

Groundwater Prospect Zonation Using Frequency Ratio Model For Banganga River Basin, India



Mukesh Singh Yadav, Shruti Kanga, Suraj Kumar Singh

Abstract: Groundwater prospective Zonation mapping and its reasonable improvement are a significant perspective in Banganga River Basin. In the present investigation, the groundwater imminent zones were depicted by receiving a recurrence proportion (FR) model Land use land cover, Geomorphology, Geology, Drainage Density, Lineament Density Aquifer, Slope, well location and water level were the Thematic layers considered for groundwater prospective Zonation mapping. There are 157 spring wells situated in the investigation Study area, of which all wells were considered for evolution rate and staying absolute wells considered for predict rate in the FR model. The last groundwater prospective map was characterized into five zones as Very Low, Low, Medium, High and Very high. Finally, appropriate destinations for Groundwater revitalize for practical groundwater the board were distinguished. The locales were chosen based on profundity of groundwater level, wellspring of spring great areas and inclination from regular spring to select invigorate wells. Groundwater Prospective zone ranging from 2.8068 to 12.3712. It classified into five prospective classes Very low classes cover 904.62 sq km, low zone covers 1220.76 sq km, medium zone covers 1821.46 sq km, High zone covers 2145.55sq km and very High zone covers 2687.57 sqkm. Areas with steeply inclined limestone terrains and younger tough rocks had moderate to weak groundwater potential. The groundwater is mostly not appropriate in the research region for consumption but may be used for irrigation under unique circumstances, on the basis of the chemical analysis. The general findings show that using remote sensing and GIS methods provides strong method for developing groundwater and developing the right exploration scheme.

Index Terms: Remote Sensing and GIS, Frequency Ratio, Groundwater Prospective Zonation,

I. INTRODUCTION

Water is an insufficient commodity and hence adequate supply of safe water is pre-requisites for the overall development of any country. This is particularly obvious in semi-arid to arid climatic regions. Moreover, with the growth in population, the demand for safe water increases much fold for the survival of the community. For this reason, the efforts related to the location, development, and

management of the groundwater supplies are of elementary financially viable importance for any country. An intensive activity in the investigation of groundwater has been initiated since the previous a small amount of decades because the groundwater like any other natural resources of the ground is becoming difficult to locate payable to variations in climatic, geomorphologic and geologic conditions. In analysis of this new technique and methodology which will help to locate the potential zone for groundwater and reduce the failure rate of wells are of paramount importance in a rising country like India. Water is an essential element which not only governs life on the earth but also influences the financially viable, industrial and agricultural development of mankind. As a subject of fact, for each capita utilization to water is worn as a yardstick to determine the prosperity level of a nation. According to (Heath and Trainer et al 1968 and Pandey and Singh 2015), the estimated quantity of groundwater in storage in the land areas may be around 80 million cubic kilometers, half of which possibly will be at a depth not as much of than 800 meters. This is around thirty-five the occasions the aggregate stockpiling of the earth and is around one-fourth of the volume put away like ice in polar territories and the world water balance ninety-four Percent of the world's water fill and rests in the seas and oceans at abnormal state of Salinity, than groundwater accounting report for around 66% piece of the spotless water assets on the planet. Groundwater constitutes an important source of water for domestic, industrial, and agricultural purposes. Its distribution with wide spatial-temporal variations depends on the underlying rock formation sand their structural fabric, geometry and surface expression. The ever-increasing stipulate water due to not decreasing demographic force has mounted innocuous force on its well thought-out consumption. The depleting water resources and consequent mounting problems necessitate sustainable water resources development plans (Rao and Narendri, 2000 and Kanga and Singh. 2017). Mapping and monitoring of existing groundwater resources and forecasting the future resource-use scenarios are therefore essential.

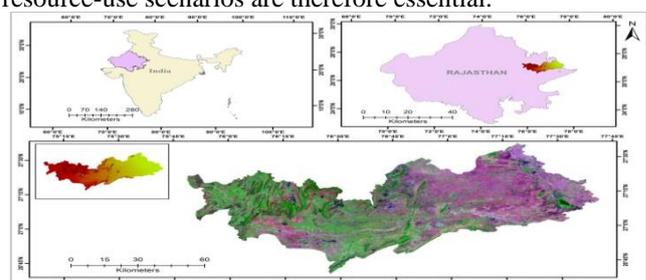


Figure 1: Study Area map (Banganga River Basin)

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* Correspondence Author

Mukesh Singh Yadav*, M.Tech Student, Centre for Climate Change and Water Research, Suresh GyanVihar University, Jaipur, India.

Shruti Kanga, Associate Professor, Centre for Climate Change and Water Research, Suresh GyanVihar University, Jaipur, India,

Suraj Kumar Singh, Associate Professor, Centre for Sustainable Development, Suresh GyanVihar University, Jaipur, India,

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The combination of data on a few ecological highlights in a systematic approach results in cheerful groundwater potential zones and structures a significant part of groundwater the board ponders. The conventional utilization of remotely detected pictures and their elucidations lie in the subjective portrayal of hydro geographical mapping units (Meijerink, 1996 and Singh and Kanga 2017). The information, related to ground truth data, give subtleties on geography, geomorphology, lineaments, and land use land spread, which eventually characterize the groundwater routine. Topographical data framework (GIS) utilizes tendency and learning from other information sources into the basic leadership procedure and aides in taking care of and the board of substantial and complex information bases. Remote detecting (RS) joined with GIS encourages better information examination and elucidation. Appropriate examinations on the utilization of these methods in the investigation and evaluation of groundwater assets, choice of destinations for fake energize, and subsurface stream displaying. This part exhibits the job of RS and GIS in groundwater examines the depiction of different morphometric parameters, factors engaged with groundwater potential outline and class appraisal for drinking and emption purposes. It additionally audits the past works completed dependent on RS and GIS innovations identified with morphometric thinks about, groundwater potential evaluation and groundwater quality investigation

