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Ground Water Resource and their Characteristics of the Eastcentral Rajmahal Highlands, Jharkhand, India

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Abstract:
This study examines the ground water resources and their characteristics of the Eastcentral Rajmahal Highlands in Jharkhand, India, The study aims to provide a comprehensive analysis of the ground water resources in the region and their geographical distribution. The study categorizes the area into four water table classes on the basis of 67 water samples sites, and explores the role of ground water in maintaining agriculture, the economy, and the environment in the region. The results of the study will provide valuable information for water resource management, agricultural planning, and sustainable development in the Eastcentral Rajmahal Highlands in Jharkhand.

Keywords: Ground Water, Eastcentral, Water Table, Water Resource, Agricultural landuse

1. Introduction

Hydrology is the scientific study of the run-off, movement, distribution, and every drop of water on Earth. Development of an area has been dependent on good hydrological characters. Water resources are the vital factor for the development of agriculture or landuse pattern. Surface and ground water resources of an area can enhance the capability of terrain. According to the climatic conditions, underlying structure, morphological details and other physical aspects are the main factor for the flow of water. The humid climatic condition of the Eastcentral Rajmahal Highlands has been responsible for the water resources upon geological and surface inequalities in varying form, attitude and behaviour. These processes are influence on terrain character and agricultural landuse particularly through frequency, length and magnitude of overland and channeled flow (Patnaik, 1993, p.103). In this paper, researcher has been discussed ground water resource of the study area. These aspects are very much important for the classification as well as evaluation of terrains for the development of agriculture.

2. Main Objectives

The main objectives are –

- To identify the major water table classes.
- To find out water table depth in dry and wet season and their characteristics in detailed
- to make an analysis of all these.

3. Study Area

Extending from 23° 55´15"N to 24° 10´15" N latitudes and 86°56´00" E to 87° 30´00" E longitudes, the Eastcentral Rajmahal Highlands covering three blocks of Dumka district *viz;* Dumka, Raniswar and Shikaripara in the State of Jharkhand, India is a portion of the Chotanagpur Highlands (Fig.1). Occupying an area of 1164.6 sq. kilometres, the study area comprises the entire portion of Dumka, Ranishwar and Shikaripara administrative bocks of Dumka district of Jharkhand and lies in the Eastcentral Rajmahal highlands. It includes 753 villages as well as one municipal area of Dumka Town. The study area is mainly characterised by undulating and rugged terrains dotted with residual hills and hillocks. Therefore, the area is one of the backward regions of the State of Jharkhand.

4. Sources and Methods

Georeferencing and mosaicking all the three C.D. block maps (Dumka, Ranishwar and Shikaripara) have been done (Fig. 1). Maps of water table depth have been prepared from the Central Ground Water Board, Ministry of Water Resources, Government of India. These maps have been georeferenced, digitised and calculated the area of each water table depth class through 21st Century GIS Professional 2012 software (Figs. 1, 2 & 5).

