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RESEARCH ARTICLE

PROJECTING CLIMATE VARIABILITY IN THE PURVIEW OF FUTURE CLIMATE PROJECTIONS FOR SHOLA FOREST OF NILGIRIS, WESTERNGHAT IN SOUTH INDIA.

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Abstract

To understand the temporal and spatial pattern at high altitude shola pockets, study considering shola forest of Pykara, Naduvattum, Doddabetta, Avalanche, Longwood,andThaishola of Nilgiris, a study was carried out using statistically downscaled future climate data of four Representative Concentration Pathway (IPCC, 2014) based projection scenarios. The analysis was carried out for two climatic variables, temperature,and precipitation. The projection showedan increase in temperature and decrease in rainfall in the peak monsoon months of 2050 and 2070. This situation is likely to increase towards the end of 21st century. As per the projection, Longwood, Thaishola and Naduvattum shola regions were more likely to experience less rainfall and higher temperature in all the selected patches of shola investigated. This study enabled to identify the areas in the sholas were immediate mainstreaming of the appropriate action plan required through developmental planning, as a means of resilience to climate change and, protect some of the endemic habitats in the region.

Introduction:-

India is house to unique and diversified flora and fauna, spread across the biodiversity hotspots of Eastern and Western Ghats (Balasubramanian, 2007). This virtual green lung cover is experiencing both extreme anthropogenic pressure (Srivastava, 2002) and the threat of climate change. The two together have led to shrinking of mountain glacier and loss of many endemic species (Bensekom et al., 2014). High altitude mountain regions of Nilgiris are a rich source of endemic species,and globally forty percent forest is under tropical forest with a rich source of endemism (Bubb et al., 2004; Zhao et al., 2005 and Sharma et al., 2009).

Shola forests are present in the mountain top habitats (Sukumar et al., 1995) and are also known as cloud forests of the Western Ghats. However, surrounding these forests, there are rolling grasslands. Shola forests are restricted to sheltered folds and valleys in the mountains with characteristic stunted trees, coriaceous leaves, branches usually covered with mosses, ferns,and epiphytes (Sellamuthu and Lalitha, 2010; ICFRE, 2013). Shola sites are quite dissimilar in vegetation composition with altitude, aspect,and physiognomy (Sudhakara,2001).

Temperature and rainfall along with slopes as well as terrain shape influence the shola forests (Robin et al., 2012). Higher temperature and precipitation have been shown to have serious implications on shola forest (Foster 2010;

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Sukumar et al., 1995). The threats to shola forests include annual fires (Scatena et al., 2010), grazing and encroachments for agriculture and plantation forestry especially, wattle and eucalyptus (ICFRE, 2013).

Materials AndMethods:-

In the current study, six shola forest patches selected which include, Pykara, Naduvattum, Thaishola, Doddabetta, Naduvattum, Thaishola, Avalanche and Longwood. The future climate data from WorldClim at a spatial scale of 1km used. Which is a bias-free statistical downscaled data that uses RCP(Representative Concentration Pathway) RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5scenarios. The RCPs are based on a radiative forcing target level for 2100, RCP 2.6 is a very low forcing level, RCP 4.5 and RCP 6.0 are medium stabilizing scenarios and RCP 8.5very high baseline emission scenario for the period 2050 (average for 2041-2060) and 2070 (average for 2061-2080).For the identification of shola temporal Cartosat-1 and LiSS-IV satellite data procured from National remote sensing center, Hyderabad was used. Image pre-processing, digital image interpretation and geospatial climate data analysis were carried out using ArcGIS 9.2 and Erdas 2013 software.

Statistically downscaled, calibrated, bias-corrected global climate gridded data used in the analysis. For future climate, RCP scenario was used(IPCC, 2014) based on the projections under coupled model Intercomparison project 5(CMIP5, IPCC, 2007).The two climatic variables viz., temperature and precipitation analyzedfor high altitude regions of Nilgiris using RCP projections. Under each RCP, current monthly precipitation and maximum (Max T) and minimum Temperature (MinT) analyzed,and future climate data for 2050 and 2070 for the selected shola patches. Further, monthly future climate (precipitation, Max T, Min T) and its difference with current climate data were analyzed,and the difference image gave us information on future climate scenarioin the study area.During filed survey latitude and longitude of selected shola patches was taken and were identified on Google earth.