The Groundwater Potential Index (GWPI) was determined. The model was approved utilizing borehole and siphoning test information. Lithology areas acquired from the boreholes demonstrated a 10 m thick shallow aquifer of coarse sand in the region where GWPI is more noteworthy than or equivalent to eight. An 8 m thick shallow sandy aquifer zone was recognized where GWPI is somewhere in the range of six and eight and, a dainty fine sand layer was identified in the zone where GWPI is under six. Multi-criteria investigation utilizing different parameters portraying the structure and working of an aquifer was attempted to produce a guide of various levelled groundwater potential territories in northern Iraq and observed to be increasingly powerful. Landsat ETM information, topographic maps, lithostratigraphic maps and geographical maps coordinated into GIS were utilized to find high return wells. The investigation uncovered that the groundwater amount was reliant on the capacity and velocity of the penetration in the issues and breaks of hard shake arrangements (Travaglin and Dainelli, 2003 and Tripathi et al. 2017). The data on lithology, geographical structures, land telephones, land use land spread from RS information and waste system, soil attributes and slant information of the landscape were incorporated into the GIS condition to portray town astute groundwater prospect (Jaiswal et al., 2003 and Nathawat et al. 2010). GIS was utilized as a preprocessor to the SWAT (Soil Water Assessment Tool) model for appraisal of existing and foreseen water uses and water deficiencies in incessantly dry spell inclined watershed. The yield from the SWAT model was joined with water accessibility, dregs yield, and statistic and financial information in the GIS condition for prioritization of sub-watersheds. The potential areas of water-collecting structures were recognized utilizing GIS capacities (Gosain and Sandhya, 2004 and Roy et al. 2017) investigated the potential for foreseeing the spatial variety in subsurface water level.

II. MATERIAL AND METHODS

A. Frequency Ratio Model

Frequency Ratio (FR) model can be defined as the reference of the probability of a specified feature. FR approach is a statistical model that has an application as simple tools for geospatial valuation and computation of the probabilistic association between the dependent variable (the groundwater in this work) and independent variables (the factors that affect the occurrence of groundwater). It is ordinarily supposed that the existence of GW is estimated by GW conditioning elements, and future GW wells will happen under the same situations as past occurrences of GW. Keeping these

suppositions in mind, a distinguishing line can be drawn between the correlation among GW well happening in an area and the GW conditioning influences and the correlation between GW wells not happening in an area and the GW containing influences. This method is proficient in viewing the connection between the factors that indicate the occurrence of GW and the wells of GW. FR approach is greatly toed and easy to apply compared with other statistical approaches, particularly in operations that include inputs, com-potations, and outputs. This model is considered as a good method in assessing the results of GW spring potential. It has been applied in multi-studies for example, mapping of GW potential, forest fire study and the vulnerability of landslide. To apply the FR model, each conditioning element was changed to a raster grid with 30×30 m cells. The full number of cells in the study area is 8789 sq meters. The numbers of ground-water wells assigned to the analysis are 157 wells. The association detected between the location of groundwater wells and all the influences related groundwater forms the foundation of the analysis in this approach only quantitative outcomes are achieved through this method. The equation used to calculate the frequency ratio values.

$$FR = (A/B) / (C/D) = E/F$$

Where:

A = A is the region of a class in support of each GW conditioning influence,

B = B is the whole area of each element,

C = C is the numeral of GW occurrences within the class region of the factor,

D = D: is the number of whole GW occurrences in the study area,

E = E is the proportion for the region with regard to set for the factor,

F = F is the proportion for the whole domain,

FR = FR is the ratio of the area where groundwater occurred to the entire area.

If the FR value is lower than 1 that indicates to lower relation and a assessment greater than 1 refers to a higher connection. The groundwater prospective mapping contains three main processes.

- 1) Spatial database construction.
- 2) Analysis of relationship between wells locations, and
- 3) Validation of research conclusion

Frequency Ratio (FR) model can be defined as the reference of the probability of a specified feature. FR approach is a statistical model that has an application as simple tools for geospatial valuation and computation of the probabilistic association between the dependent variable (the groundwater in this work) and independent variables (the factors that affect the occurrence of groundwater).

B. Thematic Map Preparation

Land Use and LandCover

LU/LC changes are influenced by human intercession and characteristic marvels, for example, agrarian interest and exchange, populace development and utilization examples, urbanization and monetary advancement, science and innovation, and different variables (Research on Land use change and Agriculture). As an outcome, data about LULC is fundamental for any sort of common asset the executives and activity arranging. Convenient and exact data about LULC change identification of earth's surface is critical for getting connections and cooperation's among human and regular wonders for better administration of basic leadership (Lu et al., 2004). There is a proceeding with interest for exact and exceptional LULC data for any sort of supportable improvement program where LULC fills in as one of the real info criteria. Accordingly, the significance of appropriately mapping LULC and its change just as refreshing it through time has been recognized by many research specialists for basic leadership exercises; as utilization of land spread change in urban condition by Deng et al., (2005). Human adjustments of the earthbound surface of the earth are exceptional in their pace, greatness and spatial

