Groundwater Potential Zone Mapping using Geospatial Techniques in Walayar Watershed

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***Abstract:** The groundwater is the most important resources everywhere in the world and is decrease gradually. In construction, here is a need for separation of groundwater possible region. As the awareness and needs of the common people towards water is increasing the estimation of water is touched in all divisions. At the same time, surface water assets are getting to be insufficient to satisfy the water request. With the goal that systematic ordering of groundwater development using present-day system is important for the right management and use of this respected asset. Yet at the same time, groundwater assets have not yet been accurately damaged, keeping this in view, the current analysis have contained to outline the groundwater potential regions in Varattar river basin Tamilnadu & Kerala by using geospatial approach. The geospatial have turned out to be one of the substantial tools in the field of subsurface water study, which assistances in surveying, observing and monitoring groundwater capitals. Now to identify the groundwater possible region applied through various topical maps of geomorphology, streams, soil, land use/land cover and slope with IDW strategies. From the overall outcome, the groundwater investigation zone orderly into five classes called as very good, good, moderate, poor and very poor. This research to recommended that great potential zone of groundwater arise in the areas of south west north central part of study area in the Coimbatore and Palakkad districts. The result showed that converse distance weightage technique offers an effective tool for understanding groundwater possible regions for appropriate growth and management of water level resources in different hydrogeological surroundings.*

***Keywords:** Groundwater Potential Zone, Remote Sensing, ArcGIS, QGIS, Geospatial Technology*

I. INTRODUCTION

The geospatial techniques have released new directions in groundwater exploration. The RS with its benefits of spectral, spatial and temporal accessibility of data covering big and inaccessible areas within quick time has develop a very beneficial tool in collecting, storing, translating, improving, displaying and investigative spatial data and is used for altered determinations such as chance of recharge sites, assessment of ground and surface water assets and finding the polluted sites etc. In the rough rock landscape, water level accessibility is an insufficient level. Groundwater occurrence in similar rocks is fundamentally delimited to cracked and weathered horizons. The geological plan of the zone was created from GSI. The other maps like drainage, LU/LC, slope, and soil were created from SOI Toposheet and satellite imageries using Geographic Information System. Later, by adding all the above mention map layers groundwater possible zonal map has been arranged.

Revised Manuscript Received on October 15, 2019

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All the maps were created using ArcGIS/QGIS tools by implementing digitization of scanned maps, editing/correcting for the errors, topology building for error-free, attribute assignment for spatial data and allocate appropriate plan. Therefore, we have used the geospatial data validation technics for the data study area error modification and correctness.

The fresh water properties of India are contradictorily degenerated. Through the rainy season and different physiographic situations spring rise to a varying circulation of water. The last decade population growth, urban development and agricultural extension have corrupted the state. The improper abuse of groundwater is principal to water scarcity. At present few parts of the nation are facing a severe water crisis. Despite being a significant piece of the nation's augmentation, water asset examination has been isolated. Thus, the principle point of the ebb and flow study is to decide the groundwater potential zone in Walayar area utilizing the reconciliation of land data framework and remote sensing methods. The groundwater potential was set up by incorporating the geology, slop, land use/land cover and soil maps alongside seepage designs, in the region (Mohanty, and Behrera, 2010). Hence utilized for each map was estimated and apportioned a weightage dependent on its degree of effect on groundwater revive and capacity. Subsequently, by coordination of all these topical maps and joining constrained information on groundwater level, groundwater prospect map was made.

II. STUDY AREA

The Walayar River is one of main branches of the river Koraiyar. Its starts from near to Boluvampatti reserved forest, Madukkarai, Kurumbapalayam , Palathurai and Thirumalayampalayam villages in Tamil Nadu and flows through Coimbatore, Palakkad districts, finally drains into the Koraiyar river. The research area is a coved of the Walayar basin which lies between 10°46’08” N to 10°57’12” N latitude and 76°42’18” E to 77°01’31” E

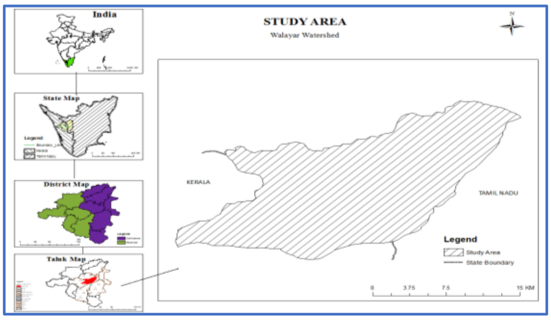

Figure 1. Study Area

longitude, covering an area of 358.6 Km2. The river crosses 56.4 km east – west direction of the study boundary. It is in the mid-western part of the Coimbatore district in Tamil Nadu, India and mid-eastern part Palakkad district in Kerala. The river water flow is only seasonal and depends both on the northeast and south-west monsoons which has a good flow during these seasons. In any case, the study area has received higher precipitation throughout the southwest monsoon. Rarely, flash floods happen when there is heavy rain in the catchment zones.

