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Morphometric Analysis of Micro-Watersheds of Dal Lake Catchment (J&K) using Geospatial Techniques

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ABSTRACT

Watershed prioritization has gained importance in natural resources management, especially in the context of watershed management. The prioritization process identifies the highest priority watershed(s) or erosion susceptibility zone in which to conduct management. Morphometric analysis has been applied to prioritization of micro-watersheds as watershed characteristics of a basin represent its physical and morphological attributes that are employed in synthesizing its hydrological response. The present study makes an attempt to prioritize thirty two micro-watersheds of Dal lake Catchment of Srinagar district, Jammu and Kashmir based on morphometric parameters using GIS techniques. Various morphometric parameters, namely linear parameters and shape parameters have been determined using Survey of India (SOI) toposheets at 1:50,000 scale for each micro-watershed and assigned ranks on the basis of value/relationship so as to arrive at a computed value for a final ranking of the micro-watersheds. The analysis has revealed that the total number as well as total length of stream segments is maximum in first order streams and decreases as the stream order increases. Horton's law of stream numbers and stream lengths is also found to be in conformity with the catchment.

Introduction

The transport of detached sediment from the watershed areas through the drainage network, gives rise to appreciable loss of soil fertility, rapid sedimentation of the reservoirs and decrease in available water for irrigation in command areas . Proper planning at smaller hydrologic units like milli and micro-watershed level is a prerequisite for development of the drainage channels. Therefore it is recognized that a micro-watershed based approach to restoration is necessary for healthy and productive watershed management. Watershed prioritization is the ranking of different micro-watersheds of the catchment according to the order in which they have to be taken for treatment and soil conservation measures. Once the micro-watersheds are prioritized, quantitative assessment of morphometric parameters of micro-watersheds serve as basic information for adopting suitable soil and water conservation measures in a micro-watershed. Morphometry is the measurement and mathematical analysis of the configuration of the earth's surface, shape and dimension of its landforms (Agarwal, 1998; Obi Reddy et al., 2002). Using micro-watershed as a basic unit in morphometric analysis is the most logical choice because all hydrologic and geomorphic processes occur within the watershed. Morphometric analysis of a watershed provides a quantitative description of the drainage system which is an important aspect of the characterization of watersheds (Strahler, 1964). The various studies indicate that morphometric attributes like bifurcation ratio, stream length, drainage density, drainage frequency etc substantially contribute to evaluate the hydrological characteristics of a basin and help in identification of overall terrain character of basin.

In the present study an attempt has been made to quantify various morphometric parameters of Dal lake Catchment and prioritize erosion susceptibility zone mapping based on ranks obtained from morphometric parameters in which to conduct management. The present study involves the Geographic Information System (GIS) analysis techniques to evaluate morphometric parameters of the micro-watersheds of Dal lake Catchment. The morphometric parameters considered for analysis like area of watershed, perimeter, length of basin, stream length, bifurcation ratio, drainage density, drainage texture, stream frequency, compactness coefficient, form factor, circularity ratio, elongation ratio, length of overland flow were derived and have been tabulated on the basis of linear and shape parameters of drainage channels. Also an attempt has been made to check conformity of catchment in accordance with the Horton's law of stream numbers and stream lengths.

Study Area

The study area is situated between the geographical coordinates of 34°02´ - 34°13´ N latitude and 74°50´ - 75°09´ E longitude. The catchment has an area of approx. 328.785 km², nearly half of which comprises the Dachigam National Park. The Dal lake catchment is a fan shaped and broadens in the westward direction. The western portion of the catchment is a flatter area, whereas the northern and eastern sides rise high. The Dal lake catchment exhibits a varied topography with altitudinal range of 1580-4360 meters. The climate of the study area is sub-humid temperate with an average annual rainfall of about 951.53 mm. The maximum temperature rises up to 37°C in June, while minimum temperature can be as low as -14°C in January. The catchment is surrounded by Sindh basin in the north and Jhelum basin in the south directions. Marsar Lake is major

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feeding source to the famous Dal Lake. The location map of the study area is depicted in Figure 1.

