

Advance GIS Analysis for Computing Strahler Stream (Narwa) Order in Chhattisgarh State

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ABSTRACT

Stream-order is a useful resource of every river network, having wide range of applications. A method for determining stream orders needs to addresses various network topologies and geographical conditions at quick and easy pace. This paper introduces a general stream-order framework for vector hydrography and a full Chhattisgarh state analysis. It also presents a linear stream order procedure for river networks. The river network identifies different situations of Narwa/streams. There are number of methodologies used for stream order, however, one of the most popular and acceptable analysis is Strahler Stream Order. In Watershed approach-based soil and moisture conservation treatment, require a wide use of structure identification by using this order. It may assume "right structure at right place".

Key Words - Strahler Stream, drainage orders, advance GIS technology,

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INTRODUCTION

In this study the Strahler drainage numbers and length of Chhattisgarh state was analyzed and detailed drainage orders along with drainage length of each stream has been calculated. The data set used in the study was prepared by NRSC Hyderabad, using Survey of India Topo sheet (1:50,000) manual digitization process. The error removal process is relatively tricky and hence because of use of advance GIS technology was used to remove the error. Streams with various orders do have their own hydraulic characteristics (Moges and Bhole 2015). These characteristics have an impact on the hydraulics of the channel with different order.

Study Area

The study area includes Chhattisgarh state has the geographical area is about 135,100 Sq. km (Anonymous, 2021). There are five major river basins

extant in the state. Mahanadi Basin drains out 75,858.45 Sq. km, Godavari Basin drains out 38,694.02 Sq. km, Ganga Basin drains out 18,406.65 Sq km, Brahmani Basin drains out 1,394.55 Sq. km and Narmada Basin drains out 743.88 Sq. km of catchment area in the state.

Objectives of the study:

- i. To identify the actual number of stream order, it will help to guidance planning proper interventions.
- ii. To calculate the accurate drainage/Narwa length stream order wise.
- iii. To prepare Drainage Line Treatment (DLT) plan

MATERIALS AND METHODS

There are various types of methodology used for



determination of stream order i.e., Strahler, Shreve, Horton, Scheidegger, Woldenberg and Hack (Doornkamp and King, 1971; Gleyzer et al. 2004) however, under this study the Strahler Stream Order method was used. The Strahler's stream order method (Strahler, 1957) assigns an order of k = 1 to the streams that have no tributaries. Thereafter, proceeding downstream, when two (or more) streams of the same order k meet, they form a stream with an order of k + 1. However, when a stream of order k is met by one of a lower order, no change occurs in the down-stream order. For this analysis using the NRSC data sets for which was procure by Rural Development in 2008-2009. The split selected lines where it intersects using Planarize Lines on the Advanced Editing toolbar was used for data correction. When Planarize is used on a multipart line feature, it is split at the point of intersection into a new feature.







Internet To address

Drainage_Intersect_Co-ordinates

Stream order 1st order stream 2nd order stream 3rd order stream 4th order stream 5th order stream 5th order stream 7th order stream

- Bih order stream
 - Micro Watershed boundary





Under the Edit tool of ArcGIS 10.3 the line feature was selected to split at intersections and Planarize Lines on the Advanced Editing toolbar was selected to get the results. The selected lines are split into new features where they intersect. Planarize also removes overlapping line segments—such as those created by constructing lines from polygons that have shared boundaries. (Source ArcGIS Desktop)

RESULTS

The result was very important to overcome the duplicate count errors. Stream Order is shown as the measure of the relative size of streams. There are only two 9th order streams naming i.e. Mahanadi and Indravati. There are 17623 micro watersheds. Drainage density is the length of all the streams and rivers in a drainage basin divided by the total area of the drainage basin. Most of the hilly and forested area under the districts, Balarampur, Bastar, Bijapur, Dantewada, Durg, Jashpur, Korba, Koriya, Narayanpur, Sarguja, Surajpur and Sukma having high drainage density area. The stream wise full details and length calculated this information support further planning process. The District-Block wise drainage count is given in appendices. Here in this analysis followed by the Strahler Method. This analysis support Narwa project for further detailing of Narwa treatment plan easily. The drainage count will give the assumptions DLT structures require every Narwa. Output of final map will support the field person for planning the structures at right locations. Over structuring may be minimize and selection process quite easy. This analysis broadly supports "Ridge to Valley" treatment concept.

