

## Assessment of Capacity Evaluation and Sedimentation of Totla Doh Reservoir, In Nagpur District By Remote sensing Technique.

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**Abstract:** Water is essential for socio-economic development and for maintaining healthy economic component of growth, poverty reduction and equality. The livelihood of the poorest sector with higher rates of urbanization, increasing demand for drinking water will put stronger by 2030. The next 25 years are challenging to create hydropower stations, the higher food production at lower rate of water consumption, development of Industrial and Agriculture sector and the economical waste water treatments.

Water Resources Management aims at optimizing the available natural water flows and competing needs. Adding uncertainty, climate change will increase the complexity of managing water resources. The mounting challenges due to demand and supply of water, It becomes essential to utilize available storage in minimize rate.

It is well established fact that reservoirs constructed on rivers are subjected to sedimentation. A reservoir sedimentation is a natural phenomena. All the reservoirs are bound to suffer a loss in their storage potential because of silt load, over a period of time. To evaluate the performance of every Major and Medium dams ,the accurate sedimentation analysis is essential in every 5-10 years of span. At present the most reliable method of assessment of sedimentation is Remote Sensing Technique.

Maharashtra Engineering Research Institute, ( MERI ) Nashik, has conducted capacity assessment survey of several major and medium dams in Vidarbha Region by Satellite Remote Sensing (SRS) Technique. This Paper deals with the case study of Totla Doh dam for capacity evaluation and sedimentation. This also suggests necessity for planning the water use more effectively.

**Key words :** Sedimentation, Reservoir capacity, Satellite Remote Sensing ( SRS ), Mapping of water spread area, Area capacity curves, Cloud free satellite pass, and Evaluation of capacity of reservoir.

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### I. Introduction:

Remote sensing is an art and science of collecting information about earth's features without being in physical contact with it. Various features on earth surface reflect or emit electromagnetic energy depending upon their characteristics. The reflected radiation depends upon physical properties of the terrain and emitted radiation depends upon temperature and emissivity. The radiations are recorded by the sensors onboard satellite and then are transmitted back to earth. Discrimination between features depends on the fact that the response from different features like vegetation, soil, water is different and discernable. Data received at ground stations, is digitally or visually interpreted to generate thematic maps.

Remote sensing based reservoir capacity assessment surveys are essentially based on mapping of water-spread areas at the time of satellite over pass. It uses the fact that water-spread area of the reservoir reduces with the sedimentation at different levels. The water-spread area and the elevation information are used to calculate the volume of water stored between different levels. These capacity values are then compared with the originally calculated capacity values to find out change in capacity between different levels.

In the present study of estimating the sedimentation in Totla Doh Reservoir, IRS LISS III data with 24 meters resolution has been used .In this survey the live storage capacity between MDDL 464.00 m. and FRL 490.00 m. has been evaluated for sedimentation assessment. SRS survey of Totla Doh Reservoir have been conducted in 2002-03, 2006-07 and 2010-2011.

### II. Salient Features Of Totla Doh Project :

The Totla Doh Reservoir is constructed in the year 1982-83 on the Pench river at Totla Doh village, in Ramtaka Taluka of Nagpur district in Maharashtra .It is an Interstate Hydro cum Irrigation project of Maharashtra and Madhya Pradesh. The first impounding in the reservoir took place in year 1983-83. The salient features of the Totla Doh reservoir are as below.

1	Location	Near village Totladoh , Taluk Ramtek, district Nagpur, Maharashtra. Latitude : 21° : 39' : 30" to 21° : 48' : 35" N Longitude : 79° :07' : 35" to 79° : 17' : 10" E
2	Year of first Impounding	: 1982-83.
4	Important Reservoir Levels	( i ) Crest level of Spillway : 482.00 m. ( ii ) MDDL : 464.00 m. ( iii ) FRL : 490.00 m. (iv) MWL : 493.00 m. ( v ) TBL : 495.50 m.
5	Reservoir capacity data (original )	( i ) Gross storage : 1241 Mm <sup>3</sup> ( ii ) Live storage : 1091 Mm <sup>3</sup> ( iii ) Dead storage : 150 mm <sup>3</sup>
6	Length of Dam	( i ) Earthen Dam : 2381 m. ( ii ) Masonry Dam : 680 m.
7	Maximum height of Dam	: 74.50 m.
8	Total area of submergence	: 7771 Ha.
9	Projects Benefits	Hydropower & Irrigation