reach, of these, none could really compare to changes in land spread and land use (Turner II, B.L., W.B. 1994). Despite the fact that land use land cover changes are the backhanded outcome of national financial development, it is imperative to assess land use and land cover changes in the provincial and the neighborhood setting so as to help with foreseeing the effects related with change and add to a comprehension of beneficial ecological manageability (Laymon, C. 2003). Land Use as well as Land Cover To prepare the Land use in addition to the land cover map we use the Landsat data satellite data and use ArcGIS 10.3.1 software and Erdas Imagine 2015 Software. For classification, we use Erdas Image and for map preparation, we use ArcGIS Software .in land use in addition to land cover we categorize the entire area in nine categories. Agriculture/Fallow, Water, River/canal, Industrial, Villages, Forest, Urban Area, Open, Low Densevegetation, etc. In the entire area open Area covered (3976.059315 Square Km), Agriculture/Fallow Area are covered (3503.427388 Square Km) total Villages are covered (93.35 Square Km), Low Dense Vegetation are covered (519.61 Square Km) Forest is covered (596.04 Square Km), Water is covered (41.998994 Square Km), River/Canal is covered (17.01 Square Km), Urban Area is covered (35.79 Square Km) and Industrial area is covered (5.063 Square Km).

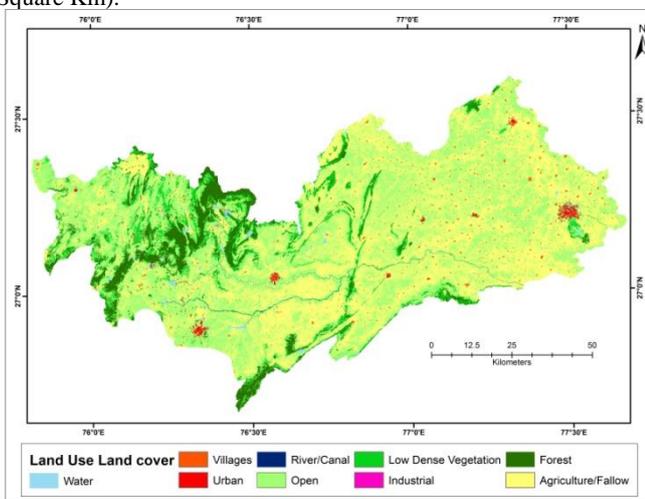


Figure 2: land use and land cover of Banganga river basin

C. Geomorphology

Geomorphological mapping is viewed as a crucial procedure of the control delivering significant base information for geomorphological and natural research and practice. Geomorphological maps are able to be viewed as graphical inventories of a scene portraying landforms and surface just as subsurface resources. Geomorphological mapping are a starter instrument for land the board and geomorphological hazard the executives, additionally giving pattern information to different segments of natural research, for example, scene biology, ranger service or soil science. The broad dissemination and expanded graphical abilities of GIS-programming just as the accessibility of high-goals remote detecting information, for example, aeronautical and satellite symbolism or computerized rise information has prompted a restoration of the technique. This part diagrams the history, creation, and spread of geomorphological maps; it gives a concise outline of field and computerized mapping procedures, just as early on data on cartographic principles related to geomorphological mapping. To create the geomorphology thematic map we used ArcGIS 10.3.1 in addition to Erdas Imagine .we categorize the map base the geomorphology types there are six types of geomorphology these are Fluvial Origin ,Water Bodies, Structural Origin, Aeolian Origin, Denudational Origin ,and Hills. In the Banganga River Basin Fluvial Origin covered (6292.400Sq Km) Water Bodies are covered (138.44 Sq km), Structural Origin are covered (1.51 Sq Km), Aeolian Origin are covered (132.100676Sq km) Denudational Origin are covered (949.182818

Sq km) Hills are covered (1275.02 Sqkm).

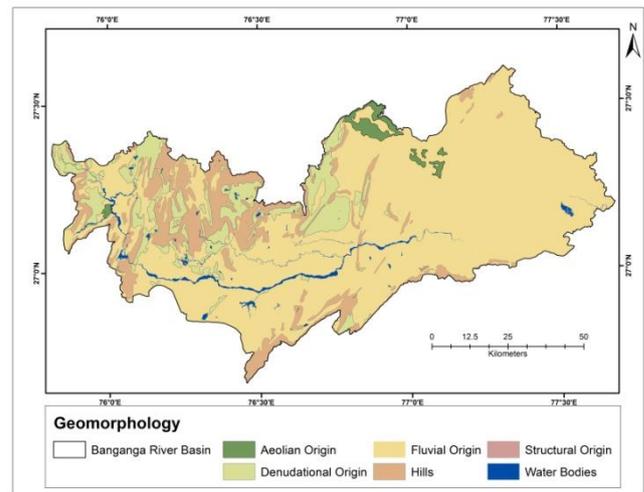


Figure 3: Geomorphology Types of Banganga River Basin

D. Slope

Slope measures the price of change of elevation at a surface location. The slope may be expressed as a percent slope or degree slope. Feature is the directional calculate of the slope. Aspect starts at 0° in the north, moves not opposite of clockwise, as well as ends with 360° also at the north. Because it is a circular measure, we often have to manipulate aspect measures before using them in data analysis. The slant and viewpoint for a region unit are estimated by the amount and course of the tilt of the unit's ordinary vector—a guided line opposite to the unit. Diverse estimate (limited contrast) techniques have been proposed for figuring slant and angle from a height raster. These techniques vary in the quantity of neighboring cells utilized in the estimation and the esteem applying to every phone. In the slope map we use the ASTER Dem Data and the Use the ArcGIS Software slope tool to create the Map. We categorized based on elevation in the entire areas four Types 0-4.505581486 (Low), 4.505581486-11.76457388 (Medium), 11.76457388-23.52914776 (High), and 23.52914776-63.82907104 (Very High). In the Banganga river Basin very low Slope cover 5325.93Sqkm, Medium Slope cover 2706.84Sq km, High Slope cover 431.87818 Sq.km and Very High Slope cover 263.48 Sq.km.

