

TERA VILLAGE LAKE: SCOPE FOR TOURISM

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Introduction:

Tera [Lat. 23°17' North & Long 68°56'06" East] is a historic village (500 years old) in Abdasa taluka (13 km) of Kutch district (84 km from Bhuj) in Gujarat State of India. It lays on the banks of Tretara (Three lakes) namely Chattasar, Sumrasar and Chatasar. There are three ancient man-made lakes adjacent to each other in vicinity of village, which provides water for village needs and are interlinked through underground channels. The interlinking of these three man-made lakes known as *talavs* in local language is a fascinating work of engineering and water management. It is a remarkable example of traditional knowledge of water conservation and management. (Wikipedia)



Figure 1: Tera fort adjacent to lake

According to a study “Reviving a Water Heritage: Economic and Environmental Performances of Traditional Water Harvesting Systems in Western India” reveals that Rukmavati River traverses south east to North West and crosses village Tera in the north. The river is ephemeral in nature and flows for few days in monsoon season only. (Keshab Das, 2002)

The talavs are reservoirs connected with each other in such a way that the overflow of first talavs fills the second talav and overflows to the second talav and falls in the third talav. Overflow of the third talav spills over to the river. The talavs are dug from ground level to levels below ground level to depths (-) 6-8m bgl. The soil, which is obtained on digging, is used for raising embankments on the side. In the present study the focus was mainly on Sumrasar talav (spread area: 6000 m², average volume: 20,190 m³) which is used for drinking water purpose.

Origin of Research problems:

- *Social Health & Economical Aspects:* The health issues affecting Tera village are mostly diabetes, arthritis, blood pressure, skin ailments, paralysis, fever, waterborne diseases etc, due to the current water supply which has low water quality. The survey shows water deficiency for the households at 37 percent. At present, farming is the main occupation of inhabitants but also crafts such as Bandhani, block printing, mirror work and *Jats* embroidery also provide main revenue. (survey report by Chandra, 2014)
- *Ecological & Environmental Aspects:* From the above survey work, it indicates need for continuous study of lake water became essential because of dependency of people on these talavs for daily requirements. Therefore water quality analysis for done in Jan – 2014 & Jan – 2015, to study the chemical and microbiological characteristics. (Sandeep, 2015 & 2016) Tera and its environment are furthermore noted for a variety of wildlife, including chinkaras, blue bulls, wild boars, hyenas, great Indian bustards, peacocks, black partridges, desert foxes, Indian wolves, caracals, wild ass, etc. (Wikipedia)
- *Religious, Cultural & Historical Aspects:* By other references and observations made during the field study & survey it revealed that this place has unique features of architectural village setup, historically important fort and Kutchi culture, pilgrim centres like temples of Pingleswar Mahadev, Goddess Modheshwari and Goddess Ashapura for Hindus and five Derasar together at Kothara, Naliya, Jakhau and Suthri make it *Moti Panchtirthis* (or Greater Pilgrimage) for Jains including *Kanch Mandir* (Glass Temple), as there are elaborate carved paintings on glass inside the temple with an idol of Parshwanath carved on black marble. Also this place is in the vicinity of Rann Utsav (White Desert Festival, an annual celebration) conducted by Govt. of Gujarat.

Rationale:

On the basis of above studies, it shows that Tera has variety of feature in terms of different classes of tourism viz; pilgrim tourism, nature and wildlife tourism, historical and cultural tourism, recreational tourism, business tourism, etc. In order to protect the place from the negative impacts due to loss of biodiversity and degradation of water quality, it becomes important to focus on development of tourism activity in near future as a source of employment for local people, a revenue generation for the government and conservation of environment. Since the environmental problem at Tera is due to lack of economic support, it is essential to work on improving lives of people and then automatically will influence the environment positively.

Objective:

The objective of research was to study the possible problem which may come in the way of development of tourism in this village.

