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Trap Efficiency Of Kodar Reservoir

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Abstract – The REDUCE aspect has been studied at KODAR Reservoir for analysis of sediment trap efficiency towards smooth operation of Reservoir up to its designed grass capacity. It has been carried out through available three empirical relationship – Namely, Gill, Brown, and Brin with their comparison and field validation in conjunction with 25 years (1983-2017) rainfall data.

Keyword - Trap Efficiency, Trap Efficiency, Gill method , Brown method, Brune method

1 INTRODUCTION

The KODAR Watershed has been selected for area of study, since it has verity of major Hydraulic Structures. It belongs to Mahanadi river catchment in district MAHASAMUND. It has catchment area of 317.17 Sq. Km. The Area of study has several Hydraulic Structures namely: Earth dam having 2.36 KM. length, Waste Weir 183 Mtr, Sluices, Left Bank Canal 29.33 KM., Right Bank Canal 10.6 KM., Kodar Reservoir had been constructed during 1976-1981 in the name of Shaheed Veer Narayan Singh Bandh

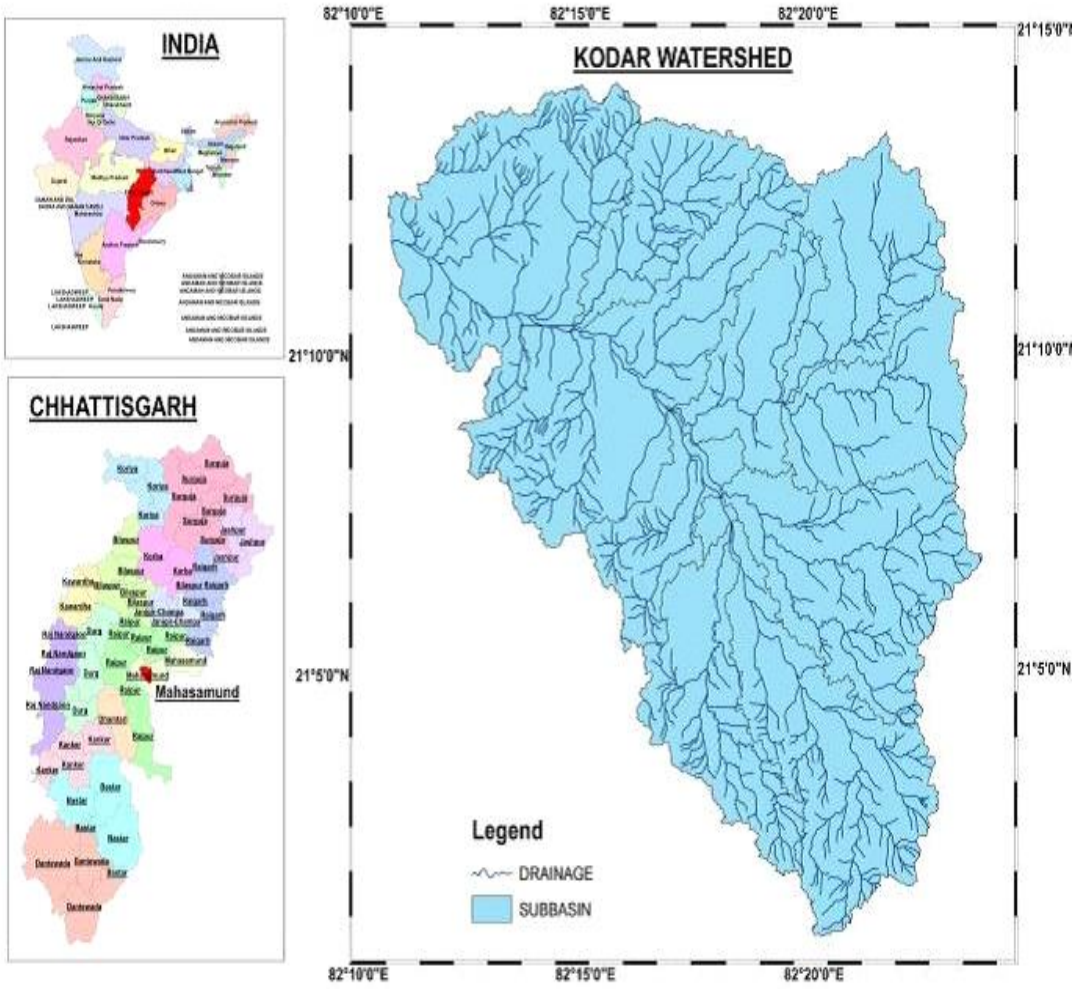

Figure – 1.1 Location map for area of study

2 METHODOLOGY

Trap Efficiency-

The Trap Efficiency (TE) is an important aspect of the design and construction of reservoirs, as the volume of sediment trapped in a reservoir depends on it. In a comparative study of three different methods of trap efficiency, Taher-Shamsi and Sabzivand (1999) applied to several reservoirs in Iran. The Brune and Brown method of estimation of TE provided closer values to field data, while the Churchill method was found to be less sensitive to the reservoir characteristics and overestimated the values. The characteristics of the sediments also affect the sediment trap efficiency. In a study of three reservoirs in Missouri USA (Rausch and Heinemann 1975), the trap efficiency was found to be affected by the detention time of storm