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SI	Stream	emattisgam
no	order	No. of streams (Count)
1	1	375086
2	2	88229
3	3	20383
4	4	4737
5	5	1065
6	6	282
7	7	76
8	8	25
9	9	2
Gra	nd total	489885
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2797.15	7 10.67	-	p24.3	1 b24.3	3051.2/ I 524.3	4 3051.2/ I 524.3	1192.00 4 3051.2/ I 524.3	1/ 1192.00 4 3051.2/ 1 524.3	/322.35 I/ 1192.00 4 3051.2/ I 524.3	1 1322.35 1/ 1192.UU 4 3UB1.2/ 1 124.3 25 2550 x5 1 200.77	252414.14 81 /322.35 1/ 1192.00 4 3051.2/ 1 524.3	
	70.07	71 1	1248	7257 2 1248	3061.267257 2 1248	4 3061.267257 2 1248	280.4/ 280.4/ 1262.12 4 3061.267257 2 1248	4 280.47 18 1262.12 4 3061.267257 2 1248	2350.45 4 280.47 251.262.12 2 2248 251.262.257 2 1248	26 2350.45 4 280.47 5 5152.91 18 1262.12 4 3061.267257 2 1248	19/145.44 26 2350.45 4 280.47 7 280.47 7 280.47 7 2 280.47 7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	100 13/145.44 26 2350.45 4 280.47 19/145.44 280.47 10 13/148
4535.50	395.33 4	.06 5	1873	177 3 1873	9183.80177 3 1873	12 9183.80177 3 1873	3576.00 12 9183.80177 3 1873	51 3576.00 12 9183.80177 3 1873	21515.64 51 3576.00 12 9183.80177 3 1873	238 21515.64 51 3576.00 12 9183.80177 3 1873	1103625.25 238 21515.64 51 3576.00 12 9183.80177 3 1873	1069 1103625.25 238 21515.64 51 3576.00 12 9183.80177 3 1873
2267.75 1 1442.	790.67 2	1.56 10	2747	938 44 2747	140818.2938 44 2747	9 184 140818.2938 44 2747	50835.29 184 140818.2938 44 2747	725 50835.29 184 140818.2938 44 2747	276629.69 725 50835.29 184 140818.2938 44 2747	3060 276629.69 725 50835.29 184 140818.2938 44 2747	6698316.62 3060 276629.69 725 50835.29 184 140818.2938 44 2747	12628 6698316.62 3060 276529.69 725 50835.29 184 140818.2938 244 2747
1133.88	158.13 1	60 2	8116	2832 13 8116	60460.02832 13 8116	2 79 60460.02832 13 8116	25522.82 79 60460.02832 13 8116	364 25522.82 79 60460.02832 13 8116	133794.75 364 25522.82 79 60460.02832 13 8116	1480 133794.75 364 25522.82 79 60460.02832 13 8116	3763302.96 1480 133794.75 364 25522.82 79 60460.02832 13 8116	6122 3763302.96 1480 133794.75 364 25522.82 79 60460.02832 13 8116
	316.27	.60 4	8116	3204 13 8116	45153.69204 13 8116	9 59 45153.69204 13 8116	19843.29 59 45153.69204 13 8116	283 19843.29 59 45153.69204 13 8116	106674.19 283 19843.29 59 45153.69204 13 8116	1180 106674.19 283 19843.29 59 45153.69204 13 8116	2882552.87 1180 106674.19 283 19843.29 59 45153.69204 13 8116	4763 2882552.87 1180 106674.19 283 19843.29 59 45153.69204 13 8116
2267.75 1 1442.	316.27 2	5.78 4	1373	1373 1373	79592.94867 22 1373	2 104 79592.94867 22 1373	30290.82 104 79592.94867 22 1373	432 30290.82 104 79592.94867 22 1373	173119.56 432 30290.82 104 79592.94867 22 1373	1915 173119.56 432 30290.82 104 79592.94867 22 1373	5110931.05 1915 173119.56 432 30290.82 104 79592.94867 22 1373	8322 5110931.05 1915 173119.56 432 30290.82 104 79592.94867 22 1373
5669.38 2 2885.	1581.33 5	0.53 20	5744	928 92 5744	326024.9628 92 5744	21 426 326024.9628 92 5744	126492.21 426 326024.9628 92 5744	1804 126492.21 426 326024.9628 92 5744	690218.19 1804 126492.21 426 326024.9628 92 5744	7635 690218.19 1804 126492.21 426 326024.9628 92 5744	18455103.50 7635 690218.19 1804 126492.21 426 326024.9628 92 5744	31835 18455103.50 7635 690218.19 1804 126492.21 426 326024.9628 92 5744
3401.63	3	5	624.3	7257 1 624.3	3061.267257 1 624.3	4 3061.267257 1 624.3	1542.59 4 3061.267257 1 624.3	22 1542.59 4 3061.267257 1 624.3	9220.99 22 1542.59 4 3061.267257 1 624.3	102 9220.99 22 1542.59 4 3061.267257 1 624.3	325173.87 102 9220.99 22 1542.59 4 3061.267257 1 624.3	348 325173.87 102 9220.99 22 1542.59 4 3061.267257 1 624.3
	395.33	54 5	6243.5	9027 10 6243.5	35969.89027 10 6243.5	5 47 35969.89027 10 6243.5	13322.35 47 35969.89027 10 6243.5	190 13322.35 47 35969.89027 10 6243.5	67801.39 190 13322.35 47 35969.89027 10 6243.5	750 67801.39 190 13322.35 47 35969.89027 10 6243.5	1815431.87 750 67801.39 190 13322.35 47 35969.89027 10 6243.5	3160 1815431.87 750 67801.39 190 13322.35 47 35969.89027 10 6243.5
