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Ground Water Potential Map Of Dhalai River Basin, Tripura, India

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***Abstract:** With the increase in demand for water for competing uses, it is difficult to meet the entire demand from a single source and it is a challenge to plan and manage the different water resources. Among the two major water resources, surface and ground water, it is the ground water resources, which needs to be managed carefully, especially in drought prone area. The hydro-geological features such as sub-soil structure, rock formation, lithology and location of water play a crucial role in determining the potential of water storage in ground water reservoirs. To assess the ground water potential, a suitable and a accurate techniques is required for a meaningful and objective analysis. A critical study is carried out on the different methods of estimating the ground water potential and compared to arrive at the most suitable technique for practical utility. In this work four methods of estimating ground water recharge were studied yearly water level fluctuation, ten year average water level fluctuation, fluctuation between the lowest and highest water levels over ten years and fluctuation in monsoon seasons. The results of this study help in accurate prediction of ground water availability, which in turn may avoid ground water over exploitation and help restore the aquatic eco-system.*

***Keywords:** Rainfall analysis, Recharge by average of Ten year Fluctuation, Estimation of Ground water Recharge, Result.*

I. INTRODUCTION

Ground water is a dynamic and replenishing natural resource which forms the core of the ecological system. But in hard rock terrains, availability of ground water is of limited extent. Ground water is an important resource for meeting the water requirement for irrigation, domestic and industrial uses every year throughout the world.

Agricultural is the main stay in India because 69% of the total population depends on it. Poor knowledge about this resource due to its hidden nature and its occurrence in complex subsurface formation is still a big obstacle to the efficient management of this important resource. According to the Central Ground Water Board (Report 97) the amount of ground water has decreasing rapidly from 1990-2012, through the world. In India 60% people are drinking not good quality of drinking water and all disease are coming from that source. In coming 2030 the most crisis resource in this world is that drinking water or ground water. Ground water contained in the voids of the geological materials that comprise the crust of the earth is the ground water. It exits at a pressure greater than or equal to atmospheric pressure. The experimental and methods required for analyses are distinctly different as it is exploited and used in human affairs in different ways.

LOCATION OF STUDY AREA

Dhalai district is situated between two hill ranges-Sakhantlang and Atharmaura. This District created in the year 1995 by bifurcating North Tripura districts. The district consists of four sub division and five blocks of which 70% area is covered by forest area and 59% of total population is belonging to ST communities. Thus it is a tribal dominated district and very much rich in bio-diversity. The Dhalai district of state Tripura lies between of $23^0 25'19''$N and $24^0 15'37''$ and longitude of $91^0 45'01''$E and $92^0 10'26''$E the state is situated in the extreme northeastern part of India and is surrounded by Bangladesh on the west, South and North. As a part the landlocked stated like Tripura the Dhalai Districts is also surrounded by Bangladesh in north district west in west and south districts in the northwest and district North to the east.

The district Dhalai covered an area of $2495km^2$.This district consists four sub-division namely Ambasa, Gandacherra, Langtaraivalley and Kamalpur and 5(five) namely Ambasa, Salema, Dumburnagar, Manu and Chawmanu. There are 96 ADC village and 34(thirty four) Gram Panchayats in the district and 1 (one) Nagar Panchayats in the district. Gomati, Khowai Dhalai and Manu are the major rivers which are originated from Dhalai. The major hill ranges in this districts are Athamura, Longtharai, Kalajharai and Kalajharai and part of Sakhan.

PROBLEMS OF THE STUDY AREA

Ground Water is the most important resource in human life because without water no men live. Tripura is a hilly state and here precipitation also very high and most of rain water flow as a surface runoff so the infiltration is also low but almost all areas in Tripura has porous sandy soil so the recharge level is also high for the long duration of rainfall .In future how much amount of water can be used for irrigation that is the main reason for preparing the ground water potential map in Dhalai District in Tripura.

Population growth rate is high in Salema district. So the demand of drinking water also increasing. Rainfall is one of the most important parameter for recharging ground water but now a day's all over north –east rate of rainfall decreases so ground water level also decreasing.

Keeping in the view the significance of Ground water problem, this study has been taken ground water potentional mapping causes behind occurrences of Ground water problem.

Various important routes have been selected for the detailed study of Rainfall infiltration methods, Ground Water flucation methods, Rainfall recharging in the different parts of the district. However most emphasis has been given on highly populated sub-division or division. During intensive field survey, it is found that the most of the Ground water flucation level has occurred in the high populated zone.

