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Regionalization of Rainfall in Kerala State

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Abstract

The main objective of this study is to classify the entire State of Kerala into optimum number of homogeneous zones based on monthly rainfall. The same is done by Ward's Clustering method by taking the monthly rainfall data for five consecutive years from 2008-2012 of 63 raingauge stations in Kerala state. Clustering is the process of dividing the area under consideration to a limited number of climatologically homogeneous zones, based on any hydrologic parameter. The purpose of cluster analysis is to place objects into groups suggested by the data, so that objects in a given cluster tend to be similar to each other and objects in different clusters tend to be dissimilar. It is found that the region can be grouped into seven clusters. There exists large variability in average annual rainfall of different clusters. There are cluster groups where the annual rainfall is as high as 1.5 times and as less as half of average annual rainfall of Kerala as a whole.

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1. Introduction

Kerala experiences rainfall for around 120 to140 rainy days per year. Climate of Kerala state is influenced by the seasonal heavy rains of the southwest summer monsoon and northeast winter monsoon. Around 65% of the rainfall occurs during southwest monsoon and the rest during north east monsoon. The hills and mountains of the Western

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Ghats located on the eastern boundary of the State provide orographic lifting for the southwest monsoon winds resulting in heavy precipitation over the western slopes and good rain over mid and low lands. Northeast monsoon also contribute to the annual rainfall, especially in the southern parts of the State.

Though, the state of Kerala is blessed with 44 rivers, the inhabitants of major part of it experience water scarcity in summer season. During this period, most of these rivers remain as still water pools or marsh lands. Due to the population increase, rapid industrialization and unhealthy anthropologic interventions, there is a sharp decline in the level of water table also. Thus there exists a pressing need for a sustainable methodology to develop watershed so as to manage the optimum use of available water resources round the year. For sustainable accomplishment of watershed management, climatic parameters of the entire basin are to be known which consist of both gauged and ungauged sub- basins. The parameters at the ungauged sub-basins can be made available via regionalization. And hence the technique of regionalization gains significance by which similar watershed basins can be identified.

[5] has observed that in order to get a good regionalization, it is important to answer two questions: i) how many clusters are required according to the type of data or objective and ii) how good is the clustering itself. To answer these questions, hierarchical and non-hierarchical algorithms were applied to six experiments based on the data sets for precipitation and temperature available from traditional weather stations.

[4] used Principal Component Analysis to divide Spain in to a number of climatically homogeneous zones. Here Ward's method is used for clustering. Here, optimum number of clusters is determined by plotting distance between merged clusters as a function of the stage analysis.

[1] has conducted clustering analysis of Australia using Principal Component Analysis and k. means cluster analysis. Results have shown that the regions identified by both analyses are largely same.

In [3], the entire region of Bangladesh is grouped into certain homogeneous regions based on temperature and rainfall by using K mean clustering method.

In this paper an attempt has been made to group the entire region of Kerala into an optimum number of clusters using Ward's method of clustering. The purpose of Clustering Analysis is to place objects into groups suggested by the data, not defined previously, so that objects which are similar to each other in some sense are grouped into one cluster, and dissimilar objects in different clusters.

Nomenclature

P	number of clusters
N	number of elements (gauging stations) in each cluster
M	number of variables (months)
X_{kij}	j^{th} month at the i^{th} gauging station in the k^{th} cluster
$\bar{X}_{kj}$	average value of the i^{th} gauging station at the j^{th} month in the k^{th} cluster

2. Study Area and Data Description

For this study, the entire state of Kerala, which occupies the southernmost part of India, is selected. Kerala is a small coastal State, situated in the southwest peninsular part of India. It lies between a latitude of 8^0 18'N and 12^0 48'N and a longitude of 74^0 52'E and 77^0 22'E. The total area of the state accounts to around 38863 sq.Km, with a coastal belt of around 600km. Kerala state is endowed with rich water resources like 44 rivers and two important