	79.07	6 1	1873.0	3584 3 1873.0	9949.118584 3 1873.0	13 9949.118584 3 1873.0	2804.71 13 9949.118584 3 1873.0	40 2804.71 13 9949.118584 3 1873.0	16724.34 40 2804.71 13 9949.118584 3 1873.0	185 16724.34 40 2804.71 13 9949.118584 3 1873.0	571474.14 185 16724.34 40 2804.71 13 9949.118584 3 1873.0	723 571474.14 185 16724.34 40 2804.71 13 9949.118584 3 1873.0
	158.13	1 2	2497.41	0443 4 2497.41	2295.950443 4 2497.41	3 2295.950443 4 2497.41	1051.76 3 2295.950443 4 2497.41	15 1051.76 3 2295.950443 4 2497.41	5514.51 15 1051.76 3 2295.950443 4 2497.41	61 5514.51 15 1051.76 3 2295.950443 4 2497.41	225722.41 61 5514.51 15 1051.76 3 2295.950443 4 2497.41	240 225722.41 61 5514.51 15 1051.76 3 2295.950443 4 2497.41
3401.63	632.53 3	8	11238.37	2655 18 11238.37	51276.22655 18 11238.37	1 67 51276.22655 18 11238.37	18721.41 67 51276.22655 18 11238.33	267 18721.41 67 51276.22655 18 11238.37	99261.24 267 18721.41 67 51276.22655 18 11238.3	1098 99261.24 267 18721.41 67 51276.22655 18 11238.3	2937802.29 1098 99261.24 267 18721.41 67 51276.22655 18 11238.33	4471 2937802.29 1098 99261.24 267 18721.41 67 51276.22655 18 11238.35
1133 88	1 06 756	٣	6867 90	11 6867 90	33673 03082 11 6067 00		13883 70 44 33673 93987 11 6467 00	108 13883 70 AA 33673 93987 11 6967 00	76118 27 198 13883 70 AA 33673 93687 11 6667 00	847 76118 37 198 13883 20 AA 33673 93697 11 6667 00		34675 19075609 10 847 75118 37 198 13883 29 44 33679 0 257 90
00.CC11	T 02./62	n	68.1000	68./050 II 2000	68/1980 TT 79255,5/055	52/1020 TT Z0555/055 +++ 5	1000.127 144 33075.2306 11 080/.89	201720 TT 70055,57055 444 70055 7057 7057 7057 7057 7057	52/1929 TT 7025550055 +++ 5775005T 02T /500TT0/	68/1980 TT 78655'5'005C +++ 57'5005T 06T /5C'0TTD/ 7+0	58/020 TT 78656'5'00CC +++ 57'500CT 96T /5'0TT0/ 7+0 NT'550'/0CT	58/080 TT 73655700CC +++ 57000CT 92T /C'0TT0/ 7+0 AT-550/ACT CACC
	79.07	-	4370.48	3761 7 4370.48	22194.18761 7 4370.48	29 22194.18761 7 4370.48	9606.12 29 22194.18761 7 4370.48	137 9606.12 29 22194.18761 7 4370.48	50534.64 137 9606.12 29 22194.18761 7 4370.48	559 50534.64 137 9606.12 29 22194.18761 7 4370.48	1351513.94 559 50534.64 137 9606.12 29 22194.18761 7 4370.48	2257 1361513.94 559 50534.64 137 9606.12 29 22194.18761 7 4370.48
	79.07	1	3746.12	3628 6 3746.12	15306.33628 6 3746.12	20 15306.33628 6 3746.1	7923.29 20 15306.33628 6 3746.1	113 7923.29 20 15306.33628 6 3746.1	4839.32 113 7923.29 20 15306.33528 6 3746.1	496 44839.32 113 7923.29 20 15306.33628 6 3746.1	1216589.22 496 44839.32 113 7923.29 20 15306.33628 6 3746.1	2073 1216589.22 496 44839.32 113 7923.29 20 15306.33628 6 3746.1
-	-	+										
		77	3121.7	5398 5 3121.	20663.55398 5 3121.	27 20663.55398 5 3121.	8273.88 27 20663.55398 5 3121.	118 8273.88 27 20663.55398 5 3121.3	49359.42 118 8273.88 27 20663.55398 5 3121.	546 49359.42 118 8273.88 27 20663.55398 5 3121.3	1404427.08 546 49359.42 118 8273.88 27 20663.55398 5 3121.	2321 1404427.08 546 49359.42 118 8273.88 27 20663.55398 5 3121.3
1133.88	395.33 1	25 5	18106	177 29 18106	91838.0177 29 18106	8 120 91838.0177 29 18106	39686.58 120 91838.0177 29 18106	566 39686.58 120 91838.0177 29 18106	220851.74 566 39686.58 120 91838.0177 29 18106	2443 220851.74 566 39686.58 120 91838.0177 29 18106	5890229.33 2443 220851.74 566 39686.58 120 91838.0177 29 18106	10156 5890229.33 2443 220851.74 566 39686.58 120 91838.0177 29 18106
	158.13	06 2	1873.	1328 3 1873.	6887.851328 3 1873.	9 6887.851328 3 1873.	2103.53 9 6887.851328 3 1873.	30 2103.53 9 6887.851328 3 1873.	9130.59 30 2103.53 9 6887.851328 3 1873.	101 9130.59 30 2103.53 9 6887.851328 3 1873.	304212.65 101 9130.59 30 2103.53 9 6887.851328 3 1873.	375 304212.65 101 9130.59 30 2103.53 9 6887.851328 3 1873.
		I	1875	1875	3826.584071 3 1875	5 3826.584071 3 1875	911.53 5 3826.584071 3 1875	13 911.53 5 3826.584071 3 1875	4248.89 13 911.53 5 3826.584071 3 1875	47 4248.89 13 911.53 5 3826.584071 3 1875	207615.60 47 4248.89 13 911.53 5 3826.584071 3 1875	203 207615.60 47 4248.89 13 911.53 5 3826.584071 3 1875

