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Evaluation of Capacity of Salandi Reservoir Using Remote Sensing Data Along With Qgis Software

Rupali Dhal, Dr. D. P. Satapathy
College of Engineering and Technology, Bhubaneswar,
Odisha, India

Abstract:

The dynamic aspects of the reservoir which are water spread, suspended sediment distribution and concentration requires regular and periodical mapping and monitoring. Sedimentation in a reservoir affects the capacity of the reservoir by affecting both life and dead storages. The life of a reservoir depends on the rate of siltation. The various aspects and behavior of the reservoir sedimentation, like the process of sedimentation in the reservoir, sources of sediments, measures to check the sediment and limitations of space technology have been discussed in this report. Multi satellite remote sensing data provide information on elevation contours in the form of water spread area. Any reduction in reservoir water spread area at a specified elevation corresponding to the date of satellite data is an indication of sediment deposition. Thus the quality of sediment load that is settled down over a period of time can be determined by evaluating the change in the aerial spread of the reservoir at various elevations. Salandi reservoir project work was completed in 1982 and the same is taken as the year of first impounding. The original gross and live storages capacities were 565 MCM& 556.50 MCM respectively. In SRS CWC (2009), they found that live storage capacity of the Salandi reservoir is 518.61 MCM witnessing a loss of 37.89 MCM (i.e. 6.81%) in a period of 27 years.The data obtained through satellite enables us to study the aspects on various scales and at different stages. This report comprises of the use of satellite to obtain data for the years 2009-2013 through remote sensing in the sedimentation study of Salandi reservoir. After analysis of the satellite data in the present study(2017), it is found that live capacity of the reservoir of the Salandi reservoir in 2017 is 524.19MCM witnessing a loss of 32.31 MCM (i.e. 5.80%)in a period of 35 years. This accounts for live capacity loss of 0.16 % per annum since 1982. The trap efficiencies of this reservoir evaluated by using Brown's, Brune's and Gill's methods are 94.03%, 98.01and 99.94% respectively. Thus, the average trap efficiency of the Salandi Reservoir is obtained as 97.32%.

Keywords: Remote sensing: Area-capacity: Storage capacity area relationship: Quantum Geographic Information System

I. INTRODUCTION

Water is a resource which is mainly dependent on rainfall, which is most erratic in nature in India. It is estimated that of the 4000 km³ water, 1869 km³ is Average annual potential flow in river available as water resource. Out of these total available water resources, only 1123 km³ is utilizable (690 km³ from ground water resources and 450 km³ from ground water resources). India has developed 212.78 km³ as storage capacity, 107.54 km³ is under consideration and 76.26 km³ is under construction (CWC, 2006).The country has 20 major river basins.

A large number of reservoirs have been built during each plan on almost all river basins to tap the available surface water and to utilize it as and when needed. Dams and reservoirs have been constructed to collect, store, manage the supply of water to sustain civilization Reservoiralso provide benefits such as flood control, recreation, generation and various other purposes. Life of the reservoir is reduced when the rate of sedimentation is higher than the design rate. The capacity of the reservoir is considering various factors like amount of rainfall, temperature, area of the reservoir and runoff. Area-capacity curves are of the most important physical characteristics of dams reservoirs. These curves are usually used for reservoir flood routing, reservoir operation, determination of water surface area and capacity corresponding to each elevation, reservoir classification and sediment distribution.

Basically, multi-date satellite remote sensing data provide information on elevation contour areas directly in the form of water spread areas. Any water spread area at a specified elevation estimated from the satellite data is indicative of sediment deposition. Thus, the changes of water spread areas at various operating levels of the reservoir helps in estimation of quantity of sediment load. Besides, it helps in updating the existing elevation-area-capacity curves thus accounting for the storage loss due to sedimentation for different time period.

When a river is stilled behind a dam, the sediments it contains sink to the bottom of the reservoir. The proportion of a rivers totally sediment load captured by a dam known as its trap efficiency. It has been observed that most of the reservoirs trap about 95% to 100%, sediment brought into them. It is not possible to reduce this value below 9%. The live storage of reservoir is getting reduced due to siltation; a systematic effort has been made by various departments/ organizations to evaluate the capacity of reservoirs. Various techniques like boat echo sounder, etc. being replaced by hydrographic data acquisition system (HYDAC) and HITECH method using Differential Global Positioning System (DGPS). These techniques are found either time consuming or costly and require considerable manpower. But in Remote sensing technique to calculating the present capacity of reservoir has been adopted without being in physical contact with earth surface. These techniques give accurate estimation for shaped reservoir where is a considerable change in water spread area and with change in water level. In this paper satellite imaginaries were analyzed to calculate the capacity of Salandi Reservoir by using Qgis Software and compare with original & CWC data.

II. OBJECTIVE OF THE STUDY

1. To evaluate the capacity of Salandi Reservoir using Remote Sensing and GIS Technique
2. Comparison of the result of Reservoir capacity obtained by RS and GIS technique with Original and CWC Data.

III. STUDY AREA AND LOCATION

STUDY AREA

The first National Water Policy was adopted in September, 1987. It was reviewed and updated in 2002 and later in 2012. Odisha in its part has its State Water Plan 2004 and Water Policy 2007. Salandi Irrigation Project is also one such project which was conceived in early sixties with sole purpose of providing irrigation facilities in the area and for the protection of low lying areas along the banks of Salandi River from floods. . Prior to the construction of the Dam and canal system, the agricultural operation in the area was dependent on rainfall. The cultivators of the area were very poor and were following age old traditional agricultural practices resulting in low crop yields of about 1200kg/ha. due to lack of irrigation facilities.