Results AndDiscussion:-

Monthly temperature scenario compared with current normal temperatureMinimum temperature difference of future climate data from the normal was analyzed for the RCP4.5, 8.5, 6.0 and 2.6 scenarios of the shola pockets of Naduvattum, Pykara, Doddabetta, Longwood, Avalanche andThaishola.

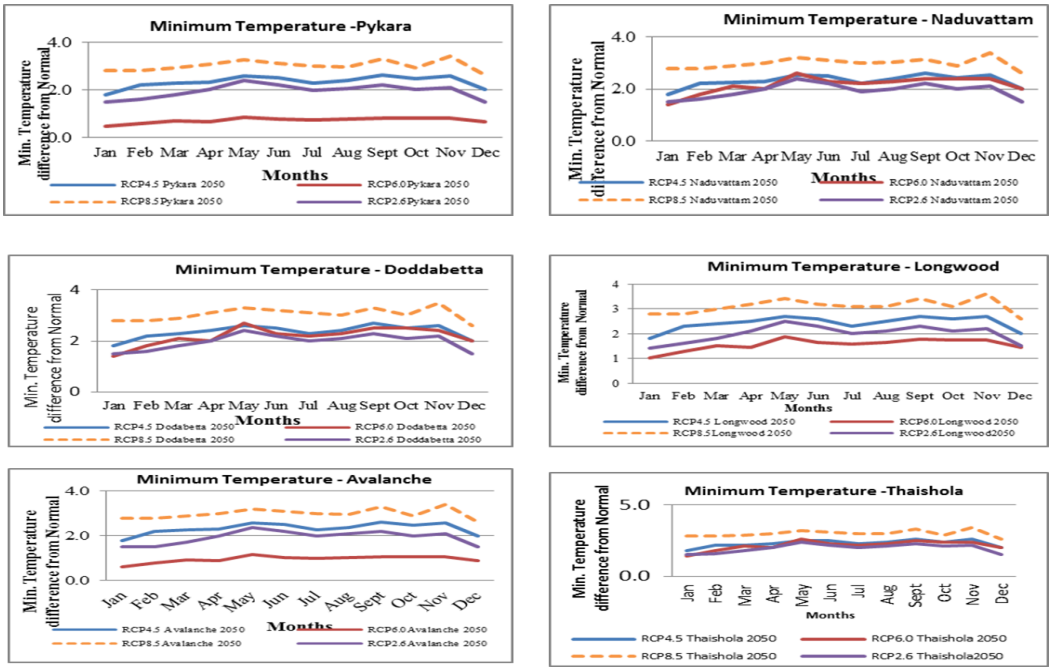

Fig 1:-Monthly profile of minimum temperature difference of future climate data from normal under various RCP scenarios for 2050.

