INVESTIGATION OF GROUND WATER POTENTIAL ZONES BY USING GIS TECHNIQUESIN BEKI RIVER BASIN, ASSAM

Saurabh Kumar Sarma
Ph.D. Scholar,Department of Geography and Resource Management,Mizoram University, Aizawl-796004, India

Ch.UdayaBhaskara Rao
Professor and HOD,Department of Geography and Resource Management, Mizoram University, Aizawl - 796004, India

Abstract:

The Beki River Basin which spreads in a space of around 3744.75 km2 in the region of Assam is defying the lack of surface water during dry season. The significant level strategies for geological information system have formed into an extraordinary engine in portraying groundwater potential zones. An undertaking has been made in this audit to depict the normal zones of groundwater in Beki Stream Bowl, Assam using remote recognizing and GIS procedures. The thematic layers such as rainfall, slope, geology, geomorphology, soils, drainage density, lineament density and land use /land cover have been integrated in ArcGIS environment by multi-criteria assessment. The guide was spatially arranged into high potential, moderate potential and low potential. The aide was spatially gathered into high potential, moderate potential and low potential. The endorsement results showed that GWPZs classes decidedly get over with the well deliveries and groundwater significance arranged in the given area.

Keywords: *Groundwater, potential zones, Beki River basin, remote sensing, GIS, multi-criteria evaluation.*

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Introduction

Ground water is an essential resource and has a colossal impact in the economy. It is the essential wellspring of water for water framework and drinking reason. Around 43% of Ground water is used for water framework. It expects an essential part especially during the drier months where there is to some degree quick recharge from Rainfall. It helps untamed life and plants to make due in those high temperatures. Ground Water moreover expects a huge part in extending the water levels in stream [1,2]. Because of its ability on a more profound level, it is less degraded with the pollution and thusly it doesn't require huge hypothesis is treatment. Groundwater is an essential ordinary resource for the trustworthy and monetary plan of consumable water supply in both metropolitan and commonplace circumstances. Subsequently, it expects a critical part in human well animals, as well as that of a couple of maritime and terrestrial conditions. At present groundwater contributes around 34% of the hard and fast yearly water supply and is a huge freshwater resource. Subsequently, an assessment of this resource is unimaginably basic for the possible organization of groundwater systems. Portraying the potential groundwater zones using remote recognizing and GIS is a convincing contraption [3,4].Actually, wide use of satellite data close by normal aides and remedied ground truth data has made it clearer to spread out the check information for groundwater potential zones. The evaluation of groundwater potential zone is a multicriteria examination (MCA). In the unique cycle, multicriteria assessment is one of the typical GIS errands used to overview and all out the various guidelines for fittingness arranging and resource portion decisions [5,6]. The most essential stage in the multi-rule's assessment is to perceive the model, an action can be described as a rule or standard by which something may be judged or picked. The standards can be an impediment or a part. Prerequisites limit the sensibility however a part works on the sensibility. The conspicuous

evidence of rules is a fundamental stage in MCA, it requires wide examination of composing and expert data in the concerned subject. All things considered, rules used in suitability assessment have a spot with different fields and besides have different units of assessment. Thus, all actions should be scaled or overlay layers[7-9].

The lineaments for groundwater exploration and others merged different factors apart from lineaments like drainage density, geomorphology, geology, slope, land use, rainfall intensity and soil texture.

Study Area

The examined area has remained ignored in the field of ground water. In this manner, the survey has been an uncommon enormous one in the applied geomorphology and topography of the basin. The huge task lies with understanding and perceiving the morphological qualities and springs, ground water expected zones of the Beki channel and its bowl associated with fluvio - geomorphology. The survey will, along these lines, be helpful to the gathering on the way of geomorphologists, coordinators, administrators and other field analysts.

The Beki Waterway Basin, Assam, India is the tremendous toward the south depleting expressway stream bowl which has a trans-limit accessory called Kurichu in Bhutan. The Beki or Mora Manas starts at the debouching point of the Manas at Mathanguri at a rise of 97m around. It is the easternmost channel of the present Manas association. It streams in a southerly heading by the side of Narainkuri, Chafakamar, Chengla, Jaipur, Goraimarigaon, Karakura, Kadang, Majidbhita and meet the Brahmaputra near Baghbar at an altitudinal level of practically 30m. The channel distance of the Beki Waterway is 90 km while the veritable stream distance is 69 km.