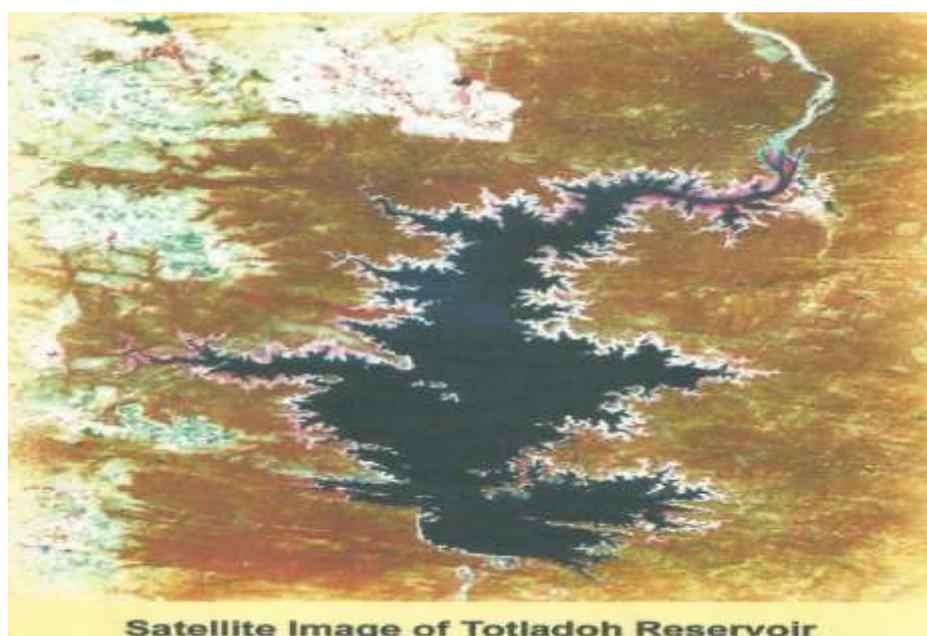


Figure No. 1

### **Objectives Of The Study:**

The objectives of the study is to estimate the present storage capacity of Totla Doh Reservoir and capacity loss due to sedimentation , through Satellite Remote Sensing . Following objectives are achieved in the study.

- Updating of Elevation-Area-Capacity curves using satellite e data in live storage zone of Reservoir.
- Estimation of storage loss due to sedimentation in reservoir.
- To provide database for developing regional indices and rational sedimentation planning of future reservoirs.

### **History Of Sedimentation Study:**

MERI. Nashik , had conducted sedimentation study of Totla Doh reservoir in 2002-03, 2006-07 and recently in 2010-11. In 2002-03, the study covered storage zone of reservoir between R.L. 463.00 m. to R.L. 488.18 m. covering 90% of designed live storage zone and smaller portion of dead storage. In 2006-07 study covered 100% live storage zone of reservoir between FRL 490.00 m. and MDDL 464.00 m. and some portion of dead storage. In the third study the reservoir zone between RL 458.30 m. and RL 490.00 m. has been covered.

**Criteria For Satellite Data Selection:**

The selection of the satellite data for the study is based on the following.

1. To carry out the feasibility assessment of the given reservoir regarding availability of cloud free satellite data of dates of satellite pass corresponding to levels near MDDL as well as near FRL and at uniform interval to extent possible in between MDDL and FRL for the latest water year or maximum up to two previous water years.
2. To carry out sedimentation analysis through SRS technique to cover the entire live storage and available dead storage zones of the reservoir.
3. In case of inability to cover the entire live storage zone of reservoir due to non-availability of cloud free satellite data at FRL and MDDL, the study may be taken up if minimum of 80% of live storage capacity is covered by the available cloud free dates of satellite pass on maximum and minimum reservoir level.

**III. Methodology Of The Study:**

The basic concept is to find out the water spread area from satellite data for different water levels between MDDL and FRL. The difference between aerial spread of water between current year and earlier year is the aerial extent of silting at these levels. The methodology for estimation of live capacity of reservoir using remote sensing consist of following.

- Digital data base creation.
- Estimation of water-spread area.
- Calculation of reservoir capacity.
- Comparison with previous surveys.
- Estimation of live capacity loss due to sedimentation.