III. METHODOLOGY

The Integrated geospatial techniques were used to delineate groundwater possible regions in the Walayar River. We have used the Survey of India tophosheets as 58 F/1, 58 B/13 and 58 B/14 on 1: 50K scale were used to prepare the base map of the study area. The Geomorphology map was obtained from the GSI and digitized the current study region. The Soil map was prepared by digitizing the geo-referenced soil map obtained from NBSS&LUP. The geomorphology, land use/ land cover map was obtained from NRSC Bhuvan-Thematic Services and digitized the same for the corresponding study area. The slope map was created from elevation data using shuttle radar topography mission (SRTM) Data. The drainage map generated from the SOI Maps. The all vector map and raster map prepared/created using ArcGIS and QGIS software. To create the subsurface water possibility map of the Walayar river and all the distinctive map were incorporated with weighted overlay in GIS. The weight for every individual highlight of a theme was given during weighted overlay studies which were basically founded on the effect towards groundwater development and penetration rate, every one of the subjects was given positioned dependent on appropriateness for groundwater event. All the thematic layers were interrelated to each other which give important data regarding the groundwater event, accordingly for the creation of groundwater possible map of the study region. In GIS condition, each subject was covering to each other to distinguish the interconnecting polygon. By along these lines, another map was made by consolidating two thematic maps. Further, a composite map was overlaid on a third subject them, and so on. In this methodology, the last composite guide was made. Along these lines, the groundwater potential map was made.

IV. GEOMORPHOLOGY

The Geomorphology is study/investigation of the form of the land form, its explanation and genesis. It is a subdivision of Geography, which has developed after the arrival of aerial photographs and satellite image. The geomorphology, along with evidence on soil, water and plant life has become one of the important contributions in planning for several

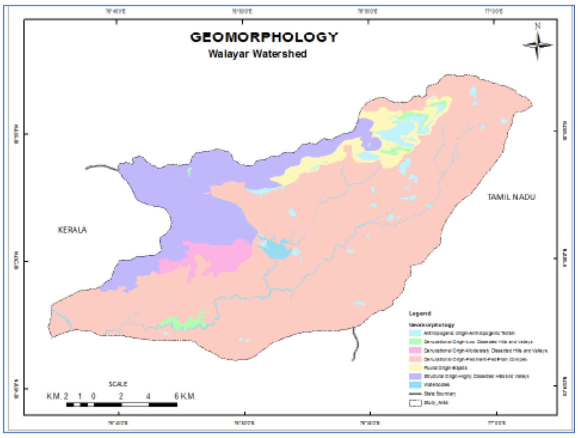

Figure 2. Geomorphology Map

developmental activities. The geomorphology of the area based on the basic assessment of geological creation. The geomorphology reflects many land form and structural landscapes and several topographies are inspiring the event of subsurface water and categorized in terms of groundwater possibility. The geomorphic parts of the basin can be divided into Anthropogenic Origin-Anthropogenic Terrain covered 9.6 K2, Denudation Origin-Low Dissected Hills and Valleys covered 3.6 KM2 , Denudation Origin-Moderately Dissected Hills and Valleys spread across 10.01 Km2, Denudation Origin-Pediment-Pedi Plain Complex covered 250.27 KM2 , Fluvial Origin-Bajada covered 15.87KM2 , Structural Origin-Highly Dissected Hills and Valleys occupies in 62.78 KM2 , and Water-bodies covers in 6.31 KM2 of the current study region.

V. SOIL

The soil is playing a vital part in representing the subsurface water quality & quantity dependent on the soil. Subject to the soil types, it likewise gives a proof around the groundwater holding limit and penetration rate. In view of the qualities and various kinds of soil present in the Varattar river area, it is arranged into five main categories, such as Black soils (calcareous) covered 191.47 KM2, Mixed Soils occupied 25.86 KM2, Red Colluvial Soils (Calcareous) covered in 0.15 Km2, Red Colluvial Soils (Non-calcareous) covered 91 KM2 and Red Soils (Non-calcareous) covered 50.10 KM2 area of the study region.

