GEO-EYE

RESEARCH ARTICLE

Unveiling the Micro Level Impediments of Geomorphology and Climatic Conditions in the Gundal Sub Basin with the Aid of Geospatial Techniques

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Abstract

The scientific trend in geo informatics has brought tremendous impetus to the field of physical geography related aspects of the study. The Gundal sub basin which lies in the extreme south of the Mysore district of the Karnataka State India is in the crossroads of agriculture development. With the aid of the geo spatial tools and techniques, the Present research helps to find the influence of geo morphometric and climatic conditions on the overall planning in the Gundal basin. To formulate the geo spatial situation of the basin into a meaningful scientific oriented approach, linear, areal, and relief aspects of morphometric have been considered along with the Climatic conditions like temperature, precipitation, and Humidity factors. The geo-informatics tools such as Arc Hydrology, watershed delineation, IDW, SRTM data set and NASA climatic dataset have been used. Based on the derived results a micro basin has been studied to unveil the controlling factors posing strong impediments to the development.

Keywords: Climate; Morphometric; Arc Hydro tool; Watershed delineation; IDW

1. Introduction

Geo morphological character and climatic condition are two significant interdependent elements of Geo physical condition. The climatic factors effect on exogenesis activity of a geographical region. The negative variation of climatic condition in the Past years of Gundal sub basin emphasizes the Geomorphologic hazard namely, Land degradation, drought, high evaporations, low precipitation, groundwater depletion, drinking water scarcity, soil quality contamination, deforestation, low agricultural production, and yield variations. Therefore, present study aims to understand the geomorphic and climatic condition through assessment of precipitation, temperature, slope gradient, morphometric character, and Geological features. Both geo-morphological and climatic conditions have been Considered for identification of micro level impediments using geospatial technology in Gundal sub basin.

Study area of the Research

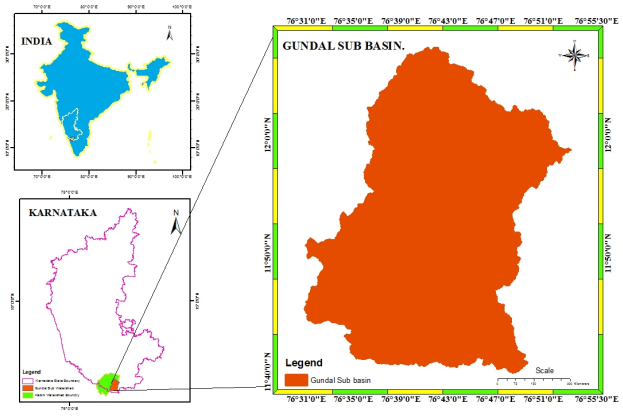

Fig. 1. Location Map

The Gundal sub basin positioned towards southern part of Karnataka state 70°.6'.31"to 76°.55'.30"East longitude and 11°40'0"to 12°.7".13" north latitude are the geo coordinates of this sub basin. The Gundal sub basin is major water source of Gundalpete taluk, and this rive originate at the Gopalaswamy Hills in the Gundalpete taluk and this river connect with Kabini River at Nanjangud taluk. A total of 59 km is the length of this river, and 1270 square kilometers is total geographical area of this sub basin. And it comes in between Mysore and Chamarajanagar district. Totally 3 taluks are located in this sub basin namely, Gundalpete and Chamarajanagar and Nanjangud. Entire Gundalpete taluk comes under this sub basin, and few villages are located in the other two taluks of the sub basin. Total 245 villages are seen in the Gundal Sub basin, out of which 132 villages from Gundalpete taluk, and 42 villages in Chamarajanagar taluk, and 61 villages' falls under Nanjangud taluk.

2. Materials and Methods of Research work

Objective of the Research:

The Kabini river basin has five sub basins; the Gundal sub basin is the 3rd largest sub basin. From past three decades to present, most of the area under this basin facing a lot of problems in socio-economic and agriculture aspects and it comes under backward condition. Due to the non favorable geo-physical conditions, many issues related to agriculture and water resources management have cropped up. The main objective of this study is to find out the factors which are solely responsible taking into consideration the Geomorphic and climatic factors for the impediments assessment study.