OBJECTIVES OF THE STUDY AREA

Main objective of our study area is that Dhalai district has more than enough ground water .How much water they can use for irrigation purposes or any other works like that domestic purposes and small industry so our objectives are:

- ✓ Prepare thematic maps of the areas such as lithology, lineaments, landforms and slopes from remotely sensed data and other data for estimating ground water of Dhalai District.
- ✓ Indentify and delineate groundwater potential zones through integration of various thematic maps with GIS techniques.

II. METHODOLOGY

The research in groundwater resources was undertaken by well-programmed and integrated approach set up on reliable methodology for data collection and review, carrying out field survey, identification, selection and evaluation of well data it was completed in three phases:

- ✓ Data collection and review of previous work
- ✓ Data Analysis and Interpretation
- ✓ Validation of results

The present work is an attempt to focus into the potential of ground water of Dhalai districts in Tripura. Any study relating to explore the historical and analytical perspective of a given sector needs to rely on collection of information in a scientific manner and analysis of the same using tools widely recognized and effective in social science. In order to reach the desired goal of the dissertation, survey has been conducted in two Blocks of Dhalai district in Tripura that is Ambasa and Salema Block Salema. The study is mainly based on the secondary data collected from various offices and departments. For doing this each of the sub-division are considered as strata. From each strata sample tappers are selecting using the random sampling. The secondary source of the information were different official documents, rules and regulations published by the different Government and semi government organizations and such other institutional documents relevant to the present study. This is also enabled talking about the objective of this study to arouse people's interest as well as cooperation. Google maps of various years are taken into concern to locate the various changes in the geo environmental changes in the area. Methodology for the investigation and study is summarized in flow chart. Dhalai districts, digital image processing for the extraction of geomorphology, lithological, linear features, land use/cover etc... The field studies were comprised of hydro geological, structural and Geomorphological investigations. DEM, which is produced from SRTM, was used to extract lineaments and for landform mapping. All data were integrated in a Geographic Information System (GIS) and analyzed to assess the groundwater controlling features. Finally groundwater potential map was prepared based on GIS analysis.

The integrated remote sensing and GIS based study has facilities to delineate the ground water potential zones by analyzing various phenomena related to land and water resources. Geographical information system helps to integrate conjunctive analysis of large volumes of multidisciplinary data, both spatial and non spatial studies and also integrated different thematic data layers such as topography, lithology, geographical structures depth of weathering extent of fractures slope and drainage pattern with the help of geographical information techniques to delineate ground water potential zones. The digital Elevation Model (DEM) provides different thematic data layers namely slope, drainage, relief structural features etc. which are obtained more easily less subjective and provides more reproducible measurements than traditional manual techniques applied to derive topographic maps. Over the last two decades digital representation of topography has facilities a lot to analyze various surface and sub- surface geomorphic and geo hydrologic features at different scales. In the field of geological and geographic research (RS) and GIS has brought a new horizon by measuring and evaluating topographic data set more conveniently. The geographic information system is very much helpful in delineation of ground water prospect and deficit zones. In the present study of preparing the ground water potential mapping of Dhalai District, various thematic maps namely slope relief land cover were reclassified on the basis of weightage assigned and brought into the raster calculation function of spatial analyst tool for integration .The weighted for different thematic data layers are assigned considering the work done by Rao and Jugranet.al. But at the time of integration of all the data layers a simple arithmetic model is adopted by averaging the weightage.

III. RAINFALL PERSISTENCE

Generally in a time series data it is assumed that the observations are independently distributed over time. But this is always true for hydrologic or climatic time series. Observations of one year general follow the character of the previous year for example the higher values follow the higher values and the lower values follow the lower values. This means that the annual rainfall of any year is dependent on the previous year or persistence of rainfall of any year is dependent on the previous year or random and non random.