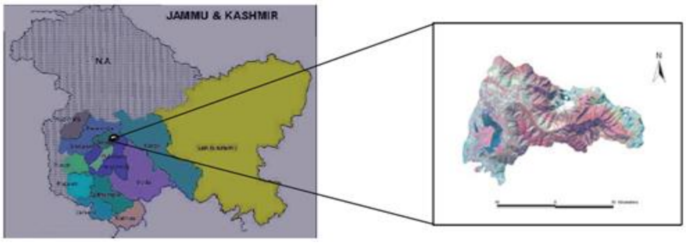

Fig 1. Location map of the Dal lake catchment

Dal lake catchment (1EZ) falls in the Water Resource Region no.1, Jhelum Basin (E) and Catchment Dal (Z). Dal lake catchment has further been divided into sub-catchments, watersheds and micro-watersheds as shown in Table 1. The codification map is given in Figure 2.

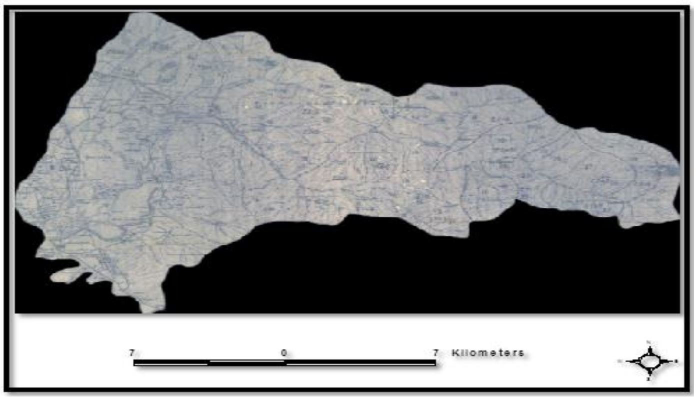

Fig 2. Micro-watershed map of Dal lake Catchment

Source: Department of soil conservation/ 2011 Srinagar, J&K.

Database and Methodology

The study was carried out on micro-watershed level utilizing Survey of India (SOI) toposheets. All the streams were digitized from Survey of India Toposheets, 1961 on a scale of 1:50,000 and codification map provided by Jammu and Kashmir Soil Conservation Department, has been taken as a reference for delineation of catchment and micro-watersheds boundary. Strahler's system of stream analysis has been adopted for this study. The study was carried out in GIS envoriment using Arcview 3.2a for digitization. Map creation, Scanning, Georeferencing, Spatial data and Topology creation are steps involved in the morphometric analysis of micro-watersheds.The various morphometric parameters were computed using standard methods and formulae given in Table 2.

The linear parameters such as drainage density, stream frequency, bifurcation ratio, drainage texture, length of overland flow have a direct relationship with erodibility, higher the value, more is the erodibility. For prioritization of micro-watersheds, the highest value of linear parameters was rated as rank 1, second highest value was rated as rank 2 and so on, and the least value was rated last in rank. Shape parameters such as elongation ratio, compactness coefficient, circularity ratio, basin shape and form factor have an inverse relationship with erodibility (Nooka Ratnam *et al.,* 2005), lower the value, more is the erodibility. Thus the lowest value of shape parameters was rated as rank 1, next lower value was rated as rank 2 and so on and the highest value was rated last in rank. Hence, the ranking of the micro-watersheds has been determined by assigning the highest priority/rank based on highest value in case of linear parameters and lowest value in case of shape parameters (Javed etal., 2009). After the ranking has been done based on every single parameter, the ranking values for all the linear and shape parameters of each sub-watershed were added up for each of the micro-watersheds to arrive at compound value (Cp). Based on average value of these parameters, the micro-watersheds having the least rating value was assigned highest priority, next higher value was assigned second priority and so on. The micro-watershed which got the highest Cp value was assigned last priority. Thus an index of very severe, severe, moderate and slight erosion class was produced.

Results and Discussion

Stream order, Stream Number and Stream length: The first and most important parameter in the drainage basin analysis is ordering, whereby the hierarchal position of the streams is designated. Following Strahler's scheme, it has been found that in Dal lake Catchment, Figure 3, the total number of streams is 817, out of which 641 belong to 1st order, 139 are of 2nd order, 31 are of 3rd order, 4 are of 4th order and 1 is of 5th order . It is also revealed that the first order streams are highest in number in all micro-watersheds which decreases as the order increases and the highest order has the lowest no of streams. The orderwise stream number, stream length and mean stream length are shown in Table 3. The regression line drawn between stream number versus stream order and cumulative mean stream length versus stream order is shown in Figure 4. The plots validate the Horton's law of stream numbers and stream lengths as the coefficient of correlation is -0.81 and the percentage variance is 67.16 for stream number where as the coefficient of correlation is 0.84 and percentage variance is 72.21 for stream length.

