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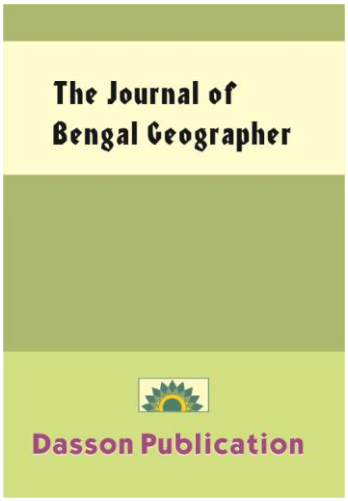

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Delimiting the Flood Risk Zones in Kuttiadi River Basin, Kerala, A Geographical Approach

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Abstract

Flood risk zonation is inexorable in watershed management, in that it provides appropriate solution guidelines to tackle the flood hazard through the construction of proper structures and infra-structures. It is also helpful in setting safe site and proper evacuation routs for flood hazard management. The geographical parameters inevitably acts as a deciding factor in the causing flood and become more hazardous in the case of heavy and unexpected rain fall. Many studies have proved that the delimiting flood risk zonation in river basin is highly appreciable in watershed management for optimizing natural hazards like flooding, land sliding, and land degradation because of its bio-geographical and hydrological similarities. This paper pertains to foresee how flood risk zones of Kuttiadi river basin can be delineated based on geographical approach and by using geospatial technologies. The weighted sum analysis on geographical parameters has been used to identify the flood risk zones.

Key Words: - *1.Watershed, 2.Hazard, 3.Landuse, 4.Aspect, 5.GIS, 6.Geospatial*

Objective

To identify the geographical factors influencing the floodand delimiting the flood risk zones in Kuttiadi river basin.

Methodology

Ten geographical parameters are taken to identify the flood risk zones of Kuttiadi river basin. They are physiography, geology, geomorphology, soil depth, soil texture, aspect, slope, land use, drainage density and water table. These geographic parameters are ranked according to their proneness to cause flood. Raster over lay analysis is applied on these parameters and a compound value is derived, to classify risk zones. The entire river basin is further classified into five flood risk zones.

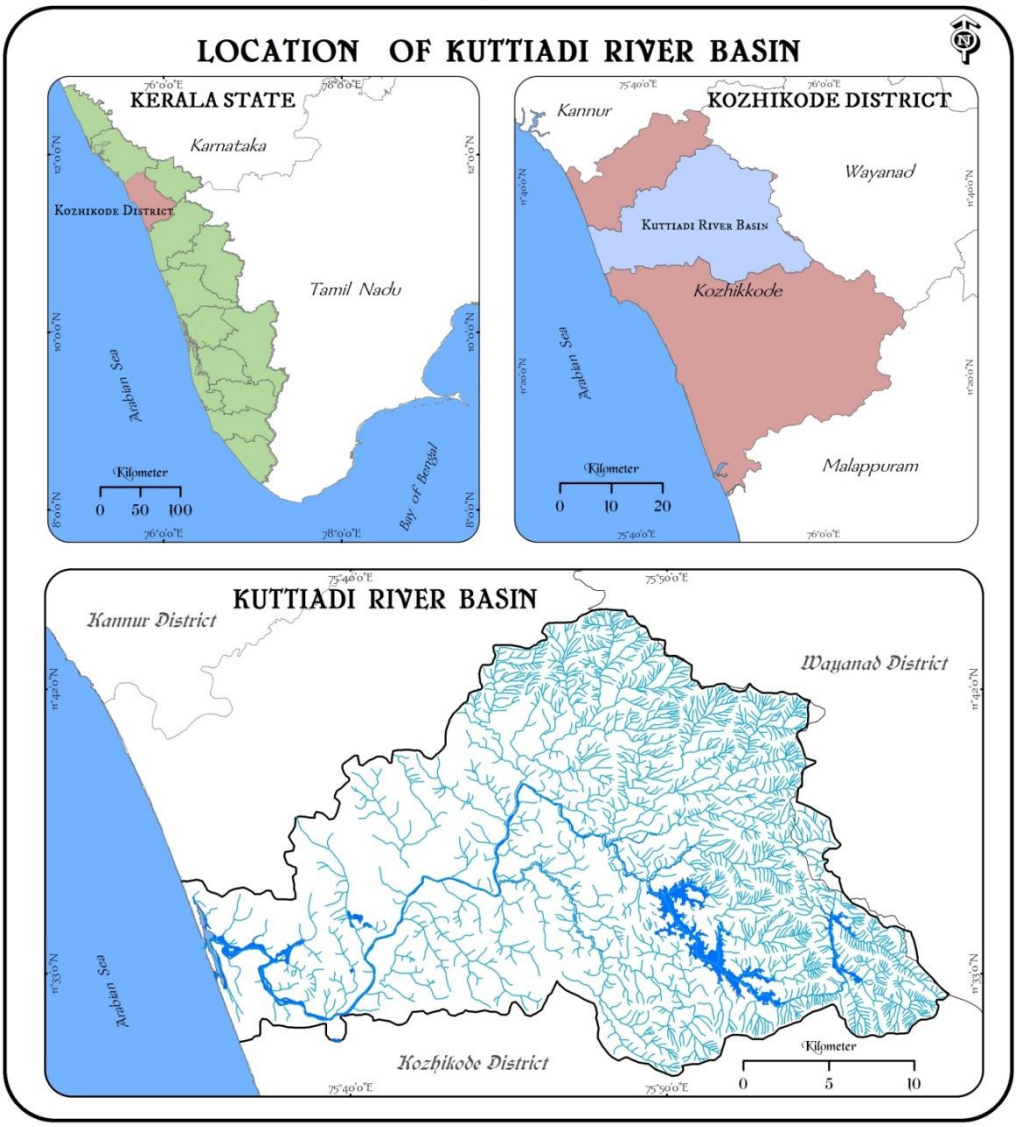
River basin Atlas prepared by Kerala Land Use Board for Kuttiadi river basin has been traced and digitized to demarcate Kuttiadi river basin and its 47 sub-watersheds. The soil data has been collected from Soil Survey Department, Government of Kerala. Landsat 8 OLI/TIRS image is used to prepare land use map and Aster image is used for preparing slope and aspect map of the river basin.The secondary data has been collected from different

sources like Survey of India, Kerala State Land use Board, Bureau of Economics and statistics, and from District agricultural offices.