Objective:

- Micro level Identification of Impediments in Geomorphology and Climatic conditions, in the study area.

Methodology of Research

The present research is based on primary, secondary, and spatial datasets. The primary data has been collected from field observations and IRS, IC,-LISS III, Sentinel-2, NASA, Earth data, FAO soil data Sets have used. For climatic data Indian Meteorology department data and Bhuvan data and Earth data sets has been used. Arc GIS, Q GIS and Erdas Immagine, Arc Hydro tool, and AHP Software and geo-informatics techniques has been used for the data analysis of the research. For watershed delineation, SRTM Dem and Arc hydro tool have been used for demarcation of study area and micro watershed. For identification of unveiling impediments area of geomorphic and climatic conditions, firstly Geo co-ordinate the spatial data sets, manipulated in GIS platform and raster layer has been generated. The priority calculation has been done by using AHP techniques, based on the priority instruction different parameters have selected, in both Geo-Morphometry and Climate Aspects. For the micro level morphometric and climatic impediment identification in the Gundal Sub Basin, reclassification rank importance has been used for the weighted overlay analysis and Raster images reclassification has been done based on the analytical hierarchy process, for the calculation of importance of percentages.

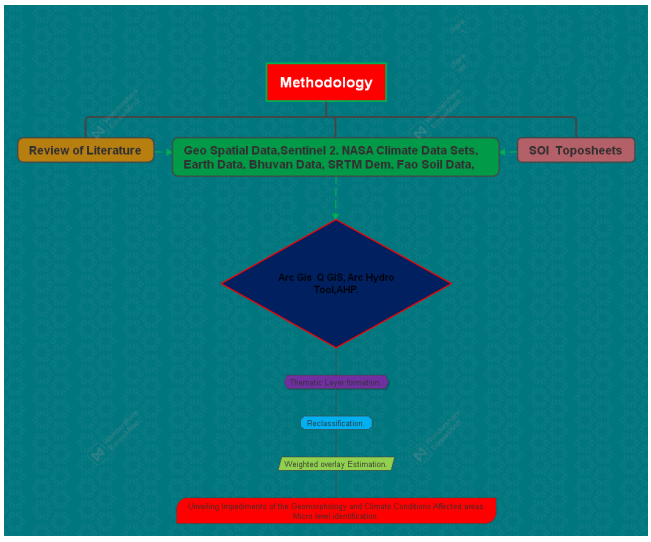

Fig. 2. Methodology flow chart of the research

Geo Spatial Data Background and Analysis

Gradient of land is the most significant for formation of different land features, the average steep is 48.82 degree and

the average lower gradient is 10 degree slope. Towards south the Bandipur national park region has highly elevated area in Gondal basins. The Normalized Difference Vegetation Index measure presents the quantity and vitality of vegetation on the land surface. The NDVI spatial composite images are developed to more easily distinguish green vegetation from bare soils. The lower range of NDVI is 0.0069 and high range is 0.995, total 73 percent of the area has very low vegetation condition in Gundal sub basin. In entire Gundal sub basin's the land use and land cover assessment indicating the 56.23% of the total area is covered by agricultural fields, and 21.56% of the area is build upland, and 15.56% of the area has the natural vegetation and scrub lands, and the remaining 6.33% of the area is flooded vegetation and water body formed in the Gondal Sub Basin. The entire Gundal sub basin has Peninsula Gneiss complex. Clay loam and Sandy clay loam are the major soil types in this area 76.8% of the area is covered by clay loam soil and then 23.2 percent of the area covered by Sandy clay loam soil. In geomorphic aspect wise the total area of Piedmont Pediplain 71% and 11% of the area is moderately dissected hills and valley are found in the Sub Basin.

