

CONSERVATION OF RAIN WATER THROUGH ARTIFICIAL LAPASARI MINI RESERVOIR AN EXAMPLE OF COST EFFECTIVE APPROACH

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1.0 Introduction :

Water is the key of life. Every Living being cell is water dependent and water sustained. The resource which is so precious is no longer an infinite resource. Water shortage in general is now a global feature. In India, like Gujarat, Rajasthan, Orissa, Andhra, etc are facing draught situation frequently. In Gujarat state, before Narmada pipeline network laid to Saurashtra-Kachchh and north Gujarat, there are places where drinking water is made available by way of transportation through Railways and temporary pipeline projects with un-planned huge expenditure. Similarly, In urban area, population is increasing rapidly which has increased water demand. Rajkot is a case where water crises arises frequently. Population growth of the city is 5% which is very high in comparison to other medium towns and cities.

In the year, 1998 RMC increased its city boundaries more 35.00Sq.Km in old limits of 69.0Sq.Km. and city area become 104.00Sq.km. Recently Kothariya & Vavadi is also merged in the city area and total area at present is 123.65Sq.km. Because of the outstanding demand for release of water connections every years, RMC has examined the possibilities to increase the capacity of existing sources and to have conservative use of water on its availability.

Drinking water is survived through various sources like Aji-1 Dam, Nyari-1, Nyari-II Reservoir, Bhadar Reservoir, Narmada Canal based State water supply scheme etc. There is no GROUND WATER source available in Rajkot. (At present water supply to the city is 300MLD Year 2017. Exclusively 200MLD of water is from Narmada Canal-Pipeline)

1.1 Source identified to satisfy partial Water supply Demand of East Rajkot Areas :

Geographically, Aji-I dam is situated on U/S of the city area with its tributary Khokhaldali and Lapasari mini rivers which are meeting the River Aji on D/S of Aji-I dam but on U/S of city area. These tributaries meeting River Aji - and flowing through city from south end to North. This river divides city in to two part as east part of 30Sq.km & west part of 75.0Sq.km Finally it meets to Aji-II reservoir exactly on D/S of the city. Because of this geographical situation, wastewater quantity of un laid sewer area of Rajkot flows to the river Aji and mixed up with Fresh flowing water of Khokhaldali and Lapasari during monsoon as well as post monsoon which is finally get stored in to the Aji-II dam on D/S of the city. On commissioning of the sewerage system (Year 1994) of west bank of river city area, waste water flow has been reduced but still wastewater is flowing due to area not coming under sewerage network. Due to large quantity of wastewater coming in to this reservoir, Govt. of Gujarat, Water Resources Department. has kept Aji-II dam for irrigation purpose only.

Tributary of Aji-II catchments(Intercepted) namely Lapasari has a catchments area of about 17.05Sq. Km. and its rain water is flowing in to river and ultimately it goes to wastewater and can not utilized as drinking water. Enclosed layout/ Index map shows various water basins near by Rajkot coming under total catchments of Aji river up to Aji-II Reservoir.

1.2 A new approach for conservation of fresh rain water:

Here author/Consultants got an opportunity to design a balancing reservoir having medium sized capacity dam on U/S of Aji-I but in the isolated catchments of Lapasari tributary which is meeting the river Aji on D/S of Aji-I reservoir. Preparing reservoir (Dam) design of Lapasari as per the design criteria of state water resources department with a design of inter-linking pipeline by gravity, fresh rain water/ Flood water is diverted and conserve in the existing drinking water reservoir Aji-I. The Aji-I dam was designed and constructed in 1950 which is over designed in terms of capacity in those days when no such rainfall runoff co-relation mathematical equations were developed in hydrology. Only Stench's curves were used to design the capacity.

The levels of the lapasari dam site is permitting the flow to transfer the water to Aji-I Reservoir. Ultimately, project was prepared to construct a dam with small capacity of 30.16 MCFT (in place of 56.27MCFT) with very limited submergence and to take an advantages of four to five rainfall spells of about 15 days interval in the monsoon season which gives storage of 30mcft in each spell and to transfer it every time with in 07 days and keep ready empty again for next rainfall spell.