Methodology:

The primary data available from the survey of Tera village done in 2014 and water analysis data of 2015 & 2016 were used to find out the real problem of villagers in maintaining the lake in good condition. The survey was done by a narrative and detailed Questionnaire method to obtain information during field visit to reach total of 165 respondents. The study of water quality parameters included analysis in laboratories which are as follows:

Physical Parameter: pH, Conductivity, Total Dissolved Solids were analysed. (Ref: Standard Methods for the Examination of Water and Wastewater; APHA, AWWA, and WEF, 21st Edition, 2005)

Chemical Parameters: Hardness, Carbonates, Bicarbonates, Chlorides and Organic Carbon were studied. (Ref: APHA, Standard Methods for the Examination of Water and Wastewater; 2005) (Ref: Trivedi R.K and Goel P.K, Chemical and Biological Methods for Water Pollution Studies, Environmental Publication, India 1986)

Chemical analysis: Heavy metal analysis was done. (SAIF, Indian Institute of Technology, Mumbai)

Microbiological: MPN, Total Microbial Count & Biochemical assay were done. (Ref: Vivekanand College, Chembur, Mumbai)

RESULT & DISCUSSION:

Table no. 1: Microbiological test of Sumrasar talav:

Sr. No.	Test Standard	Specification Requirement as per (I.S 10500 - 1991)		
		Microbiological Test on 31/01/2014 of Sumrasar Talav		
1	Total Coliform Organisms (MPN)	2.00		
2	E Coli, No./100ml	APHA 9221 C, SM 22nd Edi.	Not detected	No Sample Should Contain E. Coli in 100 ml

Source: Geo tech Testing Lab, Bhuj (Jan, 2014)

Table no. 2: Chemical Analysis of Sumrasar lake:

Parameters	Result
pH	7.9
Total hardness (mg /lit)	160
Carbonate (CO ₃) (mg/lit)	225
Bicarbonate (HCO ₃) (mg/lit)	457
Organic Carbon (%)	0.7
Chloride (Cl) (mg/lit)	49

Source: RKT College, Ulhasnagar (Feb, 2014)

Table no. 3: Heavy metal analysis of Lakes (L - 1 & L - 2): [ND – Not Detectable or less than 0.01 ppm]

Sample	Cu	Fe	Pb	Cd	Cr	Ni	As	Hg	Se
L - 1	ND	ND	ND	ND	ND	ND	ND	ND	ND
L - 2	ND	ND	ND	ND	ND	ND	ND	ND	ND

Source: SAIF - IIT, Mumbai (Feb, 2015)

Table no. 4: Microbiological analysis of Lakes (L - 1 & L - 2):

Parameter analysed	Lake 1(L1)	Lake 2(L2)	Standards (Maity)
Total Microbial count Media used: Plate count agar, Incubation 37°C for 24 hrs, pour plate method. Results are in the form of colonies seen in the plates	141 cfu/ml	237cfu/ml	??
Most probable number (MPN) Media used : Lauryl tryptone broth with inverted Durhams tube .Results are noted in the form of acid and gas production , Incubation 37°C for 24 hrs	All the tubes i.e. 10ml 1ml and 0.1 ml inoculations showed the presence of acid and gas	All the tubes i.e. 10ml 1ml and 0.1 ml inoculations showed the presence of acid and gas	In drinking water must not be detected in any 100 ml sample
Hardness	560 ppm	640 ppm	75 mg/L as a maximum acceptable limit for ISI and 200 mg/L as excessive limit
Conductivity	267 microsiemens /cm at 23 °C	230 microsiemens /cm at 23° C	No standards for drinking water
TDS	135 ppm at 50%	115 ppm at 50%	ISI(1983,1991) 500mg/L is maximum and beyond this the palatability decreases and may cause gastro intestinal irritation
Sulphate	7 mcg/ml	8.5mg/L	ISI 200mg/L(max) to 400 mg/L (max permissible in absence of alternate source 1991)
Nitrate Standards :	0.4mg/L	0.22mg/L	ISI 1983 45mg/L beyond this limit met haemoglobinemeia takes place and max permissible is 100 mg/L
pH	4.6	4.6	6.5 - 8.5
Gram staining (Isolation carried out on Nutrient Agar)	In both the lakes there gram negative short rods were seen. There were also pigmented organisms observed and the following are the results 1. Orange colony- gram positive cocci in clusters 2. Yellow colony –gram positive cocci in clusters 3. Light orange colony - gram positive cocci in clusters 4. Orange colony gram positive cocci in clusters 5. Yellow colony – gram negative rods		

Source: VES college of Arts, Science and Commerce, Chembur, Mumbai (Mar, 2015)

Table no. 5: Identification results of isolates - **Gram negative isolate** (Reference: Bergeys Manual)