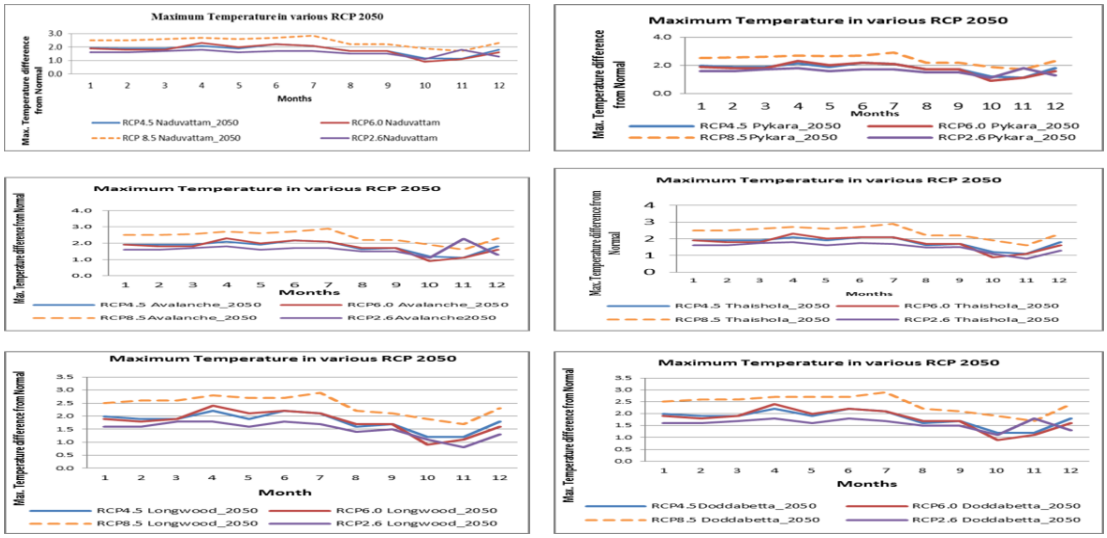

Fig 2:-Monthly profile of maximum temperature differenceof future climate data from normal under various RCP scenarios for 2050.

The minimum temperature for the period 2050:-

Amongst the selected shola patches, under RCP 2.6, 4.5, 6.0 and 8.5, between February to March, shola skin temperature was predicted to be increasing (Fathima et al., 2018). June to September being the southwest monsoon months all the shola patches showed an increase in minimum temperature by 0.2^0 C. Under RCP 2.6, Naduvattum, Pykara and Longwood temperature remained the same, during October to December being the North East Monsoon months, the minimum temperature was decreasing in all the shola, with more decrease in Longwood Shola. During winter months, between December to January, minimum temperature decreased over the shola forest exception RCP 2.6 as shown in Fig(1).

The maximum temperature for the period 2050:-

For RCP 2.6, from February to March, Shola maximum temperature increased by 0.1^0 C, whereas for RCP 4.5 & 6.0 no change was observed. In the southwest monsoon season from June to September there was a decrease in maximum temperature by 0.2^0C. Under RCP 4.5, 6.0 and 8.5, the decrease was upto 0.5^0C, except in Longwood where itwasupto 0.4^0C (RCP 4.5) and 0.5^0C (RCP6.0 & RCP8.5) as shown in Fig(2). North East monsoon months, October to December experienced an increase in maximum temperature in all the selected shola patches except Longwood shola where the increase was upto 0.5^0 C (RCP2.6 and RCP6.0) and 0.6 (RCP4.5) and 0.7^0 C (RCP8.5).