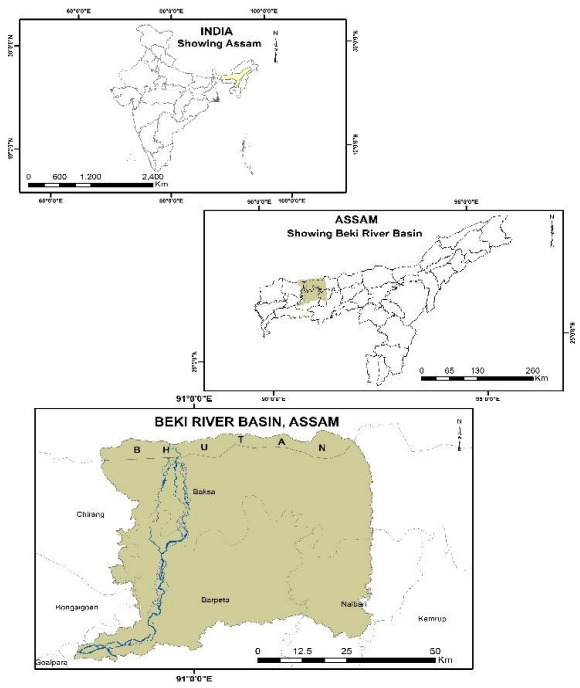

Fig 1: Locational map of Beki River Basin

The stream and its spillage channels course through the fields of Assam for around 85 km and direct in a space of around 3744.75 km2. Separating and the repetitive surges of especially serious degree by Beki Waterway have been emphatically influencing the common scenes, yields, steers and individuals of locale of Assam. The review area lies between 26^0 28/ 12.741// N to 26^0 20/ 5.358// N degrees and 90^0 52/ 5.736// E to 90^0 55/ 1.601//E longitudes. The environment is very fluctuated, going from warm and damp subtropical circumstances in the south to cold and dry high circumstances in the north. From May to October, tropical rainstorm environment gives two undeniable seasons-summer and winter. The midyear time of Spring to May is trailed by the rainstorm from June to September. This is trailed by cool winter season from October to February. Beki Riverine areas get yearly more than 4,000-4,200 millimetres in the southern parts and 550-700 millimetres Rainfall in the northern parts.

Data Source and Methodology Operated

Drainage network of Beki River basin will be delineated from survey of India toposheets, high resolution multi-date satellite imagery (IRS P6 LISS IV MX) and field surveys. Relief and slope maps will be prepared from Digital Elevation Models (DEM) acquired by CARTOSAT, SRTM

and ASTER. Drainage density of Beki River basin will be prepared from the drainage network of the area. Geomorphic and land use/land cover maps will be prepared from toposheets, satellite imageries and field surveys. Lithology map will be prepared from the Geological maps published by Geological Survey of India. Soil maps of the study area will be prepared from the soil data and maps published by All India Soils and Land use Survey. The ground water potential zones will be delineated based on the integration of the thematic layers such as relief, slope, rainfall, lithology, drainage density, soils, land use/land cover, landforms, and lineament density using Arc GIS tools [10,11].

Result and Discussion

Slope

We get less flood in sensitive inclination areas which helps water with saturating bring down even more rapidly. Notwithstanding the way that we are getting high overflow in steep inclination locales, [12] it shows less stretch of time for water to go diving. In the audit district around 80% is covered by medium to fragile inclination which shows extraordinary recharge ought to be conceivable here since those are level to undulating in nature. Using significant waste holding and its issue rank assigned freely to the brand name impact of class and grade(Fig 2).