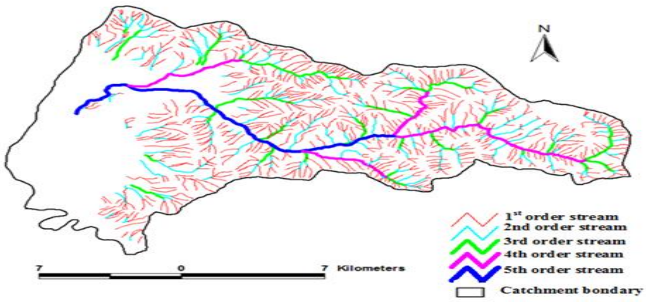

Fig 3. Drainage map of the Dal lake catchment

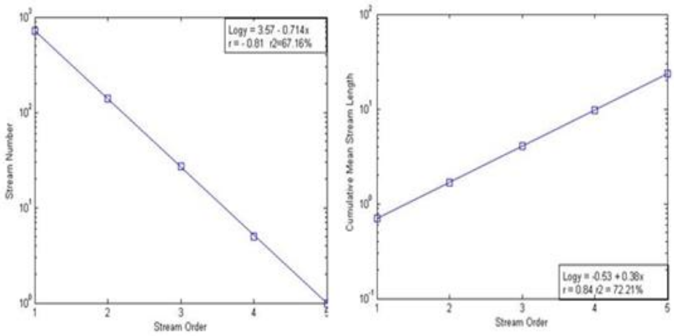

Fig 4. Streams number and cumulative mean stream length versus stream order

Morphometric Parameters: The various morphometric parameters are given in Table 4.

The drainage density in the Dal lake catchment exhibits a wide range in its values from 0.74 (lowest) in Z2b5 to 3.46 (highest) in Z2a7. The high value of drainage density (3.46) indicates that the region is composed of impermeable sub-surface materials, sparse vegetation and high mountainous relief. In Dal lake catchment the lowest stream frequency is in Z2b5 (1.11), followed by Z1a1 (1.33) and Z1a3 (1.53). The highest stream frequency is found in Z1b3 (4.74). High stream frequency is indicative of high relief and low infiltration capacity of the bedrock pointing towards the increase in stream population with respect to increase in drainage density.

Table 1. Codification of watersheds for Dal lake Catchment

Basin	Catchment	Sub-Catchment	Watersheds	Micro-Watersheds
Jehlum (1E)	Dal catchment (1EZ)	Nambal(1EZ1), Dara(1EZ2)	Z1a,Z1b,Z2a,Z2b	Z1a1 $_{to}$ Z1a9
				Z1b1 $_{to}$ Z1b8
				Z2a1 $_{to}$ Z2a8
				Z2b1 $_{to}$ Z2b13

Source: Department of soil conservation J&K/1982

Table 2. Formulae for computation of morphometric parameters

Morphometric parameters	Formula	Reference
Stream order	Hierarchial rank	Strahler (1964)
Stream length (Lu)	Length of stream	Horton (1945)
Mean stream length (Lsm)	Lsm =Lu/Nu where, Lsm = mean stream length Lu = total stream length of order ‘u’ Nu = total no. of stream segments of order ‘u’	Strahler (1964)
Stream length ratio (RL)	RL = Lu / Lu-1 where, RL = stream length ratio Lu = total stream length of order ‘u’ Lu-1 = total stream length of its next lower order	Horton (1945)
Bifurcation ratio (Rb)	Rb = Nu / Nu + 1 Rb = bifurcation ratio Nu = total no. of stream segments of order ‘u’ Nu + 1 = no. of stream segments of the next higher order	Schumn (1956)
Mean bifurcation ratio (Rbm)	Rbm = average of bifurcation ratios of all orders	Strahler (1957)
Drainage density (Dd)	Dd = Lu /A where, Dd = drainage density Lu = total stream length of all orders A = area of basin (km^2)	Horton (1932)
Stream frequency (Fs)	Fs = Nu / A where Fs = stream frequency Nu = total no. of streams of all orders A = area of basin (km^2)	Horton (1932)
Drainage texture (Rt)	Rt = Nu / p where, Rt = drainage texture Nu = total no. of streams of all orders P = perimeter (km)	Horton (1945)
Form factor (R_f)	$R_f = A/Lb^2$ A = area of basin (km^2) Lb^2 = square of basin length	Horton (1932)
Circulatory ratio (Rc)	$Rc = 4*pi*A /P^2$ where, Rc = circulatory ratio pi = ‘pi’ value i.e 3.14 A = area of basin (km^2) P^2 = square of the perimeter (km)	Miller (1953)
Elongation ratio (R_e)	$R_e = 2 \sqrt{(A / Pi)}/ Lb$ where, Re = elongation Ratio A = area of basin (km^2) Lb = basin length Pi = ‘Pi’ value i.e 3.14	Schumn (1956)
Length of overland flow (Lg)	Lg = 1/Dd*2 where, Lg = length of overland flow Dd = drainage density	Horton (1945)

