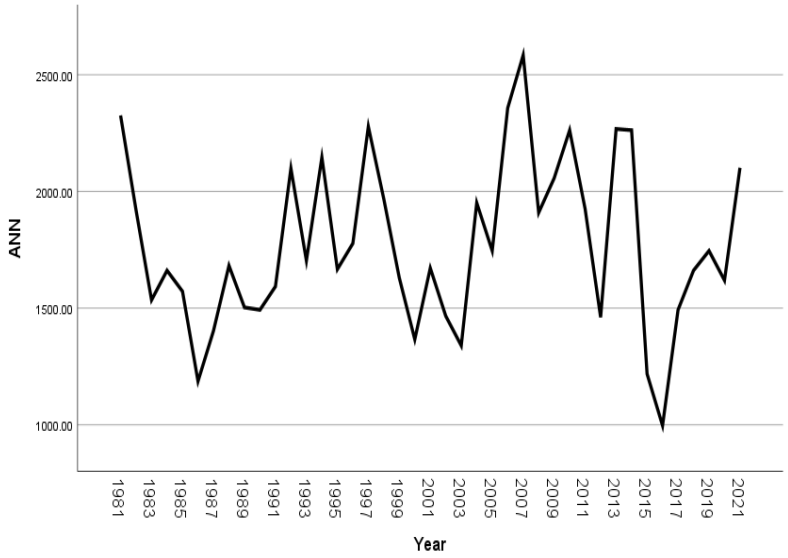
- The Pandalur taluk has 1,25,877 population (census, 2011) with 5073 Ha area of wild forest cover. Tea, coffee, vegetables and spices are the major cultivation spanning 28% of the land area (Taluk portal, 2018) .
- Weather: 12^0 C during winter, 32^0 C during summer.
- Landslides in western ghats region like mainly in pandalur occur frequently, often result in significant damage to property and agriculture.