Study Area

The longitudinal extension of the river basin is 75° 34′ 33″ to 75° 58′ 55″ East and the latitudinal extension is 11° 21′ 45″ to 11 ° 44′ 33″. The Kuttiadi River originating from the Narikota Range of the western slopes of Wayanad Hills, which is a part of Western Ghats situated at an elevation of 1220 m M.S.L. Kuttiadi River flows through two districts namelyKozhikkode and Wayanad (Figure 1). The Badagara, Quilandy and Kozhikode are the Taluks in which the river is flowing. (Panchayath level Statistics, Kozhikode 2011). The river is also known as the Murat River in Badagara Taluk. Total area drained by Kuttaidi River is 667Km^2. After flowing 74 kilometres it joins into the Arabian Sea at Kottakkal 7 kilometre south of Vatakara Town.

Figure - 1



Introduction

Floods are the most devastating natural hazard affecting the social and economic aspects of population and claiming more lives than any other natural phenomenon (Hewitt and Burton, 1971).Observations of flood characteristics, surveys of flood impacts on river valleys, and in particular on man's activities, and attempts to mitigate the adverse consequences of floods paralleled the growth of the ancient great riverine civilizations and the development of the institutions which regulated the societies of that time (Giuseppe Rossi, 1994). Flooding is typically, a common phenomenon in the plains with the either side of a stream channel overflowing with the residue deposited by the river that moves through the surface of land. Flood plains along big rivers are one of the most productive and valuable environments on the surface of the earth that provide abundant ecosystems and human services (Harun, 2009). Integration of remote sensing and geographic information system (GIS) provides a very effective means of delineating such areas at risk and for communicating this to decision-makers, emergency response teams and the general public (Ojigi and Shaba, 2012). The main benefit of using GIS for flood management is that it not only generates a visualization of flooding, but also creates potential to further analyze this product to estimate probable damage due to flood (Clark, 1998).Flood resultsfrom excessive rainfall within the short duration of time and the consequent high river discharge leading to damaging of crops and infrastructures (Joy and Lu, 2004).The intensity of flood varies according the amount of variation in rainfall received in a region.Nowadays, unexpected heavily rainfall has lead to flood hazards in Kuttiadi river basin. A comprehensive flood risk zonation is the need of the hour, as it will aid in assessing the damages caused by floods in different parts of the river basin during past few years.

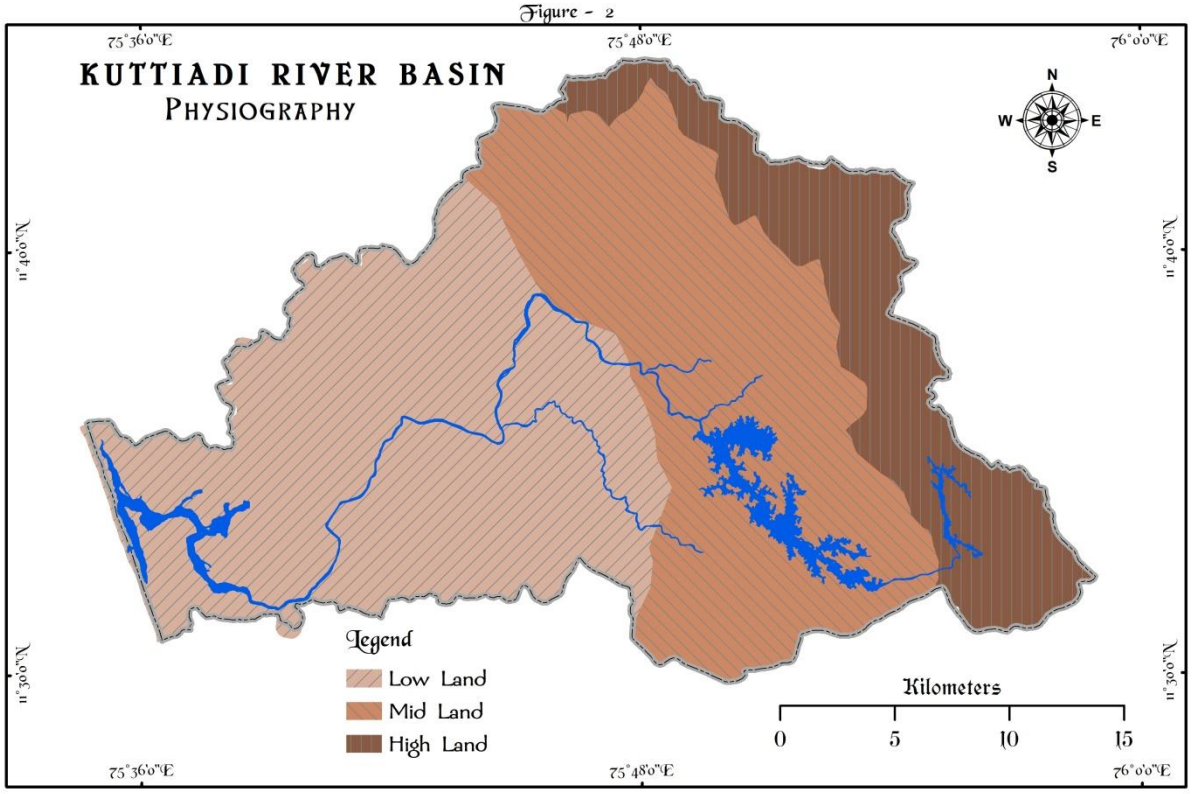
Analysis

Geography of Kuttiadi River Basin

The physiography division of the watershed is classified into three, the lowland which consists 45.48 percent of the total area. The mid land occupies 36.66 percent and the highland sharing the 17.86 percent of the total area of the river basin. The figure 1 shows the physiographic divisions of the Kuttiadi river basin.