LOCATION

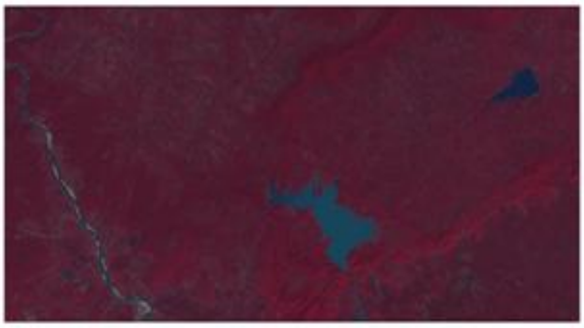
A dam has been constructed across river Salandi forming the reservoir, near Hadagarh. The river Salandi originates from Meghasini hills of Mayurbhanj district (Orissa) at an altitude of 1036m and the stream attains an elevation of about 610m within a very short distance of about 10kms which then passes through a narrow gorge for distance of about 2.5km before joining its tributary Deodar, Gobarjhara and turns to east. After flowing about 160 km joins river Baitarani and forms a part of Baitarani basin. Salandi dam intercepts a catchment of 673sqkm. With average annual rainfall of 1550mm, the catchment has annual yield of 493mcum. The reservoir capacity is 60100hamwithlive storage of 55650ham having a water spread area of 31.82sqkm at FRL 82.30m. The project caters irrigation to 107380ha GCA. Salandi dam, a composite one, constructed with 640m long earth dam and 114.6m long masonry dam having 8 spans of 12.2m each spillway. Water from the reservoir is let out through 3 sluices (1.52x2.27m) and picked up at Bidyadharpur barrage for irrigation. As per the original project proposal one left canal known as Salandi main canal was constructed. But subsequently the FRL of the reservoir was raised by 6.1m by installing 8 numbers of radial gates which facilitated irrigation on right known as Anandapur canal. For extending the ayacut by another 60000ha at present a barrage across Baitarani is being constructed near Anandapur from where left bank link canals will takeoff to feed Salandi reservoir.The irrigation distribution system comprise of Left and Right main canals emerging from either sides of the Bidyadharpur barrage through network of distributaries, minor and sub-minor canals etc. The Left canal system includes 45 km long main and branch canals having designed ayacut of 44635ha and design discharge of 42.45cumec and the right canal system has an ayacut of 40178ha with design discharge of 46.53cumec.

IV. METHODOLOGY

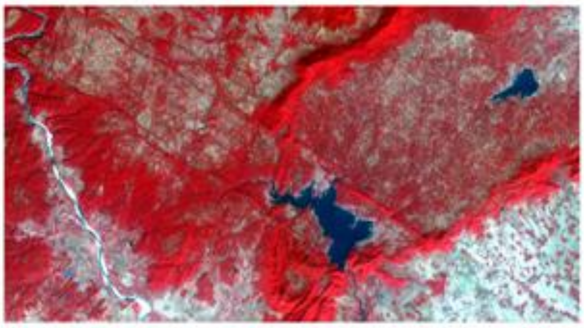
Satellite Data: Bhuban(http://bhuvan.nrsc.gov.in) is the primary data decimation service of Indian space Research Organisation, ISRO. Data from various satellites and other products are available from BHUVAN website. Accordingly a search was made for available records under satellites/ sensors for Salandi Reservoir Area under LISS - III. It was found to have 4 Nos of Scenes of IRS P6-LISS III data. Accordingly, scenes for all the four (04) dates have been obtained for use in the analysis. Table 4.1 depicts the Path and Row index along with date of pass of satellite. The four (04) images taken by satellite as described above are given below in figure 4.1:

Table 4.1: Date of pass for satellite data

Satellite	Path	Row	Date of pass	Elevation(m)
IRS-P6 LISS III	106	57	20th oct,2009	74.21
IRS-P6 LISS III	106	57	9th dec,2011	72.22
IRS-P6 LISS III	106	57	14th mar,2012	70.56
IRS-P6 LISS III	106	57	9th mar,2013	54.88



20th Oct, 2009



9th Dec, 2011

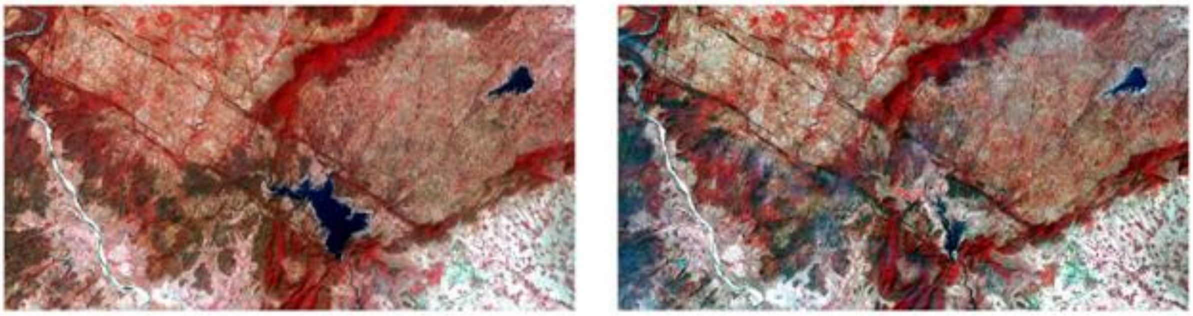


Fig.4.1: IRS-P6 LISS III (Source: BHUVAN)

Field Data

The following field data has been obtained from project authorities:

- Original Stage – Area – Capacity data,
- Reservoir levels on specified dates.
- Salient features of Salandi reservoir.
- Photographs of the Project etc.