Table 3. Order wise Stream Number, Stream Length and Mean stream length

Micro-watershed code	First Order			Second Order			Third Order			Fourth Order			Fifth Order		
	No	Length	Mean	No	Length	Mean	No	Length	Mean	No	Length	Mean	No	Length	Mean
Z1a1	19	15.42	0.812	5	1.61	0.322	0	0	0	0	0	0	0	0	0
Z1a2	19	19.06	1.003	5	4.14	0.828	1	2	2	0	0	0	0	0	0
Z1a3	7	7.64	1.091	1	1.94	1.94	0	0	0	0	0	0	0	0	0
Z1a4	22	19.92	0.905	4	5.34	1.335	1	0.8	0.8	0	0	0	0	0	0
Z1a5	17	14.64	0.861	4	3.64	0.91	1	1.07	1.07	0	0	0	0	0	0
Z1a6	14	18.71	1.336	2	2.49	1.245	0	0	0	0	0	0	0	0	0
Z2a1	25	13.931	0.557	4	2.58	0.645	1	0.237	0.237	0	0	0	0	0	0
Z2a2	35	23.753	0.679	6	10.656	1.776	1	1.0002	1	0	0	0	0	0	0
Z2a3	26	20.202	0.777	7	4.576	0.654	1	1.766	1.766	0	0	0	0	0	0
Z2a4	20	13.356	0.668	4	1.761	0.44	1	1.2905	1.291	0	0	0	0	0	0
Z2a5	29	20.654	0.712	4	5.484	1.371	1	1.3347	1.335	0	0	0	0	0	0
Z2a6	25	17.87	0.715	3	2.942	0.981	1	2.562	2.562	0	0	0	0	0	0
Z2a7	15	12.52	0.835	4	2	0.5	2	2.32	1.16	0	0	0	0	0	0
Z2a8	14	13.18	0.941	2	5.01	2.505	0	0	0	0	0	0	0	0	0
Z1b1	26	21.75	0.837	6	4.87	0.812	1	1.48	1.48	0	0	0	0	0	0
Z1b2	14	14.3	1.021	2	1.36	0.68	1	0.9	0.9	0	0	0	0	0	0
Z1b3	35	18.65	0.533	8	7.08	0.885	2	1.89	0.945	1	1.59	1.59	0	0	0
Z1b4	19	11.65	0.613	6	3.67	0.612	1	0.9	0.9	0	0	0	0	0	0
Z1b5	27	15.75	0.583	3	3.62	1.207	1	2.08	2.08	0	0	0	0	0	0
Z1b6	20	11.22	0.561	5	3.31	0.662		0	0	0	0	0	0	0	0
Z1b7	18	11.51	0.639	3	2.37	0.79	1	0.38	0.38	0	0	0	0	0	0
Z1b8	24	12.63	0.526	6	3.1	0.517	2	2.58	1.29	0	0	0	0	0	0
Z2b1	19	16.28	0.857	3	2.06	0.687	1	1.9	1.9	0	0	0	0	0	0
Z2b2	29	27.71	0.956	7	4.64	0.663	1	4.36	4.36	0	0	0	0	0	0
Z2b3	31	23.3	0.752	7	6.06	0.866	0	0	0	0	0	0	0	0	0
Z2b4	23	20.26	0.881	5	2.7	0.54	0	0	0	0	0	0	0	0	0
Z2b5	5	3.49	0.698	1	0.51	0.51	0	0	0	0	0	0	0	0	0
Z2b6	21	15.77	0.751	6	4.72	0.787	2	3.51	1.755	0	0	0	0	0	0
Z2b7	8	6.66	0.833	4	6.02	1.505	1	0.91	0.91	0	0	0	0	0	0
Z2b8	9	9.43	1.048	3	3.29	1.097	0	0	0	0	0	0	0	0	0
Z2b9	7	6.54	0.934	4	4.03	1.008	1	3.01	3.01	0	0	0	0	0	0
Z2b10	18	15.16	0.842	4	3.43	0.858	2	2.5	1.25	0	0	0	0	0	0
IEZ(Dal lake catchment)	641	493.38	0.77	139	120.23	0.865	31	51.74	1.669	5	25.93	5.186	1	20.73	20.73
Cumulative mean length			0.77			1.635			3.304			8.49			29.22