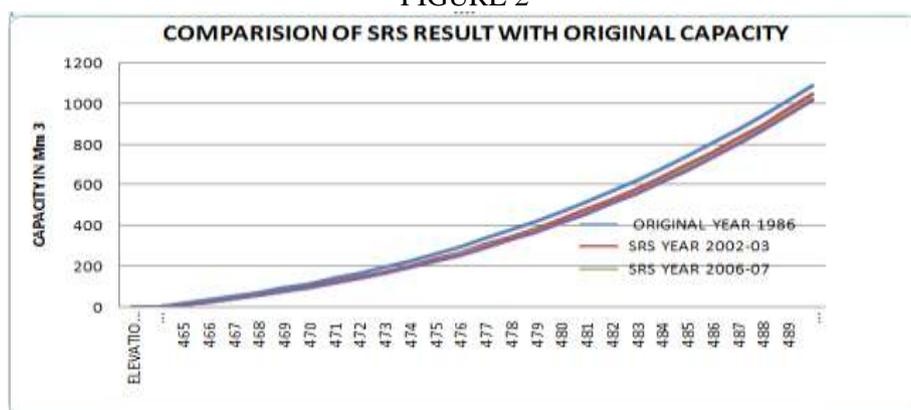
**Findings Of Satellite Remote Sensing Study :**

The satellite survey of Totla Doh reservoir has been conducted in 2002-03, 2006-07 and 2010-11. The findings of survey were compared with the original capacity table between MDDL and FRL. The findings of these three survey is tabulated as follows.

**Table no. 1 Comparison of original capacity of Totla Doh reservoir with SRS survey.**

Sr. No.	Elevation in meters	Original Year 1982-83		SRS Year 2002-03		SRS Year 2006-07		SRS Year 2010-11	
		Area in Mm <sup>2</sup>	Capacity in Mm <sup>3</sup>						
1	2	3	4	5	6	7	8	9	10
1	<b>MDDL 464</b>	15.048	0	11.633	0	11.597	0	11.498	0
2	465	16.338	16.510	11.131	12.375	12.652	12.216	12.847	12.166
3	466	17.727	32.819	14.708	26.289	14.226	25.745	14.277	25.722
4	467	19.110	51.921	16.365	41.818	15.718	40.708	15.790	40.749
5	468	20.508	71.004	18.106	59.046	17.326	57.221	17.388	57.332
6	469	21.806	93.004	19.923	78.052	19.049	75.400	19.075	75.557
7	470	23.283	114.995	21.826	98.919	20.884	95.357	20.852	95.514
8	471	25.668	140.727	23.814	121.733	22.830	117.205	22.722	117.294
9	472	28.042	166.460	25.888	146.577	24.884	141.054	24.687	140.991
10	473	30.421	196.850	28.049	173.538	27.046	167.010	26.749	166.703
11	474	32.799	227.241	30.298	202.704	29.313	195.182	28.912	194.526
12	475	35.178	262.393	32.636	234.164	31.684	225.672	31.177	224.564
13	476	37.556	297.544	35.065	268.007	34.157	258.585	33.547	256.918
14	477	39.935	337.454	37.586	304.325	36.729	294.019	36.024	291.696
15	478	42.313	377.363	40.200	343.211	39.400	332.076	38.610	329.006
16	479	44.691	421.431	42.908	384.757	42.167	372.851	41.309	368.958
17	480	47.070	466.698	45.711	429.059	45.028	416.441	44.122	411.666
18	481	50.144	516.804	48.611	476.212	47.983	462.939	47.052	457.245
19	482	53.218	566.910	51.609	526.315	51.028	512.436	50.101	505.813
20	483	56.292	623.504	54.706	579.464	54.162	565.024	53.271	557.491
21	484	59.366	680.099	57.903	635.761	57.384	620.789	56.566	612.402
22	485	62.440	742.515	61.201	695.304	60.691	679.819	59.987	670.670
23	486	65.514	806.102	64.602	758.198	64.082	742.198	63.537	732.423
24	487	68.588	873.498	68.107	824.544	67.555	808.010	67.218	797.792
25	488	71.662	942.063	71.717	894.448	71.108	877.334	71.032	866.908
26	489	74.736	1016.797	75.433	968.014	74.739	950.251	74.983	939.907
27	<b>FRL 490</b>	77.710	<b>1091.531</b>	79.256	<b>1045.350</b>	78.447	<b>1026.837</b>	79.072	<b>1016.925</b>

FIGURE 2



#### IV. Discussion And Conclusions:

The results of the SRS survey are expressed in Table 1 and Graph 1. From the findings of the results the rate of sedimentation between MDDL 464 m. and FRL 490 m. are as follows.