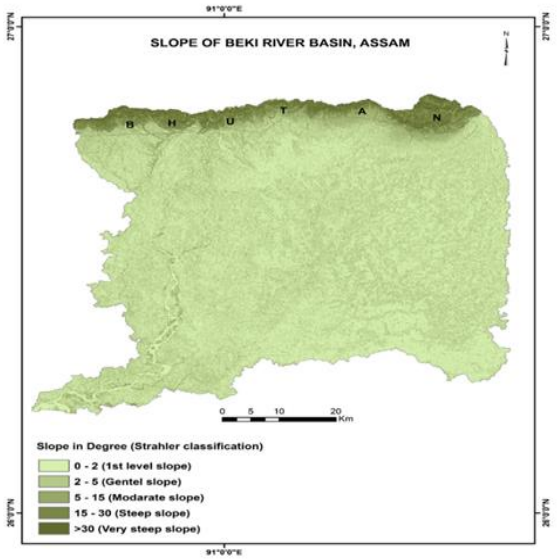

Fig 2. Slope map of Beki River Basin

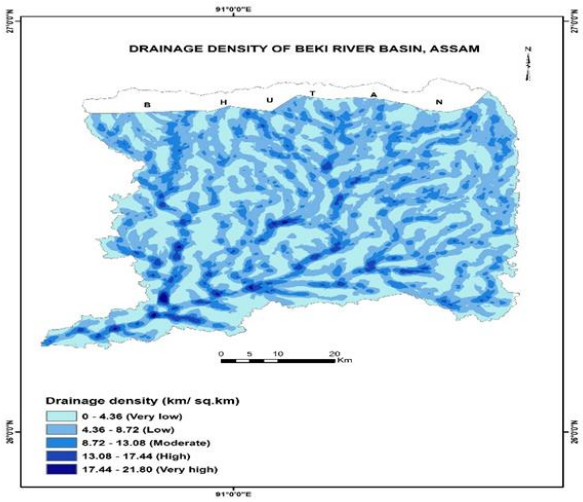

Fig 3 Drainage density map of Beki River Basin

Drainage density

In this study region found in the centre part is covered by moderate to high drainage density due to fluvial environment. High drainage density shows the central layers is more doused accordingly more surface flood occurs rather than pervasion. In the low leakage density area edges, more entrance occurs. As soil infiltration rate by suggestion related with drainagedensity [13,14] here it is showing low density. (Fig3).

Lithology

The survey has a variable lithology and it participate in dominant work to control the presence of groundwater. As it tends to a fluvial environment here extra leftovers unconsolidated rather than rock mass. Record, phyllite and mica schist (figure 4) covers most of the portion in the inspection district. These got through zones can similarly hold a sensible proportion of groundwater. Towards the Centre portion of the survey district unclassified soil and alluvium are winning. So enveloped areas may be grouped under least recharge zones. The locale like quartzite, fundamental and ultrabasic and ultramafic rocks have no porosity and permeability condition and Laterite goes probably as a good recharge zone. Thusly, these zones can be ordered under moderate to low recharge zones.

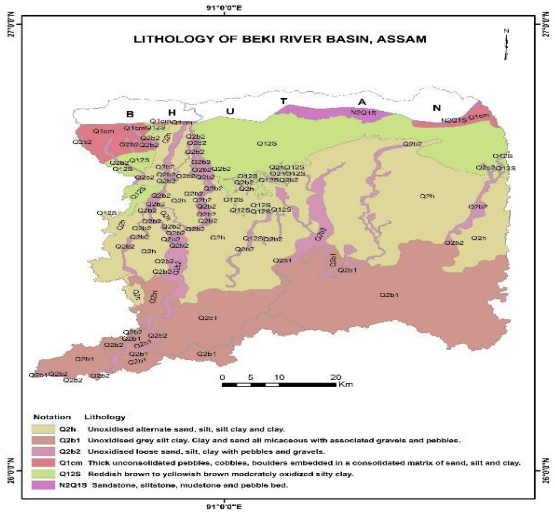

Fig 4: Lithology map of Beki River Basin

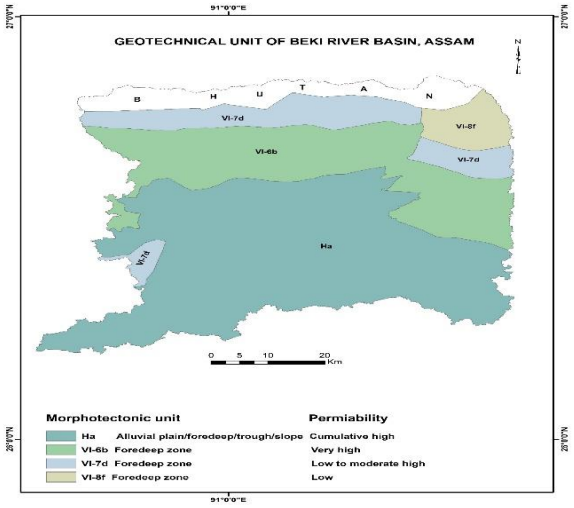

Fig 5: Geo-tectonic Unit of Beki River Basin

Geomorphology:

How ample slop is there, gives clue what kind of landform [15] we attain and explain, till which degree we get enduring there. Then no one but we can choose the groundwater accessibility of any area [10,11,13]. Seven divisions have been made using Geological survey of India classification schemes. Here found theLow laying flats / plains / present flood plains, Alluvial fans / piedmont cut and fill, coalescing fan terraces / Upper / Lower, Relict Hills, Alluvial fans/piedmont cut and fill coalescing fan terrace / unclassified/ upper, Alluvial fans/piedmont cut and fill coalescing fan terrace / unclassified/ lower, Low laying flats / plains / present flood plains, Water segment and Alluvial fans / piedmont cut and fill, co-ales in fan terraces(figure 6). Penetration of groundwater is conceivable only when fractures, joints and weak zones are there. Such features are increasing the chance of groundwater recharge zones. So, the low dissected hills recharge more groundwater than highly dissected hills.

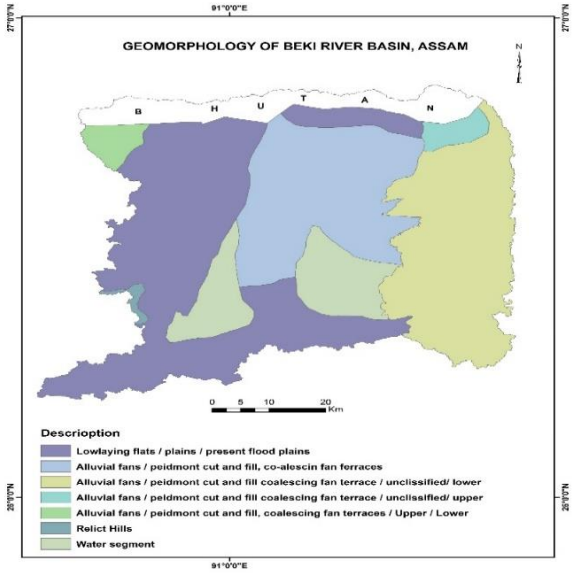

Fig 6: Geomorphology map of Beki River Basin

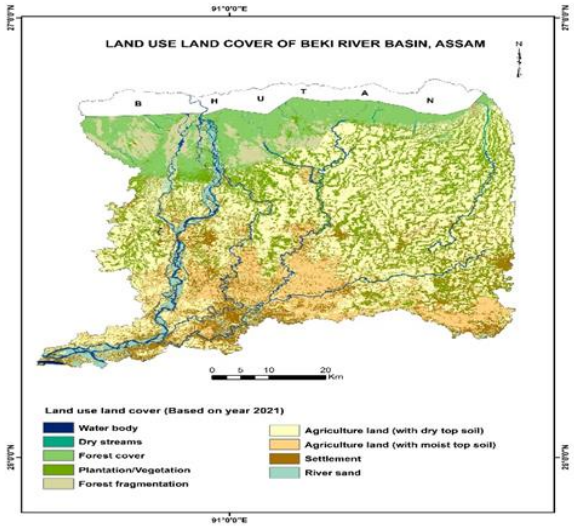

Fig 7: LULC map of Beki River Basin

Land Use and Land Cover (LULC):

This is one of the vital authorities viewing most contemptable rheostat in the public field on groundwater resources is LULC [16]. Different land use plans impression idiosyncratically to

infiltration, store and advent of groundwater. Nine divisions have been made using this LULC. (Figure 7)

Lineament Density

Lineaments are firmly connected with underground enclosed insufficiencies. Lineament density maps embodies factures and issues present in slightly slanted stratigraphic areas. Lineament density of an area can by inferencereveal the groundwater potential since the existence of lineaments stereotypically means permeable zones. Regions with high lineament density are indeed great for ground water possible zone. Arrangement of this guide is finished by manufacturenumerous kinds of slope conceals with various azimuths and elevations from spatial examiner apparatus in ArcGIS 10.4.1. Later the guides altered to get lineament density map. Acquired information is then changed over into shape record with obligatorynumeral of classes. From the guide we can presume that northern piece of locales Bhutan Narayanguri, Mathanguri (falls in Assam), have noteworthy issue and cracks. From incline guide and lineament density map we can say that northern part involved raised regions (figure 8).