E. Lineament Density

A lineament is a direct element in a scene which is a declaration of a fundamental land structure, for example, a flaw. Ordinarily, a lineament will show up as a flaw adjusted valley, a progression of shortcoming or overlap adjusted slopes, a straight coastline or to be sure a mix of these highlights. Break zones, shear zones, and volcanic interruptions, for example, dikes can likewise be communicated as geomorphic lineaments. To prepare the Lineament Density map we use Satellite data and ArcGIS 10.3.1 Software. Lineament Density from remote detecting was assessed. While building the three lineament thickness maps, right off the bat lineament length thickness esteems, checks thickness esteems and cross-focused thickness esteems are processed utilizing this content record. Subsequent to ascertaining these thickness esteems, a lineament length thickness map, a lineament checks thickness map and the lineament cross-focuses thickness map are developed dependent on the registered qualities utilizing

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business Arc View.A rising strategy for lineament thickness esteems can be eluded to Hard castle (1995).

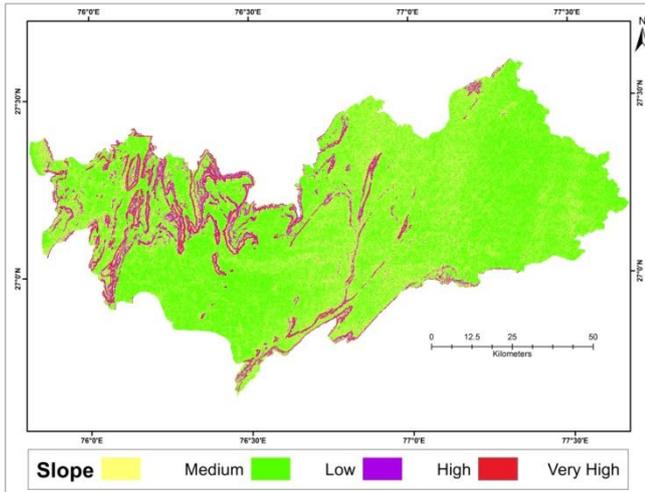


Figure 4: Slope Map of Banganga River Basin

The equi-dispersion matrices are drawn on the lineament guide and circles with a given span are built at every hub. Presently the length, tallies, and cross-purposes of lineaments inside the circle are summed and the qualities are given to every hub. The computation of the 13 lineament length depends on the separation between peaks inside the circle. On account of a crossing point between a circle and a lineament, the convergence is changed over to zenith and afterward the separation is determined. demonstrate the primary code of the PLANS content to deliver the three lineament thickness esteems. Total Lineament density cover 8788.60 sq km and categories Five parts 0-0.026853(Vey Low) Lineament Density Cover 5799.88 sq km , 0.026853-0.082138(Low) cover 1192.74 sq km, 0.082138-0.15006 (Medium)cover 963.68 sq km, 0.15006-0.238517(High) cover 642.38 sq km and 0.238517-0.401213(Very High) cover 189.89 sq km.

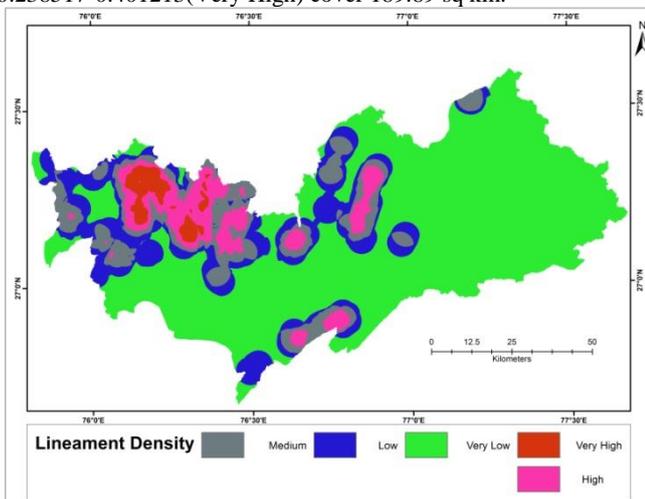


Figure 5: Lineament Density of Banganga River Basin

F. Drainage Density

Drainage density is the all-out length of the considerable number of streams and waterways in a waste bowl isolated by the all-out zone of the waste bowl. It is a computer of how well or how inadequately a watershed is depleted by a stream channel. It is equivalent to the regular of the consistent of channel upkeep and equivalent to the corresponding of multiple times the length of an overland stream. Drainage density relies on both the atmosphere and physical attributes of the waste bowl. Soil penetrability and basic shake type influence the overflow in a watershed; impermeable ground or

uncovered bedrock will prompt an expansion in surface water spill over and hence to increasingly visit streams. Tough areas or those with high alleviation will likewise have a higher waste thickness than other seepage bowls if different attributes of the bowl are the equivalent. To prepare the drainage Density Map we use the ASTER DEM and ArcGIS 10.3.1 Software. Drainage Density is the all-out length of the considerable number of streams and waterways in a seepage bowl partitioned by the absolute region of the seepage bowl. It is a proportion of how well or how ineffectively a watershed is depleted by stream channels. Total drainage Density cover 8788.681242 sq km .drainage Density categorize five parts 0-37.038049(Very Low) cover 2445 sqkm , 83.335609-135.806178 (Low) cover 2462 sq km , 83.335609-135.806178 (Medium) cover 284 sq km, 135.806178-203.709267 (High) cover 1306 sq km and 203.709267-393.529266 (Very High) cover 486.68 sq Km.