runoff and factors governing sediment particle size. The rate of removal or discharge of sediment laden outflow from the reservoir can also affect the trap efficiency of reservoirs. In an experimental study using sediment traps in an estuary in Cedar river, USA Stoddard (2001) found that at a specific discharge, the removal rates of sediment was maximum at the estuary and suggests that at lower discharge rates the tidal influence and the increased velocity at higher discharges may have led to the unsettling of the particles. Therefore, the discharge rates and the velocity of outflow can also be important factors affecting sediment retained by the reservoirs. In another experimental study on the role of over spilling condition downstream of a reservoir was assessed (Tonioloa and Schultz 2005) under five different situations and the results indicate that the maximum venting capacity (minimum trap efficiency) occurs under the over spilling condition. While many authors paid attention to the study of trap efficiency of large/medium reservoirs, Verstraeten and Poison (2001) developed a numerical model to simulate sediment deposition in a small pond, having less than 1 ha in extent. This model used in this study showed a high efficiency of prediction when applied to ponds in Belgium with a high accuracy and an RMS error of 4.7% only.

3 RESULTS ANALYSIS

Table 1 Sediment Trap Efficiency

YEAR	CAPACITY (m3) x $10E^6$	INFLOW ($10 E^6$ M3)	C/I RATIO	OBSERVED TE %	ESTIMATED (TeG) % (Gill equation)	ESTIMATED (TeB1) % (Brown equation k=1)	ESTIMATED (TeB1) % (Brown equation k=0.58)	ESTIMATED (TeB) % (Brune equation k=0.58)
1983	147	141.2	1.041	98.98	99.92	99.9	99.82	99.76
1984	145.5	201.1	0.724	96.5	99.66	99.89	99.82	99.65
1985	144.1	65.74	2.192	96.53	100.2	99.89	99.82	99.89
1986	142.6	136.2	1.048	96.57	99.93	99.89	99.81	99.76