1.3 Details of Over flow of Aji-I dam Since 1955 :

Year	Total Rainfall in the monsoon in mm	Details of over flow
1976	700	30-8-76 with 50mm overflow
1979	1313	August -79 with 200mm overflow during year Machhu-disaster
2003	849	September -2003
2008	812	August-2008
2010		August -2010
2011		Full about to overflow August-2011.
2017		Overflow August-2017

2.0 OBJECTIVE :

Designing & constructing lapasari dam, It was examined that no irrigation potential shall be curtailed for Aji-II irrigation dam due to 17.05Sq.km intercepted catchments of Aji-II dam site. As per the Govt. of Gujarat directives, equivalent quantity of treated wastewater / year is regularly provided to Aji-II canal / Dam from RMC sewage treatment plant to compensate the irrigation potential. This project has solved **two major purposes** one is of irrigation and second is **conservation of equivalent quantity of portable water /year** through Lapasari Mini Reservoir with interlinking pipeline to Aji-I dam from Lapasari.

2.1 IMPLEMENTATION OF THE SCHEME / PROJECT :

Rajkot Rotary Club took keen interest in this project and with their efforts a proposal was submitted to get financial aid from international rotary. Because of the active Rajkot Rotarians representatives of International Rotary club visited the Rajkot and the said project site and fully convinced through a presentation. Finally they provided financial aid and an amount of Rs.1,29 Crore as grant in aid out of total cost of Rs.2.41crore (Year 2000-01) for this project. Rest of amount Rs.1.12 crore was managed by the corporation from their own fund / budget.

After approval of all designs of dam by state Govt. Water resource Department, a dam was constructed by the corporation with a capacity of **24.27 MCFT** capacity in stead its optimum capacity of **56.27MCFT as per the Hydrology**. A pipeline of suitable diameter (1200mm) was designed to transfer water daily about **2.5MCFT** and can be emptied up to dead water level with in **ten days**. This has helped in cost economy of dam construction about Rs.3.00 crore cost and a small submergence to acquire only the 14acre of land area for its total storage. In actual, submergence is very temporary (only during flood time) and same is utilized by those farmers to cultivate crop in the Rabi and summer season.

3.0 SALIENT FEATURES OF THE PROJECT :

3.1 Hydrology:

1.	Location	Proposed W/S Augmentation scheme based on river Bhakharvadi near village Lapasari, Taluka Rajkot.
2.	Average Annual rainfall :	601mm (48 Years data)
3.	Dependability	50%
4.	Dependable rainfall :	528mm
5.	Dependable year:	1957
6.	Catchments Area	17.05Sq.Km.
7.	Run-off coefficient	As per Govt. of Guj . Prevailing Orders.
8.	Dependable yield per sq. mile	0.2174Mcum.(7.68Mcft)
9.	Total dependable Yield from catchments area	1.473Mcum.(50.61Mcft)

3.2 Reservoir :

1.	FSL RL	157.30
2.	. HFL RL	159.50
3.	Gross Storage; Design	1.60Mcum (56.27Mcft)
4.	Actual provided : (Under designed as per limited submergence land acquisition)	0.687Mcum(24.27Mcft.
5.	Useful storage (Live)	24.27Mcft.
6.	Dead storage	5.89mcft.
7.	Land acquisition area	14.0Acre
8.	Total land area for submergence	26.70Acre
9.	Losses in Reservoir :	Nil As it transfer to Aji-I reservoir at the rate of 2.50Mcft/day.It gets emptied with in nine days.

3.3 Head Regulator :

1.	Type of HR	RCC Well type @ Ch 1665
2.	Sill RL of HR	154.30m. 1.0m d/n out going pipe IL 153.30m
3.	Tail end RL at Aji-I Basin Aji-I dam crest level 147.52m	147.245m Max Head available =7.05m
4.	Out going pipe dia 1000mm RCC P-2 class pipe	Slope provide 1:1400 with subsequent drops with RCC Shafts as per ground profile.