Table 1. Stream order of Chhattisgarh (Straheler Method)

701

Advance GIS Analysis for Computing Strahler Stream (Narwa) Order in Chhattisgarh State

Dhamtari	Magarlod	628	522769.86	158	14283.49	39	2734.59	12	9183.80177	2	1248.71	L	2	2267.75				841	55	2488.20
Dhamtari	Nagri	4971	2671108.99	1184	107035.80	287	20123.76	67	51276.22655	18	11238.37 3	237.2	Q					6530	28	61020.35
Dhamtari Total		6177	3705707.11	1490	134698.77	369	25873.41	93	71174.46372	26	16233.19 5	395.2	3 2	2267.75				8162	39	56350.03
Durg .	Dhamdha	414	413682.93	110	9944.20	24	1682.82	80	6122.534513	1	524.35		1	1133.88				558	43	3190.72
Durg	Durg	179	220364.41	45	4068.08	80	560.94	3	2295.950443									235	22	7289.38
Durg	Patan	283	285529.21	58	5243.31	18	1262.12	Э	2295.950443	1	524.35							363	29	4954.94
Durg Total		876	919576.54	213	19255.60	50	3505.88	14	10714.4354	2	1248.71		1	1133.88				1156	95	5435.04
Gariyaband	Bindranavagarh (Gariyaband)	3972	2229833.33	946	85520.16	228	15986.82	54	41327.10797	14	3740.95 2	158.1	m					5216	23	81566.50
Gariyaband	Chhura	2564	1280077.17	635	57405.18	165	11569.41	40	30612.67257	6	5619.18 2	158.1	e S					3415	13	85441.75
Gariyaband	Deobhog	544	339787.42	146	13198.67	38	2664.47	6	6887.851328	e	1873.06 1	79.07			1	1442.77		742	36	5933.31
Gariyaband	Mainpur	5645	3045051.47	1323	119601.66	308	21596.23	76	58164.07788	16	9989.66 4	316.2	7 2	2267.75	1	1442.77		7375	32	58429.88
Gariyaband	Rajim	280	208590.53	64	5785.72	15	1051.76	e.	2295.950443	2	1248.71 1	79.07		1133.88				366	22	0185.62
Gariyaband Tota		13005	7103339.92	3114	281511.39	754	52868.70	182	139287.6602	44	27471.56 10	790.6	7 3	3401.63	2	2885.54		17114	. 76	11557.06
Gaurela-Pendra- Marwahi	Marwahi	1602	991717.53	379	34262.30	68	6240.47	19	14541.01947	5	3121.77 3	237.2	0					2097	10	50120.29
Gaurela-Pendra- Marwahi	bendra	940	523338.01	222	20069.21	48	3365.65	13	9949.118584	 m	1873.06 1	79.07						1227	55	8674.11
Gaurela-Pendra-	Pendra Road	1100	NO 7111731	663	E0026 42	161	10507 76		30901 00000		1001 02							2765	Ę	00 267 12
IVId! WdIII		1167	+0./1+1/01	500	C+.0CEEC	101		70		0	co.4664							CD/C	ì	00'/7+T/
Gaurela-Pendra-	Marwahi Total	5 453 202	31864/3.3/ 27/3/0 00	1264 65	11426/.95 5876.12	2 88 10	20193.88	- 64	48980.2/611 765 3168142	16	9989.66 4	316.						378	5C 5C	80221.40 3375 68
Janijgir-Champa	aloda 3aloda	760	311135 91	101	21.0 /0C	ų K	1757 0/	- u	1201010101	1	50/1 35							0/6	37	67/1 58
Janigir-Champa	Champa	141	180869.04		12 2333 71	10	701.18	'n	+ otorovor	1 -	22.22							311	2 C	86 8637
Janijgi - Crianipa	Chhro	147	22770E 11	00	1/10000	27	1002 10	~	5357 317600	+ -	1 17 0 10 1	20.02		1122 00				1710	51 12	1366 04
Janigir-Champa	laijaipur	181	190158.45	41	3706.48	6	631.06	, 1	765.3168142	1	524.35	2.77		00.0011				233	10.11	5885.65
Janigir-Champa	Malkharoda	145	121390.96	33	2983.26		210.35	. +	765.3168142	- m	1873.06							185	12	7222.95
Janigir-Champa	Vawagarh	344	348180.27	85	7684.16	14	981.65		2295.950443	1	\$24.35							447	35	9766.38