1987	141.2	203.3	0.695	96.6	99.62	99.89	99.81	99.64
1988	139.8	135.9	1.029	96.63	99.92	99.89	99.81	99.76
1989	138.4	52.09	2.657	96.67	100.3	99.89	99.81	99.91
1990	137	17.14	7.994	96.7	100.5	99.89	99.81	99.97
1991	135.6	61.07	2.221	96.73	100.3	99.89	99.8	99.89
1992	134.3	193.2	0.695	96.77	99.62	99.89	99.8	99.64
1993	132.9	63.92	2.08	96.8	100.2	99.88	99.8	99.88
1994	131.6	158.7	0.829	96.83	99.77	99.88	99.8	99.7
1995	130.3	134.6	0.968	96.86	99.88	99.88	99.8	99.74
1996	129	337.7	0.382	96.89	98.89	99.88	99.79	99.33
1997	127.7	99.93	1.278	96.92	100	99.88	99.79	99.8
1998	126.4	70.76	1.787	96.96	100.2	99.88	99.79	99.86
1999	125.16	92.66	1.351	96.99	100.06	99.877	99.79	99.814
2000	123.91	48.1	2.576	97.02	100.29	99.876	99.79	99.903
2001	122.67	54.4	2.255	97.05	100.25	99.875	99.78	99.889
2002	121.45	32.65	3.72	97.08	100.36	99.873	99.78	99.933
2003	120.23	130.97	0.918	97.1	99.84	99.872	99.78	99.725
2004	119.03	66.47	1.791	97.13	100.18	99.871	99.78	99.86
2005	117.84	139.58	0.844	97.16	99.78	99.869	99.78	99.701

2006	116.66	73.82	1.58	97.19	100.13	99.868	99.77	99.841
2007	115.49	148.73	0.777	97.22	99.72	99.867	99.77	99.674
2008	114.34	43.52	2.627	97.25	100.29	99.865	99.77	99.905
2009	113.2	153.14	0.739	97.27	99.68	99.864	99.77	99.657
2010	112.06	145.47	0.77	97.3	99.71	99.863	99.76	99.672
2011	110.94	143.31	0.774	97.33	99.72	99.861	99.76	99.673
2012	109.83	190.7	0.576	97.36	99.44	99.86	99.76	99.559
2013	108.74	320.28	0.34	97.38	98.69	99.859	99.76	99.243
2014	107.65	218.57	0.493	97.41	99.26	99.857	99.75	99.483
2015	106.57	151.76	0.702	97.43	99.63	99.856	99.75	99.639
2016	105.51	117.96	0.894	97.46	99.83	99.854	99.75	99.718
2017	104.45	112.9	0.925	97.48	99.85	99.853	99.75	99.727

The sediment trap efficiency (Te) of Kodar Reservoir on Kodar Nala in Mahasamund district, Chhattisgarh state, India has been estimated using Gill method, Brown‘s methods by (k=1 and k=0.58), Brune‘s Method. The estimated Te was compared with the measured Te as well as Gill method, Brown‘s methods by (k=1 and k=0.58) and Brune‘s Method. It was found that the trend of results closely follow the Brune‘s method curve which shows that the sediments in this particular reservoir are mainly coarse sediments in nature, the results were compared with solution of actual trap efficiency in year 1983, 1984, 1986, 1988, 1988, 1994, 1995, 2003, 2005, 2007, 2009, 2010, 2011and 2017. Brown‘s method with κ = 1.0 it was found that the trend of results closely follow in the year 1990 and Hence, the constant κ was modified to κ = 0.58 (average of the observed C/I values). The modified Brown‘s method (κ = 0.58) and present study regression equation have been found to be below than estimating the trap efficiency in the present study area, 1985, 1989, 1991, 1993,1997 ,1998, 1999, 2000,2001, 2002, 2004, 2006 and 2008 Kodar Reservoir. It was also found that, Gill

method 1987, 1992, 1996, 2012, 2013, 2014, 2015, and 2016. The major advantage of these empirical methods was to give fairly reasonable results from very limited data: storage volume, average annual inflow and catchment area. As a limitation, the methods are applicable only to long-term average conditions. In the country like India where the sediment inflow and outflow are not usually measured, these empirical approaches are the best suitable approach to estimate sediment retention.

4 CONCLUSION

Brune‘s Method. It was found that the trend of results closely follow the Brune‘s method curve which shows that the sediments in this particular reservoir are mainly coarse sediments in nature, the results were compared with solution of actual trap efficiency in year 1983, 1984, 1986, 1988, 1988, 1994, 1995, 2003, 2005, 2007, 2009, 2010, 2011and 2017. 14 Years Correlated with Actual Study hence Brune method is based for kodar reservoir.

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