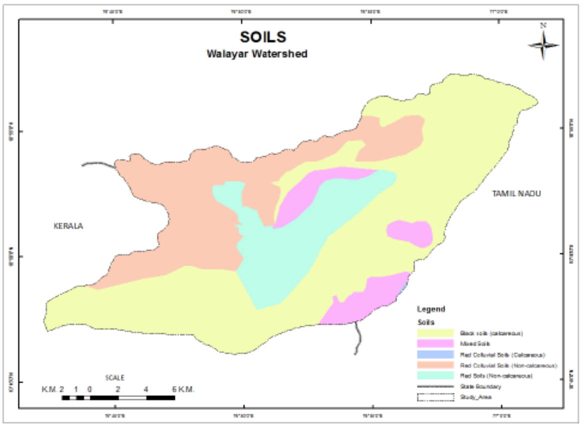

Figure 3. Soil Map

VI. SLOPE

The slope is one of the crucial variables which is predictable to groundwater revive. It controls the ratio of penetration and surface spill-over. It gives an awareness about the amount of groundwater recover dependent on the slope angles. The steep slope causes less penetration due to fast surface runoff while, level and mild slope areas encourages minimum runoff, accordingly allowing additional time to infiltrate rainwater and helps large groundwater rejuvenate. The level and moderate slopes are measured as great subsurface water revive. The slope map was prepared from Shuttle Radar Topography Mission DEM. This data use to extract the study area and created the slope map and categorized based on the degree of slope. The study area region in North, North West and North east parts are having maximum + 15 degree slope and inside few are having residual hills like Pathimalai Murugan Kovil and few hard rock terrine of study area.

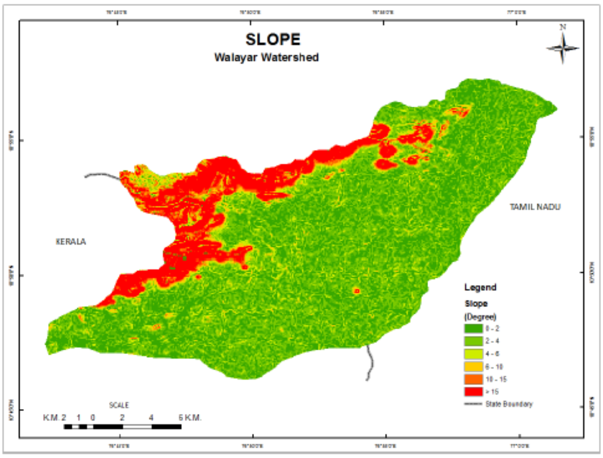

Figure 4. Slope Map

VII. DRAINAGE

The drainage pattern decides the physical appearance of both surface and sub-surface developments. The drainage network gives the pathways for the runoff and storage volume of groundwater. The region with maximum drainage concentration designates the huge overflow though the smaller the stream density, the minimum runoff and maximum prospect of groundwater occurrences. The drainage map says the river shape of the Varattar study zone is originated mainly from north

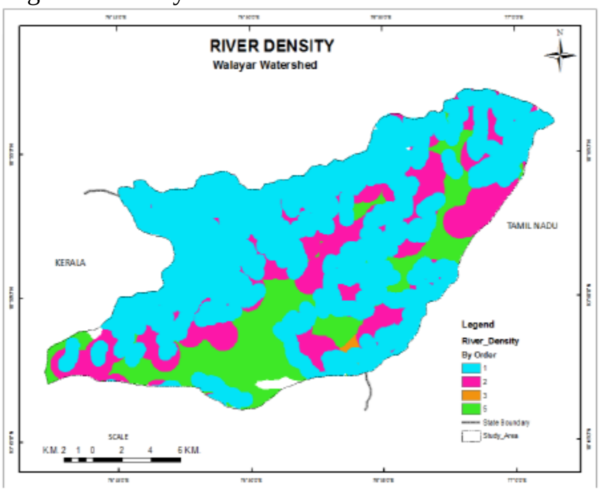

Figure 5. River Density Map

east and eastern part of the study extent where more elevation is placed. The dense drainage pattern is mostly located in north eastern, north western and north part of the study area than the rest. The drainage density of the study region is classified into five classes as shown in the map. The first order streams flowing 85.41 Km, second order streams running 44.54 Km, Third order streams running 18.52 KM, fourth order streams flowing 17.22 and fifth order streams running 24.11 Km distance of the current study region.

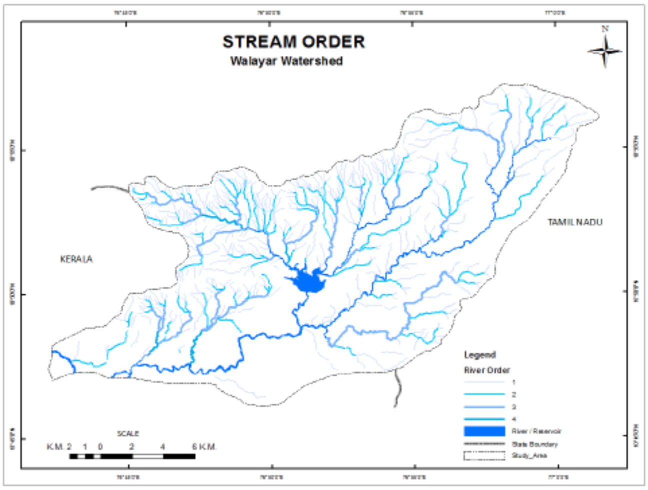

Figure 6. Stream order Map

VIII. LAND USE/LAND COVER

The land use represents the human actions and many other uses which are carried out on land, example cultivation, built-up area or industry, though land covers incorporates common natural vegetation, water bodies, rock/soil, artificial cover, and others resulted due to land transformation that is present on the earth surface. The land use/land cover is categorized by a combination of forest covers, cultivation activities, built-up area, water bodies etc. the geospatial method provide the consistent information for land use/land cover mapping. Here

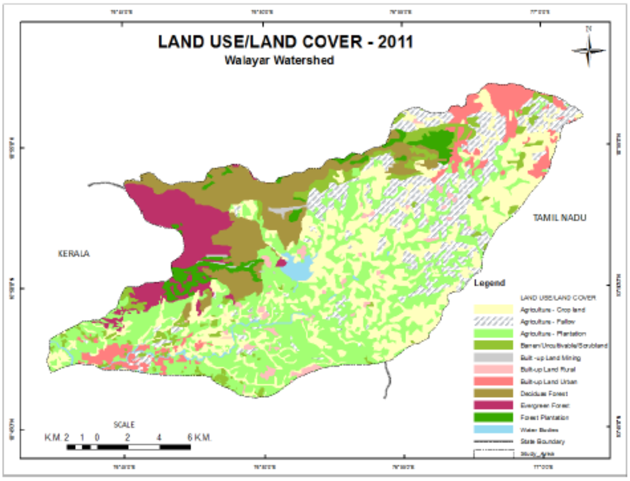

Figure 7. Land Use and Land Cover Map

we have totally eleven different types of LU/LC has been delineated in the study area as shown in the map. The map shows that the large area belongs to the Agriculture – Plantation coered in 102.16 KM2 and Agriculture – Fallow covered 45.09 KM2, Agriculture - Crop land covered 84.75 KM2, Barren/Uncultivable/wasteland covers in 17.97 KM2, Built-up Land Rural area covered in 5.46 KM2, Built-up Land Urban land covered in 19.41 KM2, and Built -up Land Mining area covered in 1.22 KM2 , Deciduous Forest covered in 41.14 KM2, Evergreen Forest area coved in 24.50 KM2, Forest Plantation occupied in 11.74 KM2, and Water Bodies covered in 4.87 KM2 of the study region.

IX. OVERLAY ANALYSIS

The reason behind for handiness of weighted overlay examination is having the choice to make spatial multifaceted nature to straightforwardness in appropriateness investigation and site determination are primarily founded on general estimation of unique and differing impacts. To delineate groundwater possible zone, all the maps were given reasonable weight utilizing the strategies of weighted overlay in ArcGIS/QGIS programming. The weightage and ranking for every individual element of the thematic layers were allocated dependent on their effects towards the groundwater recharge. All the vector amps were converted into raster format layer and overlaid in ArcGIS/QGIS software. The parameter which has high weight value speaks to vital impacts in the groundwater probability. Among the thematic layers, geomorphology was given uppermost weight, due to the important role play for groundwater recharge event. To get a final output map of groundwater potential zone, every individual components of the thematic layers were superimposed to each other.

Table. 1. Assigned weightage for Groundwater potential zone map

Thematic map	Weight assigned (%)
Soil map	20%
Geomorphology map	10%
Land use and land cover map	25%
Drainage density map	20%
Slope map	25%

X. GROUND WATER POTENTIAL MAP

The ground water subsurface map is created subject to study of several topics geomorphology, land use/land cover, soil, slope, stream order and density sustains by using consolidating verification thought, other than the collected data gained from State Ground Water Board with major field/ground checks. The ground water potential maps disclose the available volume of ground water. This map is showed into five zones as Zone I, Zone II, Zone III, Zone IV and Zone V likely very good, good, moderate, poor and very poor ground water potential zones. The Good and moderate zones address zones with adequate ground water resources, poor and very poor zones address where superfluous with drawls may prompt ground water exhaustion. The Groundwater potential zone mapping is finished utilizing weighted overlay in ArcMap/QGIS Tool. The various weights are given dependent on the variables affecting the groundwater. The maximum study area falls under nearly moderate potential zone which covers 115.60 km2 area, spreading all over the entire study zone and found largely in the flat terrain, next zone will be Good potential zone covers

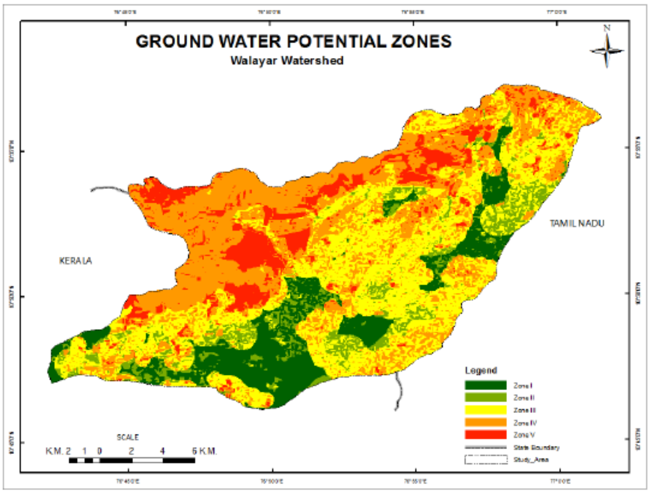

Figure 8. Ground water potential Zone Map

123.72 km2. The very good potential zone area 39.74 km2 were mainly found close to the waterbodies (lakes, rivers, etc.) where major cultivation is practiced and covered by fallow land. The poor potential zone covers in 31.14 km2 and very poor potential zone in 47.78 Km2 was found in the hilly terrain of upstream region and granitic terrain in the downstream region, indicating high runoff and less infiltration of the area.

XI. CONCLUSION

The Integrated use of geospatial methods demonstrated to be a powerful tool for demarcating various groundwater forthcoming zones in the study region. The thematic maps are geomorphology, drainage and drainage density, slope, soil map, and LU/LC were created from the geospatial environment which is an important role in storage and transmit the groundwater. Every one of the maps are incorporated with weighted to create a Ground water potential zone map. The present study shows 39.74 km2 out of the total study region are identified as very good groundwater potential zones. The purpose behind favourable of subsurface water study area is because of the components like the occurrence of highly weathered, low level incline bringing about moderate surface spill-over which means moderate penetration pace of the region. It likewise demonstrates that a considerable measure of groundwater occurrence is highly possible because of very low drainage density and contiguous the stream channels. The geospatial is advances proof of the significant role being taken to investigate and demarcate groundwater recourses in any regions to a large extent with minimal effort, minimum time and low labour work. The map obtained by this technique gives data about subsurface water level of the region. The investigation proposed that the Ground water potential zone map produced will fill in as helpful rules for organizers, designers and leaders giving quick decision- making in the administration of groundwater assets, site determination for Ground water investigation and exploitation.

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Dr.M.Balakrishnan is working as Geospatial Team Lead in Accenture Solutions India Pvt Ltd Bangalore. He has 11+ Years' experience in geospatial industry. He has completed Ph.D. in Geography in Bharathiar University, Coimbatore with specialisation of "Water Resource Management". He is expertise in Geospatial and its Application. His Research Interest is Water and Soil conservation using GIS and Remote Sensing Technology.