Table 4. Micro-watershed wise Morphometric Parameters in Dal lake catchment.

Micro-watershed code	Linear parameters					Shape parameters				
	Mean Bifuricati on Ration (R_b)	Drainage Texture (R_t)	Length of overland flow (L_g)	Drainage Density (Dd)	Strean Frequency (F_s)	Form factor (R_f)	Elongation ratio (R_e)	Circulatory Ratio (R_c)	Compactn ess coefficient (C_c)	Shape Factor (Bs)
Z1a1	3.8	1.03	2.12	0.94	1.33	0.39	0.71	0.42	1.55	2.55
Z1a2	4.4	1.75	0.88	2.27	2.25	0.42	0.73	0.68	1.21	2.39
Z1a3	7	0.57	1.05	1.91	1.59	0.47	0.77	0.32	1.76	2.14
Z1a4	4.75	1.83	0.75	2.67	2.77	0.43	0.74	0.57	1.33	2.35
Z1a5	4.13	1.58	0.8	2.49	2.83	0.44	0.75	0.5	1.41	2.27
Z1a6	7	1.21	0.9	2.23	1.69	0.43	0.74	0.69	1.21	2.34
Z2a1	5.13	1.74	1.12	1.79	3.21	0.43	0.74	0.4	1.59	2.33
Z2a2	5.92	2.69	0.76	2.64	3.14	0.41	0.72	0.69	1.2	2.45
Z2a3	5.36	2.07	0.82	2.44	3.12	0.42	0.73	0.51	1.4	2.38
Z2a4	4.5	1.47	0.9	2.22	3.38	0.44	0.75	0.32	1.76	2.26
Z2a5	5.63	2.06	0.74	2.69	3.33	0.42	0.73	0.47	1.45	2.36
Z2a6	5.67	1.96	0.78	2.56	3.18	0.43	0.74	0.52	1.38	2.33
Z2a7	2.88	2.15	0.58	3.46	4.31	0.47	0.77	0.64	1.25	2.13
Z2a8	3.5	1.28	0.85	2.36	2.07	0.44	0.75	0.62	1.27	2.27
Z1b1	5.17	2.12	0.8	2.49	2.92	0.42	0.73	0.59	1.31	2.39
Z1b2	4.5	1.31	0.83	2.42	2.49	0.45	0.75	0.51	1.4	2.24
Z1b3	3.46	2.61	0.66	3.01	4.74	0.43	0.74	0.39	1.59	2.34
Z1b4	4.58	1.68	0.83	2.41	3.87	0.45	0.76	0.35	1.68	2.23
Z1b5	6	2.64	0.71	2.82	4.08	0.44	0.75	0.69	1.2	2.27
Z1b6	4	1.93	0.74	2.69	4.62	0.46	0.77	0.4	1.57	2.17
Z1b7	4.5	2.08	0.81	2.47	3.81	0.46	0.76	0.65	1.24	2.18
Z1b8	3.5	2.33	0.79	2.55	4.45	0.44	0.75	0.48	1.44	2.25
Z2b1	4.67	1.94	0.62	3.24	3.68	0.45	0.76	0.56	1.34	2.21
Z2b2	5.57	2.27	0.6	3.33	3.36	0.42	0.73	0.52	1.39	2.39
Z2b3	4.43	1.84	0.75	2.65	3.44	0.42	0.73	0.33	1.75	2.39
Z2b4	4.6	1.72	0.69	2.92	3.56	0.44	0.75	0.37	1.64	2.28
Z2b5	5	0.44	2.71	0.74	1.11	0.46	0.77	0.36	1.66	2.17
Z2b6	3.25	2.09	0.79	2.53	3.05	0.43	0.74	0.62	1.27	2.34
Z2b7	3	0.93	1.16	1.72	1.65	0.44	0.75	0.51	1.4	2.28
Z2b8	3	0.96	0.97	2.06	1.95	0.45	0.76	0.5	1.42	2.2
Z2b9	2.88	0.77	0.93	2.15	1.9	0.45	0.76	0.33	1.75	2.21
Z2b10	3.25	1.9	0.73	2.72	3.1	0.44	0.75	0.61	1.28	2.27