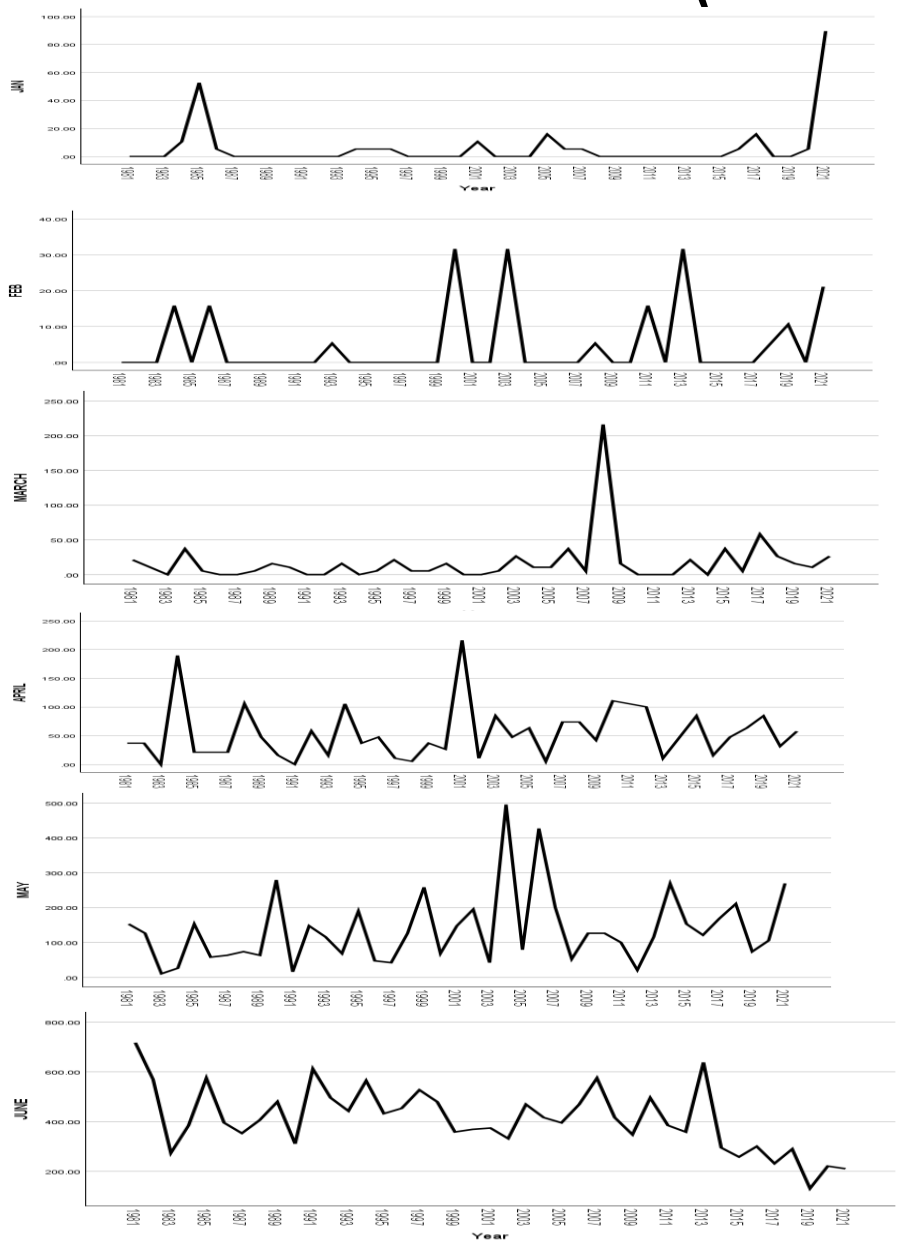
RAINFALL PATTERN IN PANDALUR TALUK

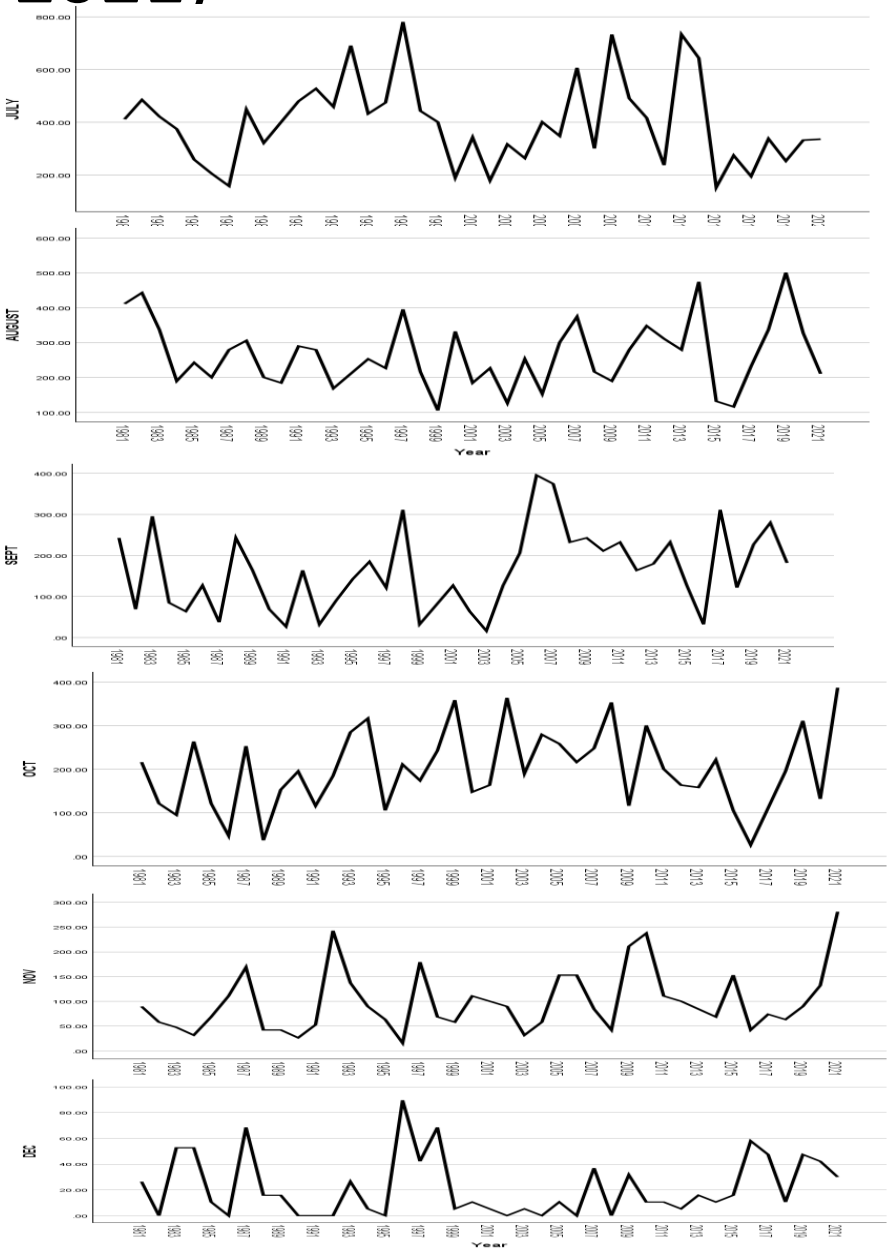
- Rain fall data in Nilgiris district (PANDALUR) shows that the rain fall pattern is fluctuating in every alternative year and gradually increased since 1981 to 2021.