The first order serial correlation methods have been used to determine the nature of persistence in the annual rainfall. This method indicates that whether the serial dependence among the number of events in successive annual rainfall is present or not in a time series of rainfall. The formula for determining the rainfall persistence for the area under study is as follows

$$r_1 = \frac{\frac{1}{N-1}\sum_{i=1}^{N-1} x_i x_{i+1} - \frac{1}{(N-1)^2}\left(\sum_{i=1}^{N-1} x_i\right)\left(\sum_{i=1}^{N-1} x_{i+1}\right)}{\sqrt{\left[\frac{1}{N-1}\sum_{i=1}^{N-1} x_i^2 - \frac{1}{(N-1)^2}\left(\sum_{i=1}^{N-1} x_i\right)^2\right]}\sqrt{\left[\frac{1}{N-1}\sum_{i=1}^{N-1} x_{i+1}^2 - \frac{1}{(N-1)^2}\left(\sum_{i=1}^{N-1} x_{i+1}\right)^2\right]}} \qquad \ldots 7.3$$

where, N = Length of time series of different stations.
r_1 = First order serial correlation coefficients.
x_i = Annual rainfall of different years.

Name of the stations	Annual rainfall persistency	Annual Ground water level(m)	Monsoon Rainfall persistency	Monsoon Ground water level(m)
Chawmanu	-0.300	3.580	0.03	3.500
Ambasa	-0.020	2.230	0.11	0.620
Kamalpur	-0.200	1.900	-0.28	1.780

Table 1: Relation between Rainfall persistency and Ground water level

Rainfall persistency is positive that means that two variables are increasing gradually means that present year rainfall and the previous year rainfall increasing and also increase ground water level also. In Chawmanu station rainfall persistency is -0.300 means that amount of rainfall is more that's why the total ground water level also decreasing beneath the surface.

RAINFALL VARIABILITY

Rainfall variability of an area has a great importance to find out the role of rainfall in shaping the physical as well as socio-economic aspects of a particular area. Landform configuration depends on the variability of rainfall to a great extent. Since the study area belongs to the monsoon climate regions the monsoonal rainfall variability has also great importance parallel with the annual rainfall variability. Thus both annual and monsoonal rainfall variability has been taken into consideration to find out their individual role in influencing the fluvial dynamics in the Dhalai District.

The mean the standard deviation of rainfall in mm and the co efficient of variability in percentage of annual as well as monsoonal rainfall.

On the basis of the calculation values of the rainfall station c.v the annual and monsoonal rainfall variability maps have been draw

Name of the Station	Rainfall variability(%)	Annual ground flucation water level (m)	Monsoon rainfall variability(%)	Monsoon ground flucation water level(m)
Chawmanu	22.0	3.580	21.40	3.500
Ambasa	25.50	2.230	23.20	0.620
Kamalpur	20.60	1.900	27.80	1.780

$$CV = \frac{\sigma_p}{\bar{P}} \times 100 \qquad \ldots 7.2$$

where, CV = Co-efficient of variability,
σ_p = Standard deviation of rainfall,
$\bar{P}$ = Mean rainfall.

Table 2: Relation between Rainfall variability and Ground water flucation level

If rainfall variability is more than the Ground water flucation level is more. In above table showing this, in Chawmanu stations rainfall variability is 22.0% and ground water flucation level is 3.580.Ambasa is lowest rainfall variation and ground water flucation level is low (25.50/2.23annual) (23.20/0.620 monsoon)comparatively in the station of Kamalpur.

Name of the Stations	Annual rainfall(mm)	Ground water level in Annual(m)	Monsoon rainfall (mm)	Ground Water flucation level in Monsoon Period(m)
Kamalpur	19583.70	1.900	10732.10	1.78
Ambasa	22077.27	2.230	15811.73	0.62
Chawmanu	21442.20	3.580	11739.60	3.5

Table 3: Relationship between rainfall and ground water level

The amount of this recharge depends upon the rate and duration of rainfall, the subsequent condition at the upper boundary, the antecedent soil moisture condition, the water table depth and the soil type. If the Rainfall is more than the ground water level is less from the surface. In Ambasa station rainfall is above 22000mm and ground water fluctuation level is less 2.23m from the surface.

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DEPTH OF RAINFALL

Average depth of rainfall is an important method to find out the average amount of rainfall accumulation over an area. Different methods have so far been postulated to calculate the average depth of rainfall over an area .Among them the Isohytal method has been used for the present study to analyze the average depth of rainfall over the Dhalai District. This method has been chosen as the present study area has got sufficient orographic effect being characterized by both hills and plains. On the basis of those points rainfall values a number of isohyets have been indrawn to find out the zones having different ranges of mean annual rainfall depth of the total area. According to original techniques the average value of each zone is then determined by compiling the mean value of the incremental amount between each pair of isohyets encompassing a particular zone. The individual average depth of rainfall of each zone has been weighted by the respective areas occupied by them. Finally the total of their weighted values has been divided by the total area of the sub division to get the average annual precipitation of the whole study area. The average annual rainfall of the whole subdivision is thus determined by the following formula

$$\bar{P} = \frac{1}{A}\sum_{j=1}^{J}\frac{A_j}{P_j} \qquad \text{....... 7.1}$$

where, P = Average annual precipitation

$A = \frac{1}{A}\sum_{j=1}^{J} A_j$, i.e. the total area computed by adding the individual zones.