Table 5. Prioritization of Micro-Watersheds in the Dal lake Catchment

Ranking of Morphometric Parameters													
	Linear parameters					Shape Parameters							
Micro-watershed code	R_b	F_s	R_t	L_g	D_d	R_e	R_c	R_f	C_c	B_s	Compound value (Cp)	Priority	Erosion class
Z1a1	20	31	27	2	29	8	1	1	17	29	16.5	25	slight
Z1a2	17	24	18	8	21	21	3	2	2	21	13.7	21	moderate
Z1a3	1	30	31	5	26	1	7	7	24	26	15.8	24	slight
Z1a4	11	22	17	18	9	15	4	3	8	9	11.6	15	severe
Z1a5	18	21	22	13	15	11	5	4	13	15	13.7	21	moderate
Z1a6	1	28	26	7	22	22	4	3	2	22	13.7	21	moderate
Z2a1	9	14	19	4	27	7	4	3	19	27	13.3	19	moderate
Z2a2	3	16	1	16	11	21	2	7	1	11	8.9	4	very severe
Z2a3	7	17	10	11	17	12	3	2	12	17	10.8	12	severe
Z2a4	15	11	23	7	23	1	5	4	24	23	13.6	20	moderate
Z2a5	5	13	11	18	8	9	3	2	16	8	9.3	5	very severe
Z2a6	4	15	12	15	12	13	4	3	10	12	10	8	severe
Z2a7	25	4	6	25	1	19	7	7	4	1	9.9	7	severe
Z2a8	21	25	25	9	20	18	5	4	5	20	15.2	23	slight
Z1b1	8	20	7	13	15	16	3	2	7	15	10.6	10	severe
Z1b2	15	23	24	10	18	12	5	5	12	18	14.2	22	moderate
Z1b3	22	1	3	22	4	6	4	3	19	4	8.8	3	very severe
Z1b4	14	6	21	10	19	3	6	3	22	19	12.3	18	severe
Z1b5	2	5	2	20	6	21	5	4	1	6	7.2	1	very severe
Z1b6	19	2	14	18	8	7	7	6	18	8	10.7	11	severe
Z1b7	15	7	9	12	16	20	6	6	3	16	11	14	severe
Z1b8	21	3	4	14	13	10	5	4	15	13	10.2	9	severe
Z2b1	12	8	13	23	3	14	6	5	9	3	9.6	6	very severe
Z2b2	6	12	5	24	2	13	3	2	11	2	8	2	very severe
Z2b3	16	10	16	17	10	2	3	2	23	10	10.9	13	severe
Z2b4	13	9	20	21	5	5	5	4	20	5	10.7	11	severe
Z2b5	10	32	32	1	30	4	7	6	21	30	17.3	28	slight
Z2b6	23	19	8	14	14	18	4	3	5	14	12.2	17	severe
Z2b7	24	29	29	3	28	12	5	4	12	28	17.4	29	slight
Z2b8	24	26	28	5	25	11	6	5	14	25	16.9	26	slight
Z2b9	25	27	30	6	24	2	6	5	23	24	17.2	27	slight
Z2b10	23	18	15	19	7	17	5	4	6	7	12.1	16	severe

The watersheds having large area under dense forest have low drainage frequency and the area having more agricultural land have high drainage frequency. High value of drainage frequency produces more runoff in comparison to others. The mean bifurcation ratio of the Dal lake catchment is 5.073. The lowest Rb is found in Z2a7, Z2b9 (2.875) whereas highest Rb of 7 is in Z1a3, Z1a6. Low Rb value indicates less structural disturbance and the drainage patterns have not been distorted whereas high Rb value indicates high structural complexity and low permeability of terrain. The lowest drainage texture of (0.44) is in Z2b5, while as the highest is in Z2a2 (2.69).The drainage Texture of the micro-watersheds in Dal lake Catchment ranges from very course to course. The length of overland flow of Dal lake Catchment is 0.94. It is highest in Z2b5 (2.71), while as lowest is found in Z2a7 (0.58). Higher value of Lg is indicative of low relief and where as low value of Lg is an indicative of high relief.

