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Hydrological Characteristics And Watershed Prioritization in The Water Resources Management

KEYWORDS

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ABSTRACT *Water is the most valuable natural resource and therefore its proper management and sustainable use is prerequisite for any region. The present paper aims to deal with the hydrological characteristics of the study region, i.e., Chakia tahsil of Chandauli district and to develop sub watershed prioritization for suggesting some water resource management strategies. Reservoirs, canals, streams, ponds etc. are the sources of surface water in this region, whereas ground water prospect is also demarcated in the northern alluvial plain and some part of southern region.*

1.1INTRODUCTION

Water resources planning and development is concerned with modifying the time and space availability of water for various purposes so as to accomplish certain basic national, regional and local objectives. In most cases, the ability to achieve these objectives is limited by the non uniform availability of water and other resources[1]. Ground water and surface water are the two reservoirs mostly used by man. Fresh ground water is about 100 times more plentiful than fresh surface water, but we use more surface water because it is so easy to find and use[2]. Land, water and forest are considered as important natural resources. Their proper management and planning is prerequisite in the development of any region.

The present study region has immense potential for water resources development. The sources of surface water are reservoirs, Tals, ponds, rivers, streams, canals etc. The main reservoir are Bhainsora, Mushkhand, Naugarh, Latifshah, Chandraprabha, Muzaffarpur, Bhonka which mainly store the rain /river water to ensure continuity in supplying water through canals. The Tals, ponds etc which are mainly concentrated in Gangetic plain. Seasonal cultivations within the dry –beds of such Tals are practiced by local farmers during dry seasons. The main canal are Chandauli main canal(CMC), Left Karamnasa(LKC), Right Karamnasa(RKC), Baburi (BC) and Nakoiya Canals(NC). The northern region reflects a dead level plain whereas the southern hilly tract hinders the development process as this part is highly rugged terrain and covered with dense forest.

1.2OBJECTIVE

Development of priority of different sub watersheds based on lineament density, lineament frequency, drainage density, drainage frequency and land use/ land cover is the major objective in water resource management.

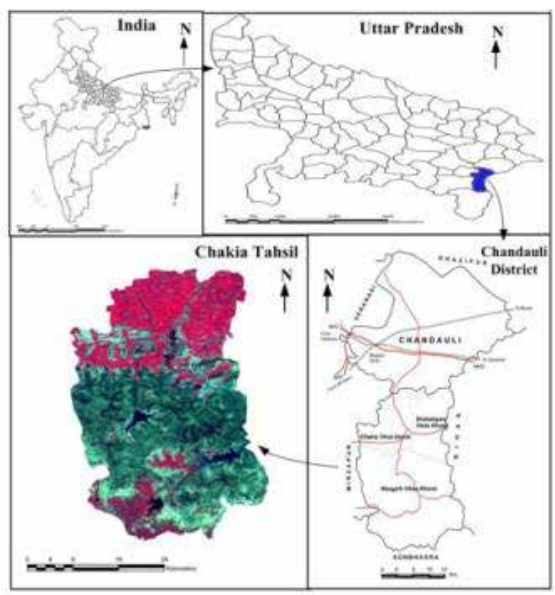
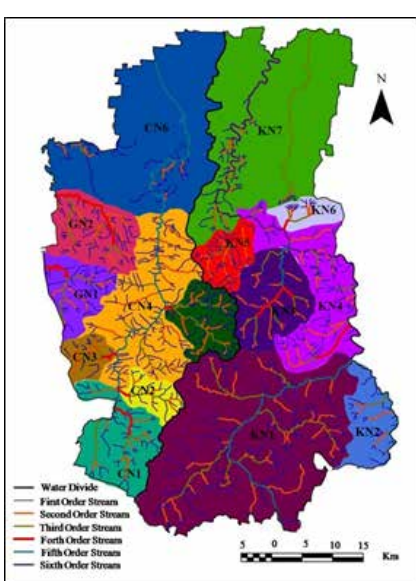