Janjgir-Champa	Pamgarh	211	225990.35	38	3435.27	9	420.71		765.3168142									256	23	0611.65
Janjgir-Champa	Sakti	408	269893.20	94	8497.77	26	1823.06	6	4591.900885	l								534	28	4805.93
Janjgir - Champa	Total	2720	2254672.29	618	55868.35	139	9746.35	25	19132.92035	6	5619.18 1	79.07	н ,	1133.88				3513	23	46252.03
Jashpur	Bagicha	6286	3271187.76	1483	134065.96	341	23910.11	80	61225.34513	13	8116.60 4	316.2	7 1	1133.88				8208	34	99955.91
Jashpur	Duldula	2862	1421550.03	699	60478.84	154	10798.12	38	29082.03894	10	5243.54 2	158.3	ei Ei		1	1442.77		3736	15	29753.47
Jashpur	Farsabahar	3339	1709190.43	781	70603.85	182	12761.41	41	31377.98938	10	5243.54 3	237	0 1	1133.88				4357	18	31548.29
Jashpur	Jashpur	3025	1549830.92 •47264.02	711	64275.72 27607.17	164 oc	11499.29	39	29847.35575		4370.48 2	158.		00 0011				3948	16	59981.90 0045 64
Jashpur	Kunkuri	1330	750970.11	365	32996.68	84	5889.88	20	15306.33628	n 10	3121.77 1	79.07		1133.88				1806	8	9497.72
Jashpur	Manora	3912	2019035.88	931	84164.13	190	13322.35	36	27551.40531	9	3746.12							5075	21	47819.89
Jashpur	Pathalgaon	3194	1542723.18	794	71779.08	172	12060.23	41	31377.98938	13	3116.60 5	395.5						4219	16	66452.41
Jashpur Total		25584	13111752.33	6150	555971.43	1382	96902.57	315	241074.7965	67	11831.69 17	1344	13 4	4535.50	1	1442.77		33520	14	054855.22
Kabeerdham	Bodla	7147	3656000.15	1655	149615.08	399	27976.94	106	81123.5823	28	17481.90 7	553.4	7 1	1133.88				9343	33	33884.99
Kabeerdham Kabeerdham	Sandariua	137E	201946.48	41 576	3/U0.48 47551 38	115	8063 53	77	30663 55308	~	107 01							7000	17	0494.30 83073 60
Kabeerdham S	ahaspur Lohara	669	494232.63	159	14373.90	35	2454.12	6	4591.900885	7	1248.71 1	79.07						872	51	6980.32
Kabeerdham Tot:	IE	10340	5756426.98	2381	215246.83	561	39335.99	139	106379.0372	34	21228.02 8	632.5	3 1	1133.88				13464	61	40383.27
Kondagaon	Bade Rajpur	1060	667561.13	261	23594.89	61	4277.18	11	8418.484956	2	1248.71 2	158.1	m					1397	70	5258.52
Kondagaon	Farasgaon	1735	1075625.00	417	37697.58	94	6591.06	21	16071.6531	00	1994.83 1	79.07						2276	11	41059.18
Kondagaon	Keskal	2018	1271291.50	507	45833.74	125	8764.70	29	22194.18761	9	3746.12							2685	13	51830.26
Kondagaon .	Kondagaon	4137	2352773.87	992	89678.64	233	16337.41	46	35204.57345	7	4370.48 1	79.0;						5416	24	98444.03
Kondagaon	Makdi	1742	1130045.38	408	36883.96	88	6170.35	19	14541.01947	2	1248.71		_					2259	11	88889.42
Kondagaon Total		10692	6497296.87	2585	233688.81	601	42140.70	126	96429.91859	25	15608.84 4	316.2	7					14033	68	85481.40
Korba	Kartala	1130	779907.01	281	25402.92	70	4908.23	19	14541.01947	e	1873.06 1	79.0;						1504	82	6711.31
Korba	Katghora	581	403204.09	150	13560.28	35	2454.12	6	6887.851328	2 5	3121.77 3	237.	1	1133.88	_		_	784	43	0599.18
Korba	Korba	4897	3027256.93	1171	105860.58	277	19422.59	89	52041.54336	18	11238.37 5	395.	3 1	1133.88	_			6437	32	17349.21
Korba	Poundi Uproda	7243	3974521.11	1759	159016.87	409	28678.11	94	71939.78053	17	10614.01 2	158.1	3 2	2267.75	+			9526	42	47195.77