The area of Kuttiadi river basin is 667 sq. km and has a total stream length of 1492.54 kilometres. The river basin consist six stream order and has 1993 number of streams .The density of the drainage density of the river basin is 2.24 kilometre per square kilometre. The figure 3 shows the drainage of Kuttiadi river basin. Low drainage density watersheds are concentrated in the low land area of the river basin.

Figure - 2



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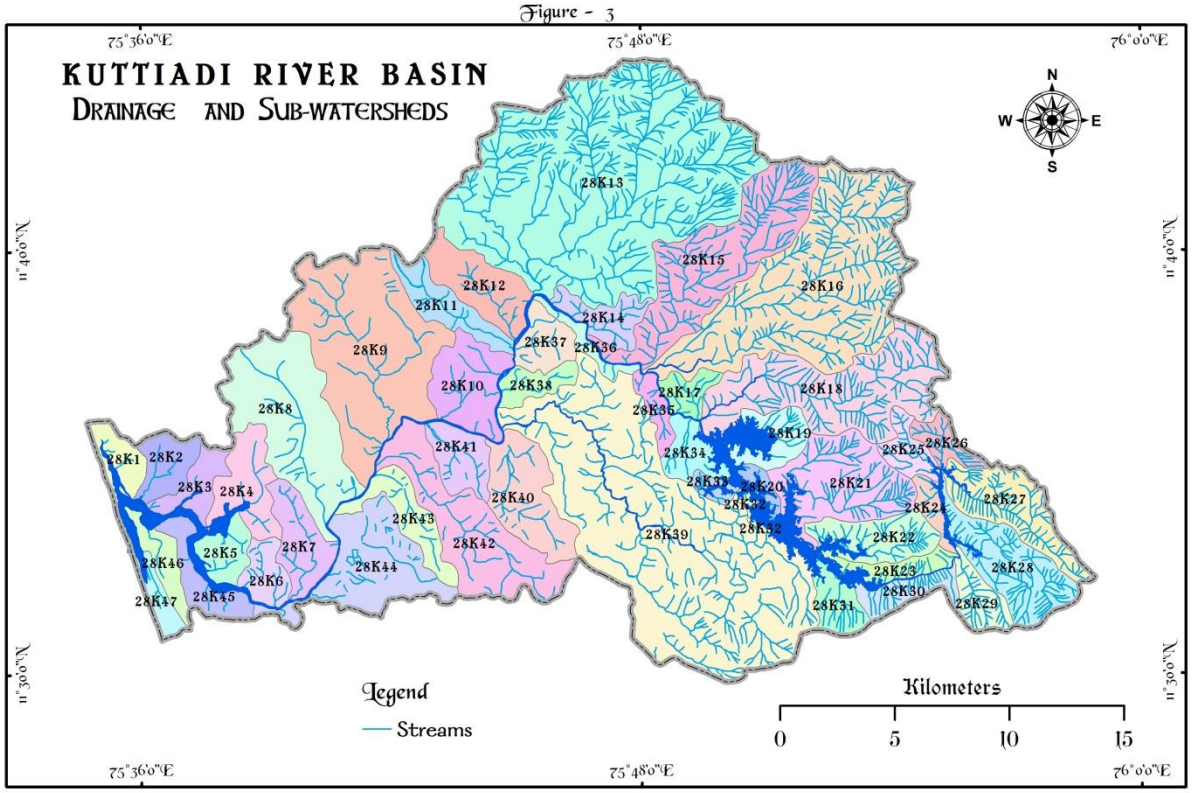
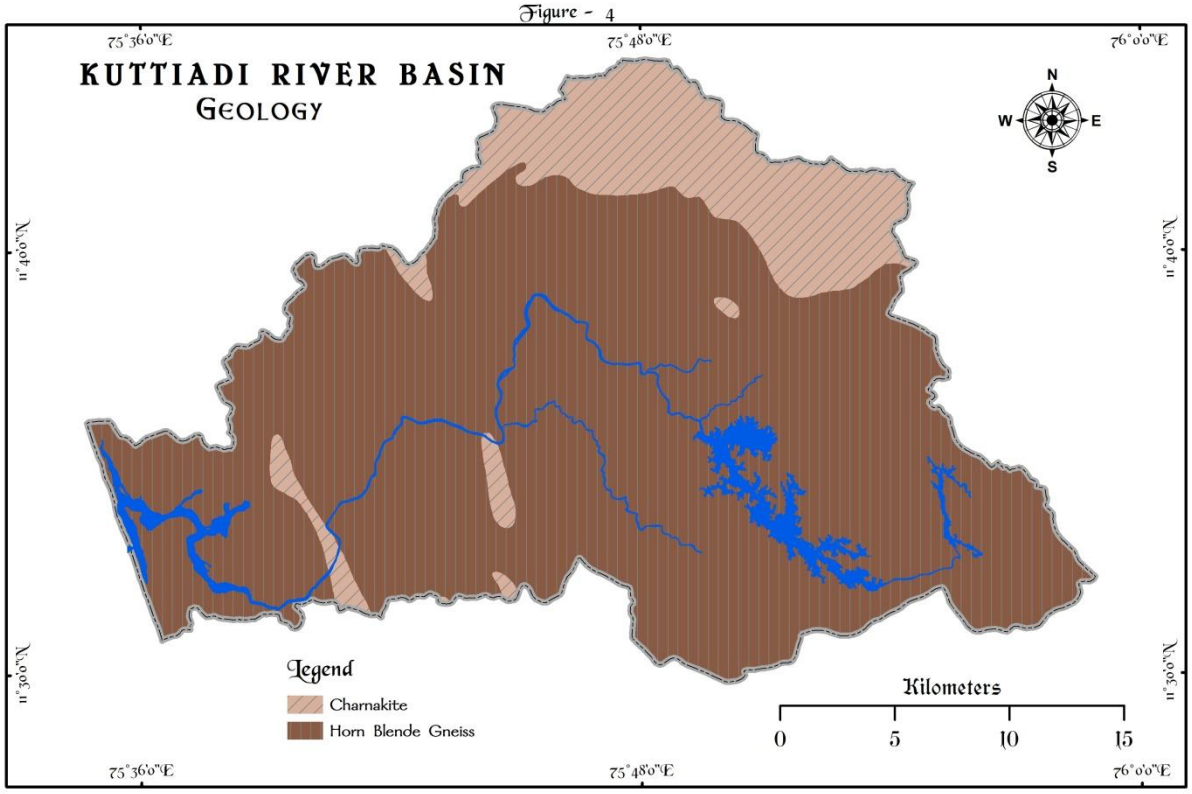