Test	Result
Indole test	Negative- no production of pink ring with Kovacs reagent
Methyl red test	Positive – production of red colour with Methyl red reagent
Voges Proskaver test	Production of pink colour with Omearas reagent
Simmons Citrate test	Negative – no production of blue colour, citrate not utilized
Nitrate test	Brick red colour present with Griss Illoways reagent
Oxidase	Positive
Catalase	Positive
Glycerol	Growth present
Sucrose	Growth present
Lactose	Not utilized
Glucose	Growth present
Galactose	Growth present

Source: VES college of Arts, Science and Commerce, Chembur, Mumbai (June, 2015)

Table no. 6: Identification results of isolates - **Gram positive isolates** (Reference: Bergeys Manual)

Test	Colony 1	Colony 2	Colony 3	Colony 4
Colony characters	2 mm , irregular Orange pigmented Opapue, smooth, Gram positive cocci in clusters	1 mm , irregular Orange pigmented Opapue, rough Gram positive cocci in clusters	4 mm , irregular , Light Orange pigmented Opapue, smooth Gram positive cocci in clusters	4 mm , irregular Yellow pigmented , Opapue, rough Gram positive cocci in clusters
Simmons Citrate test	Negative – no production of blue colour, citrate not utilized	Negative – no production of blue colour, citrate not utilized	Negative – no production of blue colour, citrate not utilized	Negative – no production of blue colour, citrate not utilized
Nitrate test	Negative – No Brick red colour present with Griss Illoways reagent	Negative – No Brick red colour present with Griss Illoways reagent	Negative – No Brick red colour present with Griss Illoways reagent	Negative – No Brick red colour present with Griss Illoways reagent
Oxidase	Negative	Negative	Negative	Positive
Catalase	Positive	Positive	Positive	Positive
Glycerol	Growth present	Growth present	Growth present	Growth present
Glucose	Growth present	Growth present	Growth present	Growth present
Motility	Non motile	Non motile	Non motile	Non motile
7.5% NaCl	No growth	No growth	No growth	No growth
Starch hydrolysis	Negative – no colourless zone when starch plate flooded with iodine solution	Positive - colourless zone when starch plate flooded with iodine solution	Positive - colourless zone when starch plate flooded with iodine solution	Positive - colourless zone when starch plate flooded with iodine solution
Result – needs further confirmation	<i>Micrococcus roseus</i>	<i>Micrococcus</i> , <i>Stomatococcus</i>	<i>Micrococcus</i> , <i>Staphylococcus</i>	<i>Micrococcus nishinomiyaensis</i>

Source: VES college of Arts, Science and Commerce, Chembur, Mumbai (June, 2015)

Interpretation:

1. Microbiological Analysis: As per table no. 1 presence of E. coli has not been indicated in 100ml sample but the MPN shows 2 for Coliform which reveals that water is not suitable for drinking as per the standards. The diseases associated with this have also been reported during survey conducted. Presence of gram positive and negative cocci bacterias are seen as indicated in table 4, 5, 6. This also reveals the severity of water condition.
2. Chemical Analysis: As per table no. 2 water quality parameters shows concentration to be on higher side in comparison with Indian Standards prescribed for drinking water. Acceptable value for hardness is 150 mg/L, Alkalinity should be below 150 mg/l, Chlorides should be less than 10 mg/l but here it is 5 times more. The higher range of these parameters is due to human interference as well as due to natural constitution of soil of this region. It's good to see that the lake water contain negligible concentration of heavy metals, as shown in table no. 3.

Discussion:

The chemical analysis of lake waters indicates hardness high above the limits mentioned. In the village survey also people have complaints about lake water to be hard and not advisable to drink. Since the geological record shows limestone and sandstone in abundance in soil and rocks of these regions, there could be possibility of increase in hardness (Krishnan, 1982).

The average rainfall is about 380 mm ranging from 440 mm in southern Kutch to 338 mm in western Kutch (Raju 1995). It is reported by the villagers that one spell of 150mm rainfall at the catchment Bhavanipar is sufficient to fill all the three talavs. (Keshab Das et al, 2002) The rainfall ranged between 78–888 mm during 2000 – 2010. It only rains a few days per year in Kutch (15 days on average) and is considered to be a drought prone district as droughts are a recurring phenomenon (Mehta 2001, Lamba and Kapoor 2006, Joshi et al. 2009).