Fig. 1 Location Map



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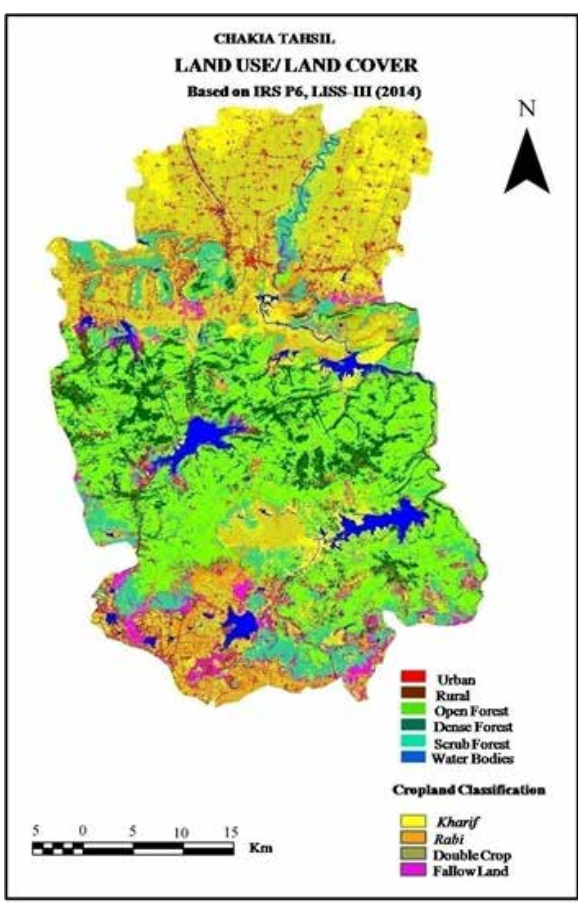

1.3STUDY AREA

The study is carried out in Chakia tahsil of chandauli district (U.P.). Physically this region constitute of alluvial plain in the north and the plateau region in the southern part. Karmanasa, Chandraprabha and Garai are the three prominent rivers flowing in this region. Socio-economically, this region is rural and dependent on agricultural activities.

1.4DATA SOURCES AND METHODOLOGY

Data Sources: Survey of India (SOI) toposheets like 63O/4, 63O/8, 63P/1, 63P/2, 63P/5 and 63P/6, Satellite data of IRS P6, LISS III (2014)

All the toposheets were brought under Arc GIS environment and were georeferenced. The subset of the study area was taken out. Based on local terrain variations and morphometry, 15 sub watersheds were identified. Drainage and lineament were digitized. Lineament density, lineament frequency, drainage density and drainage frequency were categorized into three priority levels. Land use and land cover and their priority scores were again obtained for different watersheds. All fours parameters and their priority scores were again categorized into three priority status, i.e., high, medium and low in terms of III, II and I. Accordingly, the suggestions have been put for the development related to water resources.

1.5RESULT AND DISCUSSIONS

1.5.1. Delineation of sub watersheds

Based on regional local terrain variations and morphmetric parameters, total 15 sub micro watersheds were identified. In doing so, Karmanasa watershed is divided into KN2, KN3, KN4, KN5, KN6, and KN7 sub watershed, Chandraprabha watershed is divided into CN1, CN2, CN3, CN5, CN5 and CN6 sub watersheds and Garai watershed into GN1 and GN2 sub watersheds[3].

1.5.2 Lineament

Table 1: Sub-Watershed and their Priority Status Based on Lineament Density.

Lineament Density (Km/SqKm)	Priority	Sub Watershed	Total
0.85 and Above	III	CN1,CN2,CN6,KN1,KN2,KN6,KN7	7
0.45-0.85	II	CN3,CN4,CN5,GN1,KN3,KN4	6
0.45 and Below	I	GN2, KN5	2

Source: Personal Computation done by the author

Table 2: Sub-Watershed and their Priority Status Based on Lineament Frequency.

Lineament Frequency (No. of Lineament/ Sq Km)	Priority	Sub Watershed	Total
0.30 and Above	III	CN1,CN2,CN5,CN6,KN1,KN6,KN7	7
0.15-0.30	II	KN2,KN3	2
0.15 and Below	I	CN3,CN4,GN1,GN2,KN4,KN5	6

Source: Personal Computation done by the author

Tables 1 and 2 show priority status of sub watershed based on lineament density and lineament frequency, respectively. In terms of lineament density, total seven sub watersheds are categorized under third priority status with

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value of 0.85 km/ sq km and above. Six sub watersheds comes under second priority status (0.45 km/ sq km -0.85 km/ sq km) and two sub watersheds with 0.45 km/ sq km and below under first priority status. The high lineament density and high lineament frequency indicates good water storage prospect. In the same manner number of lineament per unit area is also computed. High frequency with value 0.30 and above is categorized under third priority, includes seven sub watershed. The Second priority sub watershed has only two sub watershed. Under first category with value 0.15 and below consists of six sub watershed.