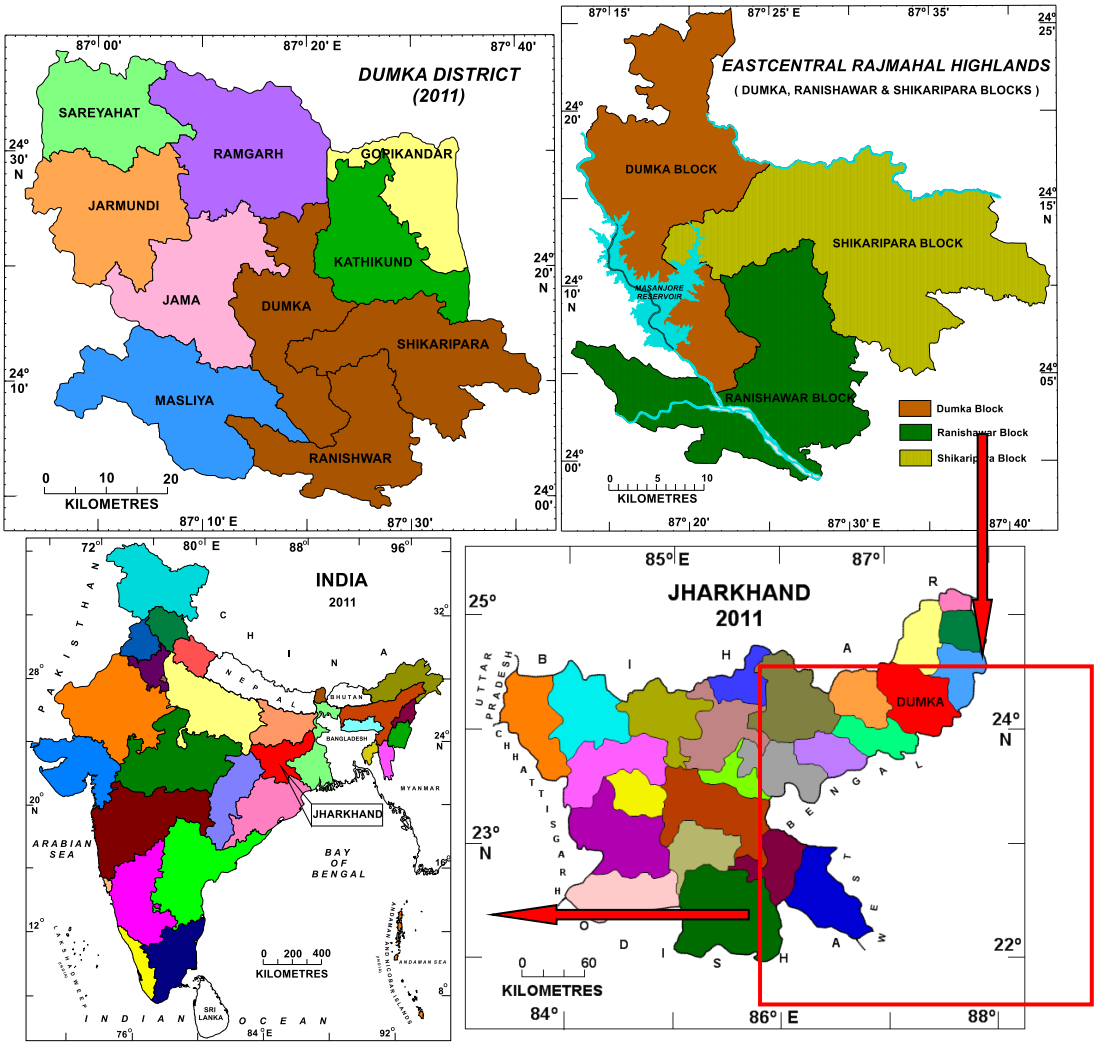

Figure 1: Location and Surroundings: Eastcentral Rajmahal Highlands

5. Ground Water Resource

Groundwater has played a significant role in the maintenance of agriculture, economy, environment, and standard of living in the Eastcentral Rajmahal Highlands. The development of ground water resource is dependent on different factors such as volume of aquifer, porosity, soil permeability, soil character, surface physiography, precipitation, temperature, runoff, basement rocks and its structural characteristics, vegetation cover *etc.* Ground water is constantly recharged by rainfall and river system. The depth of water table during summer and rainy season was measured on the basis of 67 sample point station to determine the depth and spatial character of the depth of water table. On the basis of 67 water samples sites in the Eastcentral Rajmahal Highlands firstly four water table classes have been identified *i.e.,* Shallow Depth (below 2 m.), Moderate Depth (2 - 4 m), Moderately Greater Depth (4 – 8 m.) and Greater Depth (above 8 m.).

During dry season depth of ground water table falls between below 4 metres to above 8 metres. During the wet season depth of ground water table varies between below 2 metres to above 4 metres depending on the nature of terrain, thickness of soil and the nature of basement rocks (Figs. 2, 5 and Tables 1, 3).

5.1. Water Table Depth in Dry Season

Table 1 and Fig. 2 reveal that the moderate depth (below 4 m.) of water table is found in three small patches in (i) the northern, western, southern parts of Dumka block; (ii) western, entire eastern, central and southern portion of Ranishwar block and (iii) northern, central parts of Shikaripara block. This class occupies only 27.86 % (324.53 sq.km.) to the total study area. Moderately great depth class (4 m. – 8 m.) occupies an area of 645.08 sq.km which is 55.39 % of the total study area. Except some small patches, these zones are found all over the Eastcentral Rajmahal Highlands. The greater depth of water table class (above 8 m.) occupies only 13.78 % (160.45 sq. km) of the total study area. This zone is mainly found in (a) seven small patches in the Dumka block; (b) south-western part of Ranishwar block and (c) nine small patches in the Shikaripara block. Table 2 and Fig.3 represent the seasonal fluctuation of water table in the study area. In the dry season, water table generally falls and irrigation systems as well as agriculture are badly affected. It is very difficult to lift the water from greater depth. Agricultural practices are limited as well as cost effective in this season.