P_j = Average annual precipitation of the j th zone.

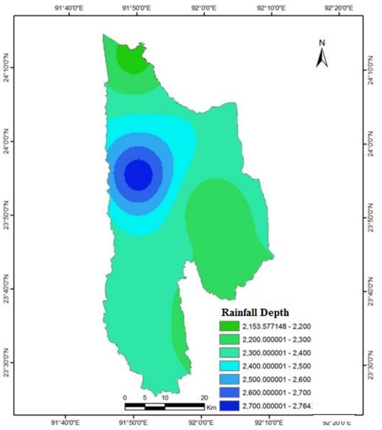
J = Total number of zones.

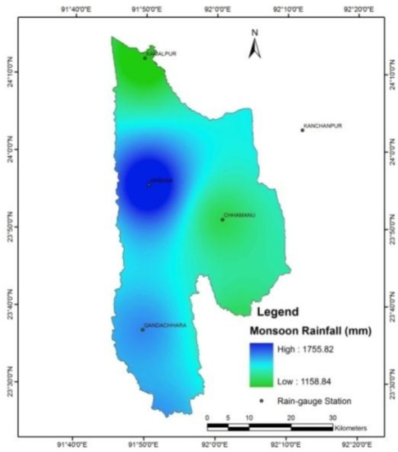
Zone	Average rainfall(mm)	Area(km^2)	Rainfall depth	Rank
1	<2200	31.46	67634.89	1
2	2200-2300	403.19	907187.8	7
3	2300-2400	771.29	1812531.5	6
4	2400-2500	182.49	447107.6	5
5	2500-2600	100.54	256376.7	4
6	2600-2700	65.44	173406.5	2
7	>2700	30.51	83361.5	3

Table 4: Rainfall depth zones with respect area

RAINFALL DEPTH AND GROUND WATER DISTRIBUTION

- ✓ High and very high rainfall occurs between 183200 and 342710 hill portion. This may be due to the collision of the incoming monsoon wind with this part of the Basin. Area about 1456 km2 receives relatively lower amount of rainfall and thereby depicts lower amount of rainfall depth.
- ✓ The amount of rainfall received by the plain area (that is below 180m) is again less because the moisture bearing wind has no orographic effect over the plain area. Therefore, rainfall depth is also low in comparison with other area.
- ✓ The higher rainfall depth zones reflect some distinctive topographic effects of the Dhalai district.





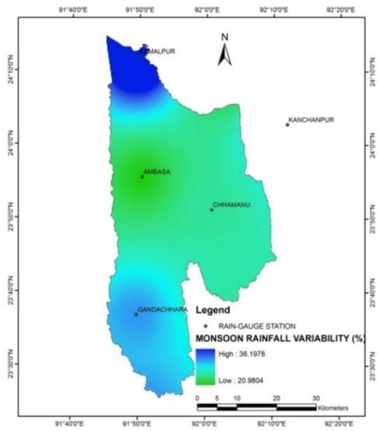


Figure 1: Rainfall depth, Monsoon Rainfall, Monsoon Rainfall Variability of Dhalai District

ESTIMATION OF GROUND WATER RECHARGE

Estimation of Ground Water Resources in the study area has been carried out based on the methodology recommended by Ground water Estimation Committee (GEC'97). The resource computations presented in this report is computed for the year 2008 - 2009. The study area experiences rainfall mainly from S-W monsoon. The monsoon period has been taken as 4 months i.e. from June to September. Remaining 8 months (October to May) has been considered as non-monsoon period. The block -wise computation has been attempted mainly due to lack of data especially on number of groundwater structures, ground water draft, and population and other vital figures on watershed basis.