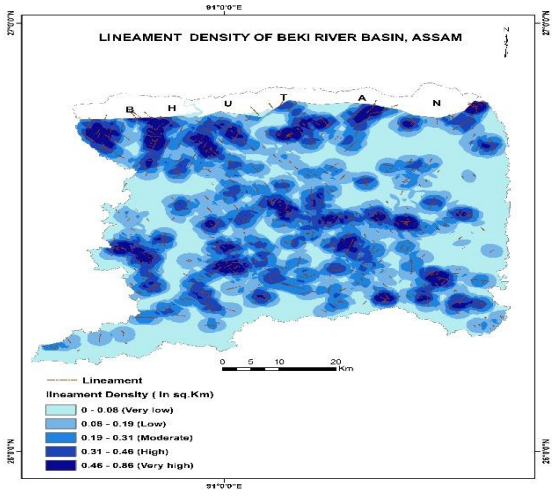

Fig 8: Lineament Density of Beki River Basin

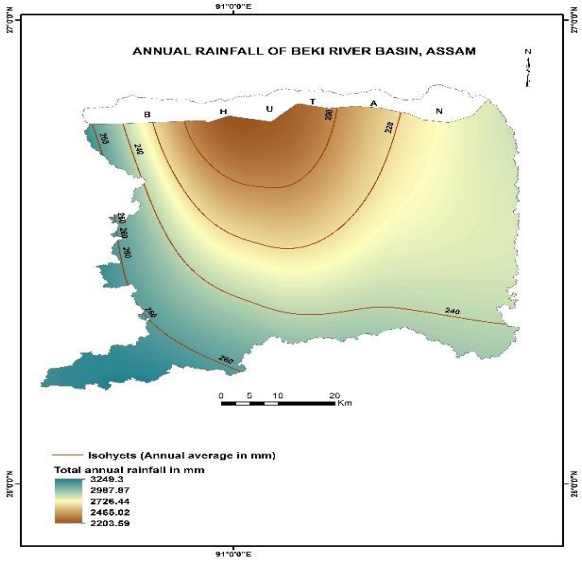

Fig 9: Annual Rainfall of Beki River Basin

Rainfall

Rainfall goes probably as the critical wellspring of entrance of ground water close by other hydro geographical sequences. Rainfall effects assortment in refreshing rate and limit cut-off of ground water. Higher speed of attack occurs during blustery season through transient water. Higher the Rainfall, more noticeable is the entrance and better will be the ground water potential; as well as the reverse way around. In the survey area south west part (figure 9) gets more Rainfall when diverged from various parts. Segments of key to east locale gets moderate Rainfall while the central part gets less.

Groundwater level

We comprehend that ground water level rewards speak relationship with recharge cut-off and potential. More is the recharge, shallower will be the water consequence and higher will be the ground water potential and lesser is the recharge, supplementary will be the water significance and less lucky will be the ground water potential. In view of the water level guide distillate on region, northern part shows a more profound water perceptiveness circumstance (figure 10) which is sign of poor GWPZ due less penetration.