Table 1: Water Table Depth in Dry Season

Water Table Class	Depth in Metres	Area in Sq. km.	% of Total Area
Moderate Depth	< 4	324.53	27.86
Moderately Greater Depth	4 – 8	645.08	55.39
Greater Depth	> 8	160.45	13.78
Masanjore Reservoir (Within Study Area)	-	34.61	2.97
Total	**-**	**1164.67**	**100**

Source: Data obtained from the Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur which have been tabulated by the researcher

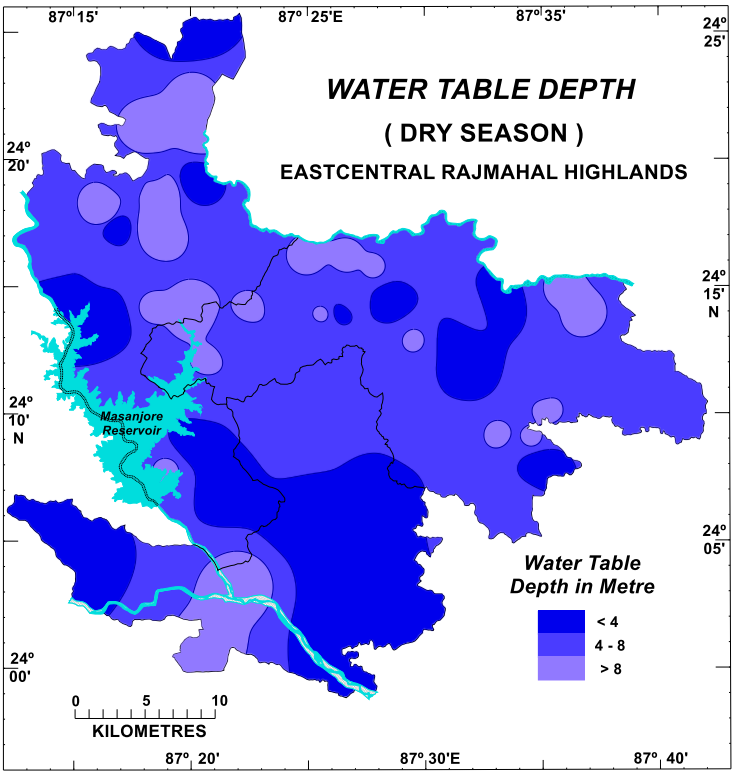

Figure 2: Water Table Depth (Dry Season)

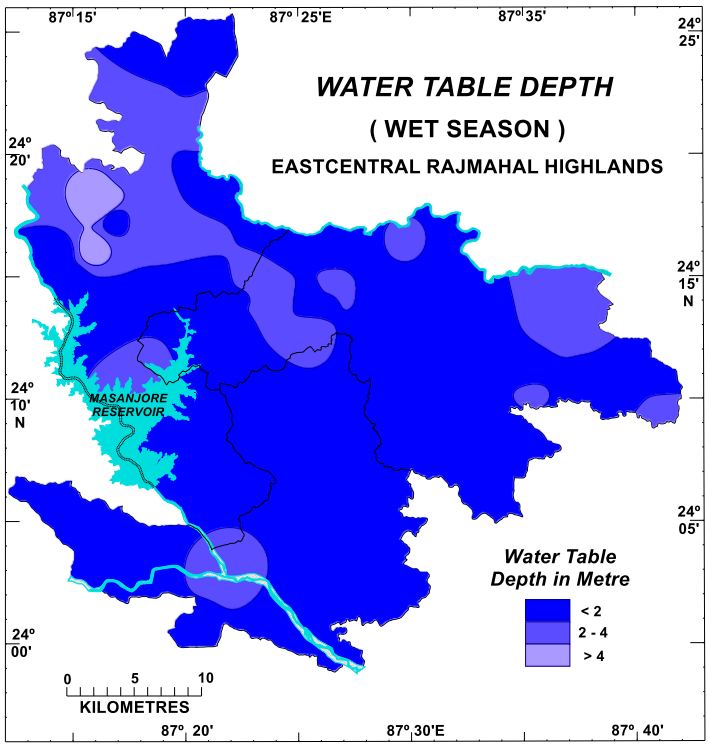

Figure 5: Water Table Depth (Wet Season)