IV. GROUND WATER RESOURCES – RECHARGE FOR VARIOUS SEASONS

For calculating recharge from return flow from irrigation, an average water requirement of 1.0 m & 0.1 m for paddy & non-paddy has been taken from Agriculture department, Govt. of Tripura. Computation factor for return flow from ground water irrigation is taken as 0.25 - 0.45 and from surface water irrigation is taken as 0.30 - 0.50 as per GEC'97 methodology. Return flow from ground water and surface water irrigation has not been considered for monsoon season, as there is enough rainfall during monsoon and irrigation is not practiced.

The aquifer remains fully saturated during the periods of intensive rainfall, additional recharge from ponds & tanks during this period is negligible. Recharge from ponds and tanks during non-monsoon period are considered for 100 days. Computation factor for seepage from ponds & tanks is taken as 0.00144 m/day as per GEC'97 methodology. The main potential aquifer in the study area is Tipam sandstone and the specific yield value for Tipam sandstone is taken as 0.08 (from GEC'97 Methodology).Recharge from Rainfall has been computed one year for the entire study area.60% of total amount of rainfall into Rainfall infiltration factors and also multiply with total amount of infiltrated areas of Dhalai. Total recharge to ground water has several components, rainfall being the major one. The other components include seepage from canals, return flow from surface water irrigation, return flow from ground water irrigation, seepage from tanks ponds etc.

HILLY AREA

Area with more than 20% slope has been excluded for the recharge computation.

Total Area of Dhalai km^2	2494
Recharged Area of Dhalai km^2	1446
Total Hilly Area of Dhalai km^2	1048

According to CGWC Plain land is recharged zone so here 1446 km^2 is plain land it is recharged area of whole Dhalai districts.

Years (1)	Total Amount of rainfall(mm) (2)	Rainfall infiltration factors (3)	Total area (km) (4)	Recharge form the rainfall 60%R.f×(3) (5)	Total amount of Recharge (5)×(4)
2001	2247	0.14	1446	188.7	27286.02
2002	2816	0.14	1446	236.5	34197.90
2003	2427	0.14	1446	203.87	29479.60
2004	2397	0.14	1446	201.35	29115.21
2005	2346	0.14	1446	197.06	28494.88
2006	2056	0.14	1446	172.70	24972.42
2007	2923	0.14	1446	245.53	35508.79
2008	1806	0.14	1446	151.70	21925.35
2009	2154	0.14	1446	180.94	26159.70
2010	2560	0.14	1446	215.04	31097.70

Table 7: Total availability of Ground water

Recharge from rainfall in the district is of the order of 43232hams, whereas that of from other sources is 7689 ham. Comparison of monsoon & non-monsoon rainfall recharge shows that monsoon recharge accounts for 65% and non-monsoon recharge accounts for 35% of total rainfall recharge. In comparison to recharge from rainfall, recharge from sources other than rainfall accounts for less than 15% of the total recharge.

Years	Recharge from the rainfall (1)	Recharge from the other sources (2)	Total amount of availability of ground water (1)+(2)
2001	272860.2	7689	28054.92
2002	341979.0	7689	34966.80
2003	294796.0	7689	30251.86
2004	291152.1	7689	29874.71
2005	284948.8	7689	29263.78
2006	249724.2	7689	25741.32
2007	355087.9	7689	36277.69
2008	219253.5	7689	22694.25
2009	261597.0	7689	26928.60
2010	310977.0	7689	31866.60

Table 8: Total availability of Ground water

Total availability of ground water between 2001-2010.In 2001 ground water levels is situated more than 25000ha.Highest ground water availability has 2007 and 2002.But the estimation trend line is increasing because sandy top soil cover in whole Dhalai district and then the possibility of recharging rainfall is more.

Years (1)	F (2)	Area (3)	Monsoon rainfall (5)	Monsoon recharge (5)×(3)×(2) (6)	Non monsoon rainfall (7)	Non monsoon recharge (2)×(3)×(7) (8)	Total recharge (8)+(6) (9)
2001	22	1446	121.1	38524.33	31.5	10020.78	48545.11
2002	22	1446	173.4	55162.00	108	34356.96	89518.96
2003	22	1446	153.6	48863.23	89.0	28312.68	77175.91
2004	22	1446	173.6	55225.63	65.8	20677.80	75903.43
2005	22	1446	102.5	32607.30	98.0	31175.76	63783.06
2006	22	1446	122.2	38874.26	117.0	37220.04	76094.66
2007	22	1446	178.7	56840.40	88.0	27799.46	84639.86
2008	22	1446	112.7	35852.12	67.7	21314.04	57166.16
2009	22	1446	136	43264.32	79.0	25226.91	68491.23
2010	22	1446	144	45809.28	107.7	34261.52	80070.80