Visual analysis have disadvantages ,therefore digital analysis are more reliable and accurate in identifying water spread and turbidity levels in detail and thus minimizing the chances of human error. The image acquired from digital analysis using the image processing system on computer gives better enhancement ratio (B/NIR. B/R, R/G).The principle component obtained from digital analysis were good for mapping water spread, turbidity levels and surgical aquatic vegetation. For Salandi reservoir studies, multi-date IRS-P6 LISS III data (04 nos. imageries) is used for the analysis.

Database Geo-referencing

The data obtained from satellite corresponding to reservoir area obtained from NRSA DATA CENTRE was loaded on the system. The scene of 20th Oct, 2009 was geo-referenced with respect to 1:250,000 Survey of India toposheet 73K. The geo-referencing was done beforehand by BHUBAN using a scale of 1:250000 and using second order equation with root mean square error less than 0.5pixel. The registered images for all four different dates pertaining to study area were used for further analysis.

Water Spread Area Estimation

Reduction in capacity of reservoir at different levels is depicted by reduction in water-spread area (WSA) at different water levels. Estimation of water-spread area is done using various digital image processing (DIP) techniques. Various techniques adopted for water-spread area estimation are generation of false color composite(FCC) and analysis of histogram & thresholding and modeling.

Generation of FCC and Analysis of Histogram

FCC is generated from three spectral bands of satellite data, generally NIR, Red and Green bands. Histogram is graph between grey values and the frequency of occurrence, is plotted for individual bands.

Thresholding and Modeling

The areas where clear water /land demarcation is there, density slicing is successfully used for delineation of water spread areas. Density slicing is a technique where the entire grey values of pixels occurring in the image are divided into series of analyst specified intervals. All the grey values falling within a range are grouped in one grey pixel. From the study of histogram peaks, minimum and maximum value for water pixels is identified and image is density sliced. Thresholding can be performed on single feature or class from the satellite data. Different ratio indices are available to enhance water, vegetation, soil etc. Normalized Difference Water index (NDWI) is one such index, which enhances water and vegetation.

For estimation of water spread area of Salandi reservoir, use of NDWI has been made. NDWI has been generated using 8-bit unsigned channel with the help of formula given below:

NDWI= (G-NIR)/ (G+NIR)

Where 'G' is digital number in green band and 'NIR' is digital number in near infrared band. The ratioed image is then density sliced. Water pixels generally occupy lower range of histogram in ratioed image.

Using the above range of values, water spread areas are extracted for all the scenes. It can be observed that the dark colour patches are water. Density Slicing above with values <0 as 1 yielded the water spread area Figure shows FCC's of different dates and figure shows the superimposed reservoir water spreads for different dates. Conversion of the area to a vector with Coordinate Reference System (CRS) of Asian Lambert Conformal Conic (EPGS: 102012) yields the water spread area in the selected date. Using the so obtained vectors with add geometry columns, results for water spread area was obtained and are tabulated.

Methods of Trap efficiency

Trap efficiency (Te) Trap efficiency (Te) is the proportion of the stream sediment that is trapped in the reservoir. Trap efficiency can be used by Brown's Method, Brune's Curve (Capacity-Inflow Method), Gill.

Brown's Method

The first trap efficiency (Te*)* estimation method was the pioneer work by Brown in 1944. USACE (1989) named this method as Capacity-Watershed method because Brown's curve relates the ratio of the reservoir capacity and the catchment or the watershed area (C/A) to the trap efficiency (Te). For estimating the value of trap efficiency Te (Gill, 1979; Campos, 2001; USACE, 1989)

$$Te = 1 - \frac{1}{[1+K\left(\frac{C}{A}\right)]} \qquad [Eqn. 1]$$

Where C, is capacity of the reservoir, A is the area of the catchment above the reservoir and K is a coefficient whose value varies from 0.046 to 1.0 depending upon different factors. According to USACE (1989), (i) K increases with the smaller and varied retention time, (ii) K increases as the average grain size increases and (iii) K increases with reservoir operation that prevents release of sediment through sluicing or prevents the movement of sediment towards the outlets by pool elevation regulation. A value of K = 0.1 is recommended for average conditions, and values of K = 1.0 for coarse sediment; K=0.1 for medium sediment; and K=0.046 for fine sediment is recommended (Gill, 1979). The Brown's method is simpler as only two parameters i.e., catchment area and reservoir capacity are required for the estimation of the trap efficiency.

Brune's Curve (Capacity-Inflow Method

Brune's curve method is most common method used for determining the trap efficiency of reservoirs. Brune drew the curves using the data from 44 normal ponded reservoirs in the United States and plotted Te against the reservoir C/I ratio. Brune plotted three curves consisting of one median and two envelop curves. Brune developed an empirical relationship between trap efficiency and the ratio of reservoir capacity to the annual inflow.

$$Te = \frac{\left(\frac{C}{I}\right)}{0.00013 + 0.01\left(\frac{C}{I}\right) + 0.0000166\left(\frac{C}{I}\right)} \qquad [Eqn. 2]$$

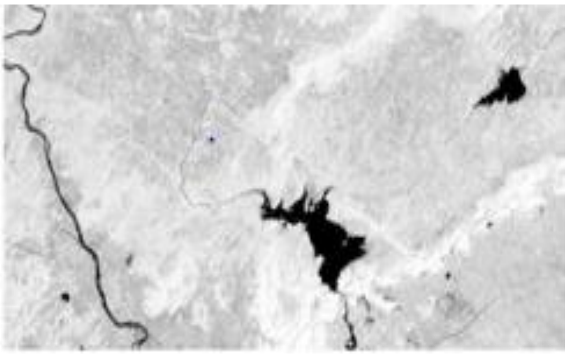
Gill Method

Gill (1979) developed empirical equations which provided a very close fit to the curves (Jothiprakash and Garg , 2008) which based on the three curves proposed by Brune.