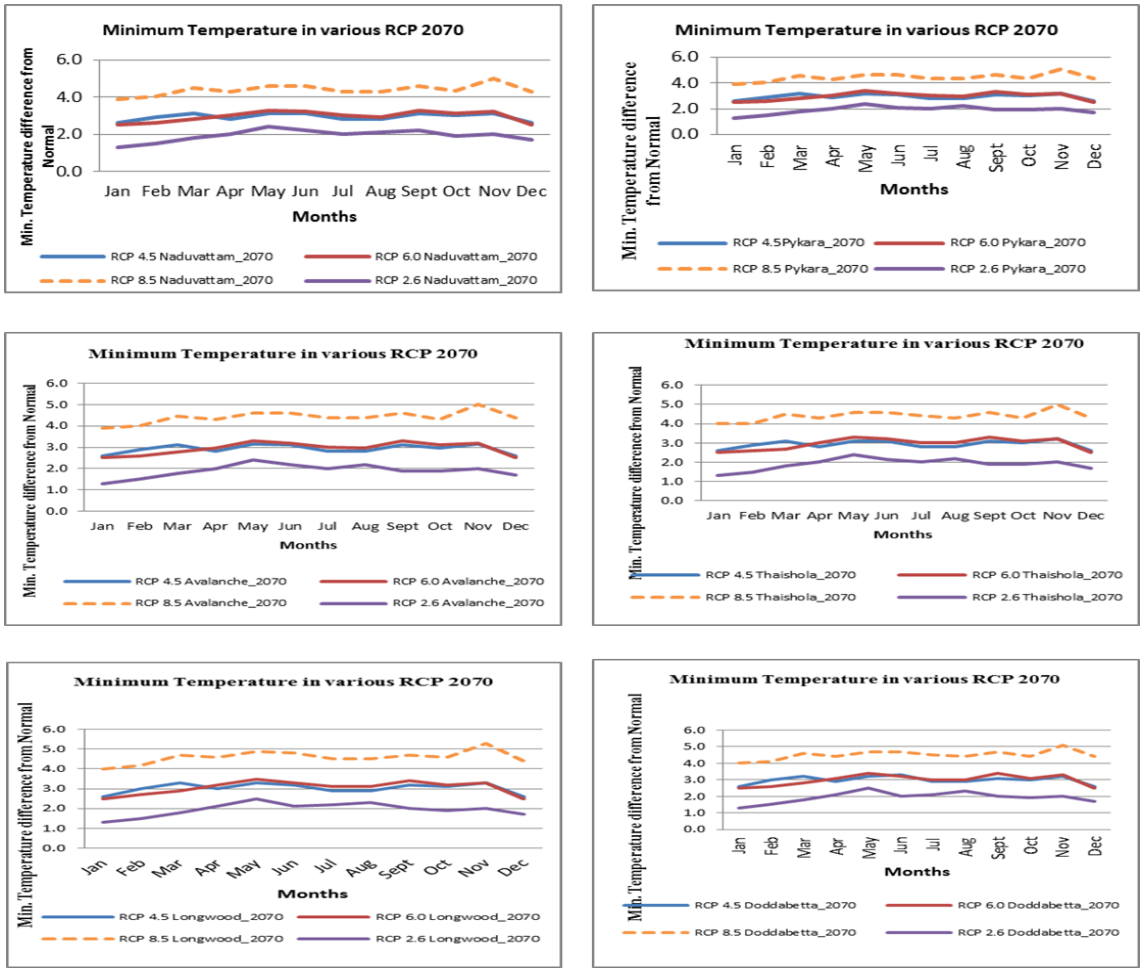

Fig. 3:-Monthly profile of minimum temperature difference from normal under various RCP scenarios for 2070.

The minimum temperature for the period 2070:-

Under RCP 2.6, an increase in minimum temperature by 0.3^0C was observed from February to March except in Thaishola where it was 0.1^0C. Naduvattum, Avalanche, Thaishola under RCP 4.5 might experience an increase by 0.2^0C. UnderRCP 6.0 increase was up to 0.2^0C. Under RCP 8.5 minimum temperature was found to increase up to 0.5^0C. Between June to September, the minimum temperature remained the same under RCP 4.5 and RCP 8.5 except in Longwood sholas where the increase was up to 0.1^0C.Under RCP 2.6 and 8.5itwas up to 0.3^0C, whereas Thaishola experiences a decrease up to 0.4^0C. December to January under RCP 2.6 and RCP 8.5 decrease was 0.4^0C with no change in RCP 4.5 and 6.0 scenarios, as shown in Fig (3).