Dal lake catchment has a Form Factor of 0.26. Form Factor is highest in Z1a3, Z2a7 (0.47), and lowest in Z1a1 (0.39), indicating them to be elongated in shape and suggesting flatter peak flow for longer duration. Shape Factor is lowest in Z2a7 (2.13), while as it is highest in Z1a1 (2.55). Dal lake catchment has a Shape Factor of (3.78). Z2a4 has the lowest Circulatory Ratio of 0.32, and it is highest in Z2a2, Z1b5 (0.69) indicating that all the watersheds represent an elongated shape. Z2a7 and Z1b6 have the highest Elongation Ratio of 0.77 and the lowest of 0.71 is found in Z1a1. Dal lake catchment has an Elongation Ratio of 0.54 which indicates high relief and steep ground slope. Compactness Coefficient is highest in Z1a3 (1.76) and lowest in Z2a2, Z1b5 (1.20). The Compactness Coefficient in Dal lake catchment is 1.55.

Watershed Prioritization

The final priority of micro-watersheds based on compound value is given in Table 5. The final priority/ranking was given by classifying the highest and lowest range of Cp value into four classes as very serve erosion class (7.2 – 9.7), serve erosion class (9.8 – 12.3) , moderate (12.4 – 14.9) and slight erosion class (>15). Out of 32 micro-watersheds under study, six micro-watersheds viz. Z2a2, Z2a5, Z1b3, Z1b5, Z2b1 and Z2b2 fall under the category of very serve erosion class. Thirteen micro-watersheds fall under severe erosion class while as six and seven fall under moderate erosion class and slight erosion class respectively (Figure 5). Micro-watersheds under very serve erosion class indicate the greater degree of erosion and these becomes potential candidates for applying soil conservative measure.

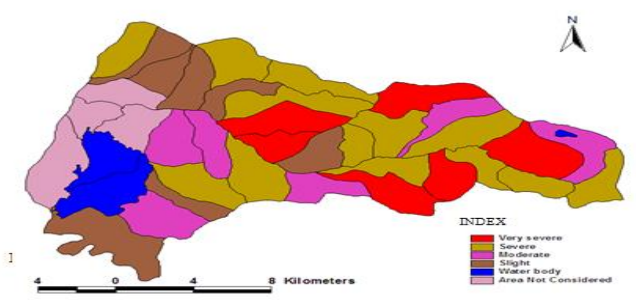

Fig 5. Prioritization map of micro-watersheds of Dal lake catchment

Conclusion

The study has shown that the catchment is in conformity with the Hoton's law of stream numbers and law of stream lengths. It is observed that there is a decrease in stream frequency as the stream order increases. The law of lower the order higher the number of streams is implied throughout the catchment. The total length of stream segments is maximum in first order streams and decreases as the stream order increases. In total 32 micro-watersheds were identified for micro-watershed prioritization study based on morphometric analysis out of which six micro-watersheds viz. Z2a2, Z2a5, Z1b3, Z1b5, Z2b1 and Z2b2 fall under the category of very severe erosion class, thirteen micro-watersheds viz. Z1a4, Z2a3, Z2a6, Z2a7, Z1b1, Z1b4, Z1b6, Z1b7, Z1b8, Z2b3, Z2b4, Z2b6 and Z2b10 fall under serve erosion class, six micro-watersheds viz. Z1a2, Z1a5, Z1a6, Z2a1, Z2a4, Z1b2 fall under moderate erosion class and seven micro-watersheds viz. Z1a1, Z1a3, Z2a8, Z2b5, Z2b7, Z2b8, Z2b9 fall under slight erosion class respectively. The very severe erosion class micro-watersheds have higher erosivity values due to their location in the hilly terrain with undulating topography. Hence, these may be taken for conservation measures by planners and decision makers for locale-specific planning and development.

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