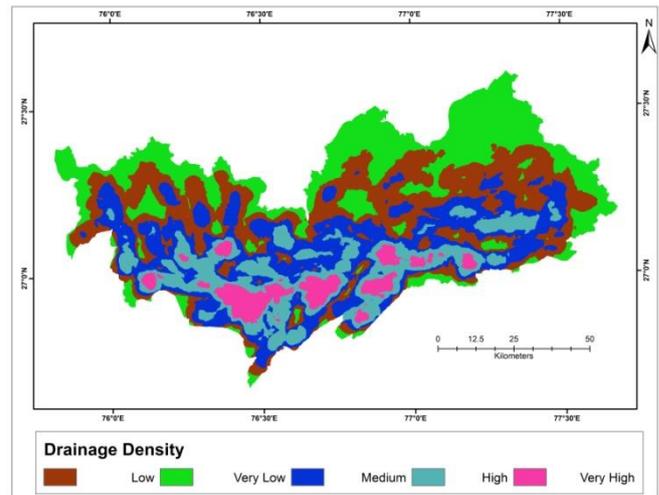


Figure 6: Drainage Density of Banganga River Basin

G. Aquifer

To create the thematic map layers of the Aquifer we used the ArcGIS 10.3.1 software and Secondary data and Satellite data in the Banganga river Basin the total entire areas aquifer types are eight types we categorize. Gneiss, Granite, Hills, Older Alluvium, Phyllite, Quartzite, Schist, and Younger Alluvium. Younger Alluvium cover 694.799697sq km, Granite cover 48.95 sq km, Older Alluvium cover 5702.05 sqkm, Phyllite cover 295.25 sqkm, Schist cover 136.39 sqkm, Quartzite cover 1272.16 sqkm, Gneiss cover 106.40 sq km and Hills cover 532.64 sqkm.

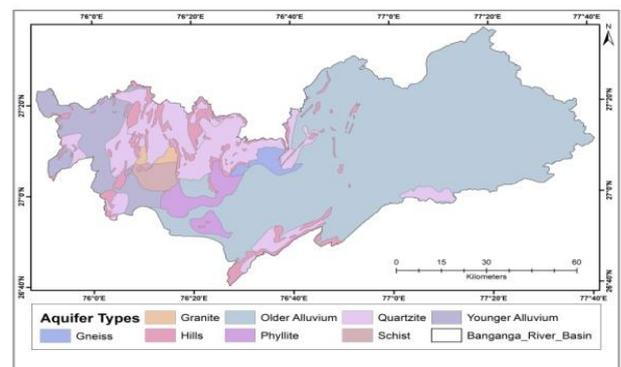


Figure 8: Aquifer Types of Banganga River Basin

Table 1: Frequency Ratio Value Of The Different Thematic Layer Attributes On Behalf Of Groundwater Prospective Zonation Mapping.

Thematic maps	Attribute details	Area in a class Area in Sq Km	Total	% of area in a class	No of well Each Area	well	% of area of Well	Frequency Ratio
LULC	Open	3976.06	8788.36	45.24	64	157	40.76	0.9
	Agriculture/Fallow	3503.43	8788.36	39.86	85	157	54.14	1.36
	Villages	93.35	8788.36	1.06	1	157	0.64	0.6
	Low Dense Vegetation	519.61	8788.36	5.91	3	157	1.91	0.32
	Forest	596.04	8788.36	6.78	2	157	1.27	0.19
	Water	42	8788.36	0.48	0	157	0	0
	River/Canal	17.01	8788.36	0.19	0	157	0	0
	Urban	35.79	8788.36	0.41	2	157	1.27	3.13
	Industrial	5.06	8788.36	0.06	0	157	0	0
Aquifer	Younger Alluvium	694.8	8788.65	7.91	8	157	5.1	0.64
	Granite	48.95	8788.65	0.56	0	157	0	0
	Older Alluvium	5702.06	8788.65	64.88	132	157	84.08	1.3
	Phyllite	295.25	8788.65	3.36	4	157	2.55	0.76
	Schist	136.39	8788.65	1.55	1	157	0.64	0.41
	Quartzite	1272.17	8788.65	14.48	9	157	5.73	0.4
	Gneiss	106.39	8788.65	1.21	0	157	0	0
	Hills	532.65	8788.65	6.06	3	157	1.91	0.32
Geology	Quaternary	4907.01	8788.65	55.83	135	157	85.99	1.54
	Bhilwara Supergroup	2074.11	8788.65	23.6	14	157	8.92	0.38
	Delhi Supergroup	1807.54	8788.65	20.57	8	157	5.1	0.25
Slope	Low	5325.93	8788.13	60.6	108	157	68.79	1.14
	Medium	2706.84	8788.13	30.8	42	157	26.75	0.87
	High	491.88	8788.13	5.6	5	157	3.18	0.57
	Very High	263.48	8788.13	3	2	157	1.27	0.42
Lineament Density	Very Low	5799.89	8788.6	65.99	135	157	85.99	1.3
	Low	1192.74	8788.6	13.57	7	157	4.46	0.33
	Medium	963.69	8788.6	10.97	8	157	5.1	0.46
	High	642.39	8788.6	7.31	5	157	3.18	0.44
	Very High	189.9	8788.6	2.16	2	157	1.27	0.59
Drainage Density	Very Low	2449.61	8788.68	27.87	32	157	20.38	0.73
	Low	2462.03	8788.68	28.01	49	157	31.21	1.11
	Medium	2084.07	8788.68	23.71	47	157	29.94	1.26