1.5.3 Drainage

Drainage density is also very important aspect in geomorphological and hydrological analysis. Actually drainage density measures how well or how poorly a watershed is drained by rivers. Its significance lies in water resource management. High drainage density generally implies less infiltration and more runoff. Ground water prospect in high drainage density areas is found to be very poor. Likewise in low drainage density regions allows more water to infiltrate, thus in turn provides good prospect for ground water potential.

Table 3: Sub Watershed and Their Priority Based on Drainage Density.

Drainage Density (Km/ SqKm)	Priority	Sub Watershed	Total
1.00 and Below	III	CN1,CN6,KN1,KN7	4
1.00-1.50	II	CN3,GN1,KN2,KN4,KN6	5
1.50 and Above	I	CN2,CN4,CN5,GN2,KN3,KN5	6

Source: Personal Computation done by the author

Table 4: Sub Watershed and Their Priority Based on Drainage Frequency.

Drainage Frequency (No./SqKm)	Priority	Sub Watershed	Total
0.8 and Below	III	CN1,CN6, KN1, KN7	4
0.8-1.30	II	GN1, KN2	5
1.30 and Above	I	GN2, CN2, CN3,CN4, CN5, KN3,KN4, KN5, KN6	6

Source: Personal Computation done by the author

1.5.4 Land Use/Land Cover

Sub watershed wise LU/LC classification is given in the Table 5. Sub watersheds CN6 and KN7 shows the highest cultivated land with 48.37% and 47.00% of the total area, respectively. These sub watersheds lie in the plain region and have fertile soils and better irrigation facilities whereas cultivation is devoid of in sub watersheds GN1, CN2 and CN3. Fallow land is prominent in sub watershed CN1 by 37.16%, whereas least is found in sub watershed KN3 by 0.48% of the area.

In terms of forest resources sub watersheds CN5 and GN1 show the highest share with more than 70% of area. The least dense forest cover is found in sub watersheds CN1, CN6 and KN7 by 5.53%, 2.07% and 6.04% of the total area, respectively. By 57.17% CN2 sub watershed exhibits maximum open forest cover and least is noted in sub watershed CN6 by 1.19% of the area. In terms of scrub forest CN6 and KN1 show highest coverage with 32.60% and 32.01% of area, respectively. The priority based on LU/LC is shown in the table 6.

Table 5: Sub Watershed Wise LU/LC Area (%), 2014

LU/LC Class	Cropland 3	Fallow Land 2	Land under Non Agricultural Uses 1	Dense Forest 3	Open Forest 2	Scrub **Forest** 1	**Total Weighted Score**	**Priority**
Watershed								
GN1	-	-	-	53.69	41.51	4.80	244.09	III
GN2	12.10	10.95	-	43.97	19.43	13.55	228.97	III
CN1	12.46	37.16	0.49	5.35	18.41	26.13	165.06	I
CN2	-	8.51	-	16.59	57.17	17.73	181.13	II
CN3	-	27.14	-	19.16	29.87	23.83	171.5	I
CN4	29.43	2.32	1.36	26.37	29.20	11.32	231.8	III
CN5	1.22	6.62	2.07	58.20	28.39	3.50	250.35	III
CN6	48.37	12.01	3.41	2.42	1.19	32.60	182.18	II
KN1	16.02	34.16	0.26	12.02	12.94	24.60	178.58	I
KN2	0.83	9.79	0.45	15.51	41.41	32.01	151.87	I
KN3	2.15	0.48	1.34	27.35	50.70	17.98	192.2	II
KN4	20.93	4.16	1.48	18.47	44.39	10.57	216.78	III
KN5	8.95	3.05	-	28.43	46.29	13.28	210.82	III
KN6	10.92	6.65	-	21.95	26.33	34.15	164.57	I
KN7	47.00	15.17	6.79	6.04	11.56	13.44	219.37	III

Source: GIS based and Personal computation done by the author.