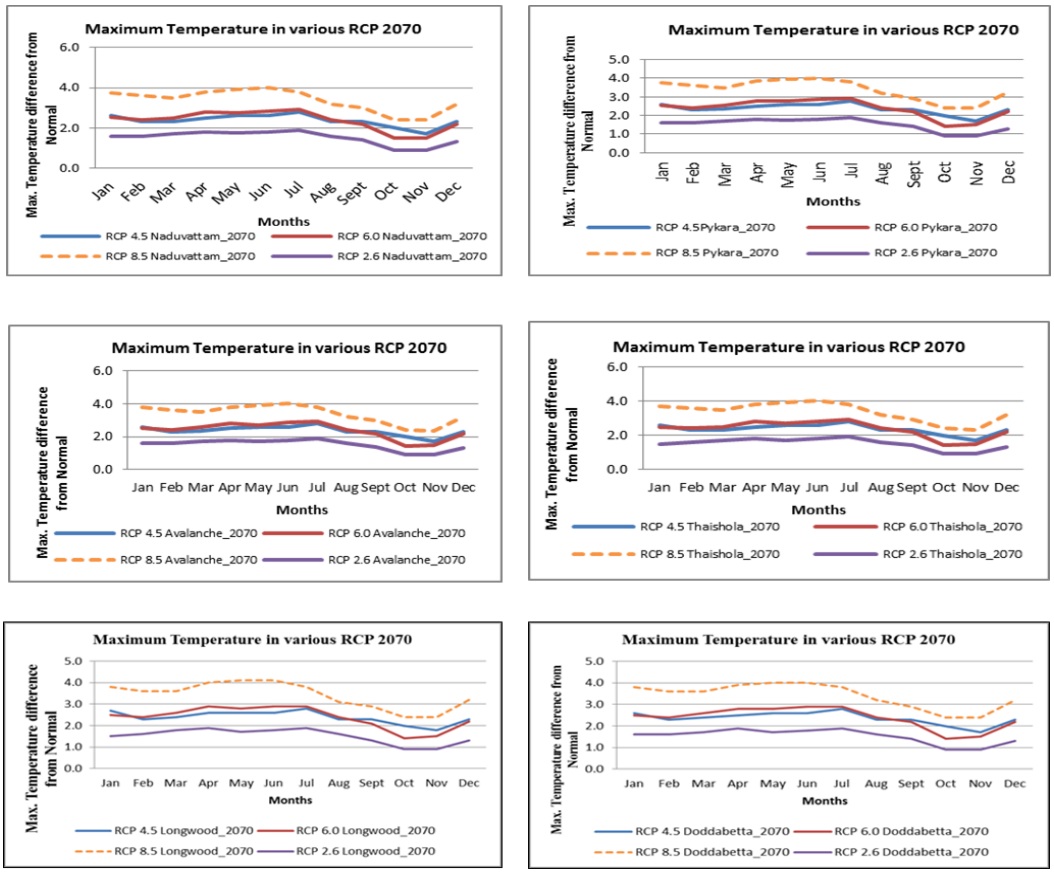

Fig. 4:-Monthly profile of maximum temperature difference from normal under various RCP scenarios for 2070

Maximum Temperaturefor the period 2070:-

Underall RCP scenarios during February to March, shola maximum temperature increase was insignificant(0.1^0C) while during June to September RCA 4.5 showed a decrease in maximum temperature by 0.3^0C. RCP 2.6 shows a decrease by 0.4^0C, except in Longwood shola where it decreased by 0.5^0C. During the Northeast monsoon months under RCP 2.6, it increasedto 0.1^0C. RCP 6.0 showed an increase by 0.7^0C, RCP 8.5 by 0.8^0C and RCP 4.5 by 0.3^0C, as shown in Fig (4).

Monthly precipitation scenario compared with current normal precipitation:-

The Nilgiris enjoy cooler climate from December to February followed by the pre-monsoon season (or hot weather period) from March to May. Southwest monsoon is from June to September and northeast monsoon seasoncomes during October to December period. The present study confirms that the projected mean annual rainfall over the Nilgirisis not likely to increase by 2050s. However, the expected rainfall may go up by 13% by 2080s, according to emission scenario A1B (CCC and AR and TNSCCC, 2015)