Table 9: Rainfall infiltration methods

Years	Rainfall recharge availability ground water (1)	Other recharge source (2)	Total availability of ground water (1)+(2)
2001	48545.11	7689	56234.11
2002	89518.96	7689	97207.96
2003	77175.91	7689	84864.91
2004	75903.43	7689	83592.43
2005	63783.06	7689	71472.06
2006	76094.66	7689	83783.66
2007	84639.86	7689	92328.86
2008	57166.16	7689	64855.16
2009	68491.23	7689	76180.23
2010	80070.80	7689	87759.80

Table 10: Total availability of ground water of Dhalai District, Tripura

This is another method of estimation of Ground water. This line graph also showing the total availability of ground water between 2001-2010.In 2001 ground water level is situated more than 4000m.Highest ground water aviable has 2007 and 2002.But the estimation trend line is increasing because sandy top soil cover in whole Dhalai district and then the possibility of recharging rainfall is more.

Sl.. No.	Block	Recharge from Rainfall Monsoon	Recharge from other Sources Monsoon	Recharge from Rainfall (Non monsoon)	Recharge from other Sources (Non monsoon)	Total Annual Ground water Recharge	Provision for Natural Discharge	Net Annual Ground water Availability
1	Salema	4519	0	3482	2492	10493	525	9969
2	Ambasa	3926	0	3026	1451	8403	420	7983
3	Manu	2495	0	1498	962	4955	495	4459
4	Chawmanu	6251	0	3752	638	10640	1064	9576
5	Dumburnagar	10820	0	3464	2146	16430	1643	14787
Dhalai district		**28010**	**0**	**15222**	**7689**	**50921**	**4147**	**46774**

Source: Central Ground Water Board ,(Agartala)

Table 11: Recharge from Various Sources Dhalai District, Tripura2010-11 (ham)

Recharge from rainfall in the district is of the order of 43232hams, whereas that of from other sources is 7689 ham. Comparison of monsoon & non-monsoon rainfall recharge shows that monsoon recharge accounts for 65% and non-monsoon recharge accounts for 35% of total rainfall recharge. In comparison to recharge from rainfall, recharge from sources other than rainfall accounts for less than 15% of the total recharge.

V. GROUND WATER DRAFT FOR VARIOUS PURPOSES

Ground water draft for various uses in different sub-units has been estimated and according to the recommendation in the methodology.

COMPUTATION OF GROUND WATER DRAFT AS PER ABSTRACTION STRUCTURE

Ground water draft for domestic use has been estimated based on the number of different types of ground water abstraction structures and their unit draft per year. The unit draft of a dug well is taken as 0.1 ham/yr from field experience and unit draft of shallow tube well (fitted with hand pumps) is 0.1 ham/yr. Block-wise ground water draft.

COMPUTATION OF GROUND WATER DRAFT AS PER POPULATION

Ground water draft for drinking and domestic uses has been calculated based on the total population. Block-wise ground water draft for irrigation was estimated based on the number of shallow tube wells fitted with pump set and unit draft of shallow tube well which is 3 ham/yr. Ground water in the study area is mostly used for domestic & irrigational purposes. Ground water for industrial draft is negligible and has not been considered while assessing the ground water draft.

Block-wise ground water draft is shown in Table and it reveals that ground water draft for all uses in the study area is 4525.06 hams. Bagafa block having the highest ground water draft of 1399.39 ham and Killa block having the lowest ground water draft of 68.16 hams. Ground water draft for irrigation and domestic purposes accounts for 57% & 43% of total ground water draft respectively.

Serial. no.	Block	Gross ground water draft for irrigation (ham / yr)	Gross ground water draft for domestic industrial supply (ham / yr)	Total draft (ham / yr)
1	Salema	0	252	252
2	Ambasa	30	123	153
3	Manu	0	189	189
4	Chawmanu	0	60	60
5	Dumburnagar	0	106	106
Total of Dhalai district		30	730	760

Source: Central Ground Water Board (Agartala)

Table 12: Ground Water Draft Dhalai District, Tripura (ham)

STAGE OF GROUND WATER DEVELOPMENT &CATEGORIZATION OF THE BLOCKS

All the 5 blocks in the study area falls under SAFE category. Manu block has the highest stage of development i.e. 3% and Chawmanu and Dumburnagar block has the lowest stage of development i.e. 1%. These figures reveal that there is enough scope for exploitation of ground water in the study area. Block-wise summary of ground water resources, stages of development and categorization.