Source: Data obtained from the Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, and map prepared by the researcher

Table 2: Water Table Fluctuation in Pre-Monsoon Period, 1996 - 2009

Well Name	PRE-MONSOON (Month: MAY) Water table depth below ground in metre													
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Masanjor	5.29	5.93	3.16	3.4	4.51	4.41	4.21	5.73	3.81	4.21	3.8	3.8	4.65	4.49
Dumka (db ib)	4.97	8.02	6.41	6.56	5.38	5.08	7.28	6.91	11.23	6.26	9.65	7.35	8.6	8.19
Patabari	9.35	8.92	8.72	NA	NA	7.1	NA	6.39	4.9	8.87	6.61	7.4	7.8	7.1
Sikaripara	7.47	7.37	7.16	7.18	5.55	5.85	6.4	7.37	5.15	6.23	7.12	6.85	6.64	5.94
Reneswar	8.75	5.82	4.56	7.5	4.65	5	5.1	6.4	4.02	6.25	5.4	6.3	6.6	6.2

Source: Data obtained from Central Ground Water Board, Ministry of Water Resources, Government of India

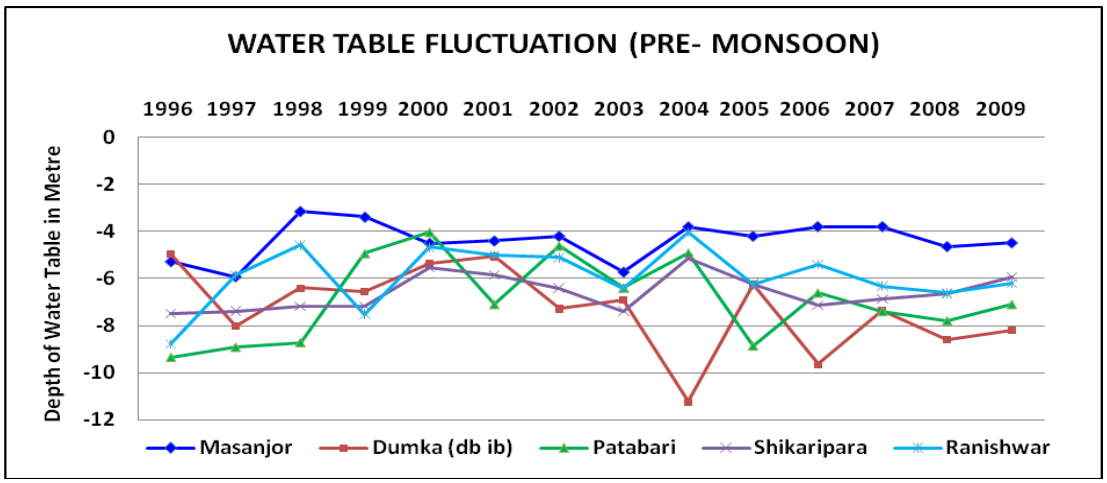

Figure 3: Water Table Fluctuation (Pre-Monsoon)

Source: Diagram prepared by the researcher on the basis of tabulated data

5.2. Water Table Depth in Wet Season

Table 3 and Fig. 5 show that the shallow depth (below 2 m.) of water table class occupies 72.71 % (846.80 sq.km.) to the total study area. Except some small patches, these zones are found all over the Eastcentral Rajmahal Highlands. Moderate depth class (2 m. – 4 m.) occupies an area of 265.44 sq.km which is only 22.79 % of the total study area. This zone is mainly found in three small patches in the Dumka block; two patches in the Ranishwar block and seven small patches in the Shikaripara block. The Moderately great depth of water table class (above 4 m.) occupies only 1.53 % (17.82 sq. km) of the total study area. This zone is mainly concentrated in the Dumka block. Table 4 and Fig.4 represent the seasonal fluctuation of water table in the study area. During wet season, water table generally remains nearer to the surface and it has positive impact on irrigation systems as well as agriculture. It is very easier to lift the water from surface and agricultural practices are boundless as well as low cost effective in this season.