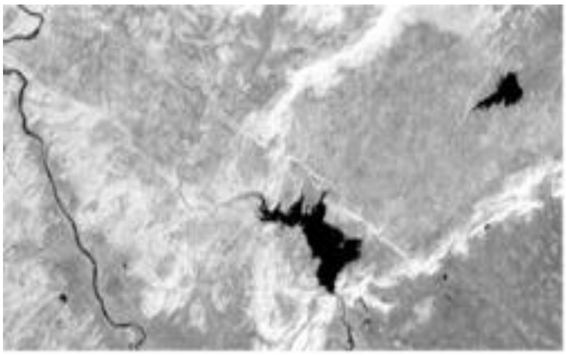
$$Te = \left(\frac{C}{I}\right)\ 0.012+1.02\left(\frac{C}{I}\right) \qquad [Eqn\ 3\ \ ]$$

V. RESULT AND DISCUSSION

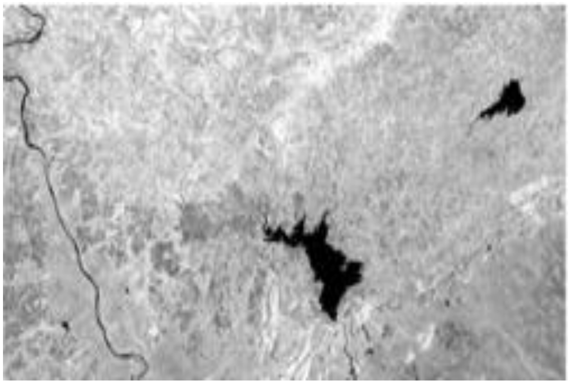
NDWI CALCULATION



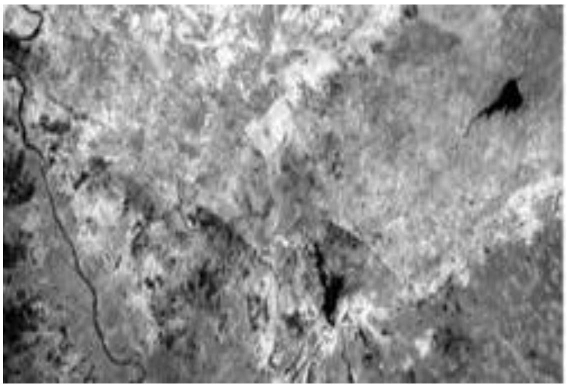
20th Oct, 2009



9th Dec, 2011



14th Mar, 2012



9th Mar,2013

Fig. 5.1: Result of NDWI Calculation on the Scenes obtained from BHUBAN

From the above figure 5.1 it can be observed that the dark colour patches are water. Density Slicing above with values <0 as 1 yielded the water spread area. Conversion of the area to a vector with Coordinate Reference System (CRS) of Asian Lambert Conformal Conic (EPGS: 102012) yields the water spread area in the selected date.

Using the so obtained vectors with add geometry columns, results for water spread area was obtained and are tabulated below. The water elevation 74.21m for 20th Oct, 2009 is below the Full Reservoir Level (FRL) of 82.30m and water elevation 54.88m for 9th Mar, 2013 is well above the Minimum Draw Down Level (MDDL) OF 50.24.

Table 5.1: Water Spread Areas estimated from Satellite Images

Date of pass	Elevation(m)	Area (million.m²)
20th oct,2009	74.21	26.37
9th dec,2011	72.22	23.55
14th mar,2012	70.56	21.95
9th mar,2013	54.88	4.67

Table 5.2: Estimation of water spread Area.

Date of pass	Elevation (m)	Area (million m²)	Remarks
1st October 2008	80.15	32.00	SRS Data
24th November 2007	76.40	28.09	SRS Data
20th October 2009	74.21	26.37	
9th December 2011	72.22	23.55	
14th March 2012	70.56	21.95	
9th March 2013	54.88	4.67	

Estimation of Area in Reservoir

Area elevation curve has been plotted using these above water-spread areas for different water level in the reservoir and a best-fit polynomial equation of third order as given below has been derived. Elevation – area curve using this equation has been plotted and shows in figure. Water spread derived from satellite data for various dates are also marked on the curve.

$Y= -0.0005X^3+0.0262X^2+0.7095X-0.123$, $R^2= 0.9994$

Where Y is Water Spread Area (Million m2), X is Elevation (m above RL= 50m).