Sr. no.	Details of the study	Reduction in Live storage	Period in Years.	Rate of Sedimentation
1	Between original capacity 1982-83 and SRS 2002-03	46.181 Mm <sup>3</sup>	20	2.31 Mm <sup>3</sup> / yr.
2	Between 1 <sup>st</sup> SRS 2002-03 and 2 <sup>nd</sup> SRS 2006-07.	18.514 Mm <sup>3</sup>	4	4.63 Mm <sup>3</sup> / yr.
3	Between 2 <sup>nd</sup> SRS 2002-03 and 3 <sup>rd</sup> SRS 2006-07.	9.912 Mm <sup>3</sup>	4	2.48 Mm <sup>3</sup> / yr.
4	Between original capacity 1982-83 and 3 <sup>rd</sup> SRS 2006-07.	74.606 Mm <sup>3</sup>	28	2.66 Mm <sup>3</sup> / yr.

The rate of sedimentation between 2002-03 and 2006-07 was 4.63 Mm<sup>3</sup> / yr. which was higher in comparison of other SRS reports. The average rate of sedimentation is 2.66 Mm<sup>3</sup> / yr. which is about 0.25 % per year of original live storage 1091 Mm<sup>3</sup> of the Totla Doh reservoir. Thus the average rate of siltation is 6.23 Ha.m / 100 km<sup>2</sup> / year. This rate of siltation is not alarming. The study of rate of siltation in the dead storage is essential. For this Hydrographic survey can be conducted after which the accurate rate of siltation of the reservoir can be predicted.

#### Limitations Of The Satellite Remote Sensing:

- The Remote Sensing based capacity estimation, works between FRL and the minimum water level in the reservoir only. Thus changes can be estimated only in this zone of reservoir. For the capacity estimation below minimum water level in reservoir, other method like hydrographic survey is to be conducted.
- Availability of cloud free dates through reservoir operation period is the problem. Hence data from different year was selected.
- Remote Sensing technique gives accurate estimation for fan shaped reservoir where there is a considerable change in water-spread area for incremental change in water level,
- Another source of general error lies in the identification of tail end of reservoir particularly, in rainy season.

#### References:

- [1] N. G . Kuralekar, (1984) Use of Remote Sensing Techniques in the hydrological studies in parts of Solapur of Maharashtra state. Proceedings of conference on development of ground water resources in Maharashtra. Bombay 222-225.
- [2] U. C. Kothiyari , Erosion and Sediment Yield : Global and Regional Perspectives ( proceedings of the Exeter Symposium, July 1996 ) IASH Publ. No. 236, 1996.
- [3] Reservoir sedimentation Assessment Guide-line by Hydrological Studies and Information Department- SIH- Brasilia DF-2000.
- [4] A. K. Sinha, D. Dhar, ( 2005 ) Remote sensing and Geographic Information System ( GIS ) for Water Resources, Investigation, Development and Management,, All India Seminar on challenging problems in Water Resources Management and Development ,Nagpur 176-179.
- [5] Y.V.N. Krishna Murthy, D.S. Pandit, ( 2005 ) Role of Remote Sensing in Water Resources Investigation, Development and Management. All , India Seminar on challenging problems in Water Resources Management and Development ,Nagpur 167-175.
- [6] D. M. More, S. K. Kalvit, (2005). Assessment of Storage Capacity of Pench Project by Remote Sensing Technique. All India Seminar on challenging problems in Water Resources Management and Development ,Nagpur 180-184.
- [7] Technical Report on Sedimentation Assessment and Storage Capacity Evaluation of Totla Doh Reservoir. Dist.- Nagpur through Satellite Remote Sensing by MERI- Nashik- 2007-08.
- [8] Technical Report on Capacity Evaluation and Sedimentation Assessment in Totla Doh Reservoir, Dist.- Nagpur by SRS Technology. MERI-Nashik-2012-13.