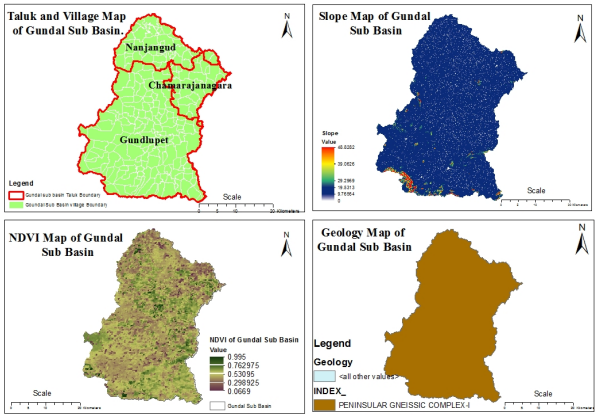

Fig. 3. Village, Taluk, Slope, NDVI, and Geology Map of study area

Climatic condition of the Gundal Sub Basin

For assess the climatic condition the precipitation temperature, water vapor pressure, solar radiation, and climatic type parameters has been considered. And each parameter wise analysis emphasizes the precipitation condition. The Assessment result shows that the lowest annual rainfall is 837 mm .and the highest average rainfall is 1148 mm. In the southern part of the 45.36% of the area has good annual rainfall conditions and 54.6 4% of the area receive low-level rainfall conditions in Gundal sub basin. The temperature ranges between 29.6 °C to 30.76°C. The Highest temperature 30.76 °C is found in most part of the north Gundal Sub Watersheds.

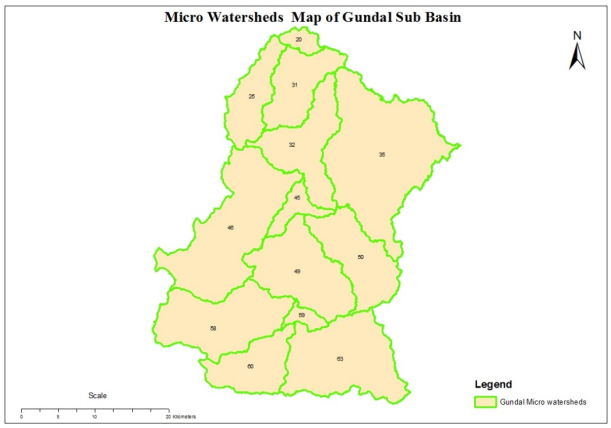

Fig. 4. Micro watershed map of the Gundal Sub-Basin

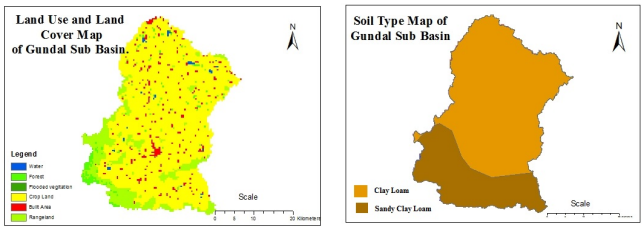

Fig. 5. The soil type and LU and LC map of the Gundal Sub-Basin

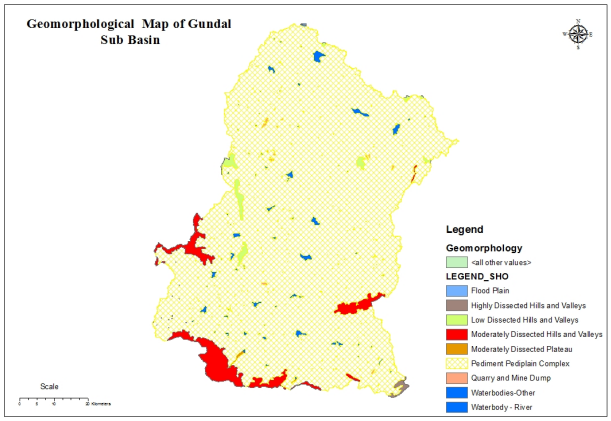

Fig. 6. Geomorphology map of Gundal Sub-Basin

In the southern parts, the basins have low-temperature conditions. The solar radiation analysis indicates the northern part of Gundal Sub basin receives Maximum of 87% amount of radiations and southern part of sub basin receives 57% radiation. With regard to water vapor and pressure conditions, entire Gundal Sub Basins experiences very low condition, but towards south water vapor and pressure condition are good.