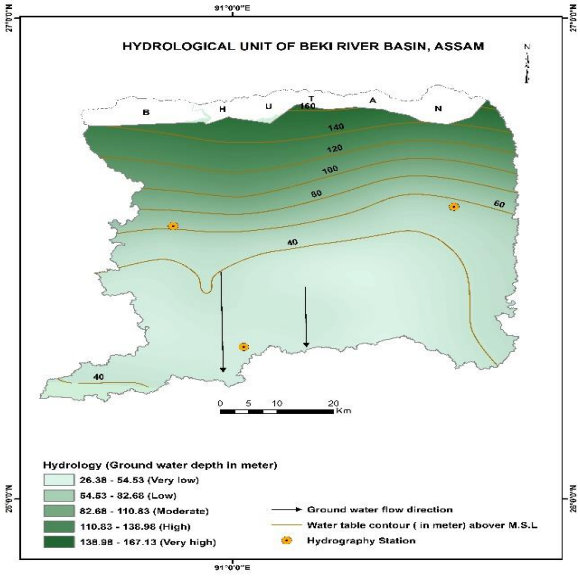

Fig10: Hydrological unit/water level of Beki River Basin

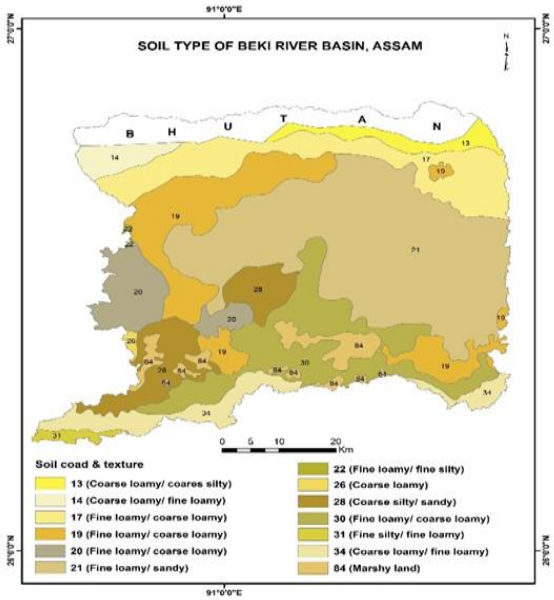

Fig 11: Soil map of Beki Basin

Soil

Soil surface is a significant constituent for portraying the ground water likely zones of an area. The holding limit and assault pace of water relies upon soil properties like construction, porosity, bond and consistency. Surface invasion frameworks ordinarily require penetrable surface soils that permit high-penetration and limit land prerequisites. The vadose zones ought to be absent any and all earth or other fine finished material layers that limit descending stream and make water logging issues diminishing ground water re-energize. Concentrate on shows that greater part of soil type is fine loamy sandy, coarse loamy, fine silty and so on and complete soil types found in the space are 13 types (figure 11).

Table 1: Groundwater Weightage table

Description (Geomorphology)	**Weighted value**	**Overlay %**
Low laying flats / plains / present flood plains	7	10
Alluvial fans / piedmont cut and fill, coalescing fan terraces / Upper / Lower	6	
Relict Hills	5	
Alluvial fans/piedmont cut and fill coalescing fan terrace / unclassified/ upper	6	
Alluvial fans/piedmont cut and fill coalescing fan terrace / unclassified/ lower	6	
Low laying flats / plains / present flood plains	7	
Water segment	8	
Alluvial fans / piedmont cut and fill, co-alescin fan terraces	7	
Description (Lithology)	**Weighted value**	**Overlay %**
Unoxidized alternate sand, silt, silt clay and clay.	2	10
Unoxidized grey silt clay. Clay and sand are all micaceous with associated gravels and pebbles.	3	
Unoxidized loose sand, silt, clay with pebbles and gravel.	5	
Thick unconsolidated	7	

pebbles, cobbles, and boulders are embedded in a consolidated matrix of sand, silt and clay.			
Reddish brown to yellowish brown moderately oxidized silty clay.		8	
Sandstone, siltstone, mudstone and pebble bed.		9	
Soil code	**Description**(Soil)	**Weighted value**	**Overlay %**
13	Coarse loamy / Coarse silty	7	10
14	Coarse loamy / Fine loamy	6	
17	Fine loamy / Coarse loamy	7	
19	Fine loamy / Coarse loamy	7	
20	Fine loamy / Coarse loamy	6	
21	Fine loamy / Sandy	6	
22	Fine loamy / Fine silty	6	
26	Coarse loamy	7	
28	Coarse silty / Sandy	7	
30	Fine loamy / Coarse loamy	7	
31	Fine silty / Fine loamy	7	
34	Coarse loamy / Fine loamy	8	
84	Marshy Land	5	
Index	**Relative relief in meters**	**Weighted value**	**Overlay %**
Very low	<13.64	5	10
Low	13.64 – 18.05	4	
Moderate	18.05 – 26.86	3	
High	26.86 – 79.75	2	
Very high	>79.75	1	
Index	**Drainage Density (Km/Km$^{2)}$**	**Weighted value**	**Overlay %**
Very low	0 – 4.36	5	10
Low	4.36 – 8.72	4	
Moderate	8.72 – 13.08	3	
High	13.08 – 17.44	2	
Very high	17.44 – 21.80	1	
Index	**Lineament density (in km/km^2)**	**Weighted value**	**Overlay %**
Very low	0 – 0.08	1	10
Low	0.08 – 0.19	2	
Moderate	0.19 – 0.31	3	
High	0.31 – 0.46	4	
Very high	0.46 – 0.86	5	
Index	**Groundwater depth (in meters)**	**Weighted value**	**Overlay %**
Very low	26.38 – 54.53	5	10
Low	54.53 – 82.68	4	
Moderate	82.68 – 110.83	3	
High	110.83 – 138.98	2	
Very high	138.98 – 167.13	1	