The Geology of Kuttiadi river basin has 84.85% of Hornblende Gneiss and 15.15% is of Charnakite. The figure 4 shows the geology of Kuttiadi river basin. Charnakite is mostly concentrated in the north of the river basin and some patches in the centre of the river basin and the remaining area is covered by Hornblende Gneiss.

The Geomorphology of the river basin consists of plateauwith 59.35 percent of the total basin area which found in midland region of the river basin. The flood plain occupied by both sides of the river basin covers 2.09 percent of the total area of the river basin and denudational complex Hill consists 34.65 percent of the total area, which are mostly dominant in high land area of the river basin. The coastal plain occupies 3.90 percent of the river basin and eastern part of river basin is Western Ghats mountain ranges. The figure 5 shows the geomorphology of Kuttiadi river basin.

Riverine alluvium, red soil, red sandy soil, red soil with grit, mountain soil and laterite soil are found in the river basin area are. The bank of rivers and tributaries has riverine alluvial Soil which spread throughout its length of the river.The figure 6 and 7 shows the soil characteristics of Kuttiadi river basin.

Figure - 4



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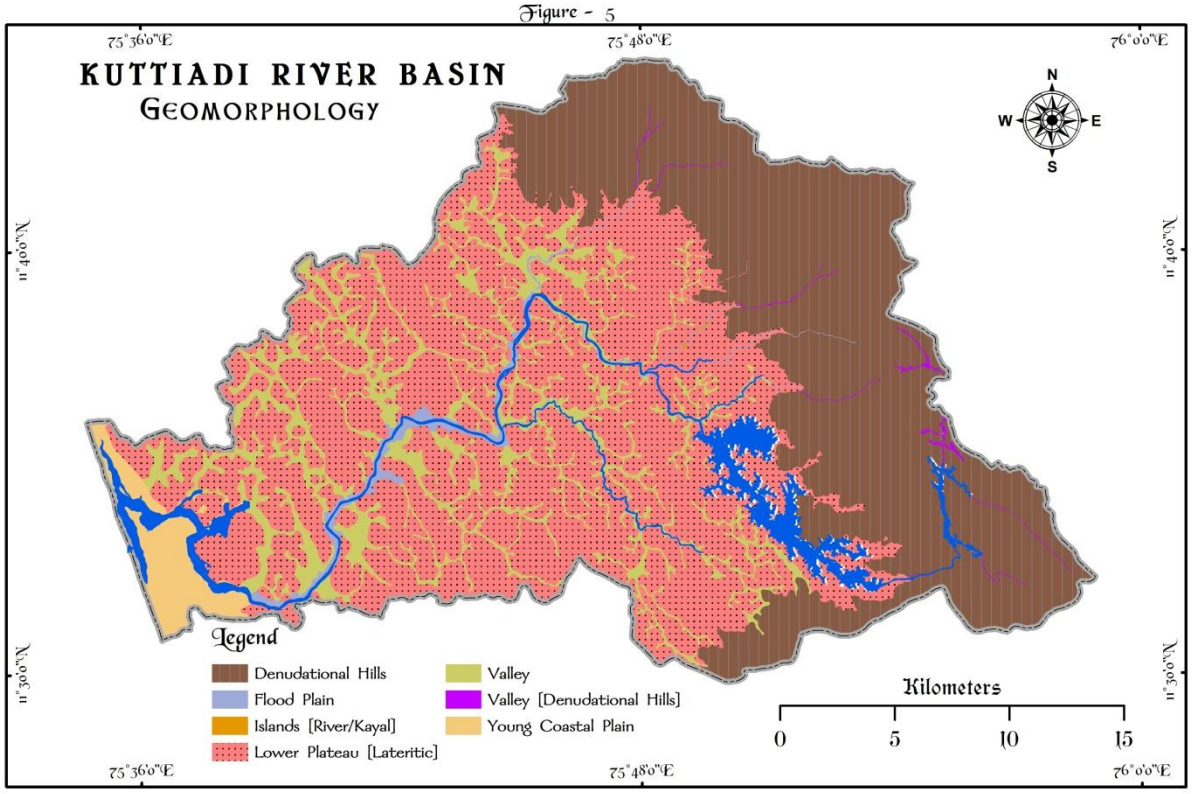