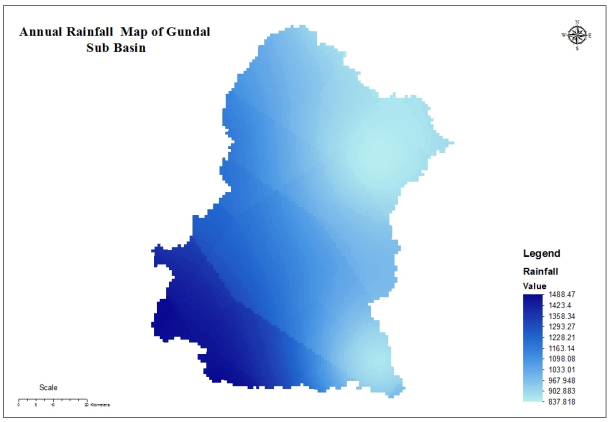

Fig. 7. Annual rainfall map of Gundal Sub -Basin

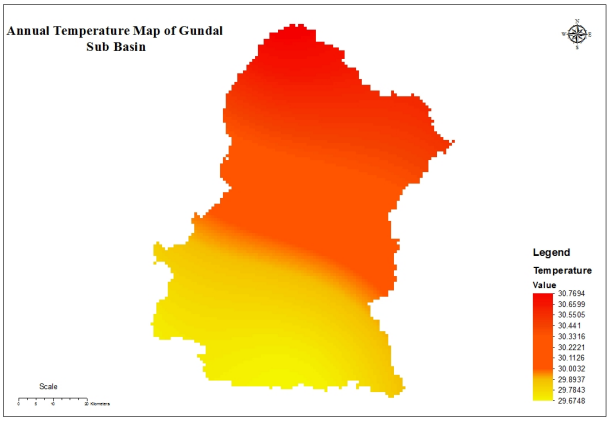

Fig. 8. Annual temperature map of Gundal Sub-Basin

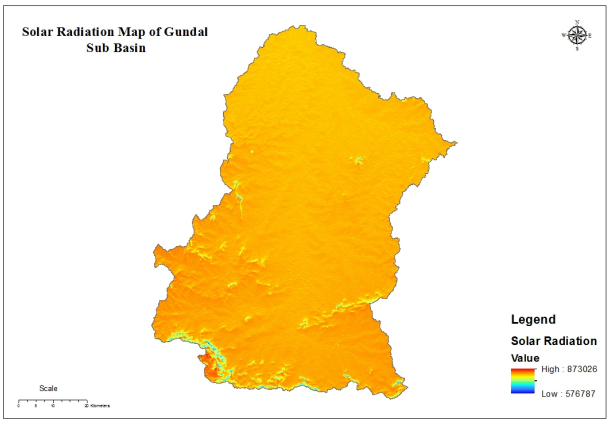

Fig. 9. Annual temperature map of Gundal Sub-Basin

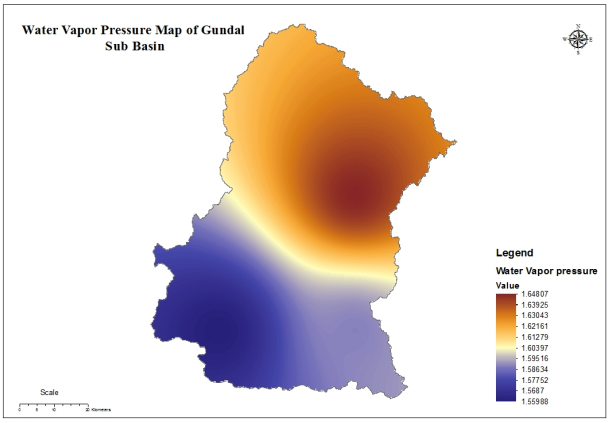

Fig. 10. Water vapor pressure map of Gundal Sub-Basin

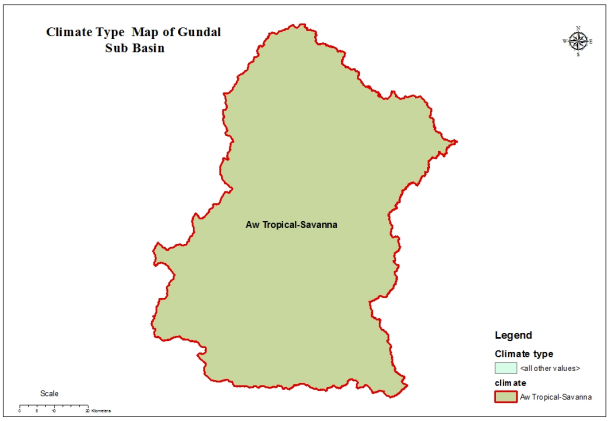

Fig. 11. Climate type map of Gundal Sub -Basin

Geo-Morphometric condition of the Gundal Sub-Basin

Identify morphometric condition stream Length Drainage density, Bifurcation Ratio, Basin relief, and Infiltration Number has been considered. The Drainage network associated surface formation and its characteristics correlated with main streams length it's calculated by dividing the total length of stream and number of stream order and increasing order increasing stream length. The micro watershed wise maximum and minimum length of Stream length ratio is 82.7781km and 5.955284 Km. The Rb range begins from 0 to 8.28 Rb value determined geological structure and slope characteristics, the range of Rb value is 3 to 5 drainage patrons has not controlled geological structure where the value is greater than 5, the drainage patron controlled by geographical structure. Lower Number of drainage density is permeable and the higher range of drainage density is non permeable and the lower range of Regions indicate the vegetative and Medium