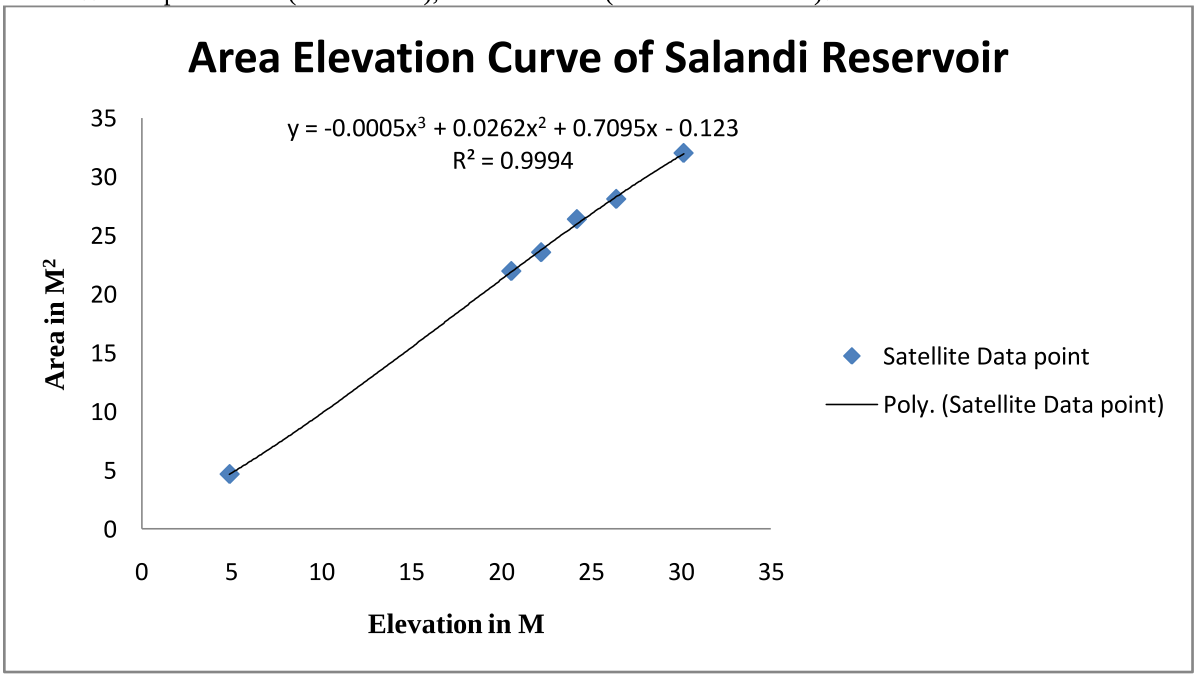


Figure 5.2 Modified area-elevation curves

Computation of the reservoir capacity

Using the formula above, water spread area is estimated at various elevations. Further using the formula below the differential volume is calculated and the cumulative results indicate the live capacity of the reservoir.

V= h/3 (A1+A2+sqrt. (A1*A2))

Where, 'V' is the reservoir capacity between two successive elevations h1 and h2, 'h' is the elevation difference (h1-h2), 'A1& A2' are areas of reservoir water spread at elevations h1 & h2.

Table 5.3 gives the values of live storage capacity and submergence areas at a regular interval of 1.0 m have been worked out using this best-fit polynomial equation at different elevations.

Table 5.3: Aerial extract of reservoir at regular (1.0m) using 2017 Survey

Elevation (m)	**Area (Million m²)**	**Live Capacity (Million m³)**
50.24	0.0487	0
51	0.6121	0.211
52	1.3967	1.189
53	2.2277	2.985
54	3.1021	5.638
55	4.0169	9.188
56	4.9691	13.673
57	5.9557	19.128
58	6.9737	25.586
59	8.0201	33.077
60	9.0919	41.627
61	10.1861	51.261
62	11.2997	61.999
63	12.4297	73.859
64	13.5731	86.856
65	14.7269	101.002
66	15.8881	116.306
67	17.0537	132.773
68	18.2207	150.407
69	19.3861	169.207
70	20.5469	189.171
71	21.7001	210.292
72	22.8427	232.561
73	23.9717	255.966
74	25.0841	280.492
75	26.1769	306.121
76	27.2471	332.831
77	28.2917	360.599
78	29.3077	389.397
79	30.2921	419.196
80	31.2419	449.962
81	32.1541	481.659
82	33.0257	514.248
82.3	33.2788	524.194

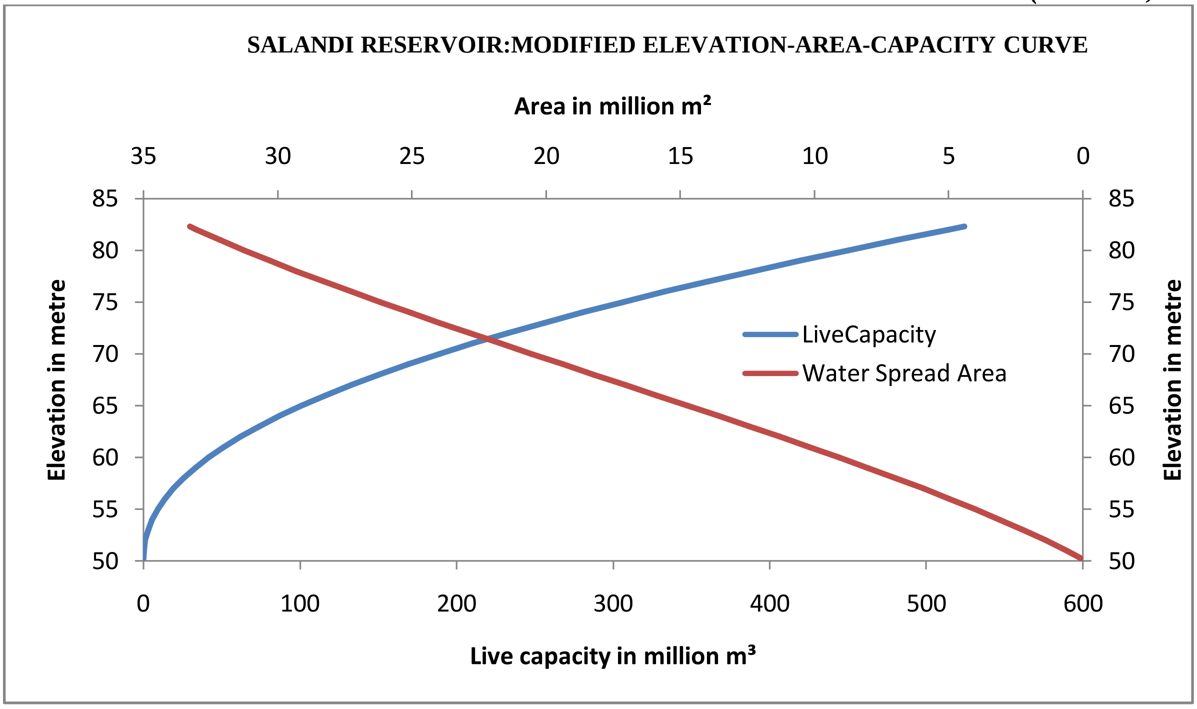


Figure 5.3 Salandi Reservoir: Modified Elevation-Area-Capacity Curve (2017)

Comparison with Previous Surveys

As regards storage capacity of the Salandi Reservoir is concerned, two previous results are available to us for comparison with our study.