Morphotectonic unit	**Permeability**	**Weighted value**	**Overlay %**
Ha Alluvial plain/foredeep /trough/slope	Cumulative high	7	

VI-6bForedeep zone	Very high	8	10
VI-7d Foredeep zone	Low to moderate high	5	
VI-8f Foredeep zone	Low	3	

Index	**Slope (in Degree)**	**Weighted value**	**Overlay %**
1st level slope	0 – 2	5	10
Gentle slope	2 – 5	4	
Moderate slope	5 – 15	3	
Steep slope	15 – 30	2	
Very steep slope	>30	1	
Rainfall (total annual rainfall in mm)		**Weighted value**	**Overlay %**
3249.3		5	10
2987.87		4	
2726.44		3	
2465.02		2	
2203.59		1	

Ground Water Recharge Potential Zone

Weightage overlay expedient is given over the amalgamation of prearranged groundwater recharge potential zone [10] guide of the area using ArcGIS. Three zones are ordered in view of adjustment of potential recharges zones (I) low anticipated zone, (ii) moderate probably zone and, (iii) high conceivable zone. We got less yield in low groundwater likely area and more yield in high groundwater conceivable locale. Moderate recharge area we got medium yield, prompts improvement of recharge zones with moderate chance zones. Broad running wells/tube a lot of found are having high groundwater recharge potential zones.

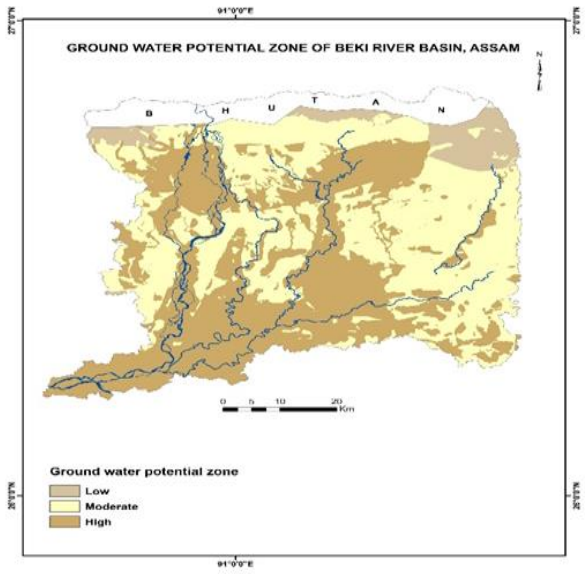

Fig 12: Ground water potential map of Beki River Basin

Conclusion

Employing geological, drainage density, lineaments, LULC and slope all these overhead thematic maps of Beki River Basin of Assam has been alienated qualitatively three zones operating their groundwater croft limit. As waterway Beki covers in excess of 20% of the region Barpeta District and 10 percent of Baksa District, that is the reason showing awesome groundwater possibility, hang around 80/90 percent region covers unclassified soil and alluvium cover along the organization of lineaments showing moderate to great shape where as 5.80 percent region low, 43.58 percent region moderate and in conclusion 50.62 percent region showing high groundwater anticipated condition. Late assessment accomplished showing best apposite outcome for groundwater panning which is south western, portions of northern side of the appraisal area.

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