- Strong winds in the lower troposphere (850 hPa) over the central Arabian Sea and Peninsular regions of India are one of the characteristic features of Indian summer monsoon (Joseph and Raman, 1966; Findlater 1969).



Precipitation pattern in Devala Pandalur Taluk (1981-2021)

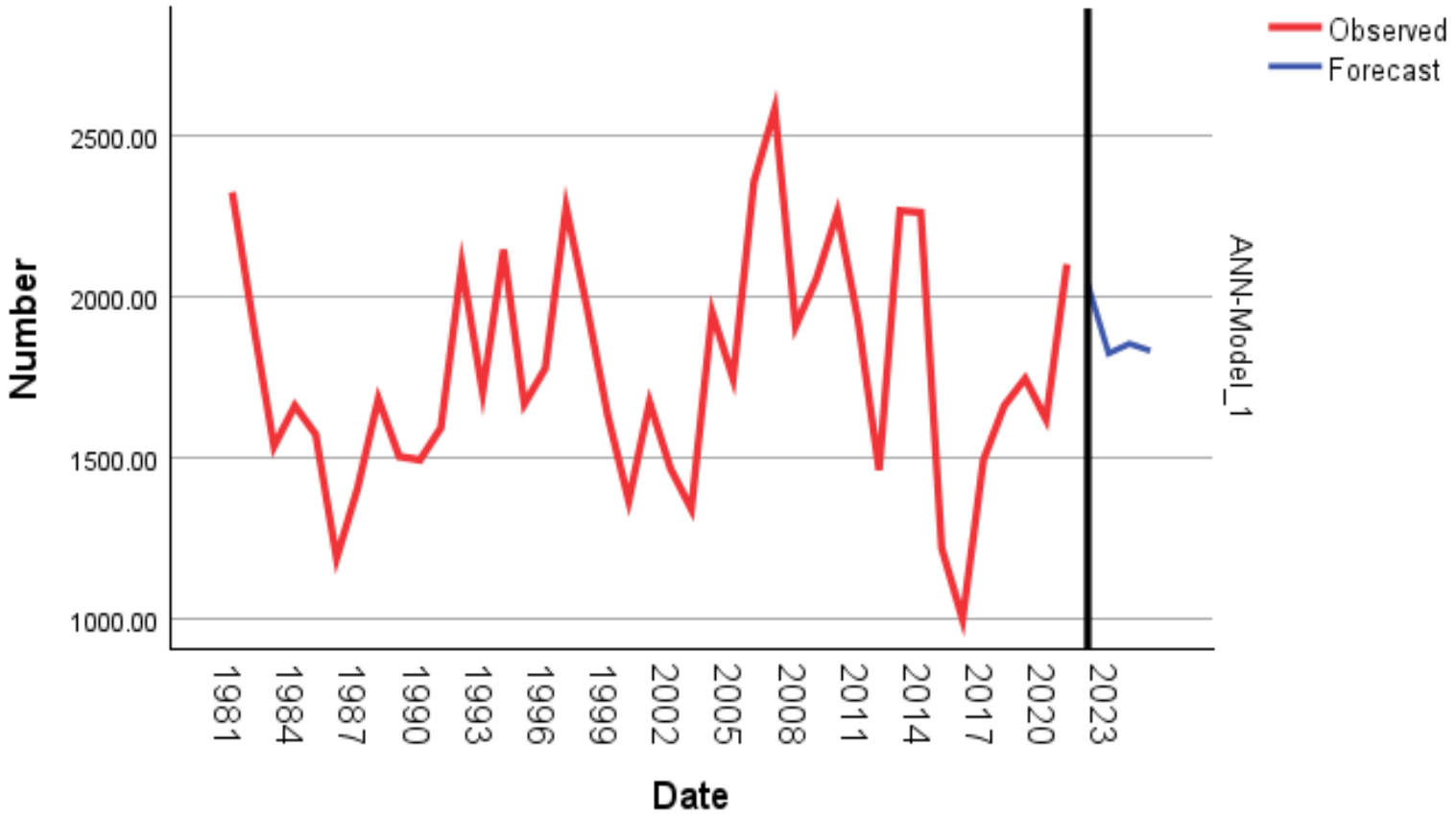




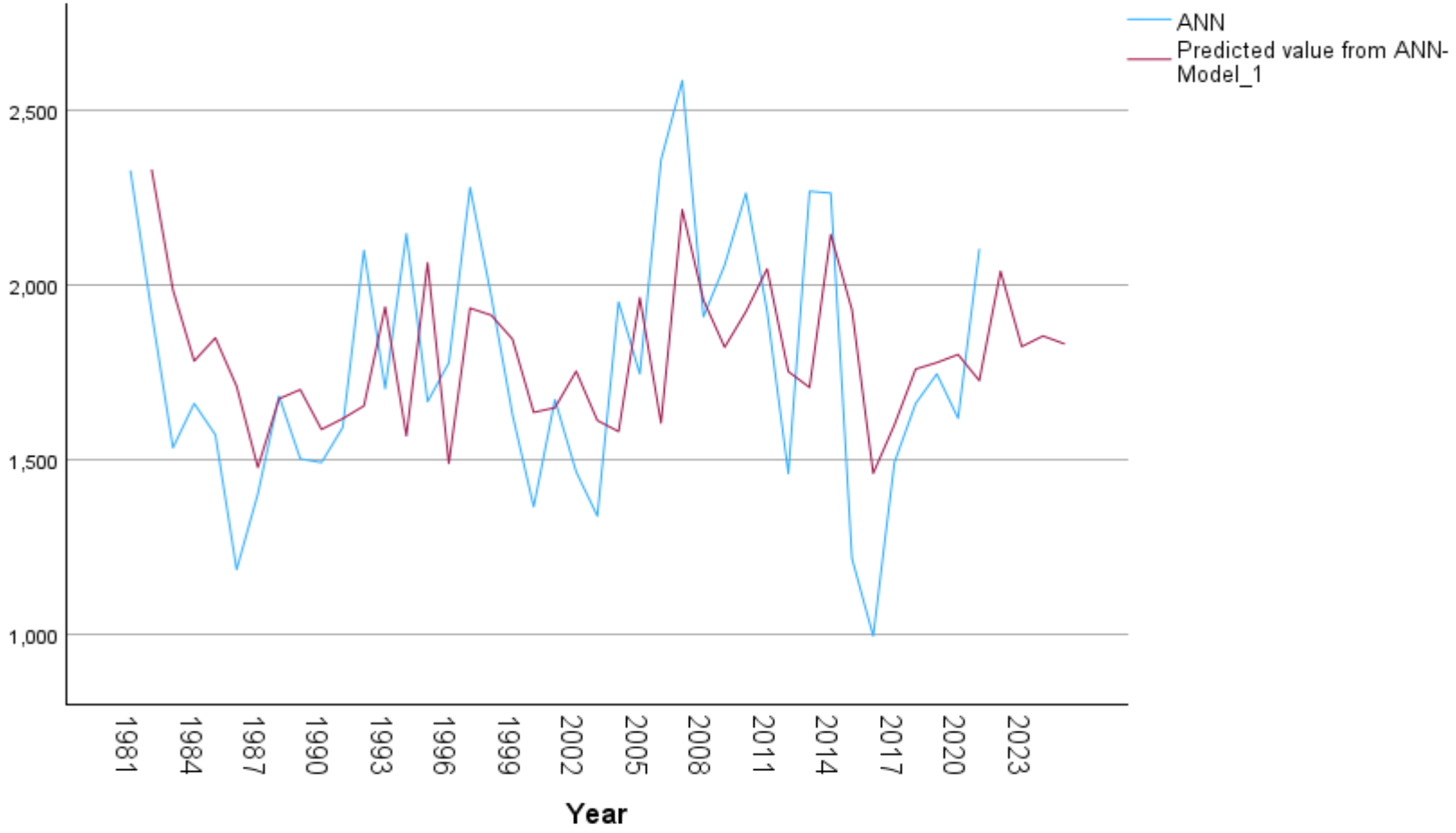
Spearman Rho Correlation test

	Month	Statistical description	Spearman Rho Test Annual Trend (N-41)		
			AVALANCHI	DEVALA	EMERALD
Spearman's rho	JAN	Correlation Coefficient	0.005	0.091	-0.055
		Sig. (2-tailed)	0.968	0.570	0.730
**. Correlation is significant at the 0.01 level (2-tailed)	FEB	Correlation Coefficient	0.130	0.204	0.089
		Sig. (2-tailed)	0.245	0.200	0.580
	MAR	Correlation Coefficient	0.029	0.256	0.005
*. Correlation is significant at the 0.05 level (2-tailed)		Sig. (2-tailed)	0.793	0.107	0.975