- Original Area – Elevation – Capacity curve, prepared during the project formulation.
- SRS Study Conducted by CWC in 2009 through remote sensing.

Area Comparison

Table 5.4: Comparisons of Water Spread Areas (Million m^2) of Salandi Reservoir

Elevation (m)	Original (1982)	SRS, CWC (2009)	Present Survey (2017)
50.24	2.47	0.25	0.05
52	3.21	1.07	1.40
54	4.59	2.37	3.10
56	6.06	3.99	4.97
58	7.67	5.9	6.97
60	9.76	8.04	9.09
62	11.92	10.38	11.30
64	14.53	12.85	13.57
66	16.93	15.42	15.89
68	19.28	18.03	18.22
70	21.6	20.64	20.55
72	24.11	23.2	22.84
74	26.25	25.66	25.08
76	28.57	27.97	27.25
78	30.47	30.09	29.31
80	32.33	31.96	31.24
82	34.14	33.54	33.03
82.3	34.38	33.75	33.28

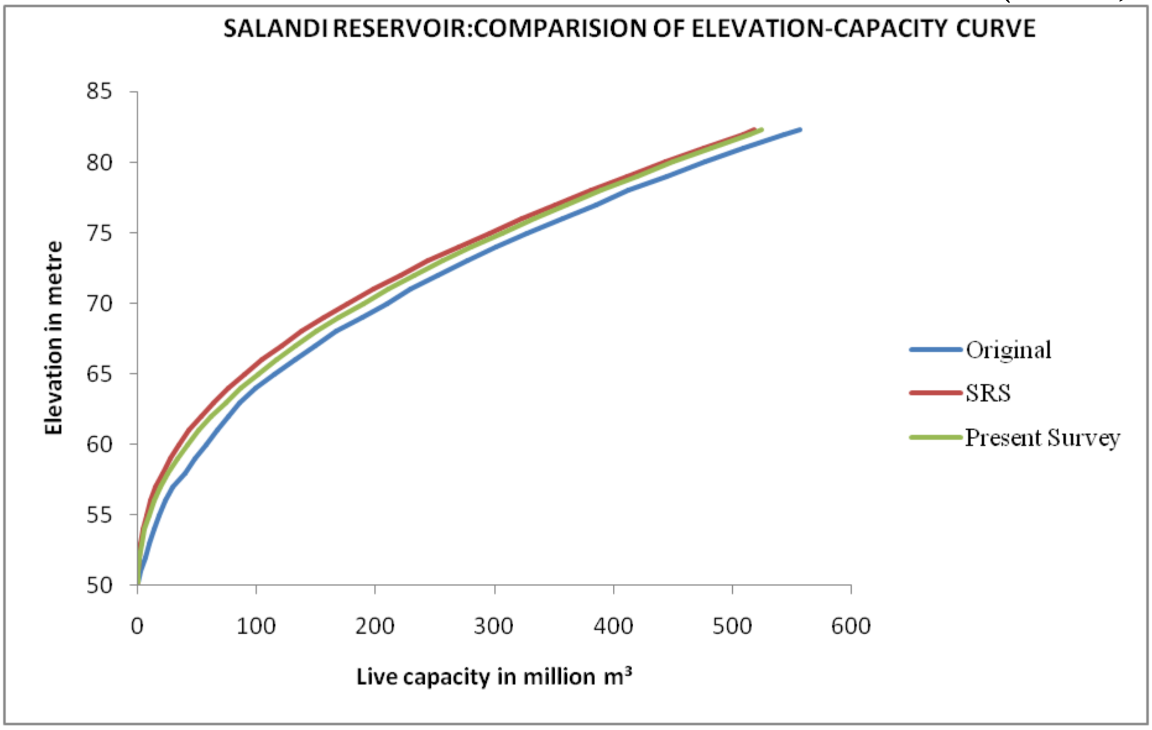


Fig. 5.4: Salandi Reservoir – Comparison of Elevation-Area Curve (2017)

Table 5.4: shows the comparison of water spread area of present SRS survey with previous surveys at various elevations. Curve showing comparison of water spread area of the present Survey (2017) with SRS survey and original survey.
The water spread area at FRL (82.30 m.) from the present Survey (2017) has been worked out as 33.28 Million m² against the value of 34.38 Million m2 reported as per original survey.