The chemical analysis result shows less salinity since the talav water is rainwater, but bacteriological study indicated presence of Coliform bacterias. The water needs to be treated with chlorine or bleaching powder. (Keshab Das, Nov 2006). The hardness, bicarbonates & chlorides seems to be on higher side of concentration scale and MPN for 100 ml sample of water indicated 2 organisms, which shows presence of Coliform due to fecal matter source (Sandeep, 2014)



Figure 2: Lake Water pollution

Observations:

Tera was the first Heritage Village declared by the government of India. Tera lies on State Highway 49, which connects it to Bhuj, Naliya and Jakhau. Accommodation and hospital facilities are also available in village. Education in Tera is provided by two primary schools and the Sri Tera Gomtiben Naranji Bhadra High School. There are three ancient man-made lakes adjacent to each other in vicinity of village, which provide for the water needs of the village. The Darbar Gadh, the house of the Chief of Tera. The house features original Ramayana wall paintings, produced by *kamanger* painters; the paintings total 21.9 metres (72 ft) in length and 87 cm in width, and cover all four walls of the Chief's bedroom.

With the availability of natural environment, heritage, culture, historic background and the prosperity of the Gujarat State with the support of Govt. of India, the lakes can be preserved properly. Even the Article 51 A (g) of Fundamental Rights under Constitution of India speaks about conservation of lakes. As per Conservation & Management of Lakes – an Indian Perspective, July 2010 there is no allocation of funds for Gujarat state.

Recommendations:

Regular purification of water, cleaning process and spraying of disinfectants can remove microbes as well as it will help people to solve their drinking water problem. The water of the lake can be used by villagers for domestic purposes continuously without any interruption. This continuous supply is possible with the effort made by government, local people and NGOs by providing facilities like toilets, piped drinking water supply, protection of lake from intruders, desilting process. Apart from this with the help of private public participation can establish socio-economic, cultural & environmental events like; Afforestation, boating in lakes, Camel riding in nearby desert and heritage festivals celebration in winter season etc. A

small amount of attention can change the scenario of the lakes and improve the living conditions of the people by providing employment in tourism industry. Availability of electricity shouldn't be an issue since Bitta Solar Power Plant (40-megawatt solar power plant) which was commissioned in 2012 is India's largest photovoltaic power plant, located only 10 km away from Tera.

Though the Tourism Year 2007 in Gujarat went unnoticed, the state is determined to deck up itself for more tourists. Tourism Corporation of Gujarat Ltd (TCGL) will soon begin work on the tourism development action plan report submitted by the Centre for Environmental Planning and Technology (CEPT) recently. The report aims at developing infrastructure of around 36 towns out of which Tera is one place identified as tourist spots in the state. The cost of the project, which is yet to be ascertained, will be borne by TCGL along with respective local authorities. The institute, in its study conducted over a period of nine months, found that instead of developing specific tourist spots, the government would be required to develop or even overhaul local infrastructure like transport system, hospitality, public amenities and health. "One cannot isolate a particular aspect of a town and develop it as a tourist destination and neglect its other parts. To promote tourism, TCGL will have to integrate all the government agencies like road department, irrigation, collectorate, municipal bodies and even the Archaeological Survey of India (ASI)," said PVK Rameshwar, in-charge of the action plan report at CEPT. The identified towns feature tourist spots ranging from historical monuments to Nature-based. Meanwhile, TCGL is believed to have begun talks with several local agencies to initiate work on restoration of monuments and local infrastructure. "Work on developing these towns will begin soon, once the cost for the project gets the nod in the state Budget," said PD Vaghela, managing director of TCGL. Vaghela, however, refused to divulge the details of the project cost. (Vinay Umarji, 2008)

On the basis of World Travel and Tourism Council (WTTC) report on Travel & Tourism Economic Impact India published in Mar, 2017 which says that the total contribution of Travel & Tourism to GDP was INR 14, 018.5 billion (USD 208.9 billion), 9.6% of GDP in 2016 and is forecast to rise by 6.7% in 2017 and to rise by 6.7% pa to INR 28, 491.8 billion (USD 424.5 billion), 10.0% of GDP in 2027. In 2016 Travel & Tourism directly supported 25, 394, 500 jobs (5.8% of total employment). This is expected to rise by 2.1% in 2017 and rise by 2.1% pa to 31, 910, 000 jobs (6.1% of total employment) in 2027.

Conclusion:

The scope for tourism in Tera can be visualized with the initiatives by TCGL, prediction by WTTC, scientific studies by Environmental & Economic researchers, Financial contributors, Government & NGO's.

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