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	High	1306.28	8788.68	14.86	26	157	16.56	1.11
	Very High	486.68	8788.68	5.54	3	157	1.91	0.35
Water Level	Low	3547.73	8788.66	40.37	56	157	35.67	0.88
	Medium	2684.97	8788.66	30.55	69	157	43.95	1.44
	High	2124.44	8788.66	24.17	30	157	19.11	0.79
	Very High	431.51	8788.66	4.91	2	157	1.27	0.26
Geomorphology	Fluvial Origin	6292.4	8788.65	71.6	143	157	91.08	1.27
	Water Bodies	138.44	8788.65	1.58	2	157	1.27	0.81
	Structural Origin	1.51	8788.65	0.02	0	157	0	0
	Aeolian Origin	132.1	8788.65	1.5	0	157	0	0
	Denudational Origin	949.18	8788.65	10.8	8	157	5.1	0.47
	Hills	1275.02	8788.65	14.51	4	157	2.55	0.18

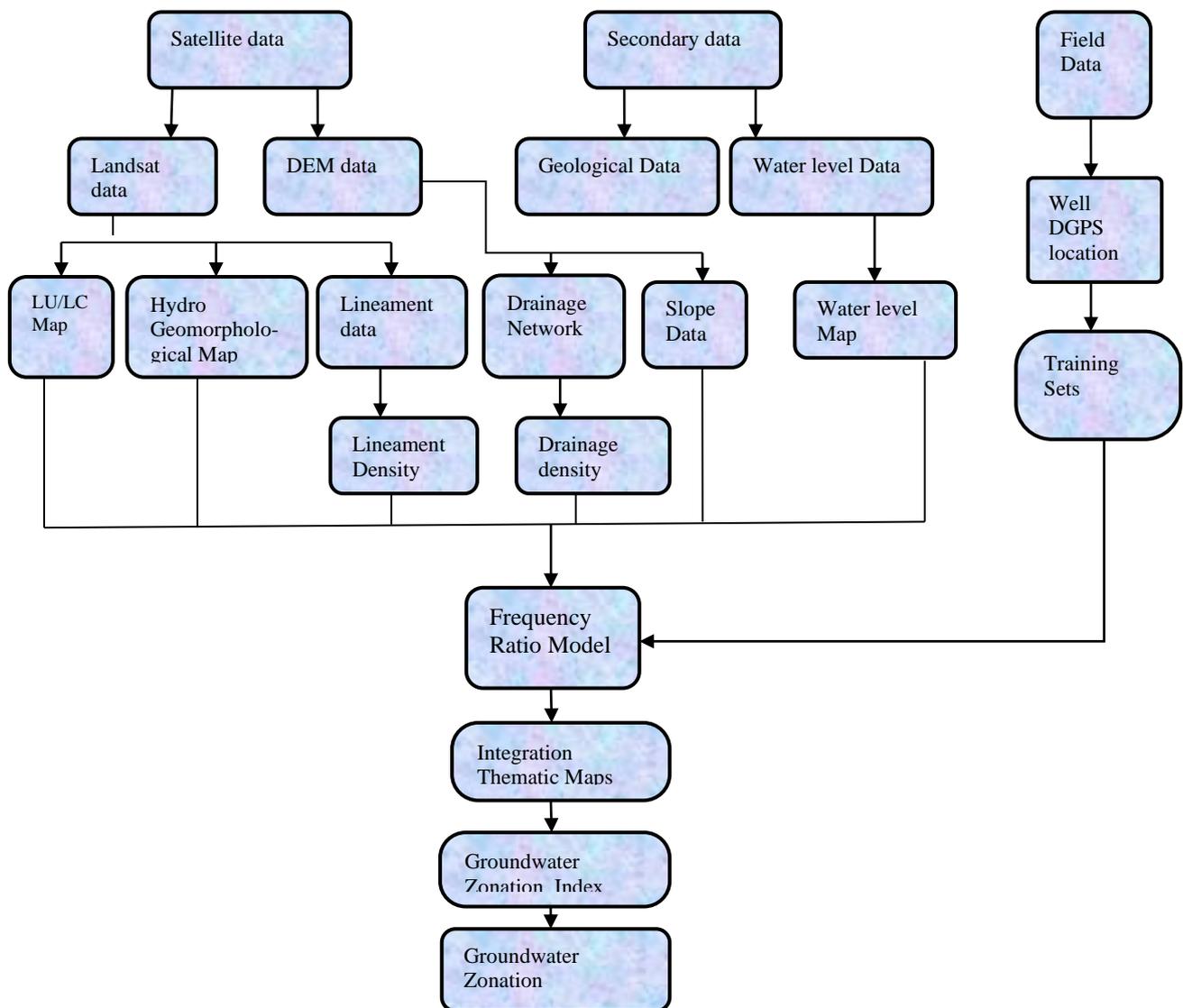


Figure 7: Flow Chart of Materials and Methodology.

H. Geology

Geography from the Greek geo (Earth) and logos (talk) is that part of physical sciences which manages the investigation of the earth, including the materials that it is made of, the physical and concoction changes that happen on its surface and in its inside, and the historical backdrop of the planet and its living things. It additionally thinks about the sea floor, and the inside of the earth. Geologists look at the structure of earth materials and distinctive land strategies to discover and experience its mineral resources. They look at geological miracles, for instance, seismic tremors and volcanoes and attempt to predict and restrain their hurting impacts. Geology, or geosciences, is the examination of the Earth. In addition to the fact that geologists address scholastic requests, for example, the development and arrangement of our planet, the reasons for quakes and ice ages, and the advancement of life, however they likewise address functional issues, for example, how to keep contamination out of groundwater, how to discover oil and minerals, and how to stay not here from avalanches. In the Banganga River, we categorize the geology map three types Quaternary, Delhi Supergroup and Bhilwara Supergroup. Total geology covers 8788.65 sq km in the entire area of the Banganga river basin. Quaternary aquifer covers 4907.01sq km; Bhilwara Supergroup covered 2074.10 sq km and Delhi Supergroup cover 1807.53 sq km.