Md. Qaiser Abdulhaque, Saheb Halder, Saroj Mahapatra, Shambhu Nath Mishra & R. K. Sharma

Korba Total		17572	10315951.35	4255	384659.91	866	69977.40	239	182910.7186	53	33090.74 13	1027.	87 4	4535.50			2313	1	0992153.49
Koriya	Baikunthpur	2972	1498845.27	711	64275.72	172	12060.23	38	29082.03894	∞	4994.83 2	158.1					3903	1	609416.22
Koriya	Bharatpur	10288	5227045.15	2366	213890.80	541	37933.64	116	88776.75044	30	18730.61 8	632.5	3 2	2267.75			1335	1 5	589277.23
Koriya	Khadganva	5202	2197195.86	1247	112731.12	281	19703.06	56	42857.74159	6	5619.18 6	474.4	0 2	2267.75			6803	2	380849.11
Koriya	Manendragarh	4254	2243592.06	957	86514.58	218	15285.64	54	41327.10797	12	7492.24 4	316.2	7 1	1133.88			5500	9 2	395661.78
Koriya	Sonhat	5664	2769844.72	1223	110561.47	261	18300.70	58	44388.37522	14	8740.95 2	158.1					7222	2	951994.36
Koriya Total		28380	13936523.05	6504	587973.69	1473	103283.28	322	246432.0142	73	45577.81 22	1739.	47 5	5669.38			3677	9 1	4927198.70
Mahasamund	Bagbahra	2197	1351400.65	580	52433.08	147	10307.29	36	27551.40531	9	3746.12 1	79.07	_				2967	1	445517.61
Mahasamund	Basna	1191	817549.69	306	27662.97	68	4768.00	23	17602.28673	، د	3121.77 1	79.07					1594		70783.78
Mahasamund	Dithorn	1094 2271	813824./b 1261775.62	2//	15.14U22	137	49U8.23 800.4 0.4	13 22	480211.9466	7 0	1248./1 2 1004 92 3	150.1	n n				0202	~ ~	12.05166
INIANASAMMUN	Pithora	1767	C0.C//T0C1	205	700071	121	8304.34 6746.35	23	5/007.200/T	0 0	1994.03 2	T-9CT	,	TE EDCE			0/05		1C.200044
Mahasamund	Saraipali	213/	138/636.65	521	4/099.3/	139	9/46.35	31	23/24.82124	л г	5 SI.9190	23/.2	7 7	c/./977			2842		4/6331.33
Mahasamund 1	Total	8940	5732187.38	2273	205483.43	551	38634.82	126	96429.91859	30	18730.61 9	711.6	0 2	2267.75			1193	1 6	094445.51
Mungeli	Lormi	3877	2257451.69	874	79011.22	219	15355.76	61	46684.32566	17	10614.01 4	316.2	2				5052	2	409433.28
Mungeli	Mungeli	174	151385.47	32	2892.86	4	280.47	1	765.3168142								211	1	55324.11
Mungeli	Pathariya	145	152803.48	36	3254.47	3	210.35										184	1	56268.30
Mungeli Total		4196	2561640.63	942	85158.55	226	15846.59	62	47449.64248	17	10614.01 4	316.2	7				5447	2	721025.69
Narayanpur	Narayanpur	3295	1929357.72	831	75123.94	201	14093.64	47	35969.89027	15	9365.30 5	395.3	3 1	1133.88			4395	2	065439.72
Narayanpur	Orchha	11865	5847698.76	2666	241011.36	564	39546.35	127	97195.2354	23	14360.13 3	237.2	0		1	1442.77	1524	9 6	241491.79
Narayanpur To	tal	15160	7777056.48	3497	316135.30	765	53639.99	174	133165.1257	38	23725.44 8	632.5	3 1	1133.88	1	1442.77	1964	4 8	306931.51
Raigarh	Baramkela	893	626611.04	202	18261.18	55	3856.47	17	13010.38584	2	3121.77 1	79.07					1173	9	64939.91
Raigarh	Gharghoda	1844	1009755.71	460	41584.86	109	7642.82	29	22194.18761	10	5243.54 2	158.1	3				2454	1 1	087579.25
Raigarh	Kharsia	1035	601446.63	246	22238.86	60	4207.06	17	13010.38584	1	524.35						1359	9 0	41527.29
Raigarh	Lailunga	3279	1680126.15	773	69880.64	187	13112.00	56	42857.74159	12	7492.24						4307	1	813468.77
Raigarh	Pusour	821	530529.15	188	16995.55	45	3155.29	3	2295.950443	1	524.35		1	1133.88			1059	5	54734.18
Raigarh	Raigarh	2036	1137937.15	439	39686.42	92	6450.82	22	16836.96991	5	3121.77 1	79.07					2595	1	204112.20
Raigarh	Sarangarh	984	715197.05	224	20250.02	44	3085.18	8	6122.534513	1	524.35		_				1261	. 7	45279.13