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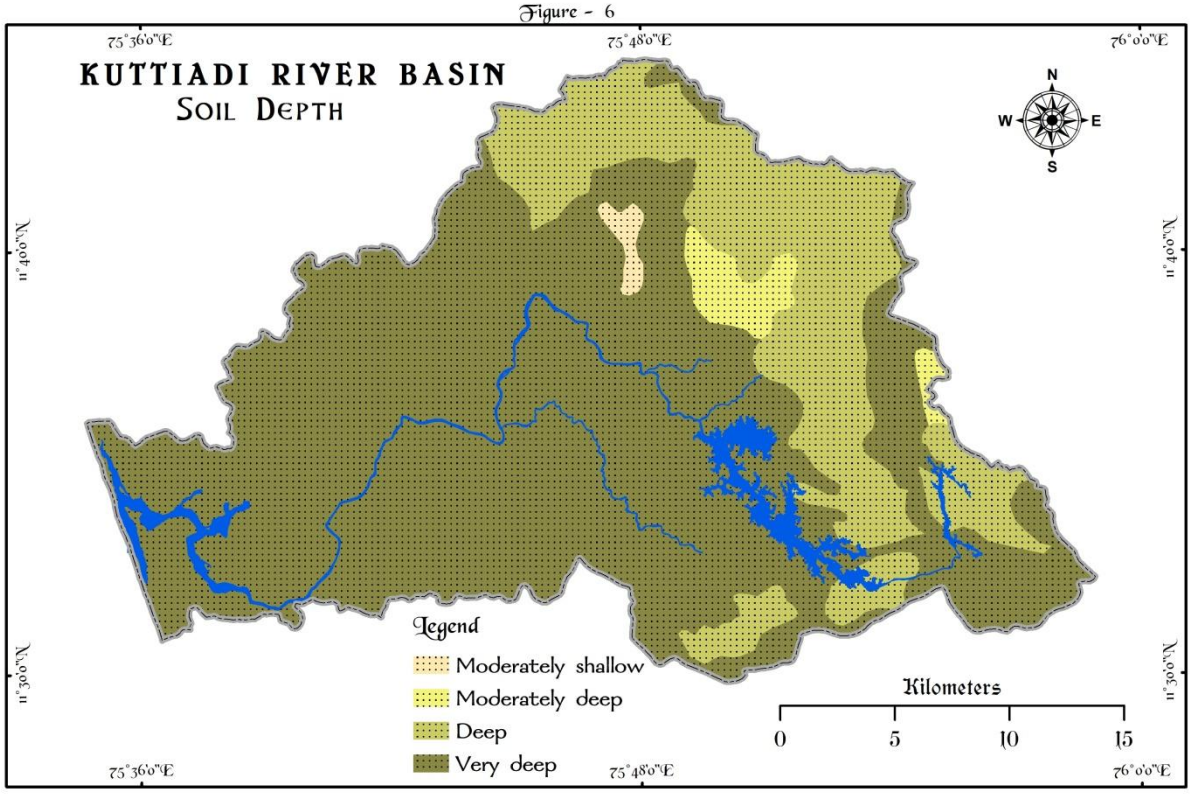

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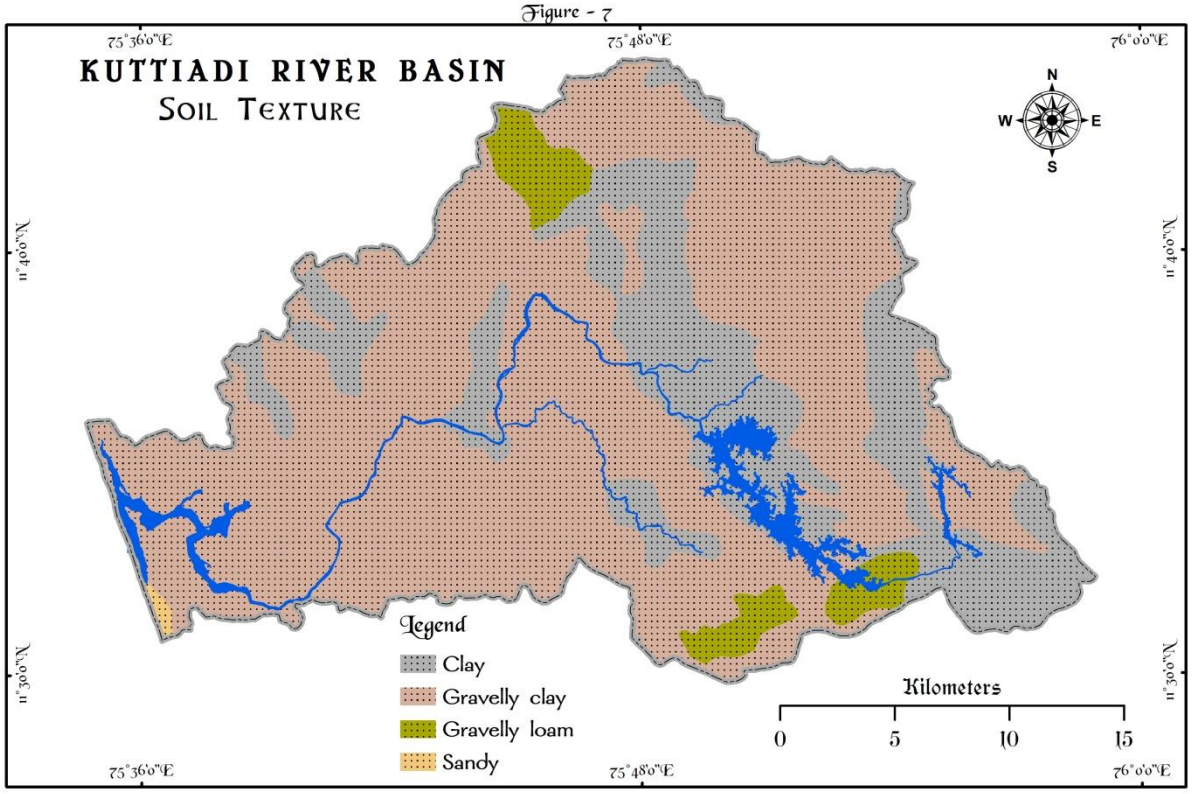