Weighted Score	Priority	Sub Watershed	Total
<180	I	CN1, CN3, KN1, KN2, KN6	5
180-210	II	CN2, CN6, KN3	3
>210	III	GN1,GN2, CN4, CN5, KN4, KN5, KN7	7

Table 6: Sub-Watershed and Their Priority Based on LU/LC

Source: Personal Computation done by the author

Considering the lineament density, lineament frequency, drainage density and drainage frequency and LU/LC, the final priority score were estimated and status was determined (Table 7 and 8).

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Table 7: Sub Watersheds and Their Final Priority Status

Sub-Watershed	Priority Level					Priority Score	Priority status
	LD	LF	DD	DF	L		
GN1	II	I	II	II	III	10	II
GN2	I	I	I	I	III	7	I
CN1	III	III	III	III	I	13	III
CN2	III	III	I	I	II	10	II
CN3	II	I	II	I	II	8	I
CN4	II	I	I	I	III	8	I
CN5	II	III	I	I	III	10	II
CN6	III	III	III	III	II	14	III
KN1	III	III	III	III	I	13	III
KN2	III	II	II	II	I	10	II
KN3	II	II	I	I	II	8	I
KN4	II	I	II	I	III	9	I
KN5	I	I	I	I	III	7	I
KN6	III	III	II	I	I	10	II
KN7	III	III	III	III	II	14	III

Source: Personal Computation done by the author

Weighted Score	Priority	Sub Watershed	Total
11 and Above	III	CN1,CN6, KN1, KN7	4
9-11	II	GN1, CN2, CN5, KN2, KN6	5
9 and Below	I	GN2, CN3, CN4, KN3, KN4, KN5	6

Table 8: Final Priority Status of Sub-Watershed Based on Hydrological Characteristics.
Source: Personal Computation done by the author

WATER RESOURCE DEVELOPMENT

Planning for water resources development involves two approaches, namely, surface water resources development (rivers, canals, tanks and reservoirs) and ground water resources development (wells, tube wells and pump sets). Two diversified physical units of the area under study, i.e., alluvial plain and Vindhyan upland have been marked with contrasting nature of water resources availability and utilization. In spite of having a good network of drainage, still the northern region has problems of water logging and salinity because older drains are usually filled with sediments. On the other hand, both surface and ground water resources in the southern region largely depend on the rainfall.

The sub watersheds GN2, CN3, CN4, KN3, KN4 and KN5 are the trust watersheds for the planning purposes so attention should be given first in these sub watersheds. From the hydrological point of view these sub watersheds reflect of poor quality. These sub watersheds are characterized by hilly terrain and dense forest. GN1, CN2, CN5, KN2, KN6 come under second priority status and shows moderate condition whereas CN1,CN6, KN1, KN7 got first priority status and are comparatively in better condition from rest of the sub watersheds. Lying in the alluvial plain, these sub watersheds have better facility for irrigational purposes.

According to Jain & Singh, there are various ways of classifying water resources projects; in the classification based on physical nature, the broad project categories are:

1. Surface storage: reservoirs, natural lakes with artificial control of outflows.
2. Channelization: irrigation canals, navigation canals, drainage works, dykes for flood protection, and erosion control reservoir.
3. Diversion of water: inter-basin water transfer projects.
4. Waste treatment and assimilation.
5. Ground water extraction and artificial recharge.
6. Catchment treatment for control of water yield and peaks.

In this region terrain conditions in the southern region are a major obstacle in both surface and ground water resources development. The Rajkura Distributory in the Naugarh block can be extended to the nearby villages. Some potential sites for constructing Bandies are proposed near villages which can be utilized to meet the local needs of Jaimohini, Malewar, Parhauti, Charanpur, DeoriKalan, Nunwat, Pandri, Lehra, Dakahi and Tala villages. Condition of ground water resources in the southern region has been marked with poor to moderate prospects hence based on lineaments some ground water exploration sites are suggested to be marked. Artifical recharge techniques can be suggested in the region at selected sites for which detailed ground survey is essential. In this reference technical support may be given by the government authority. There are several techniques of artificial recharge for both surface and sub surface water resources (Siddhartha and Thomas, 2007). Surface water recharge methods are (i) flooding and (ii) basin percolation while sub surface recharge is done by (i) recharge wells and (ii) dug wells. A detailed study of the area may be conducted for the assessment and recommendation of both the sites/points and techniques of recharge to be applied.

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