	APR	Correlation Coefficient	0.162	0.258	0.184
		Sig. (2-tailed)	0.145	0.104	0.251
	MAY	Correlation Coefficient	.219*	0.292	.404**
		Sig. (2-tailed)	0.048	0.064	0.009
	JUN	Correlation Coefficient	-.284**	-.505**	-.563**
		Sig. (2-tailed)	0.010	0.001	0.000
	JUL	Correlation Coefficient	-0.056	-0.170	-0.095
		Sig. (2-tailed)	0.620	0.288	0.556
	AUG	Correlation Coefficient	0.032	0.023	0.093
		Sig. (2-tailed)	0.773	0.889	0.564
	SEP	Correlation Coefficient	0.079	0.293	0.235
		Sig. (2-tailed)	0.479	0.063	0.139
	OCT	Correlation Coefficient	0.075	0.154	0.145
		Sig. (2-tailed)	0.505	0.335	0.366
	NOV	Correlation Coefficient	0.090	0.290	0.177
		Sig. (2-tailed)	0.423	0.066	0.269
	DEC	Correlation Coefficient	0.162	0.137	0.128
		Sig. (2-tailed)	0.146	0.394	0.425

Precipitation trend and forecast of Pandalur Taluk
ARIMA Model (p d q:0,0,1)