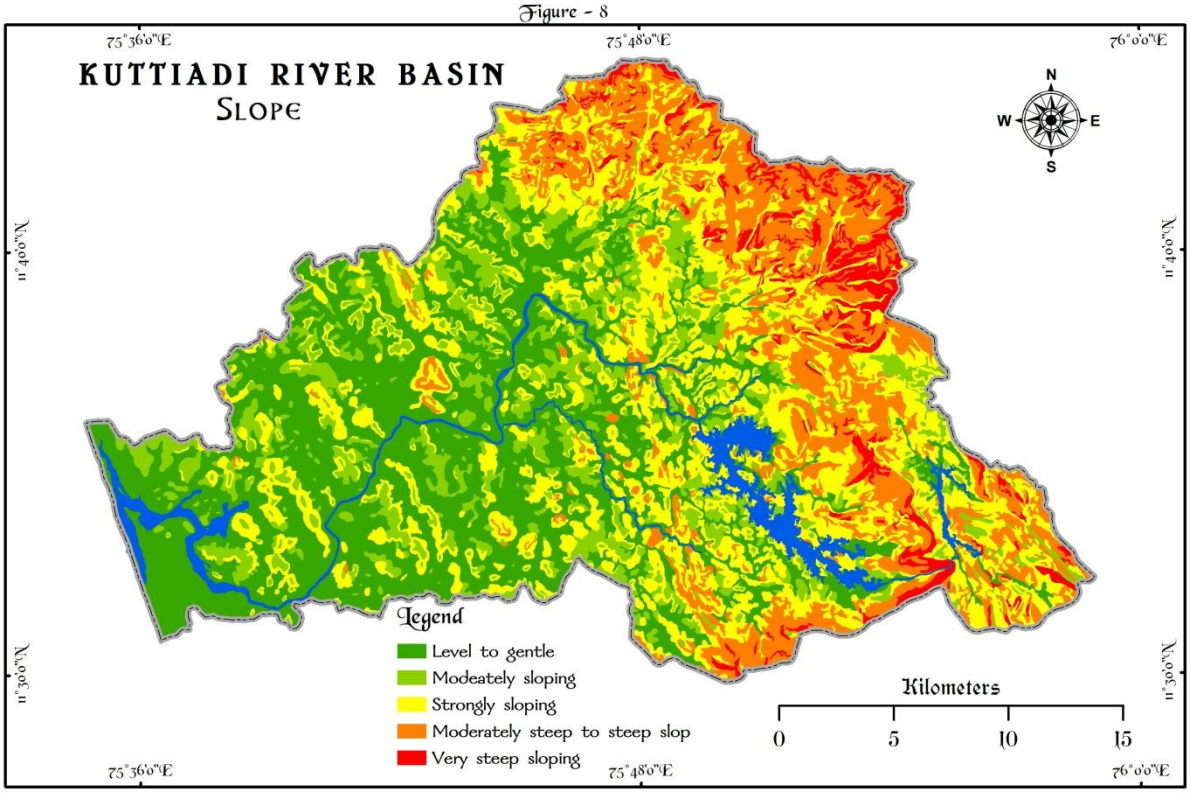
In the river basin 34.75 percent of area comes under level to gentle slopes. It is mainly concentrated in lowlands and mid lands of the basin which are more prone to cause flood. The moderate slope occupies 14.61 percent of total area and strongly slope areas are concentrated on the eastern side which is 28.16 percent of the total area of the river basin. Steep slope covers 18.11 percent and very steep slope covers 4.37 percent of the total area of the river basin. The figure 8 shows the slope of Kuttiadi river basin.

The concentration water below 0 to 2 meters is found in 1.96% and water between 2.01 to 4.00 meters is mostly concentrated in the low land and mid land of the river basin which constitute 35.56% of the total area. Remaining 62.48% of the area of the river basin has water table is below 4 meters. The figure 9 shows the water table of Kuttiadi river basin.

The river basin faces to west. Western and south west direction slope is mainly due to the location of Western Ghats. The southwest facing area occupies 18.95 percent. The west facing and south facing has of 14.73 % and 13.72 % area respectively. The distribution of aspect is shown in figure 10.

In the river basin, net area sown comprises 69.01% of the total area which is largely concentrated in the low land mid land of the river basin. In net area sown, 57.83% consists of mixed cultivation together with settlements. Tropical rain forest occupied in the eastern parts of the basin constitutes 23.97% of the total area. Water body consists of 3.35% of the area which include Peruvannamuzhi and Kakkayan reservoirs. The figure 11 shows the land use of Kuttiadi river basin.