range of relief features and 80% of the total basin relief features covered by coarse to very Coarse, and 10% to 20% of the area is comes under moderate to very fine category and the Gundal sub basin has a value of 0.004348 to close to 4.093109 it is highlighted that the range of infiltration capacity is very high in the Gundal sub basins with low runoff capacity. Basin relief helps to understand the Denudation, Geomorphic land forms features characteristics elevations highest points ranges and lowest Valley of a drainage basin it is highly influenced by slope aspects basin relief range in Gundal sub basin is begins from 0.375162296 to 0.832016818 marginal low-to-high.

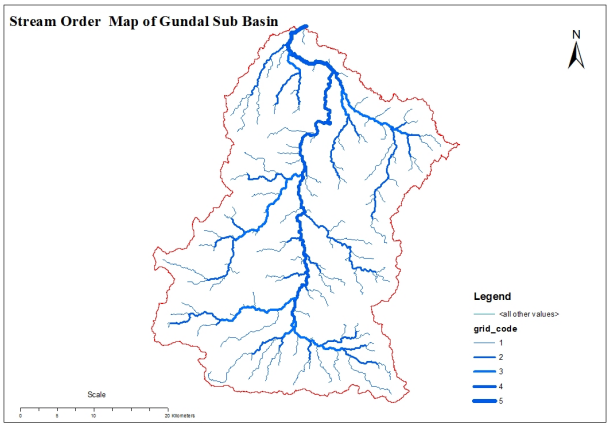

Fig. 12. Stream order map of Gundal Sub-Basin

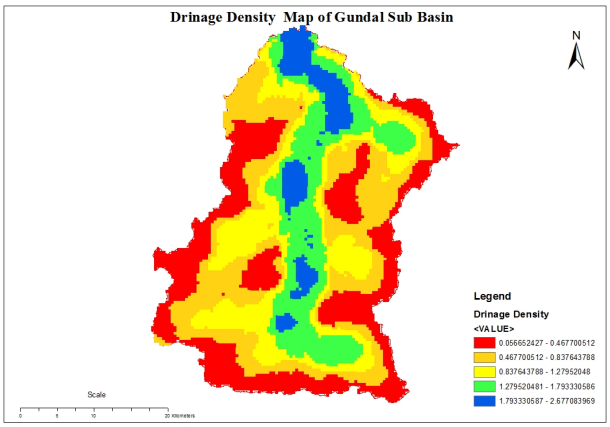

Fig. 13. Drainage density map of Gundal Sub-Basin

Identification of impediments in geo morphology and climatic condition

- **Geo Morphology**

Related to Areal, linear, and relief aspects, totally five Parameters have been selected in all the sub basins such as Stream