Capacity Comparison

Table 5.5: Comparison of Live Storage Capacity (Million m^3) of Salandi Reservoir

Elevation(m)	Original(1982)	SRS(2009)CWC	Present Survey(2017)
50.24	0	0	0
51	2.27	0.3	0.211
52	5.88	1.11	1.189
53	9.99	2.48	2.985
54	13.66	4.49	5.638
55	17.62	7.23	9.188
56	23.16	10.79	13.673
57	29.43	15.23	19.128
58	39.3	20.62	25.586
59	48.53	27.04	33.077
60	57.76	34.52	41.627
61	66.99	43.13	51.261
62	75.66	52.91	61.999
63	85.76	63.89	73.859
64	99.26	76.11	86.856
65	114.46	89.6	101.002
66	131.79	104.36	116.306
67	148.81	120.43	132.773
68	166.51	137.8	150.407
69	188.32	156.48	169.207
70	209.06	176.47	189.171
71	228.84	197.75	210.292

72	251.91	220.31	232.561
73	277.09	244.13	255.966
74	300.87	269.18	280.492
75	326.84	295.42	306.121
76	356.72	322.82	332.831
77	385.02	351.33	360.599
78	412.71	380.9	389.397
79	444.87	411.47	419.196
80	477.17	442.98	449.962
81	509.19	475.35	481.659
82	543.03	508.51	514.248
82.3	556.61	518.61	524.194

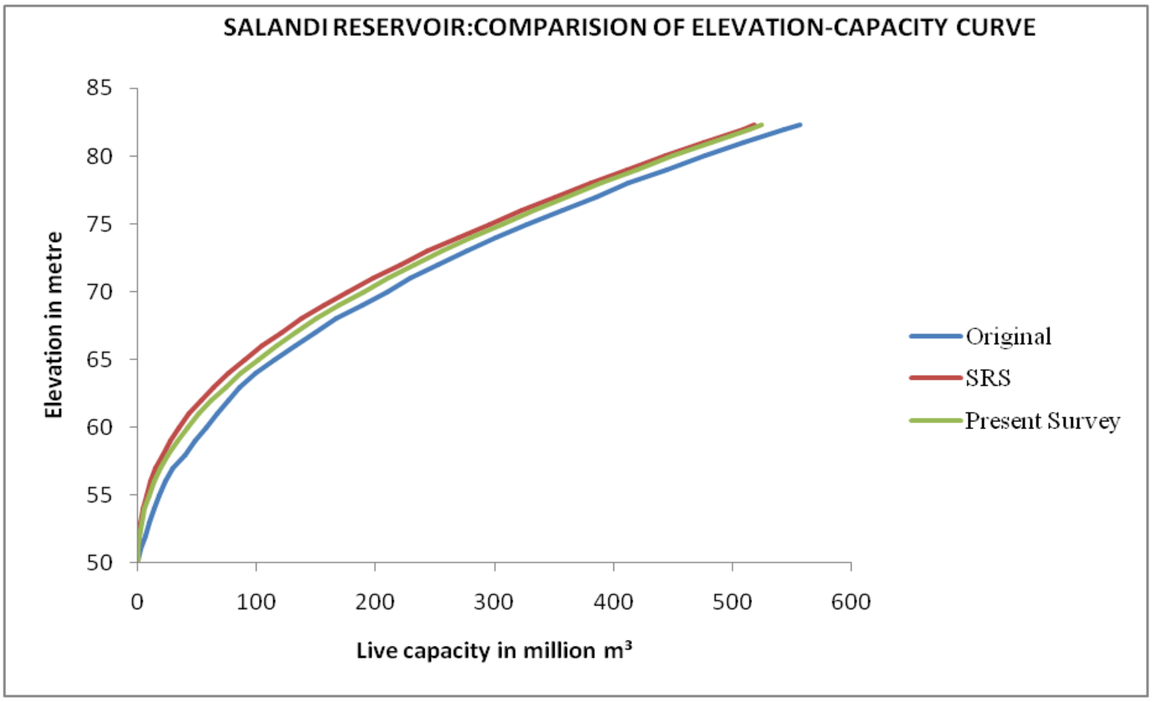


Figure 5.5Salandi Reservoir: Comparison of Elevation-Capacity Curve (2017)

Table-5.5; Shows the comparison of live storage capacity of survey with original at various elevations. Curve showing comparison of live capacity of survey with previous survey.

Earlier it was believed that sediment always get deposited in the bottom elevation of reservoir affecting the dead storage. Silting takes place not only in the dead storage but also in the live storage space in the reservoir. The most practical means of maintaining the storage capacity are those designed to prevent accumulation of permanent deposits as the removal operations are extremely expensive, unless the material removed is usable. Therefore, the redemption of lost storage by removal should be adopted as a last resort. The removal of sediment deposit implies in general, that the deposits are sufficiently compacted or consolidated to act as a solid and, therefore, are unable to flow along with the water. The removal of sediment deposits may be accomplished by a variety of mechanical and hydraulic or methods, such as excavation, dredging, siphoning, draining, flushing, flood sluicing, and sluicing aided by such measures as hydraulic or mechanical agitation or blasting of the sediment. The excavated sediments may be suitably disposed off so that, these do not find the way again in the reservoir.

Table 5.6 Live storage capacity loss due to sedimentation

Details	Original(1982)	SRS, CWC (2009)	Present Study 2017
Live Capacity in Million m3	556.50	518.61	524.19
Loss in live capacity in Million m3	-	37.89	32.31
% live capacity loss(since 1982)	-	6.81	5.80
Annual % live capacity loss	-	0.25	0.16

From the table 5.6, it is observed that there is a loss of 5.80% of original capacity in 35 years i.e. from Original (1982) to 2017 whereas there is a loss of 6.81 % of original capacity in 27 years from Original (1982) to SRS (2009) CWC of the same Salandi Reservoir. The difference in capacity losses in year 2017 is observed greater than SRS (2009) CWC data because of only CWC are used cone formula for estimation of area. The formula used here is obtained by finding the best-fit polynomial equation at different elevations (Fig 5.2).
Further, it is to add that the live storage of reservoir is getting reduced due to siltation; a systematic effort has been made by various departments / organizations to evaluate the capacity of reservoirs. Various techniques like boat echo sounder, etc. being replaced by hydrographic data acquisition system (HYDAC) and HITECH method using Differential Global Positioning System (DGPS). The conventional techniques are found either time consuming or costly and require considerable manpower.