Table 3: Water Table Depth in Wet Season

Water Table Class	Depth in Metres	Area in Sq. km.	% of Total Area
Shallow Depth	< 2	846.8	72.71
Moderate Depth	2 – 4	265.44	22.79
Moderately Greater Depth	> 4	17.82	1.53
Masanjore Reservoir (Within Study Area)	-	34.61	2.97
Total	**-**	**1164.67**	**100**

Source: Data obtained from the Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur which have been tabulated by the researcher

Table 4: Water Table Fluctuation in Post-Monsoon Period, 1996 - 2009

Well Name	POST-MONSOON (Month: NOVEMBER) Water table depth below ground in metre													
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Masanjor	3.53	3.43	3.51	3.27	3.73	1.87	3.71	2.9	NA	3.2	3	3.06	3.21	2.25
Dumka (db ib)	3.57	4.23	3.08	2.15	2.72	4.02	3.98	4.6	NA	2.46	2.82	6.75	5.05	6.75
Patabari	4.12	5.05	2.6	1.93	3.12	6.21	2.74	6	NA	3.5	3.25	4.5	4.79	3.65
Shikaripara	5.09	5.04	4.89	3.3	4.35	3.21	3.85	3.9	NA	3	2.31	4.9	4.95	4.35
Ranishwar	3.09	3.89	1.73	2.9	2.78	2.95	2.32	3.1	NA	2.93	2.63	5.3	4.45	3.5

Source: Data obtained from Central Ground Water Board, Ministry of Water Resources, Government of India

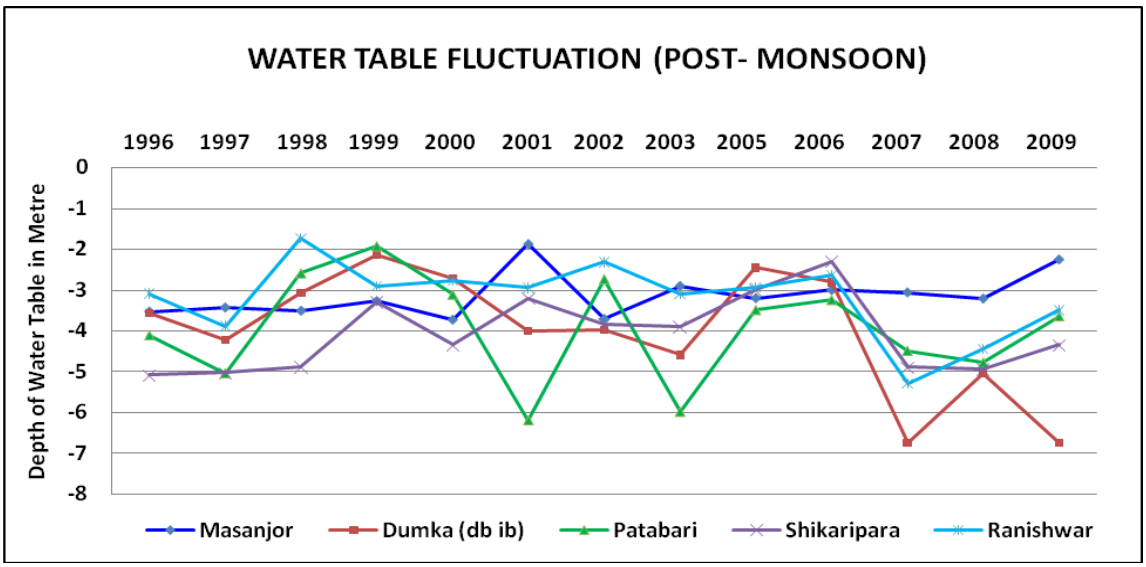

Figure 4: Water Table Fluctuation (Post-Monsoon)

Source: Diagram prepared by the researcher on the basis of tabulated data

6. Conclusion

In conclusion, the hydrological characteristics play a pivotal role in shaping the development of the Eastcentral Rajmahal Highlands. The study underscores the significance of water resources, both surface and groundwater, as essential factors for agricultural and land use patterns. The annual rainfall of 1345.93 mm, with peak values in July and August, further emphasizes the region's dependency on seasonal precipitation. The presence of moderate fertile land, coupled with the impact of basement rocks, contributes to the overall capability of the terrain. However, challenges arise during the dry season, affecting water tables, irrigation systems, and agricultural practices. In contrast, the wet season facilitates easier water access and proves beneficial for agriculture. The economic potentialities for activities, particularly agricultural prosperity, vary across the Eastcentral Rajmahal Highlands, with the study highlighting the need for judicious terrain classification to optimize utilization and sustainable development in the region.

7. Acknowledgments

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