Raigarh	Tamnar	1793	964693.82	466	42127.27	104	7292.23	25	19132.92035	9	3746.12 2	158.1	3				2396	1	037150.50
Raigarh	Udaipur (Dharamjaigarh)	5887	3220640.14	1357	122675.32	305	21385.88	75	57398.76106	12	7492.24 2	158.1					7638	3	429750.48
Raigarh Total		18572	10486936.85	4355	393700.10	1001	70187.75	252	192859.8372	53	33090.74 8	632.5	3 1	1133.88			2424	1	1178541.69
Raipur	Abhanpur	299	261607.30	68	6147.33	14	981.65	5	3826.584071	1	524.35						387	2	73187.21
Raipur	Arang	412	379398.35	06	8136.17	18	1262.12	4	3061.267257								524	3	91857.90
Raipur	Raipur	212	241611.88	46	4158.49	10	701.18	1	765.3168142				_				269	2	47236.86
Raipur	Tilda	432	408641.00	66	8949.78	20	1402.35	2	1530.633628	1	524.35 1	79.07					555	4	21227.19
Raipur Total		1355	1291258.54	303	27391.76	62	4347.29	12	9183.80177	2	1248.71 1	79.07					1735	1	333509.17
Rajnandgaon	Ambagarh	1825	927538.00	432	39053.60	100	7011.76	30	22959.50443	6	5619.18 2	158.1	3 1	1133.88			2399	1	003474.06
Rajnandgaon	Chhuikhadan	4913	2346371.77	1157	104594.95	263	18440.94	67	51276.22655	13	8116.60 5	395.3					6418	2	529195.82
Rajnandgaon	Chhuriya	2796	1505575.62	624	56410.76	130	9115.29	29	22194.18761	7	4370.48 4	316.2	7 1	1133.88			3591	-	599116.48
Rajnandgaon	Dongargaon	344	246586.81	85	7684.16	17	1192.00	4	3061.267257	1	524.35 1	79.07					452	2	59227.65
Rajnandgaon	Dongargarh	2673	1515150.81	620	56049.15	146	10237.17	36	27551.40531	б	5619.18 2	158.1	m				3486	1	614765.85
Rajnandgaon	Khairagarh	1750	1110984.72	406	36703.15	91	6380.70	24	18367.60354	7	4370.48 3	237.2					2281		177043.86
Rajnandgaon	Mahpur	2399	15 ACAC 21	1202	LUX663.U3	162	20404.23	90	45919.00885	14 0	8/40.95 4	2.0L2	、 、				0/69	7 -	22,248084
Kajnanugaon	NIUTIIA	1767	TC:20004CT	040	04.00000	CCI	00.02/01	f,	/07/077000	n	00.c/01						c0/c		C4/020/40
Rajnandgaon	Rajnandgaon	392	351035.//	8/	/864.96	21	14/2.4/	1	/65.3168142	;		1					501	m	61138.52
Rajnandgaon T	otal	23013	12352107.56	5261	475604.18	1212	84982.57	291	222707.1929	63	39334.28 21	1660.	40 2	2267.75			2986	- ·	3178663.94
sukma	Chhindgarh	2323	1618994.80	508	97.348.26	128	90.2758	67	19/81.94.127	ہ م	3/46.12	000		1133.88		1442.//	3056		/0/835.0/
Sukma	Konta	13677	7609433.40	3119	281963.40	735	51536.46	164	125511.9575	38	23725.44 10	790.6	7 1	1133.88	1	1442.77	1774	5 8	095537.97
Sukma	Sukma	3148	1894242.07	751	67891.80	170	11920.00	30	22959.50443	2	1248.71 1	79.07			, 1	1442.77	4103		999783.91
Sukma Total		19148	111226/0.2/	4438	401203.45	1033	/2431.52	223	1/0665.6496	46	28/20.2/ 11	869.7	3 2	c/./9ZZ	n	4328.30	2490	1	56.9515031
Surajpur	Bhaiyathan	1205	649132.16	281	25402.92	78	5469.18	15	11479.75221	4	2497.41 1	79.07	1	1133.88			1585	9	95194.37
Surajpur	Oudgi	10036	4258224.03	2240	202500.16	496	34778.35	108	82654.21593	24	14984.49 9	711.6	0 5	5669.38	ŝ	4328.30	1292	1	603850.52
Surajpur	Pratappur	4905	2218160.50	1133	102425.31	222	15566.12	46	35204.57345	11	5867.89 2	158.1					6319	2	378382.52
Surajpur	Premnagar	2983	1406417.78 707055 55	670	60569.25	146	10237.17	32	24490.13805	4	2497.41 1	79.07					3836		504290.82
Surajpur Suraipur	Ramanujnagar Suraipur	1202	79/966.92 694066.92	339 284	30646.23 25674.13	78 65	5469.18 4557.65	20 23	15306.33628 17602.28673		1873.06 4 1873.06 4	316.2	7 5	5669.38			2UU3 1586	7 8	51259.85 49759.69
	:										_						1	-	-