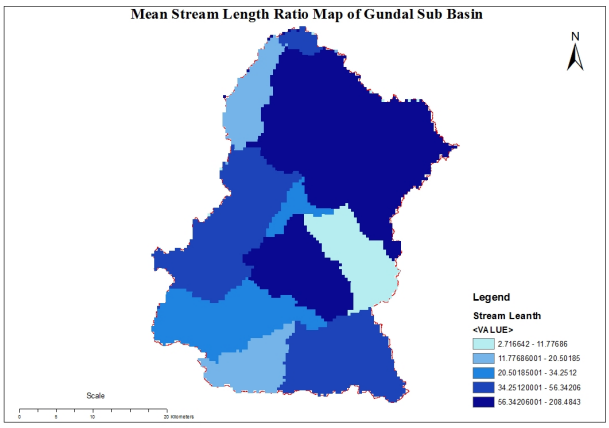

Fig. 14. Mean stream length map of Gundal Sub-Basin

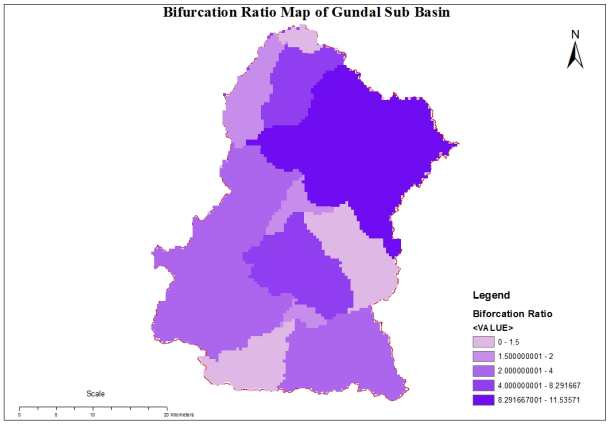

Fig. 15. Bifurcation ratio map of Gundal Sub -Basin

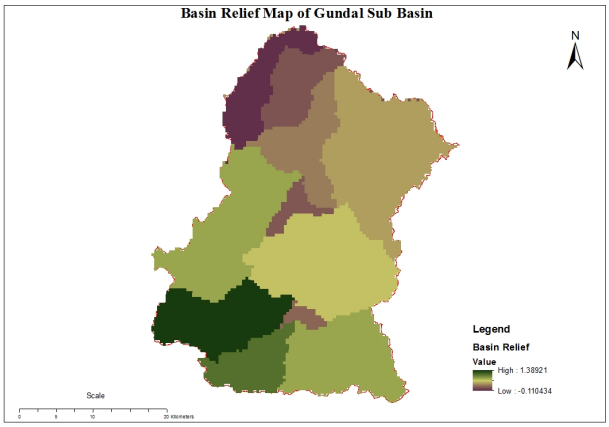

Fig. 16. Basin relief map of Gundal Sub -Basin

length, Drainage Density, Bifurcation ratio, Infiltration Number and Basin relief ratio. These factors indicate the Erodibility in the Gundal sub basin. The analytical hierarchy process has been done by assigning weightages to the different parameters such as the drainage density, bifurcation ratio, Basin Relief ratio commonly got the highest weightage whereas the Stream length, Infiltration Number secured the lowest weightage. The weightages generated in GIS platforms were further classified into low, Moderate and Good. A Total of 39.90% (481.085765 Km^2) have 3 rank with high affected area 27.77% area has 4^{th} rank (334.808619 square km) and it comes under the moderate category and 32.22% of area 389.623442 square km area under 5^{th} rank with good and the normal affects category found in Gundal Sub Basin.