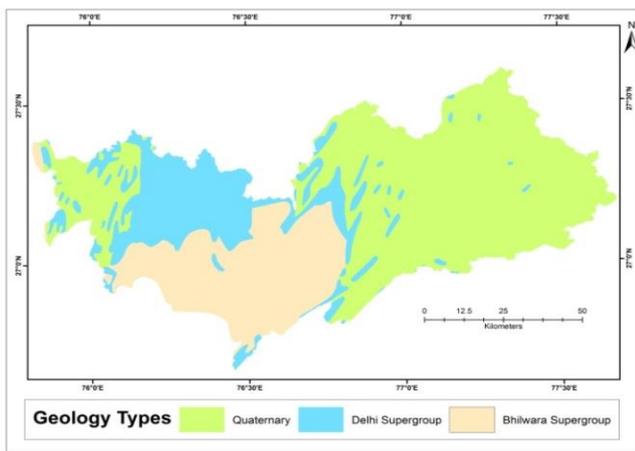


Figure 9: Geology Types of Banganga River Basin

i. Water Level

The groundwater potential Zonation was set up by overlaying aggregate weight doled out to all the five topical layers, viz., geomorphology, geography, incline, soil, and land-use/land-spread maps, utilizing the weighted overlay strategies in spatial investigation device of Arc GIS 10.3.1. Through the weighted overlay investigation process, learning based positioning and weight age of various classes for each topical layer has been given dependent on their commitment toward groundwater possibility/improvement. In the Banganga river basin low performance Water level cover 3547.73 Sq km, Medium Performance area cover 2684.98 sqkm. High performance Area cover 2124.44 sq km and very high Performance Area cover 431.51 sqkm. Groundwater resources are under stress in various regions of the world and the future water supply for certain peoples, particularly in the driest places on Earth, are undermined. Future climatic conditions and masses improvement are depended upon to uplift the issue. Understanding the variables that control groundwater capacity variety is critical to relieve its antagonistic results.

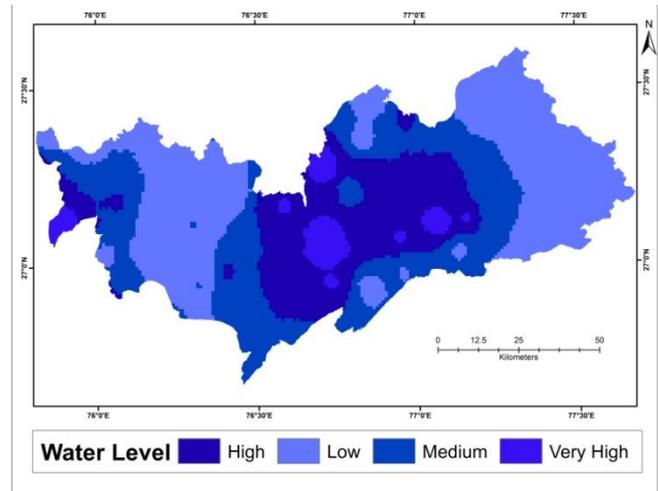


Figure 10: Water level Types of Banganga River Basin

III. RESULTS

Groundwater Potential Zonation

The groundwater potential Zonation was set up by overlaying aggregate weight doled out to all the five topical layers, viz., geomorphology, geography, incline, soil, and land-use/land-spread maps, utilizing the weighted overlay strategies in spatial investigation device of ArcGIS 10.3.1. Through the weighted overlay investigation process, learning based positioning and weight age of various classes for each topical layer have been given dependent on their commitment toward groundwater possibility/improvement. “The groundwater prospective zone (GWPZ) indicates the groundwater potentiality in quantitative form. High GWPI indicates high groundwater potentiality whereas low GWPI indicates low groundwater potentiality. In this study, the GWPI was derived by the integration of all thematic data layer using the raster calculator tool in Arc GIS 10.3.1 using Eq.” Groundwater Prospective zone ranging from 2.81 to 12.37. It classified into five prospective classes Very low classes cover 904.62 sq km, low zone covers 1220.76 sq km, medium zone covers 1821.46 sq km, High zone covers 2145.55sq km and very High zone covers 2687.57 sq Km.

$$GWPZ_{FR} = \sum(LULC_{FR} + G_{FR} + DD_{FR} + LD_{FR} + AQ_{FR} + WL_{FR} + S_{FR} + G1_{FR})$$

FR= Frequency Ratio, LULC = Land use land cover, G = Geomorphology, DD =Drainage Density, LD = lineament density WL = water level, S=Slope, A=Aquifer, G1=Geology

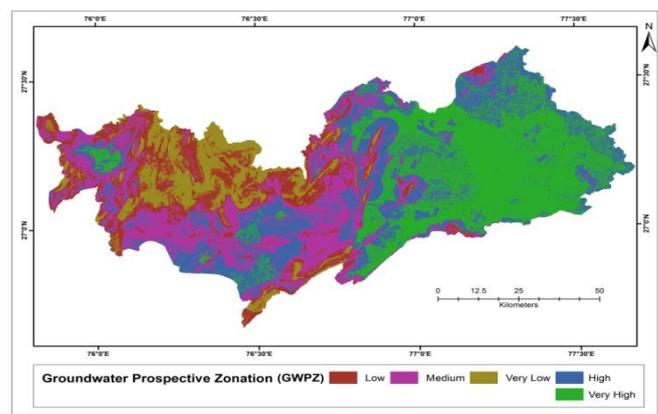


Figure 11: Groundwater prospective Zone of Banganga River Basin

Groundwater Prospect Zonation Using Frequency Ratio Model For Banganga River Basin, India