IRRIGATION POTENTIAL THAT CAN BE CREATED

The irrigation potential that could be created is shown in Table 31. The irrigation potential computed assuming a stage of development of 90% is on a higher side. This is because of the fact that as per the prevailing flood irrigation practices the actual water applied in India is 100 to 200 % more than optimum crop water requirement. On the other hand, assuming a stage of development of 70% the ground water development can be kept well within the safe limits

Block	Net Annual Ground water Availability	Gross ground water draft for irrigation	Gross ground water draft for Domestic and Industrial Use	Gross ground water draft for all uses	Provision for Domestic and Industrial Use 2025	Net Annual Ground water Availability for Future Irrigation	Stage of Ground water development
Salema	9969	0	252	252	715	9254	2
Ambasa	7983	30	123	153	358	7595	2
Manu	4459	0	189	189	411	4048	3

Chawmanu	9576	0	60	60	175	9401	1
Dumburnagar	14787	0	106	106	263	14524	1
Dhalai district	**46774**	30	730	760	1922	44822	2

Source: Central Ground Water Board (Agartala)

Table 13: Block-wise Ground Water Availability for Future Irrigation Dhalai District,Tripura (hams)

It is recommended that the strategies for ground water development should be planned in a phased manner. Initially the acceptable stage of development should be kept at 70% and further development programme should be taken up after studying the actual ground water draft, water level trends and related aspects.

The ground water potential zones are obtained by integrating all the entire thematic maps in a combination model using the spatial analysis tool in ARE GIS 9.2.During the weighted overlay analysis the ranking values are assigned for each classes of individual thematic map according to the influence of the different parameters on ground water potentially. Classification of this elevation maximum value is 5.44 and the minimum value is 1.06**.**

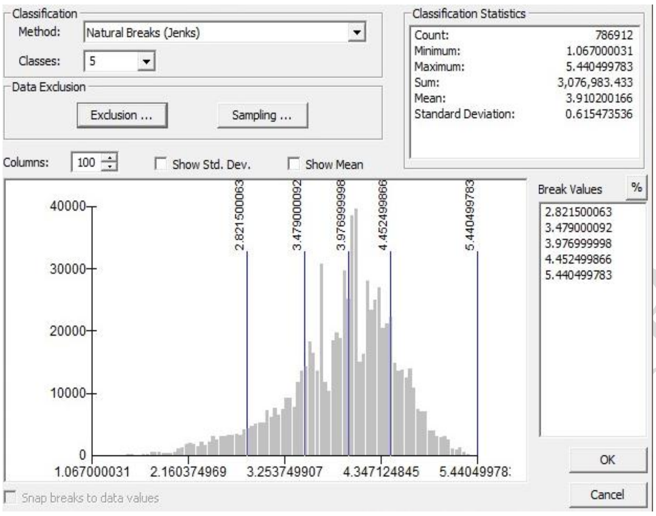


Figure 2: Assigned class Rank and Factor Weightage to all Criteria

1.	**Geomorphology**	High Relief (structural hill)	8	0.378
		Medium Relief(structural hill)	7	
		Low Relief	6	
		Denudation Hill	5	
		Residual Hill	4	
		Undulating Plain	3	
		Inter hill valley	2	
		Flood Plain	1	
2.	**Slope**	0-1	7	0.205
		1-5	6	
		5-10	5	
		10-15	4	
		15-25	3	
		25-35	2	
		≥35	1	
3.	**Relief**	≥300	1	0.146
		250-300	2	
		200-250	3	
		150-200	4	
		100-150	5	
		50-100	6	
		≤50	7	
		2-4	4	
		≤2	5	

4.	**Land-use**	Waste land	1	0.103
		Shifting cultivation	2	
		Bu	3	
		Deciduous Forest	4	
		Ever green forest	5	
		Agricultural Land	6	
		Water bodies	7	
5.	**Geology**	Alluvial	5	0.069
		Dupitila	4	
		Tipam	3	
		Bokabil	2	
		Bhuban	1	
6.	**Soil**	Redish yellow	2	0.048
		Red	3	
		Older Alluvial	4	
		Young Alluvial	5	
		Lake	6	
7.	**Drainage density**	≤8	1	0.031
		6-8	2	
		4-6	3	
		2-4	4	
		≤2	5	
8.	**Lineament density**	0.18	1	0.024
		.18-.49	2	
		.49-.82	3	
		.82-1.24	4	
		1.24-2.28	5	

Table 15: Assigned class Rank and Factor Weightage to all Criteria

Dhalai district area is divided into five elevation zones. The range of the elevation is 2.8 for very high ground water potential 3.4high ground water potential 3.9 moderate ground water potential 4.4very low ground water potential 5.4 low ground water potential.