Advance GIS Analysis for Computing Strahler Stream (Narwa) Order in Chhattisgarh State

Surajpur Total		21894	10023966.44	4947	447218.00	1085	76077.63	244	186737.3027	49	30593.33 1	-	I344.13 1	1	2472.63 3	_	4328.30			28250	10782737.77
Surguja	Ambikapur	1918	879030.89	470	42488.87	110	7712.94	39	29847.35575	6	5619.18 3		237.20 2	2	267.75					2551	967204.19
Surguja	Batouli	1251	649675.01	273	24679.71	64	4487.53	20	15306.33628	5	3121.77 3		237.20							1616	697507.55
Surguja	Lakhanpur	2142	1027452.58	492	44477.71	119	8344.00	21	16071.6531	7	4370.48 2		158.13							2783	1100874.55
Surguja	Lundra	2278	986977.71	518	46828.16	125	8764.70	28	21428.8708	9	3746.12 1		70.07							2956	1067824.63
Surguja	Mainpat	1784	961831.07	371	33539.09	78	5469.18	17	13010.38584	ñ	1873.06									2253	1015722.78
Surguja	Sitapur	1378	687415.95	323	29199.80	81	5679.53	15	11479.75221	4	2497.41									1801	736272.45
Surguja	Udaypur	2907	1501886.33	693	62648.49	148	10377.41	35	26786.0885	6	5619.18									3792	1607317.50
Surguja Total		13658	6694269.54	3140	283861.84	725	50835.29	175	133930.4425	43	26847.21 5		711.60 2	2	267.75					17752	7192723.66
Uttar Bastar																					
Kanker	Antagarh	5665	3122840.51	1315	118878.44	292	20474.35	71	54337.49381	18	11238.37 6	2	174.40	-	133.88					7368	3329377.44
Uttar Bastar										_											
Kanker	Bhanupratappur	- 2962	1616304.86	691	62467.68	160	11218.82	44	33673.93982	6	5619.18 2		158.13		133.88					3869	1730576.49
Uttar Bastar																					
Kanker	Charama	1056	631523.71	262	23685.29	64	4487.53	12	9183.80177	2	1248.71 2		58.13							1398	670287.17
Uttar Bastar																					
Kanker	Durgkondal	3022	1616452.37	682	61654.07	153	10728.00	37	28316.72212	8	4994.83 2		158.13							3904	1722304.12
Uttar Bastar																					
Kanker	Kanker	1998	1113416.78	485	43844.90	116	8133.65	22	16836.96991	1	624.35 3		237.20							2625	1183093.85
Uttar Bastar																					
Kanker	Narharpur	2986	1654196.28	721	65179.74	173	12130.35	36	27551.40531	6	3746.12									3922	1762803.90
Uttar Bastar																					
Kanker	Pakhanjur	8034	4436990.51	1976	178634.07	428	30010.35	93	71174.46372	17	10614.01 6	*	174.40 1	1	133.88					10555	4729031.68
Uttar Bastar Kar	iker Total	25723	14191725.01	6132	554344.20	1386	97183.04	315	241074.7965	61	38085.57 2	1	1660.40 3	3	401.63					33641	15127474.65
Grand Total (in I	Metre)	375086	206214996.38	88229	7976065.62	20383	1429207.77	4737	3625305.749	1065	664936.60 2	82 2	2296.82 7	'6 8	6174.52 2	25	36069.20	2	1770.14	489885	220056822.79
Grand Total (in I	(ilometers)	375086	206215.00	88229	7976.07	20383	1429.21	4737	3625.31	1065	664.94 2	82	2.30 7	,e 8	6.17 2	55	36.07	2	1.77	489.89	220056.82

Md. Qaiser Abdulhaque, Saheb Halder, Saroj Mahapatra, Shambhu Nath Mishra & R. K. Sharma

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