Parameters	Range	Area (Km Sq.)	Area (%)
Final Groundwater Prospect Zone	Very Low	904.62	10.30
	Low	1220.76	13.90
	Medium	1821.46	20.74
	High	2145.54	24.44
	Very High	2687.57	30.62

Table 2 Area Statics of GWPZ

Hence the performance of the FR model is significantly methods depend on the assignment of a relative score according to their importance which requires considerable knowledge of the factors. By contrast, the Frequency ratio is easier and accurate which does not as well depend on user-based scoring to the different factors. As per Table 2 the Groundwater Prospect zone is said to be in a very Low (10.30 %), Low (13.90 %), Medium (20.74 %), High (24.44 %), and Very High (30.62 %).

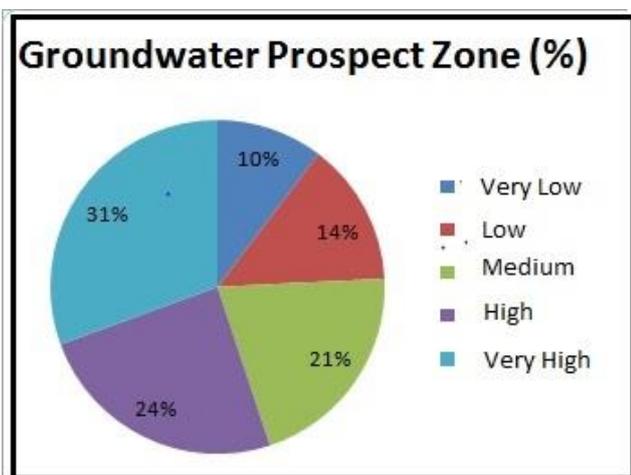


Figure 12. Chart of GWPZ

The groundwater potential maps demonstrate that the beachfront districts are having higher groundwater prospect Zonation rather than the focal and eastern segment of Banganga River bowl, which is productively upheld by groundwater yield information and the groundwater vacillation maps.

IV. CONCLUSION

The boundary of groundwater potential zones in the Banganga River Basin is completed by utilizing the impacting factor, recurrence proportion, and explanatory chain of importance procedure models in a GIS domain. Specialists have underlined that present days remote detecting and GIS apparatuses are the most expense and time viable instruments for groundwater contemplates. The groundwater probability of a locale relies upon the immediate and roundabout impact of a few ecological elements. Complete nine layers of various factors, for example, topography, geomorphology, slant, seepage thickness, land use, lineament thickness, precipitation, soil surface, and profundity are coordinated together with GIS and resultant maps are produced. Three-way approval is performed in this examination to check the exactness of resultant groundwater potential maps. A sum of 157 wells is recognized for the approval of each model utilizing the region under the bend examination. The present situation at the Banganga River Basin zone requires the execution of a feasible aquifer recharging program in the Basin. In this condition, building fake revive structures is a significant strategy for groundwater collecting. In view of the parameters, for example, groundwater level, common inclinations from spring great

source to counterfeit energize areas, groundwater abuse from existing wells, and subsurface lithology, seven exceptionally good areas were recognized for fake revive for feasible groundwater the board. The groundwater level in these locales changes. This is falling in shallow and medium groundwater level zones. The shallow water level region is additionally considered for long haul reasonable advancement of groundwater of Banganga River Basin. The profound and exceptionally profound groundwater level zones can be proposed to limit the usage of groundwater assets. To satisfy the water request of local people in such ominous districts, the water ought to be circulated through engine siphons from springs or shallow aquifers. The subsurface data was gotten from bore well cross-segment to be considered to build up the fake energize through a characteristic procedure. The wellspring of counterfeit energize from springs to revive wells is distinguished utilizing vicinity investigations and the thought about separation between the two areas. The spring areas are situated at higher heights than the fake revive wells so that the energize wells get water through an incline slope by regular procedures. The rise distinction between the spring and the recharge wells varies.

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international conferences. He is also course coordinator of different modules of EDUSATbased distance learning programmeorganized by IIRS, ISRO, Govt. of India. He has 09 years of teaching and research experience.

AUTHORS PROFILE



Mukesh Singh Yadav, currently pursuing M.Tech in Geo-informatics from Centre for Climate Change and Water Research (C3WR), Suresh GyanVihar University, Jaipur, India.



Dr. Shruti Kanga, obtained her Ph.D in Geospatial Technology, M.Sc (Geo-informatics) from BIT Mesra(Ranchi) and joined as AssociateProfessor & Coordinator of Centre for Climate Change & Water Research, Suresh GyanVihar University, Jaipur (India). She has nine years of teaching and Research experience in field of Forest fire management, Natural resource management, Regional & urban planning, Disaster

management. Dr. Kanga has published several papers in National, International Journals and students are presently doing Ph.D under her supervision. Dr. Kanga is presently on the reviewer panel for a number of research journals.



Dr. Suraj Kumar Singh is working as an Associate Professor in the Centre for Sustainable development, Suresh GyanVihar University, Jaipur. He did his Ph.D. degree in Technology (Geoinformatics) from Department of Remote Sensing, Birla Institute of Technology, Ranchi in 2012. He has worked in the areas of waterlogging and flood hazards, geospatial applications in water

resources, disaster management, hydrogeomorphology, urban planning & wasteland mapping. He has publications in peer refereed international journal and books. He has attended and organised around 15 national and