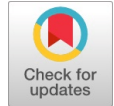# Identification of Water Resource Potential Zones of Baghmundi Block in Purulia District, West Bengal

Shambhu Nath Sing Mura

Abstract: Remote sensing and GIS techniques have been broadly used to determine the water resource potentiality for the development and management of water resources. It is a vital natural resource in our daily lives and is used for domestic purposes. Its amount varies from place to place and season to season. It is scarce during the dry season, but plentiful during the rainy season. Assessment of water resource potential is crucial for managing surface and groundwater resources. Water resource potential zones are delineated with the help of RS & GIS. In this paper, a standard methodology has been employed to delineate water resource potential zones using RS and GIS techniques. Different parameters have been considered for identifying water resources, including drainage frequency, drainage density, geology, groundwater level, slope, soil, surface water bodies, and land use/land cover. Satellite data and Survey of India (SoI) toposheets at a scale of 1:50,000 have been generated. Suitable ranks are assigned to these parameters. Various thematic maps of each parameter have been prepared by using the 'Ordered Weighted Averaging' technique. Finally, the composite map is generated by assigning all the parameters to demarcate the zones of water resource potential. The study area has been classified into five categories: very poor, poor, moderate, good and excellent. This suggested methodology has been employed to achieve the objectives of the study area. This paper will help identify suitable locations for the agricultural and domestic use of surface and underground water resources.

Keywords: Water Resource, RS&GIS, Overlay Analysis, Thematic, Potential Zone

I. INTRODUCTION

Underground and surface water are essential for human beings in agricultural, industrial, household, recreational, and environmental activities. Precipitation is the primary source of water on the Earth's surface. Water is drained out quickly through surface runoff after precipitation due to sloping ground. Some portion of rainwater is stored as underground water. It depends on voids within geological systems and the formation of the Earth's crust, which act as conduits for transmission and reservoirs for storing water.

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Some portion of water is stagnant on the earth's surface, like streams, ponds, khals and canals, etc., can act as recharge zones [1][17]. The rapid growth of the population and unscientific exploitation of water are creating a water stress condition. Currently, rainfall is gradually decreasing, although its spatial distribution remains uncertain and uneven. This alarming situation is a cost-effective and time-saving technique for the proper evaluation of water resources and management planning. Several key parameters are crucial for developing a water resource model of the study area. Baghmundi Block of Purulia District encompasses parts of the Subarnarekha River basin and the Kangsabati River basin. Ajoydha Hill acts as a water divider between the Subarnarekha and Kangsabati river basins. Catchment and watershed are widely used to denote the hydrological units [2]. A watershed is a natural hydrological entity that covers a specific area on the Earth's surface from which rainfall runoff flows through a drain, channel, gully, stream or river at any particular point. Considering various opinions, an attempt has been made to identify water resource potential zones for assessing water availability in the present study area using remote sensing and GIS techniques.

Remote Sensing (RS) and Geographical Information Systems (GIS) techniques are widely used in the field of hydrology and water resource development. Satellite (Remote Sensing) information helps solve water resource use. RS and GIS play a significant role in present-day multi-criteria analysis for water resource evaluation and hydro-geomorphological mapping, supporting water resource management. Geology, Geomorphology, slope, and land use/land cover have been extracted from satellite images and the Survey of India toposheet. The GIS platform has been utilised for integrating various themes. Water resource potential zones indicate that the occurrence of water resources is controlled by indicators related to structures, slopes, and landforms. Assessment of the groundwater's possible recharge processes is an essential indicator for the management of water resources and protection of water quality [3]. The drainage, slope, soil, lithology, and geomorphic features of the study area have been identified, and suitable methods for assessing water resource potential have been proposed.

Identification of Water Resource Potential Zones of Baghmundi Block in Purulia District, West Bengal

II. OBJECTIVES

The study area is situated in the western part of Purulia District, West Bengal. The state of Jharkhand borders it to the south and southwest, the Jhalda and Arsha blocks of Purulia District to the north, and the Balarampur block to the east. Baghmundi Block is part of the Subarnarekha River and Kangsabati River basins, and the Ajoydha Hill range acts as a water divider between the two basins. The area of study receives water from rainfall during the rainy season, but in summer, it becomes dry. During the dry season, people suffer from a lack of water due to insufficient water in rivers, ponds, khal, surface wells, and improper management. The study area has a subtropical climate characterized by high evaporation and low precipitation. Average rainfall ranges from 1100 mm to 1500 mm. The relative humidity is high during the monsoon season, ranging from 75% to 80%. However, in the summer, it drops to 25-35 per cent. Keeping this in mind, this study attempts to demarcate the potential water resource zones in the Baghmundi Block of the Purulia District. This potential map will help to achieve a proper understanding of the sustainable use of water resources in the study area. Geographically, Baghmundi Block is located between 23 ° 05'0.96 "N to 23 ° 17'56.4" N latitude and 85 ° 11'55.68 "E to 85 ° 52'0.48" E longitude, covering an area of 450 square kilometres with a perimeter of 123 km. The maximum and minimum heights of this block are 677 meters and 190 meters, respectively. Rainwater is rapidly washed out from the ground surface due to steep slopes without recharging the groundwater. Agricultural activity is the primary source of income for the people living in this block. Surface and groundwater are used for drinking and irrigation purposes. Proper water resource management is crucial for both the local population and for irrigation and domestic purposes. Figure 1 shows the location of the study area.
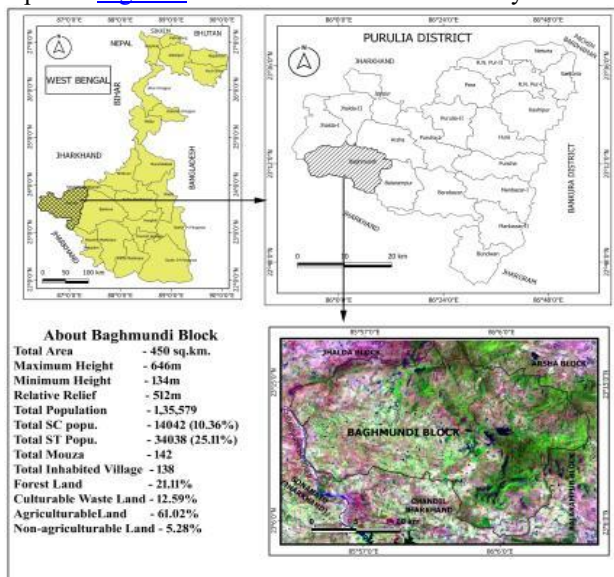

Fig. 1. Location Map of the Study Area

III. MATERIALS/DATA USED

Different types of data have been utilised to achieve the study area's objective. Landsat 8 data has been used to determine the different geomorphic features. Topographical maps at a scale of 1:50,000 (No. 73E/15, 73E/16, 73I/3, and 73I/4) from the Survey of India have also been used. The elevation of the study area has been determined using SRTM data (Cartosat-I). Geological maps (GSI) and groundwater level data from the Central Ground Water Board (GoI) have been used for the identification and delineation of water resource potential zones in the Baghmundi Block, Purulia district.

IV. METHODOLOGY

The proposed methodology of the study comprises the preparation of base maps, land use/land cover, and geological maps, as well as the application of digitising and image processing techniques using GIS software, and the interpretation of the resulting outputs. The administrative boundary has been digitised and divided into a one-square-kilometre grid (Figure 2). Various parameters related to water resources, such as average slope, drainage frequency, and drainage density, have been extracted from each grid and classified into several classes, each assigned a score. The soil texture of the study area is categorised based on water content, and a corresponding score has been assigned. Other parameters, in this way, such as land use/land cover, rock geology, groundwater, and surface water bodies, are used to demarcate the water resource potential. SRTM data (Cartosat-I) is used to prepare slope and drainage maps by extracting elevation in RS&GIS software. This methodology is widely used for creating water resource maps for small to medium-sized hydrological units. All the above thematic information has been analysed, and weights are given to evaluate suitable water potential available zones. In the present study, the following factors are considered for identifying the water resource potentiality in Baghmundi Block: average slope, drainage density and frequency, soil texture, groundwater, surface water bodies, geology, and land use/land cover. All these thematic layers are analysed using a weighted sum raster overlay in QGIS and SAGA. The proposed methodology of the study is given below diagrammatically (Figure 3).

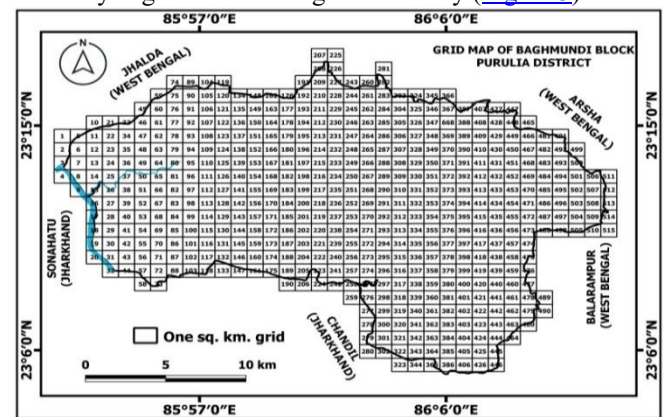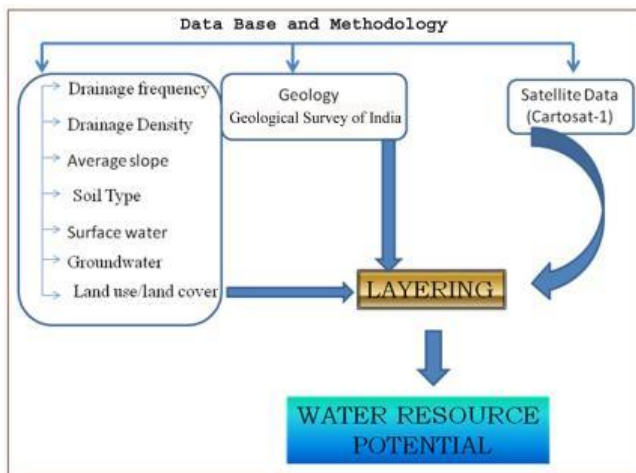**Fig. 2. Grid Layout of the Study Area**
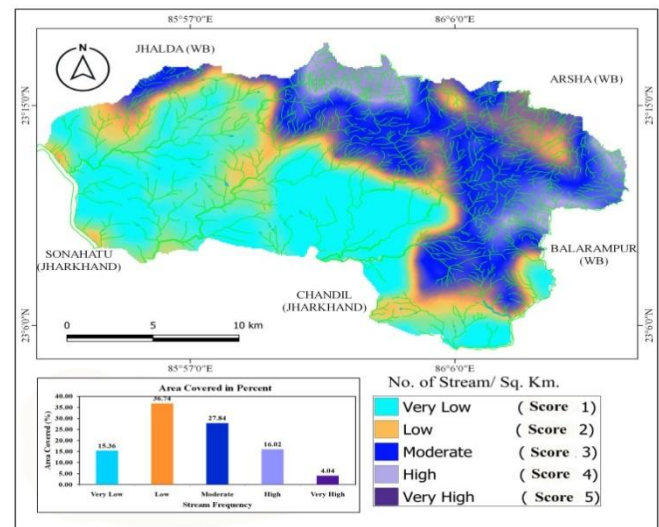
Fig. 3. Database and Methodology

V. RESULT AND DISCUSSION

A. Drainage Frequency

Drainage is an essential parameter for the availability of water resources. The regional rock structure and geomorphology control the drainage pattern of the study area. Remote sensing information and Geographical Information System (GIS) have been used to generate data and to know the spatial drainage deviation characteristics, thus providing an insight into hydrological conditions necessary for developing watershed management strategies [4]. The drainage pattern of the Baghmundi block is dendritic, with streams generally flowing in a north-south direction. This drainage pattern indicates the homogeneity in texture and lack of structural control and helps in understanding various terrain parameters such as natural bedrock, infiltration capacity, etc. [5]. Several streams have been extracted from each grid (one square kilometre) for the preparation of a drainage frequency map. It has been classified into very high (> eight streams per sq. km.), high (6 to 8 streams per sq. km.), moderate (4 to 6 streams per sq. km.), low (2 to 4 streams per sq. km.) and very low (< 2 streams per sq. km.) drainage frequency zones. A very high drainage frequency zone covers an area of 1.04% of the study area. High, moderate, and low drainage frequency zones cover 16.02%, 27.84%, and 36.74% of the area, respectively. Additionally, 15.36% of the area falls under very low drainage frequency zones. Table 1 presents the different drainage frequency zones and their scores based on water availability in the study area.

Table I: Drainage Frequency Zones and Score Assigned

S. No.	No. of Stream/Sq. Km.	Water Resource Prospects	Area Covered in Sq. Km.	Area Covered in %	Score
1	< 2	Very Low	69.1	15.36	1
2	2 to 4	Low	165.33	36.74	2
3	4 to 6	Moderate	125.28	27.84	3
4	6 to 8	High	72.09	16.02	4
5	>8	Very High	18.2	4.04	5

Fig. 4. Weighted Score of Drainage Frequency Map Based on Water Prosperity
Source: SRTM 2015 & author's compilation

B. Drainage Density

According to Strahler [6], drainage density is shown by $Dd=L/A$, Where L is stream length, and A is unit area. Figure 5 and Table 2 illustrate the various drainage density zones and their assigned scores for the study area. The drainage density map has been categorized into very high (> 4 km stream length per sq. km.), high (3 to 4 km. stream length per sq. km.), moderate (2 to 3 km. stream length per sq. km), low (1 to 2 km. stream length per sq. km.) and very low (< 1 km. stream length per sq. km.) drainage density zones and assigned score based on drainage density of the study. A very high drainage density zone covers 0.44% of the area. The study area is divided into high, moderate, and low drainage density zones, which cover 14.24%, 34.61%, and 51.15% of the area, respectively. 6.24 per cent of the study area lies in a very low drainage density zone. Low drainage density area indicates a poorly drained area with a slow hydrological response, making it highly susceptible to flooding, gully erosion, etc. [7]. A high drainage density zone indicates a quick hydrological response to rainfall events. Besides, high drainage density areas are marked by impermeable subsoil material, sparse vegetation, and high relief [8].

Table II: Drainage Density Zones and Score Assigned

S. No.	Stream Length in km/Sq. Km.	Water Resource Prospects	Area Covered in Sq. Km.	Area Covered in %	Score
1	< 1	Very Low	28.06	6.24	1
2	1 to 2	Low	200.11	44.47	2
3	2 to 3	Moderate	155.74	34.61	3
4	3 to 4	High	64.09	14.24	4
5	>4	Very High	2.00	0.44	5

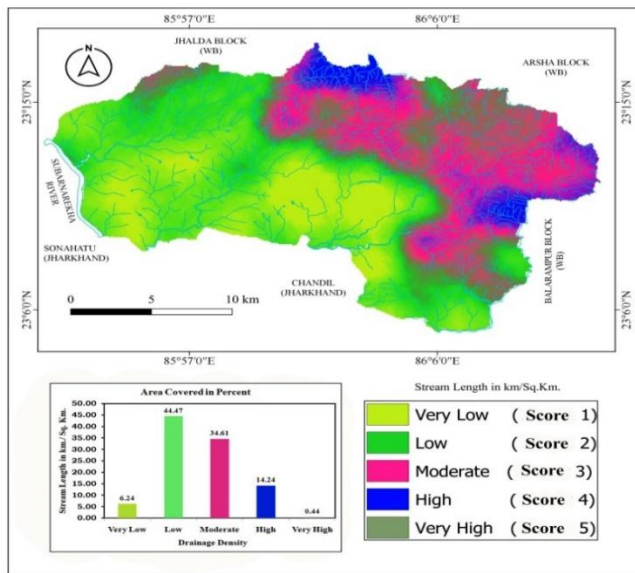# Identification of Water Resource Potential Zones of Baghmundi Block in Purulia District, West Bengal

Fig. 5. Weighted Score of Drainage Density Map According to Water Prosperity
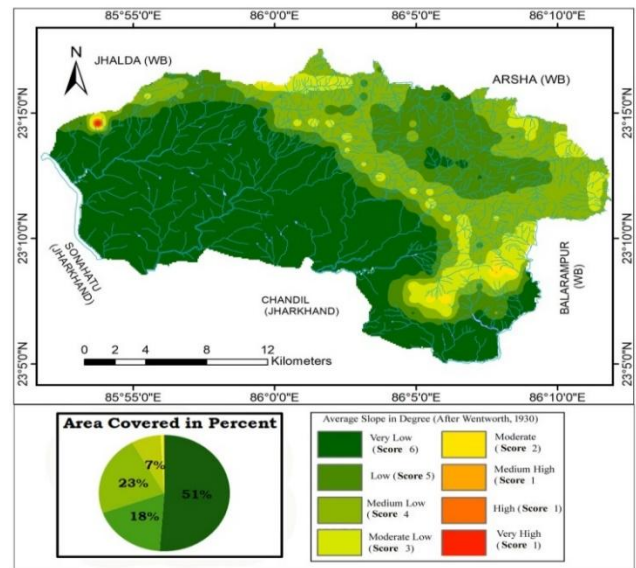Source: SRTM 2015 & author's compilation

Fig. 6. Weighted Score of Average Slope Map as Per Water Holding Capacity
Source: Toposheet no. 73E/15, E/16, 73I/3, I/4 (SoI) & author's compilation

C. Average Slope

Slope is an element of the Earth's terrestrial and submarine surfaces; it is, therefore, simply an element of the interface between the lithosphere and atmosphere [9]. According to Wentworth 1930 [10], average slope is defined by using the formula: $\theta = \tan^{-1}(N \times i/K)$, where N is the number of contour crossings per kilometre, i is the contour interval, and K is a constant (636.6 for the kilometre grid). The average slope of the Baghmundi Block has been categorized into very high (> 35 degrees), high (30 to 35 degrees), medium high (25^0 to 30^0), moderate (20^0 to 25^0), moderately low (15^0 to 20^0), medium low (10^0 to 15^0), low (5^0 to 10^0) and very low (< 5^0) and assigned score of each zone of the basis of water prosperity. It is a crucial parameter for determining the availability of both surface and subsurface water. It also controls infiltration and surface runoff, which affects the availability of water resources. 0.87 per cent of the area is under the above 20^0 slope of the study area, and 47.96 per cent of the area is between 5^0 and 20^0 slope of the study area. 57.16 per cent of the area lies under slopes of less than 50 degrees. Figure 6 and Table 3 illustrate the average slope zone score based on water resource prosperity.

Table III: Average Slope Zones and Assigned Score

Sl. No.	Slope in Degrees	Water Resource Prospects	Area Covered in Sq. Km.	Area Covered in %	Score
1	< 5	Very Low	230.24	51.16	7
2	5 to 10	Low	82.43	18.32	6
3	10 to 15	Medium Low	100.53	22.34	5
4	15 to 20	Moderate Low	32.87	7.30	4
5	20 to 25	Moderate	2.82	0.63	3
6	25 to 30	Medium High	0.4	0.09	2
7	30 to 35	High	0.37	0.08	1
8	>35	Very High	0.34	0.08	1

D. Soil

The water retention capacity of the soil is mainly dependent on the particle size of the soil. The water-holding capacity of the soil is higher in finer-textured soils due to their cohesive nature. The pore space in the soil refers to the voids between soil particles, which are occupied by air or water. Soil texture, bulk density and structures of the soil determine the quantity and size of pore space [11]. Soil texture controls the water percolation through the soil, which in turn recharges the groundwater. The soil of the study area is classified into fine texture, fine loamy, coarse loamy, fine loamy, and gravelly loam, and each category has been assigned a score based on its water-holding capacity. Figure 7 and Table 4 show the soil characteristics score of the study area. Fine soil texture covers 33.02% of the study area. 33.65 per cent of the study area is composed of fine loamy and coarse loamy soils. Fine loamy and gravelly loam soil covers 12.40 and 20.93 per cent of the area of the Baghmundi Block, respectively.

Table IV: Soil Texture Characteristics and Assigned Score

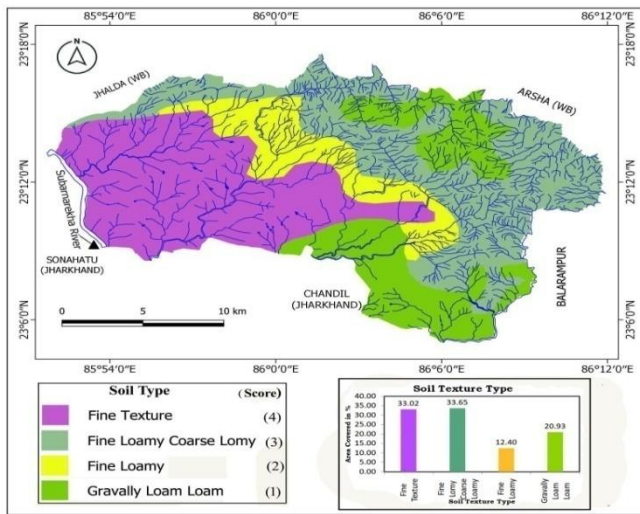| Sl. No.	Soil Type	Water Resource Prospects	Area Covered in Sq. Km.	Area Covered in %	Score
1	Fine Texture	High	148.58	33.02	4
2	Fine Lomy Coarse Loamy	Medium	151.41	33.65	3
3	Fine Loamy	Low	55.82	12.4	2
4	Gravally Loam Loam	Very Low	94.19	20.93	1

Fig. 7. Weighted Score of Soil Texture Map based on Water Holding Capacity
Source: NBSI, Regional Centre, Kolkata & author's compilation

E. Surface Water

Surface water has been important not only to humans but to all life forms on Earth ever since life began. Plants and animals congregate around waterways simply because water is essential to life. It might seem that rivers run through many cities in the world, but it is not that the rivers go through the town, but rather that the city was built and grew around the river [12]. Most of the surface water originates from rainfall and runoff within the surrounding catchment area. Of course, not all water ends up in rivers; some evaporates, some is used by vegetation, and part of it soaks into the ground to recharge our groundwater systems, some of which can seep back into the riverbeds. Various forms of surface water on the Earth's surface, such as water in streams, rivers, lakes, wetlands, reservoirs, and creeks, serve as indicators of water availability on the planet. The basis of the area under surface water has been classified and assigned a score for each zone (Figure 8 & Table 5). The high surface water zone (above 4% water) covers 4.92% of the study area. The medium (2.0 to 4.0% surface water) and low (0.5 to 2.0% surface water) surface water zones cover 9.80% and 39.90% of the total study area, respectively. A very low surface water zone (below 0.5% surface water) covers an area of 40.12 per cent of the Baghmundi Block.

Table V: Zones of Surface Water Bodies and Assigned Score

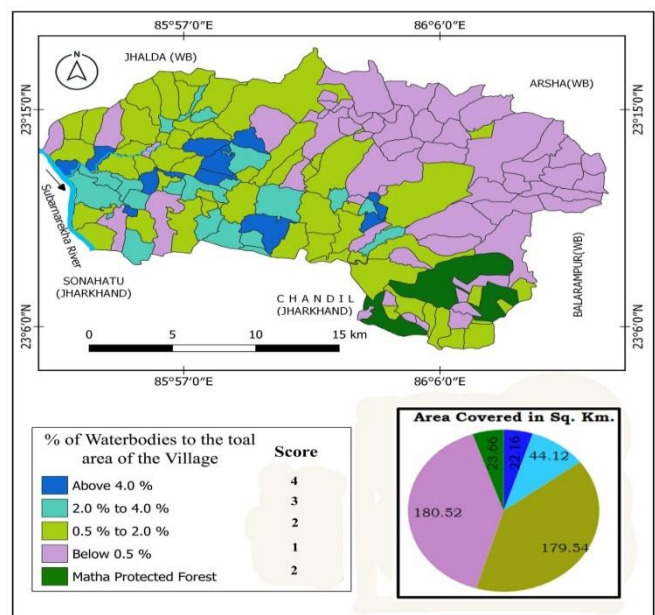| S. No.	% of Surface Water Bodies to the total area of the village	Water Resource Prospects	Area Covered in sq. km.	Area Covered in %	Score
1	Above 4.0	High	22.16	4.92	4
2	2.0 to 4.0	Medium	44.12	9.80	3
3	0.5 to 2.0	Low	179.54	39.90	2
4	Below 0.5	Very Low	180.52	40.12	1
5	Matha Protected Forest	Low	23.66	5.264	2

Fig. 8. Surface Water Map as Per Weighted Score
Source: Google Earth, 2022 & author's compilation

F. Groundwater

Soils and rocks of the upper-level surface of underground water are permanently saturated with water [13]. Different kinds of ecosystems depend on groundwater, including aquatic (such as wetlands, rivers, and lakes that receive groundwater), terrestrial (with phreatophyte vegetation, which is either shallow-rooted in alluvial settings or deep-rooted in arid zones), and even subterranean (in limestone formations with karstic caverns). Groundwater is an integral part of an ecosystem-based adaptation measure, green infrastructure, or nature-based solution [14]. Groundwater level has been measured from the ground surface. In this study area, 11.33 per cent of the area is classified as a high (0.80 to 4.05 mg/L) water resource prospects zone. Medium (4.05 to 4.77 mbgl) water resource prospects zone covers 65.56 per cent of the area of the study, and 23.11 per cent of the area lies in the low water prospects zone (4.77 to 5.38 mbgl) (Figure 9). According to a meter below ground level, a score has been assigned to each zone to understand the variability of groundwater resources of the study area. Table 6 shows the groundwater level (mbgl) zone and assigned score.

Table VI: Zones of Groundwater Level and Assigned Score

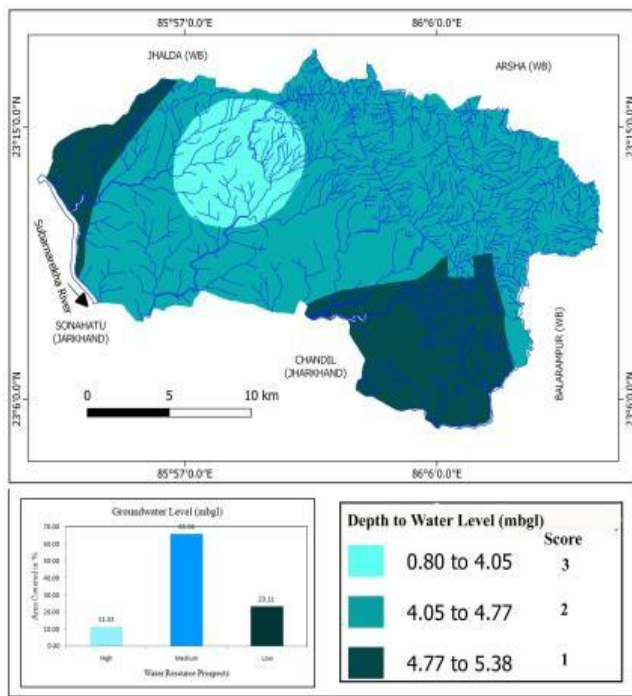| S. No,	Depth to Water Level (mbgl)	Water Resource Prospects	Area Covered in sq km.	Area Covered in %	Score
1	0.80 to 4.05	High	51	11.33	4
2	4.05 to 4.77	Medium	295	65.56	3
3	4.77 to 5.38	Low	104	23.11	2

Fig. 9. Groundwater Level Prospects Map According to Weighted Score
Source: CGWB, Govt. of India & author's compilation

G. Geology

Underground geological rock characteristics are a crucial factor controlling the infiltration of surface water into the subsurface, which is the most significant factor in determining the infiltration of surface water into the subsurface. Various types of rocks are present in the study area, including alluvium, granite gneiss, mica schist, amphibolites, phyllite mica schist, quartz veins, quartzite, and quartz schist. Alluvium (high water resource prospects) covers 24.60% of the study area. Granite gneiss (medium water resource prospects) covers an area of 59.45%. 8.79 per cent of the area is under mica schist (low water resource prospects. Amphibolites, phyllite mica schist, quartz vein, quartzite and quartz (very low water resource prospects) cover 7.16 per cent of the area of the Baghmundi Block. Based on the groundwater recharge ability of the rocks, scores have been assigned to each rock. Figure 10 and Table 7 illustrate the various types of stones and their corresponding water potential.

Table VII: Geological Characteristics of Rocks and Score Assigned

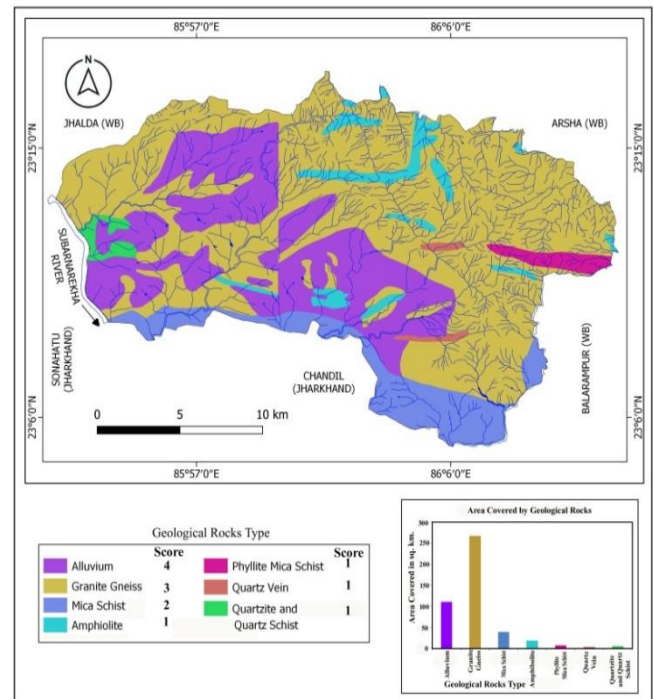| S. No.	Rocks Type	Water Resource Prospects	Area Covered in Sq. Km.	Area Covered in %	Score
1	Alluvium	High	110.69	24.60	4
2	Granite Gneiss	Medium	267.52	59.45	3
3	Mica Schist	Low	39.56	8.79	2
4	Amphibolite	Very Low	18.52	4.12	1
5	Phyllite Mica Schist	Very Low	6.52	1.45	1
6	Quartz Vein	Very Low	2.66	0.59	1
7	Quartzite and Quartz Schist	Very Low	4.53	1.01	1

Fig. 10. Geological Characteristics Map According to Water Resource Prosperity
Source: SoI, Govt. of India & author's compilation

H. Land use/Land Cover

The land use/land cover parameter plays a crucial role in determining the availability of water resources on the Earth's surface. It includes agricultural land, surface water bodies (ponds, wetlands, lakes, khal streams, etc.), vegetation cover, current fallow land, bare soil and rock, and built-up areas. Land use/ land cover plays a significant role in hydrological processes, such as the infiltration rate of surface water and surface runoff. The infiltration rate of surface water is high, and the discharge of surface water is less in forest areas. It can also modify the underlying mechanisms of transforming rainfall to water yield by altering the ecosystem's hydrological characteristics, such as infiltration, evapotranspiration and groundwater recharge capacity [15]. Figure 11 and Table 8 show the classification of land use/land cover, which has been assigned a score based on the water availability of the study area. Whereas 6.36 per cent of the area is water bodies (high water resource prospects), and 47.34 per cent of the area is under vegetation cover (medium water resource prospects). Current fallow land (low water resource prospects) covers 44.26 per cent of the area, and 2.04 per cent of the area is under built-up/bare rock (very low water resource prospects) of the study area (Table 8). Based on water-holding capacity, scores have been assigned to each land-use/land-cover zone, and the variation reflects the hydrological services provided by different land ecosystems.

40

Table VIII: Land Use/Land Cover Category and Assigned Score

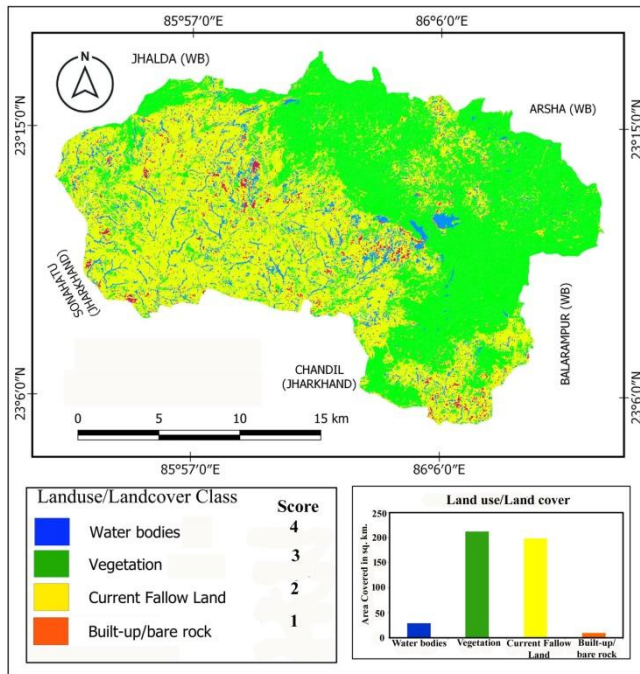| S. No.	Land use	Water Resource Prospects	Area Covered in %	Score
1	Water Bodies	High	6.36	4
2	Vegetation	Medium	47.34	3
3	Current Fallow Land	Low	44.26	2
4	Built-up/Bare Rock	Very Low	2.04	1

Fig. 11. Land Use/Land Cover Category as Per Water Holding Capacity
Source: Landsat 8, 2020 & author's compilation

VI. WEIGHT ASSIGNMENT

Water resource potential zones are determined by overlaying all the thematic maps, and the weighted overlay averaging method is used in GIS software. Weight has been assigned according to the influence of water resources on each thematic map [16].

All the thematic maps are converted from vector to raster format. Surface water bodies, drainage density, drainage frequency, and average slope are assigned higher weights, whereas geology, soil texture, groundwater level, and land use/land cover are assigned lower weights comparatively. Assigned weights to the different thematic maps, and individual scores are given for the sub-variable. GIS has been analyzed carefully, and scores are given for sub-variables [17].

The highest score is assigned to the feature with the highest potential, and the lowest score is given to the feature with the lowest potential. Higher drainage frequency areas are assigned the highest score, while lower drainage frequency areas receive a lower score. Higher drainage density areas are assigned the highest score, while lower drainage density areas receive a lower score. As far as slope, higher scores are

assigned for lower (gentle) pitch, and lower scores are assigned to higher (steep) slope areas. In land use/land cover, a higher score is assigned to surface water bodies and vegetated areas, and a lower score is assigned to built-up, fallow land, and bare rock areas. All assigned scores and weighted values for the different thematic maps are tabulated in Table 9.

Table-IX: Assigned Score and Weight for Various Parameters of Water Resource Potential Zones

S. No.	Parameter	Classes	Water Resource Prosperity	Score	Maps Weight
1	Geology	Alluvium	High	4	0.5
		Granite Gneiss	Medium	3	
		Mica Schist	Low	2	
		Amphibolite	Very Low	1	
		Phyllite Mica Schist	Very Low	1	
		Quartz Vein	Very Low	1	
		Quartzite and Quartz Schist	Very Low	1	
2	Average slope (Degree)	< 5	Very Low	7	1
		5 to 10	Low	6	
		10 to 15	Medium Low	5	
		15 to 20	Moderate Low	4	
		20 to 25	Moderate	3	
		25 to 30	Medium High	2	
		30 to 35	High	1	
		>35	Very High	1	
3	Drainage Frequency (Number of Streams/ sq. km.)	>8	Very High	5	2
		6 to 8	High	4	
		4 to 6	Moderate	3	
		2 to 4	Low	2	
		<2	Very Low	1	
4	Drainage Density (Stream Length in km/sq. km)	>4	Very High	5	2
		3 to 4	High	4	
		2 to 3	Moderate	3	
		1 to 2	Low	2	
		<1	Very Low	1	
5	% of Surface Waterbodies to total area of the Village	Above 4.0	High	4	3
		2.0 to 4.0	Medium	3	
		0.5 to 2.0	Low	2	
		Below 0.5	Very Low	1	
		Matha Protected Forest	Low	2	