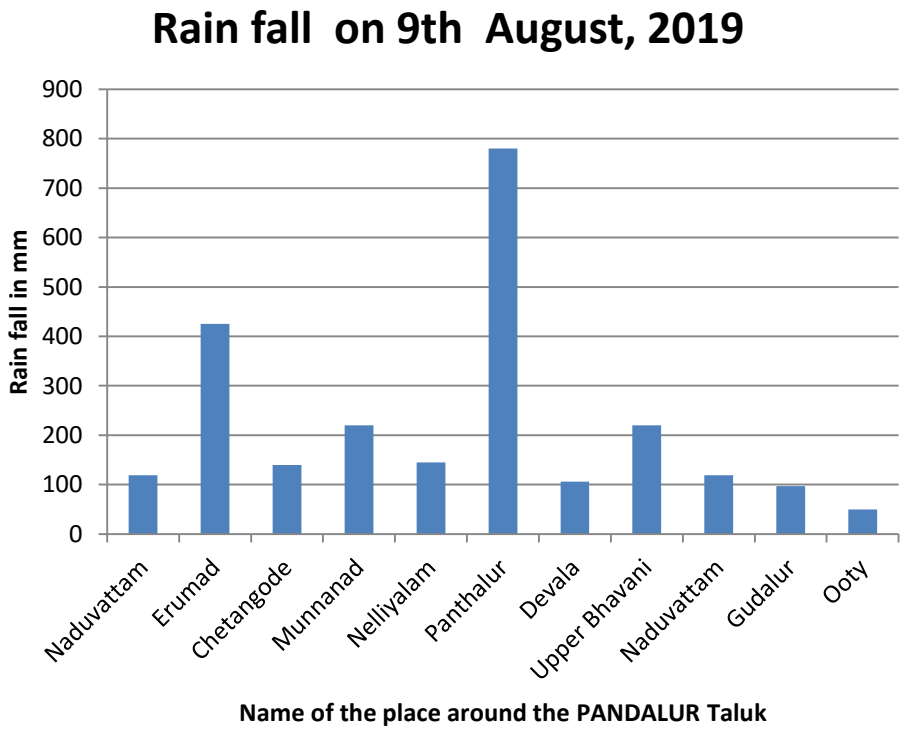


Precipitation trend and forecast of Pandalur Taluk ARIMA Model (p d q:0,1,1)



INTENSE RAIN FALL INCIDENCE AROUND THE PANDALUR TALUK

- The Pathalur region in the Nilgiris district has records with a whopping **780 mm** of rainfall in a span of just 24 hours on 9th August, 2019.
- Even, the entire district had recorded 820 mm of extremely heavy rains, thus breaking a 76-year-old record in Tamil Nadu.



Source : Regional Meteorological department, Chennai.

780mm Rainfall in a day resulted heavy floods in Pandalur Taluk

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Volunteers actively involved in Evacuation

Intense rainfall revealed the natural drainage system in valley which is altered by monocrop cultivation, and land use pattern.

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Number of landslide been reported and damaged the road facility in PANDALUR Taluk

Floods and landslide damaged the thousands acres of agricultural land

Tribal school building lost its stability during heavy rain fall

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Thousands of Tribes , Tea estate workers lost their Livelihood, shelter and infrastructure

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TWO DISTINCTIVE MONSOON HITS THE NILGIRIS REGION

- The Nilgiris district is very vulnerable to landslides as it receives heavy rainfall from both South West (SW) and North East monsoons (NE).
- Although it falls under seismic zone the major natural disasters that occurred from 2010 to 2022 have been landslides and floods.
- This has made a significant negative impact on the environment (fauna and flora) and human settlements in this region (Kumar *et al*.,2017).

Conclusion

- Precipitation pattern in PANDALUR taluk gradually increased since 1990.
- Cutting of tree, change of land use pattern and vegetative cover, cutting slope at the toe are influenced the landslide in Pandalur Taluk during intense rainfall of 780mm in 24 hours during the month of July and August 2019.
- The sudden heavy downpours triggered the landslide and floods in low-lying areas, but also damaged the farm field, settlements and infrastructure.
- Perhaps global climate change altered the south west monsoon pattern in India which resulted in heavy rainfall in single day caused the floods and landslide in PANDALUR Taluk.

Thank You