Estimation of Trap efficiency
The trap efficiencies calculated by using Brown's Method, Brune's Curve (Capacity-Inflow Method), and Gill method from 2007 to 2015. The trap efficiency by Brown method is determined by using the equation 1,
Which uses the capacity-area ratio and the K factor whose value is adopted as 1 as K=0.1 is showing underestimated values. The trap efficiency by Brune method is obtained using the equation 2, which uses the capacity-inflow ratio for medium sediment depending upon the size of the reservoir. The trap efficiency by Gill method is obtained by using the equation 3, which is for medium sediment. The trap efficiencies of this reservoir evaluated by using the above three methods are 94.03%, 98.01% and 99.94% respectively. Thus the average trap efficiency of the Salandi reservoir is obtained as 97.32%.

Table 5.6 Estimated trap efficiencies by different methods

Year	Capacity (Million m^3)	Annual Inflows (Mcum)	C/I Ratio	C/A Ratio	Te (Brown) %	Te (Grill) %	Te (Brune)%	Average %
2007	524.194	17.98	29.1543	15.751	94.0302	97.9997	99.9247	97.3182
2008	524.194	12.07	43.4295	15.751	94.0302	98.0127	99.9449	97.3293
2009	524.194	11.97	43.7923	15.751	94.0302	98.0129	99.9453	97.3295
2010	524.194	11.68	44.8796	15.751	94.0302	98.0135	99.9463	97.33
2011	524.194	12.08	43.3935	15.751	94.0302	98.0126	99.9449	97.3292
2012	524.194	6.73	77.8892	15.751	94.0302	98.0244	99.9645	97.3397
2013	524.194	22.16	23.655	15.751	94.0302	97.9905	99.911	97.3106
2014	524.194	22.77	23.0213	15.751	94.0302	97.9891	99.909	97.3094
2015	524.194	17.97	29.1705	15.751	94.0302	97.9997	99.9248	97.3182
	Average				**94.0302**	**98.0061**	**99.935**	**97.3238**

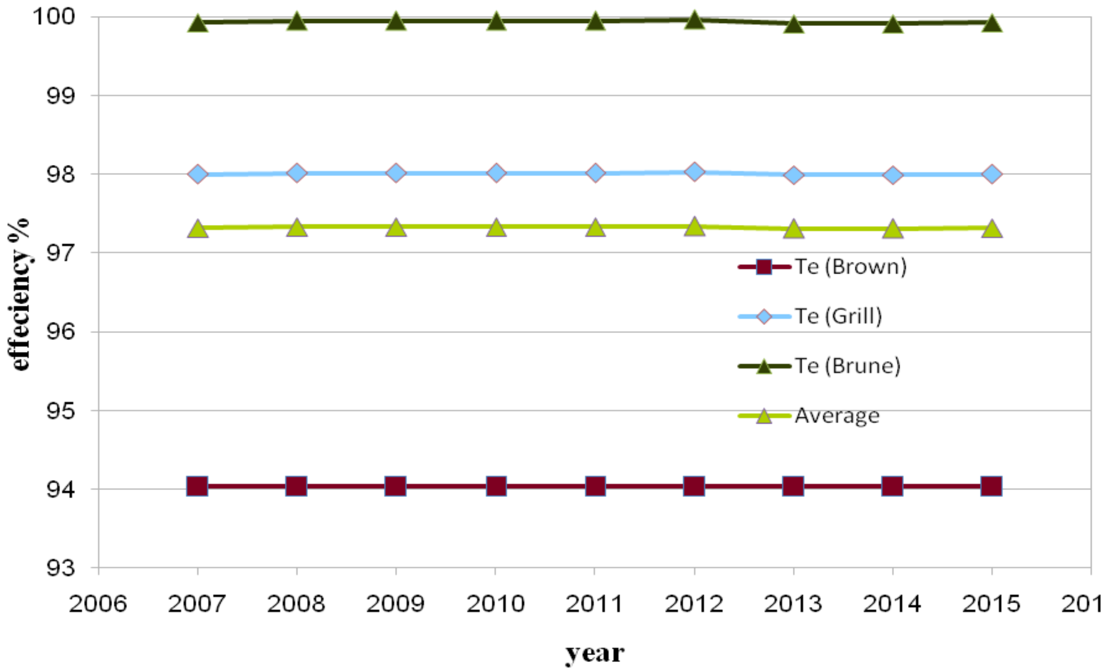


Fig 5.6: Trap Efficiency of Salandi Reservoir

VI. CONCLUSIONS

The project aims to the qualitative use of the Remote Sensing and Q-GIS that are employed to find out the area of the Salandi Reservoir. The area found out there on, is used to evaluate the capacity of the reservoir on the present day.

- The live storage capacity of Salandi reservoir has been found to be 524.19 Million M^3 in 2017 by using software against the original live storage capacity of 556.50 Million M^3in 1982.
- There is a live capacity loss of 32.31 Million M^3in 35 years which is 5.80% of original live capacity. Annual live capacity loss is 0.16%.
- The trap efficiencies of this reservoir evaluated by using Brown's, Brune's and Gill's methods are 94.03%, 98.01% and 99.94% respectively. Thus the average trap efficiency of the Salandi reservoir is obtained as 97.32%.

SCOPE FOR FURTHER STUDY

- From this research work further studies can be done related to the life span of Salandi Reservoir.
- The research work can be extended to interpret NDWI.
- The life expectancy and operational behavior of reservoir can be estimated through this study which will help provide us with the knowledge of sediment deposition rate, so that the desired reservoir capacity can be maintained.

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