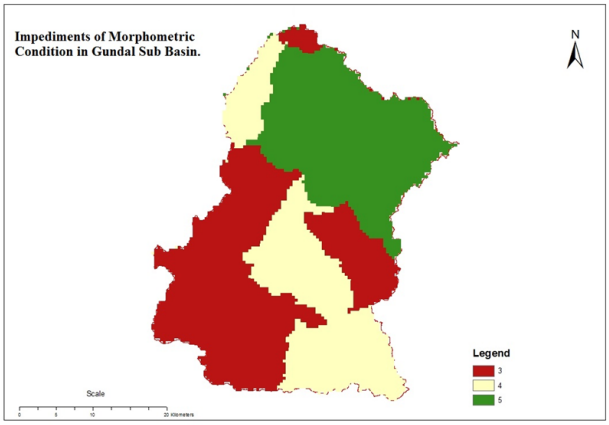

Fig. 17. Impediment scenario map of morphometric condition in Gundal Sub -Basin

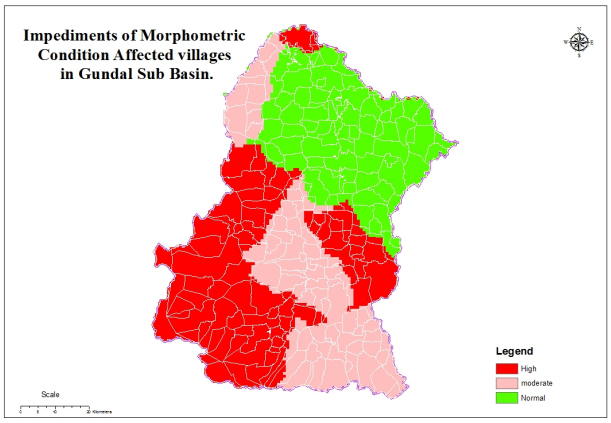

Fig. 18. Micro level impediment affect scenario map of morphometric condition in Gundal Sub -Basin

- **Climatic Condition**

Table 1. Impediments of Morphometric condition in Gundal Sub-Basin

SL No	Rank	Area	Percent
1	3	481.085765	39.90
2	4	334.808619	27.77
3	5	389.623442	32.22

For the assessment of Climatic condition Impediments five major factors have been considered, Such as Precipitation and temperature, solar radiation, water vapor pressure and climate. Analytical hierarchy process and geographical information weighted overlay has been employed to assess the Climatic condition Impediments. As per the calculations, precipitation and temperature got the highest importance and solar radiation water vapor pressure got the lower importance. Each Parameter acts both negatively and positively. On the basis of Priority rank has been assigned. The rank varies from 2 to 7. The values obtained between the 2 and 7^{th} rank has been further categorized as very low, low, high, and very high. Certain areas fall between 2 and 3 rd rank, and they come under the category of very low. The 4^{th} rank regions possess low and 5^{th} rank regions possess moderate, and 6^{th} rank to 7^{th} rank possess Good climatic condition. In terms of percentage 25.10 % (303.70114 km^2) of the area has very low weightages, and they are highly affected. The 4^{th} rank region possesses total area of 44.12% with low rank and are highly affected area. Another 25.95% of the area has secured 5th rank and come under the moderate affected climatic area. Lastly 5 % of area falls under 6th to 7^{th} rank with normal condition.

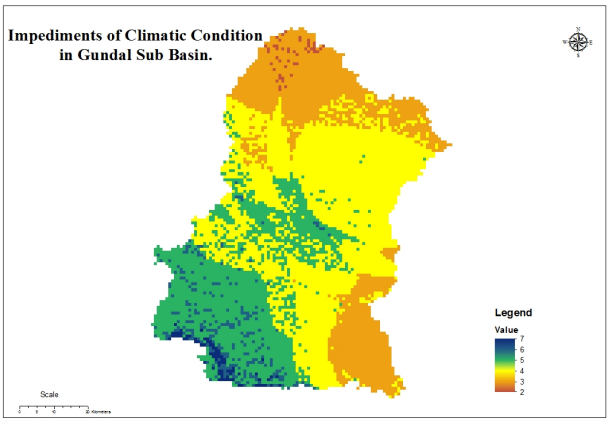

Fig. 19. Impediment scenario map of climatic condition in Gundal Sub -Basin

3. Result and Discussion

A scientific study of geomorphic and climate condition for micro level identification of impediments is the Gundal

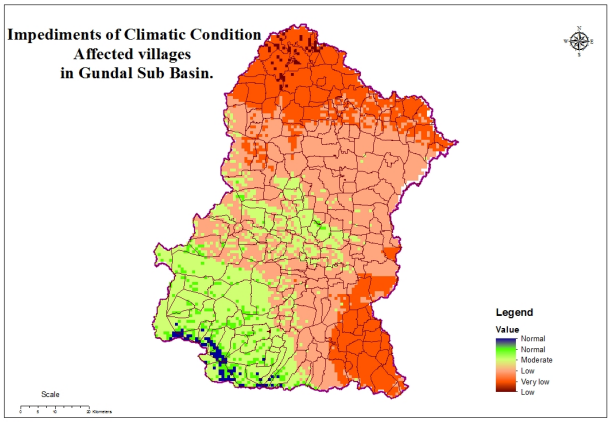

Fig. 20. Micro level impediment affect scenario map of climatic condition in Gundal Sub -Basin