Figure - 8



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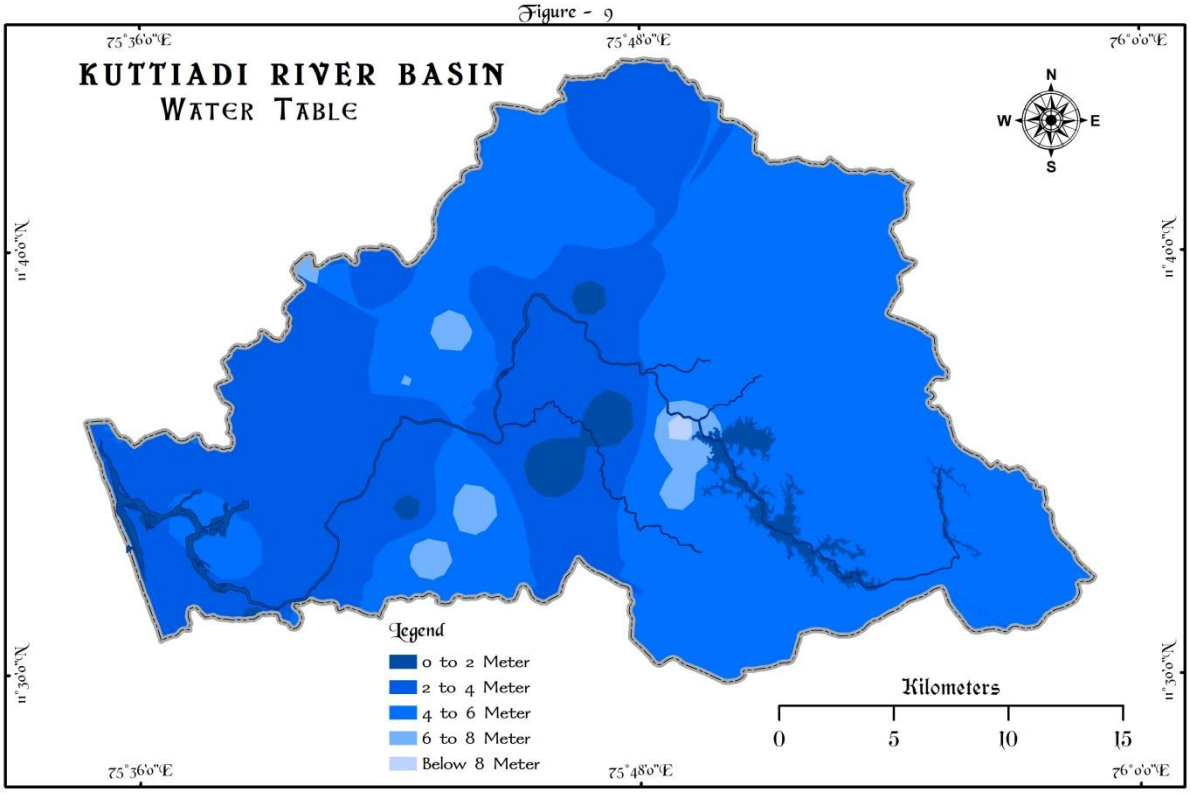

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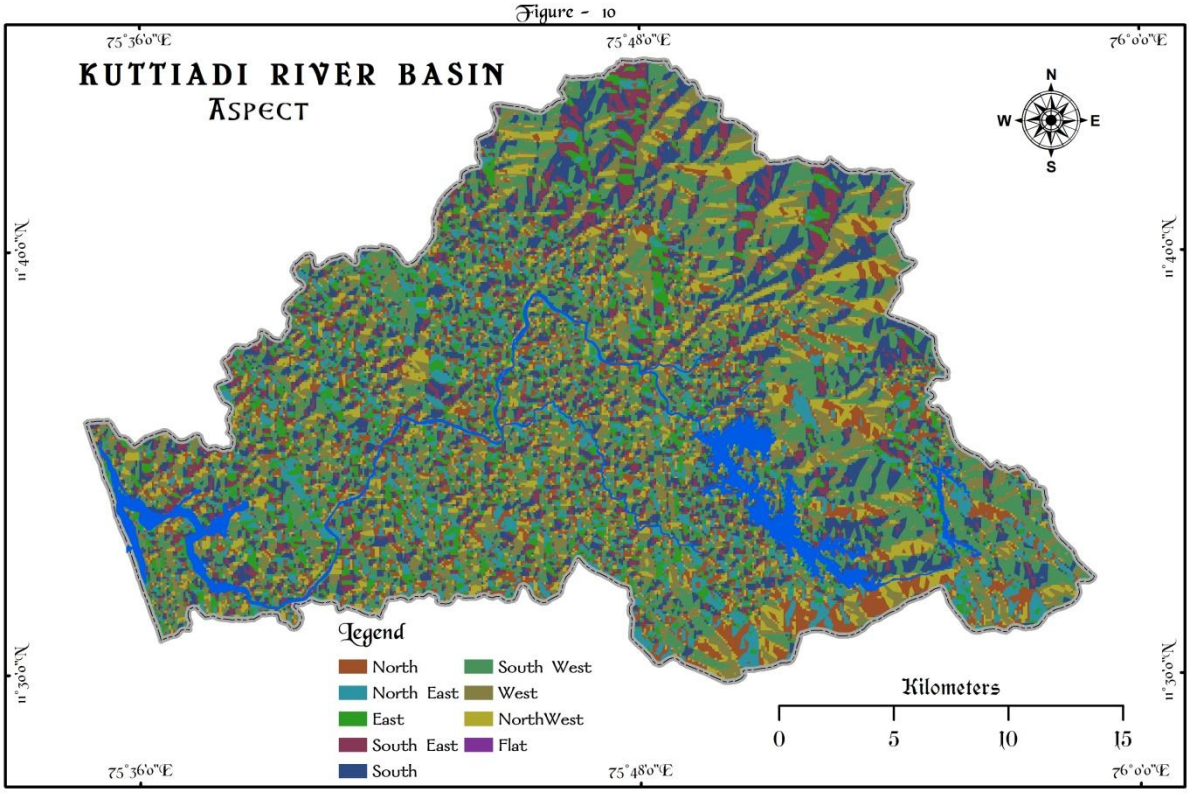


Ranking of Compound for Raster Overlay

The compound values of each group of parameters are classified into three, for converting it into raster format. Highest rank 1 is given for high proneness criteria and the lowest rank is the 3 for lowest proneness criteria or categories. The raster maps of physiography, geology, geomorphology, soil depth, soil texture, aspect, slope, land use, drainage density and water table are converted to raster format by giving appropriate rank according to their indication to proneness in making flood. The rank given to all parameters are shown in table number 1. Appropriate ranking is been given to each land use according to their geographical location and susceptibility to flooding. Suitable ranking also given for aspect of the terrain according to direction it's facing to windward side.