6	Soil Texture	Fine Texture	High	4	0.5
		Fine Loamy	Low	2	
		Gravally Loam Loam	Very Low	1	
7	Groundwater Level (mbgl)	0.80 to 4.05	High	4	0.5
		4.05 to 4.77	Medium	3	
		4.77 to 5.38	Low	2	
8	Land use/land cover	Water bodies	High	4	0.5
		Vegetation	Medium	3	
		Current Fallow Land	Low	2	
		Built-up/Bare Rock	Very low	1	

VII. CONCLUSION

Remote Sensing and Geographical Information System (RS&GIS) techniques are essential tools to determine the water resource potentiality in the Baghmundi Block of Purulia District, West Bengal; it reveals that integration of eight thematic maps such as average slope, soil texture, drainage density, drainage frequency, groundwater level, surface water bodies, geology and land use/ land cover gives information to the local people, authorities and planners about the area suitable for water resource exploration. The study area has been classified into four zones based on water potential: excellent, very good, good, and poor. These zones are indicated in Figure 12. As per Table 9 & Table 10, the study area reveals that having very low drainage frequency (below 2 number of streams/ sq, km.), very high average slope (above 35^0), fine loamy and gravelly loam loam soil, very low surface water bodies (below 0.5% area to total area), low groundwater resource prospects (4.77 to 5.38 mbgl), the area under granite gneiss and amphibolites, and areas covered with vegetation and bare rock/soil is poor water resource potential zone and it covers an area of 1.96 per cent of the study. It has been observed that the good water resource potential zone in the study area is considered as having the area of low and moderate drainage frequency (2 to 4 and 4 to 6 number of streams per sq. km.), low and moderate drainage density (1 to 2 and 2 to 3 stream length in km. per sq. km.) respectively). Mild and medium high slope (20^0 to 35^0), fine loamy soil texture, the area under low water resource prospects (0.5 2.0 % surface water bodies to the total area), area of medium groundwater resource prospects (4.05 to 4.77 mbgl) from the ground surface, the area under granite gneiss rock and area covered with vegetation and bare rock/soil are observed as good water resource potential zone. It covers an area of 27.26% of the study area. The area has high drainage frequency (6 to 8 number of stream per sq. km.), high drainage density (3 to 4 stream lengths in km. per sq. km.), low and moderate low slope (5^0 to 15^0), fine loamy and coarse loamy texture soil, medium (2.0 to 4.0 %) surface water bodies, area of medium groundwater resource prospects (0.80 to 4.05 mbgl), granite gneiss rock and covered with agricultural land and scatter vegetation are observed as perfect water resource potential zone. It covers an area of 67.18% of the study area. Excellent water resource potential zone is noticed in the area where

there are very high drainage frequency (above 8 number of streams per sq. km.), very high drainage density (above 4 km. stream length per sq. km.), very low slope (below 5^0), fine texture soil, the area under surface water bodies (above 4.0 per cent to the total area), area of high groundwater resource prospects (0.80 to 4.05 mbgl), area of alluvium soil and area covered with agricultural land are observed as excellent water resource potential zone. It covers an area of 3.59% of the total study area. The water resource potential information of the study will help local people and planners effectively identify suitable locations for the proper use and management of water resources. The methodology and work presented in this paper will serve as a valuable guideline for the researcher to further their research.

Table-X: Water Resource Potential Zones

S. No.	Water Resource Potential Zones	Area Covered (sq. km.)	Area Covered (%)
1	Poor	8.84	1.96
2	Good	122.68	27.26
3	Very Good	302.31	67.18
4	Excellent	16.17	3.59
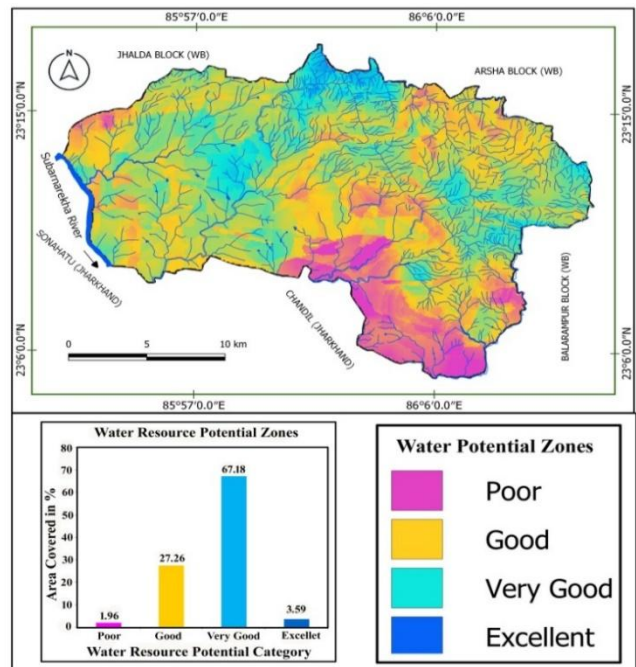
Fig. 12. Water Resource Potential Zones Map of Baghmundi Block

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