Geomorphological the study area is classified into seven units such as badlands, duricrusts, flood plains; Para deltaic fan surface, pediments and Pedi plains, ridges and hills and upland plains. Drainage are attributed as low drainage density and good ground water potentiality Middle and Southern part shows moderate level of drainage density with moderate ground water potentiality

	[1]	[3]	[3]	[4]	[5]	[6]	[7]	[8]	Weightage
Geomorphology [1]	9	8	7	6	5	4	3	1	0.378
Slope[2]	7	6	5	4	3	2	1	1/3	0.205
Relief[3]	6	5	4	3	2	1	½	1/4	0.146
Landuse[4]	5	4	3	2	1	½	1/3	1/5	0.103
Geology[5]	4	3	2	1	½	1/3	¼	1/6	0.069
Soil[6]	3	2	1	1/2	1/3	¼	1/5	1/7	0.048
Drainage density[7]	2	1	½	1/3	¼	1/5	1/6	1/8	0.031
Lineament density[8]	1	1/2	1/3	1/4	1/5	1/6	1/7	1/9	0.024
Consistency Ratio									

Table 14: Original pair-wise comparison matrix

Ground water potentiality Index value =

Slope (0.205)+ Relief(0.146) + Geomorphlogy(0.378) + Geology(0.069) + Soil(0.048)+Drainage Density(0.031) + Land use/land cover(0.103) + Lineament density(0.024).

VI. CONCLUSION

The main objective of this project is to use GIS And Remote sensing technique for the assessment evolution and analysis of spatial distribution of ground water potential zones with in an area of 2494km2.Ground water potential zone map have been produced using eight thematic maps have been produced using eight thematic maps from satellite images, existing data and field data. The delineation of ground water potential zones by reclassifying into different potential zones, Very good, Moderate, poor and very poor was made by utilizing the model designed using ARCGIS model builder engine. The potential of the project area is related mainly to lineament, Geology and slope. The ground water potential zones have been derived for the entire Dhalai District and it has been divided into mainly four categories namely very low, low, medium and high recharge potential zone.

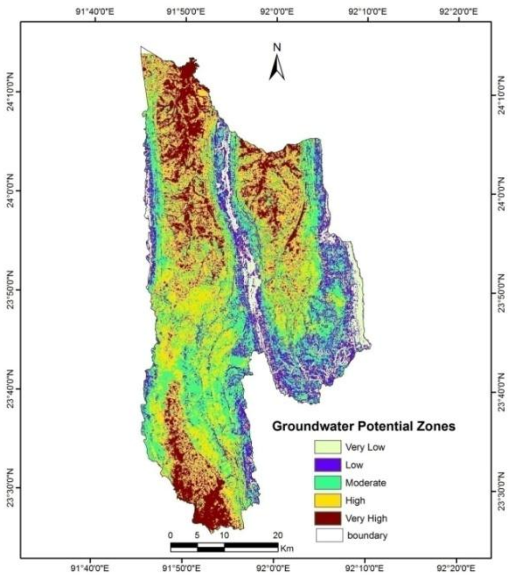


Figure 3: Groundwater potential Zone of Dhalai district

- ✓ It is observed from the study- the ground water recharge zone is located only in the plain land portion of the study area.
- ✓ Rain water is mainly responsible for the ground water recharging for the study area.
- ✓ Hilly zones are less amount of ground water because lack of recharge.
- ✓ More recharged zone is Kamalpur station along the Dhalai river basin and another important sub division is Salema.
- ✓ Remote sensing data are powerful tools to improve our understanding of ground water systems. Despite unable to measure hydrological properties directly they provide continuous detailed terrain information and allow the mapping of features significant to ground water development therefore it is important to incorporate them in the data collection stage of ground water exploration works.

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