Table No. 1

The Ranking of Compound Values

Geographic parameters	Rank	Geographic parameters	Rank
Physiography		***Soil Depth***	
Low Land	1	Very deep	1
Mid Land	2	Deep	2
High Land	3	Moderately deep	3
		Moderately shallow	3
Geographic parameters	**Rank**	**Geographic parameters**	**Rank**
Drainage Density		***Soil Texture***	
Low Density	1	Gravelly clay	1

Medium Density	2	Clay	1
High Density	3	Gravelly loam	2
		Sandy	3
Geology			
Charnakite	3	***Slope***	
Horn Blende Gneiss	1	Level to gentle	1
		Moderately sloping	2
Geomorphology		Strongly sloping	3
Valley	1	Moderately to steep slop	3
Lower Plateau [Lateritic]	2	Very steep sloping	3
Flood Plain	1		
Valley [Denudational Hills]	3	***Water Table***	
Young Coastal Plain	1	Below 2.00	1
Denudational Hills	3	2.01 to 4.00	1
Islands in River/Kayal	1	4.01 to 6.00	2
		6.01 to 8.00	3
		Above 8.01	3

Source :Copiled by Researcher

The raster over lay analysis has been applied on the ten geographic parameters to identify the flood risk zones of the region. The derived compound value after raster calculation has been classified in to five categories to classify area of flood risk zones in Kuttiadi river basin.

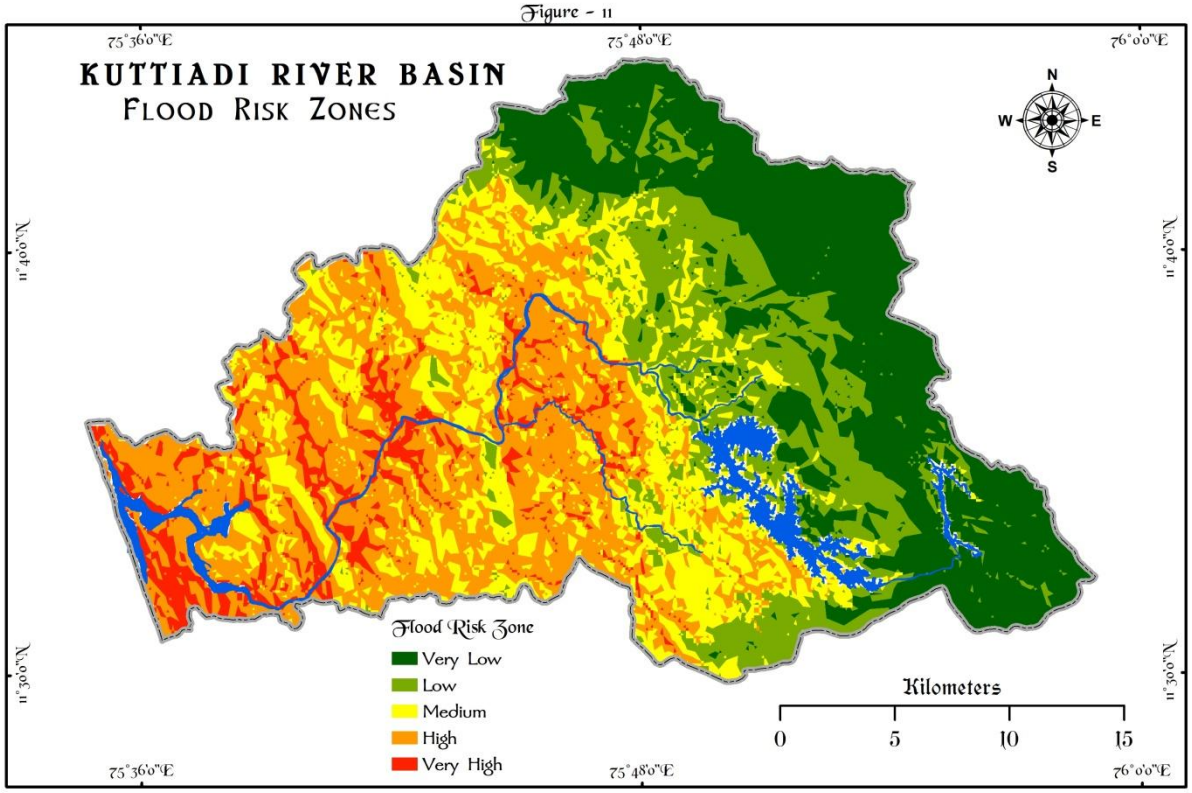
Result

The Table No. 2 shows the area of flood risk zones of Kuttiadi River basin. The result of quantitative analysis shows that geographicaly Kuttiadi river basin has 41.17 sq.km area under very high flood risk zone, which covers 10.22% of total area of the river basin. Very high flood risk zones are mainly concentrated in low land of the river basin on the either side of river channels. High flood risk zones are also concentrated in the low land of the river basin which occupies 185.37 sq.km area which comprises 27.99% of the total area of the river basin. Medium flood risk zones are concentrated in low land and mid land region of river basin occupies 131.23 sq.km and it comes 19.87% of total area of river basin. Low and very low flood risk zones occupies 16.88% and 25.04% of total area of the river basin respectively.Figure 12 shows the delimited flood risk zones of Kuttiadi river basin.

Table No. 2: **Area of Flood risk Zones-Kuttiadi River basin**

Sl. No.	Flood risk Zones	Area in Sq.Km	Area in Percent
1	Very Low	167.04	25.04
2	Low	110.56	16.88
3	Medium	131.23	19.87
4	High	185.37	27.99
5	Very High	41.17	10.22
	Total	667.00	100.00

Figure - 11



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