Table 2. Impediments of climatic condition in Gundal Sub-Basin

SL No	Rank	Area	Percentage
1	2	7.51.714	0.60
2	3	296.184	24.95
3	4	523.6899	44.12
4	5	308.0618	25.95
5	6	39.59272	3.33
6	7	12.18238	1.02

sub basin is the main purpose of the present research and slope, geology geomorphology land use and land cover soil types considered for basic assessment of land. The analysis indicates that average slope condition is < 10 degree and in southern part of the Gundal basin the terrain is Moderately dissected with Hills and valleys. The dissected hills act as the impediment on the free flow movement of the southwest monsoon winds and there by reduces the rainfall in Gundal sub basin. Another impediment for the low rainfall and negative land carry capacity of the land is due the water divide line which bifurcated the stream orders into two. The north sloping streams forms the Gundal Sub basin and the south and southwest gradient forms Moor River basin. This basin has taken away the major portion of the catchment toward the Kerala state. Thus, Gundal sub basin region is fed with low rainfall catchment area with negative impact on the region.

Peninsular gneisses are major type of geology found in the region. Due to its non acquiferous character, it has promoted deep ground water and the quality of ground water is also not potable in many areas of the Gundal sub basin. With regard to the Land use and land cover aspect, most of the area covered by cropland and mono crop system. Due to scarcity of rainfall the ground water irrigation is common in the region. Moreover, the unscientific cropping system followed with overuse of insecticide and pesticide has drastically reduced the soil quality condition in the Gundal sub basin. The Morphometric aspect wise selected factors weighted overlay assessment emphasizes that the gradient from south to north direction is decreasing and in the northern part of Gundal basin there is high concentration of bifurcation ratio. This result defines that area is geophysical controlled structure by drainage pattern. Whereas the mid part of the Gundal sub basin has moderate affected drainage pattern and in south Gundal sub basin Normal morphometric condition is seen without significant negative or positive controlled geology physical aspects.

Pertained to the climatic aspects such as, precipitation temperature, solar radiation, and pressure the south Gundal sub basin possess normal condition. In the north Gundal basin these factors are showing negative impact.

On the basis of the results obtained the basin has been identified into highly sensitive area, which comprises 80 % of the basin area, and another 20 % of the area possesses high rank with moderate to Normal condition which is the result of climatic impediments. The Morphometric impediments assessment provides that, 39.90% of total area has low rank and highly effected condition. Another 27.77 % of total area has moderate rank and moderately affected condition. Remaining 32.22% of total area has normal affected condition.

4. Conclusion

The overall research shows that the mid and northern part of The Gundal sub-Basin unveil more impediments of climatic and Geo-Morphomertic condition, whereas the southern portion of the basin is normally affected with less climatic and geo morphometric impediments. Therefore, the crop suitability planning taken meticulously focused on sustainable water resources management. Another major threat in the regions is overuse and abuse of ground water. The dug bore well in the region has erratically sucked the ground water resulting into dire consequences such as desertification and upcoming human migration due to fall in the carry carrying capacity of the land. Land environment management action plans need to be taken as immediate measure.

5. Recommendation

- A forestation is on e of the main solution for improving the weather and climate condition in Gundal sub basin.
- In Gundal Sub Basin most of the streams and lakes have vanished, planners need to improve the stream path and refilling of lakes is highly recommended.
- Geomorphologic oriented construction of Percolation tanks and check dams are required to improve the ground water.

- Rainwater harvesting and river inter connection methods suggested for avoiding water scarcity.
- Efficient use of water with Modern irrigation techniques are recommended for balancing soil alkalinity.
- Liquid and soiled waste management plans need to adopt in municipality, town Panchayath and industrial areas of Gundal sub basin to check the future threat of pollution.
- Avoid sewage water connection into the stream is strongly recommended for reducing drinking water and groundwater contamination.
- Awareness programmes need to be conducted for local people for better utilization of bio fertilizer in agriculture and land environment protection.

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