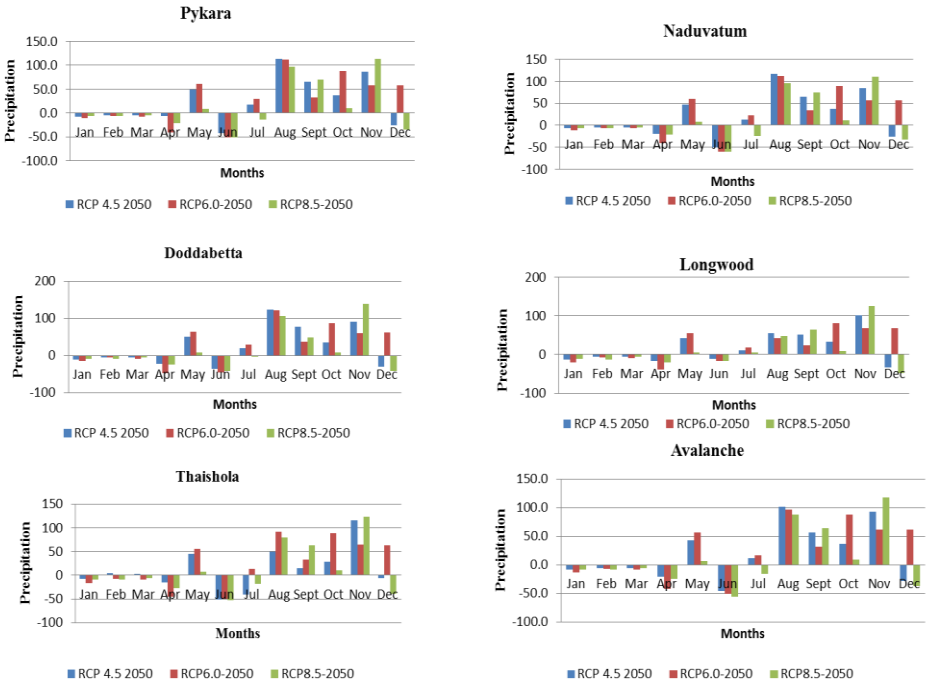

Fig. 5:-Monthly precipitation scenario for the period 2050 (RCP 4.5, 6.0 and 8.5)

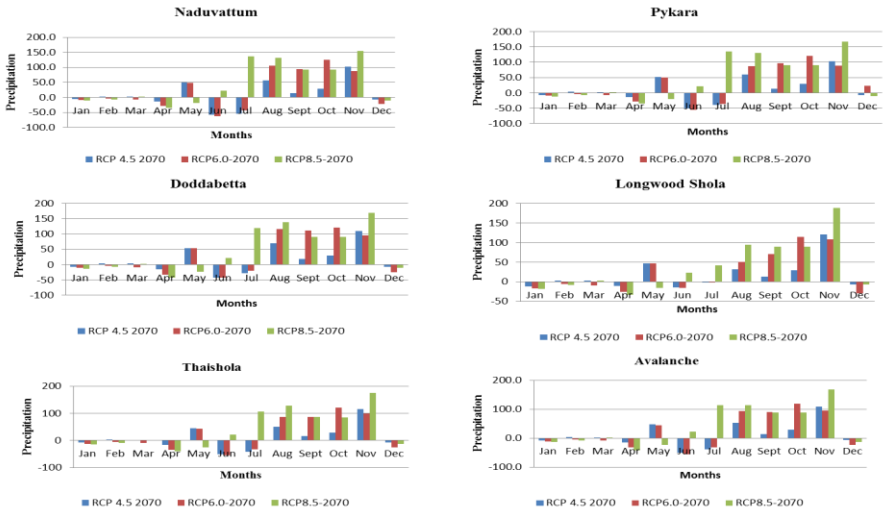

Fig. 6: -Monthly precipitation scenario for the period 2070 (RCP 4.5, 6.0 and 8.5).

RCP scenario 4.5, 6.0 and 8.5 during 2050 between February and March month showed a decrease in precipitation,and it reduced more in Longwoodshola. June month was projected to receive reduced precipitation under all the RCP scenarios (4.5, 6.0 & 8.5). Also, under RCP 8.5 decrease in precipitation extended up to July in Pykara, Naduvattum, Doddabetta, Avalanche andThaishola. North East monsoon season from October to December monthalso highlighted a decrease in precipitation projection under both RCP 4.5 and RCP 8.5 scenarios throughout the study area, as shown in Fig (5).

During the period 2070, decreased in precipitation was observed in June – July under all RCP scenarios. A similar decrease in precipitation was observed (fig.6) from December to January months. Under RCP 6.0 and 8.5 for February to Marchdecreasein precipitationis observed, as shown in Fig(6).

Low temperature prevails in shola forest as they represent the cloud forests. The findings of the present study,however, shows that rainfall pattern was likely to reduce during southwest monsoon and may increase towards northeast monsoon as highlighted by Warrier (2017)in his studies, which might result in more intense cyclones and floods. The extreme rainfall events could result in higher flooding in the streams.

In general, overall temperature in the Shola forest is increasing up to 2050 and in 2070 more increase is expected based on the RCP projections due to various anthropogenic pressures.Withan increase in a greenhouse gas emission could lead to loss of some intolerant endemic species. Therefore, it is necessary to identify the vulnerable zones, their accomplishing vegetation and identify the species requiring immediate attention as opined by Fathima et al., (2017). Fires in the adjacent grassland would also contribute to loss of endemic habitat of shola forests. The clearing up of invasive species is likely to promote the regeneration of shola species. Due to climate change, fruiting and,the flowering pattern of the shola species is likely to shift, which means a negative effect on the unique shola species. As such conserving species in the gene pool will go a long way in conserving biodiversity and, protect the species from getting extinct.

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