3.4 Waste Weir :

1.	Designed Flood discharge	398.44Cusecs.
2.	Length of weir	45.00m. (Ch. 1400 to 1445m)
3.	Flood lift	2.20m
4.	.Crest RL: Design	157.30m
6.	HFL RL	161.05 under designed 159.50
7.	Type of weir	Ogee Shaped

3.5 Earthen Dam :

1.	Length	1860mt.
2.	Top R.L Actual	161.00
3.	Top With	5.0 m
4.	Free Board	1.50m
5.	Slopes d/s	2.5:1
6.	Slope U/S	2.5:1
7.	Max. Height	8.785m.

3.6 Cost of the Project :

1.	Land Acqqsation	Rs. 46.67 Lakh
2.	E-Dam	65.39
3.	Waste weir	87.82
4.	Head Regulator	3.22
5.	Pipeline to Aji-I 1200mm dia RCC	41.50.
6.	Shifting of village roads, minor structures etc.	4.46Lakh.
	Total cost	Rs. 2.41Crore.

4.0 NET WATER UTILIZED AFTER CONSTRUCTION OF THE SCHEME :

Construction Year : January 2000-01.

Rainfall data: 2001 to 2010 (monthly /daily) (Data Source RMC & Irrigation Dept.)

Total replenishment in different years (June-October) after construction is as under.

Year	Period	Total rainfall in the season	Total replenishment As per RMC record	Capacity stored/ transferred in MCFT. to Aji-I reservoir	Losses in Aji-I reservoir 55%	Net Quantity used for drinking purpose by RMC In MCFT
2001	June-October	389	40.00	30.00	16.50	13.50
2002	June-October	325	32.00	32.00	17.60	14.40
2003	June-October	849	82.00	75.00	41.25	33.75
2004	June-October	636	61.00	50.0	27.50	22.50
2005	June-October	1014	97.00	90	49.50	40.50
2006	June-August	1013	100.0	90	49.50	40.50
2007	June-August	1354	130.00	110	60.50	49.50
2008	June-August	812	78.00	70	38.50	31.50
2009	June-August	573	55.0	50	27.50	22.50
2010	June – August	538	52.00	50	27.50	22.50
					Total	412.65
Net average quantity /year utilized for drinking purpose by RMC						41.25MCFT

Notes :

1.0 As per Designed yield series 528mm is giving replenishment of 7.68mcft water/one sq. mile. (As per 50% dependability as per design norms of Govt. of Gujarat for average total. rainfall between 15 to 30 inches) Lapasari has got 6.59 Sq.mile CA. which gives 50.61MCFT (As per DPR)

2.0 Evaporation & absorption losses average annual in Aji-I basin as per govt. survey is 55%.

5.1 Sustainability of the Project:

This reservoir has got **Zero O & M as gate of HR is kept open** . Spillway is ogee shaped with apron type energy dissipation constructed with Stone masonry & concrete which has No maintenance. **No additional or special staff is occupied** for its O & M. Therefore, It has almost Zero operation & maintenance. Due to limited submergence and continuous transportation of storage by gravity pipeline no danger to near by village Lapasari. during flood.

Conservation of water is the only way we can save the millions. Every drop counts its value. Here, Fresh water conserved through artificial arrangement and utilized for drinking purpose for more then **15,000 population throughout the year** at a **zero production cost** and without additional O & M. within very small capital cost as under.

5.2 Cost Recovery benefit of the Project :

Cost of Narmada canal raw water **per KL** to RMC as per tariff of GOG. = **Rs. 8.00**

Average cost in city water supply after the treatment and distribution to consumer's tap (Rs.16 / KL in scarcity years and Rs.11/ Kl in normal year respectively)

Net Average benefit of raw water / year = 41.25MCFT /35.315
= 1.168MCUM ie. 1168000m3/year.

An average amount saved/ benefited to RMC = Rs. 93,44,000.00 /year.

Recently the rates are reduced by GOG to Rs.4.00/KL and hence since rates reduced benefit is reduced to 50%.

This benefit is continuing for long life.

With in first three years monsoon water, 100% cost is recovered and it has saved small but partial procurement of water from Narmada. This benefit will be continuing for ever to RMC.

5.3 Potential for replication :

Water is utilizing for drinking purpose for more then 15,000 population with net 3000 water supply house connections throughout in each year.

PHOTOGRAPHS

1. Construction Phase :



2. Inaugural Phase :



3. Operational Phase:

