ISSN: 2277-9655
Impact Factor: 1.852

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

A Study of Techno Economic Feasibility for Safe Drinking Water Supply in Coastal Village Nana Ashota in Jamnagar District, Gujarat

Rahul Oza
PG Student of Faculty of Technology & Engineering, M.S University of Baroda, India
rahuloza.engg@gmail.com

Abstract

This project is helpful to those people who live in the coastal based and they are suffering every year with problem of safe drinking water and not available throughout the year. It has given ideas, technology and economical way of solution for water crisis and it's also solving problem of scare by use of different methods to development new water source in water scare area of Saurashtra and Kutch in Gujarat.

Saurashtra land is containing of different types of minerals specially bauxite, calcite, fluoride so many mineral based industries are developed here and those who continuous need this as raw materials and they used many mines and processes units. These minerals are creating problem to polluted ground water some are melting and increasing TDS more than 6000 mg/l and Hardness of water.

Key words*: *TDS, Hardness, RO Technology, Water Harvesting.

INTRODUCTION:

Saurashtra has long sea shore and rain falls has not sufficient in amount or not even in time period since last 20 year so sea water intrusion inside the land in the several kilometers and to lead polluting fresh water. This can increase TDS and result of this makes unsafe water for drinking purpose.

For unsafe water, it is due to major contents of chloride, hardness of carbonation, more content of fluoride, magnesium and potassium, calcite, TDS is more than 6000 mg/l and it is not suitable for drinking water.

SELECTION OF VILLAGE:

Criteria for selection of village is minimum population near by 1000 , located near coastal based, scare in most of the year, near the calcite and bauxite mines, from the list of GWWSB and other Govt Agencies more than thirty villages of khambhalia and kalyanpure Taluka in Jamnagar District has covered under this criteria. Nana Ashota and Mota Ashota village is twin villages and just in 5 km distance between them and both are 35 km from the khambhalia city. Nana Ashota is less population and just 10 km from sea shore, many mines near this village. This village used only ground water and all wells of gram panchayat have unsafe declared by govt. agencies. Narmada water pipe line is passing from 20 km from the Village and extended up to this village will be in proposed work.

ISSN: 2277-9655
Impact Factor: 1.852

Fig1 shown Location of Nana Ashota Village

Population Table:

	Population base On year 2001	Population at present year 2013	Projected population after 10 year means Year 2023
No of population in village	1388	1688	2088

Water requirement calculation:

As per WHO and Indian BIS guideline used water requirement per capita per day is 20 to 30 lite so 2088 X 30 = 62640 liter

This 62640 liter per day + 10% extra + 10 % emergency service

= 62640 + 6264 + 6264

= 75168 say 100000 liter per day requirement

Village required 100000 liter of water per day

WATER QUALITY TABLE FOR VILLAGE WELLS:

(TESTED AND CERTIFIED BY GWSSB LAB AT JAMNAGAR)

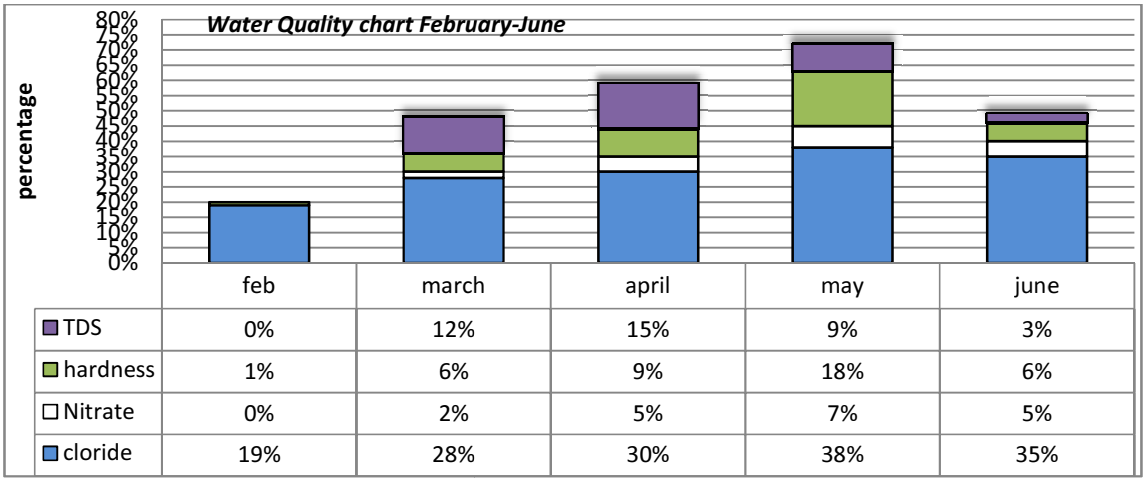
CHARACTERISTIC	DESIRABLE	PERMISSIBLE	WELL 1	WELL2	WELL3	WELL4
COLOUR HAZEN UNITS	5	25	COLERLESS	COLERLESS	COLERLESS	COLERLESS
ODOUS	U.O	U.O	U.O	U.O	U.O	U.O
TURBIDITY NTU	5	10	NIL	NIL	NIL	NIL
DISSOLVED SOLIDS (mg/l)	500	2000	7024	6880	5900	8200

ISSN: 2277-9655
Impact Factor: 1.852

PH	6.5 TO 8.5	----	6.68	7.2	7.1	6.9
TOTAL HARDNESS (AS CaCo3) mg/l	300	600	3144	3200	4050	4000
CALCIUM (AS Ca) mg/l	75	200	661	665	580	700
MAGNESSIUM (AS Mg) mg/l	30	100	373	363	345	380
CHLORIDES (AS Cl) mg/l	250	1000	2148	2400	2245	2346
SULPHATES (AS SO4) mg/l	200	400	524	498	560	552
NITRATES (AS NO3) mg/l	45	---	112.96	108	122	120.23
FLORIDES (AS F) mg/l	1.0	1.5	.18	.12	.29	.15
ALKALINITY (AS CaCO3) mg/l	200	600	160	140	180	190

- Above test was conducted for four different well in different month form September to February and it's average could consider

Water Quality problem chart Month v/s Wells:



	feb	march	april	may	june
TDS	0%	12%	15%	9%	3%
hardness	1%	6%	9%	18%	6%
Nitrate	0%	2%	5%	7%	5%
cloride	19%	28%	30%	38%	35%

DIFFERENT TECHNO ECONOMICAL METHODS:

- So many different methods are available to solve this problem by providing proper treatment plant and it is based on technical and economical . Criteria for selection of methods are Energy consumption ,Technical skill, Instrument availability , Local material available, Economic way, Less Maintenance , more Efficiency are used as prime factor

- These methods are

1. Reverse Osmosis Plant method
2. Thermal Distillation Process
3. Narmada Pipe line water Supply
4. Water Harvesting System

1) RO Plant

ISSN: 2277-9655
Impact Factor: 1.852

- The phenomenon of osmosis occurs when pure water flows from a dilute Saline solution through a membrane into a higher concentrated saline solution.
- Membrane is placed between two compartments. “Semi-permeable” means that the membrane is permeable to some species, and not permeable to others.

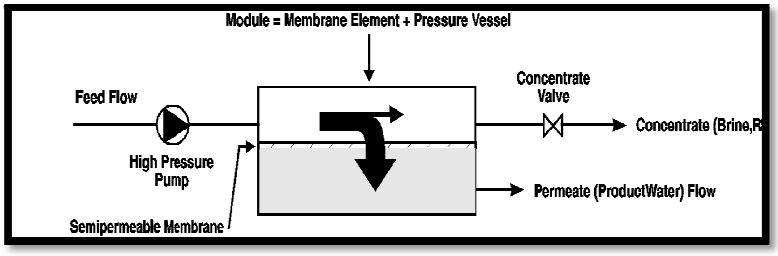


Fig.2 shown principle of RO Plant works

FLOW DIAGRAM OF RO PLANT:

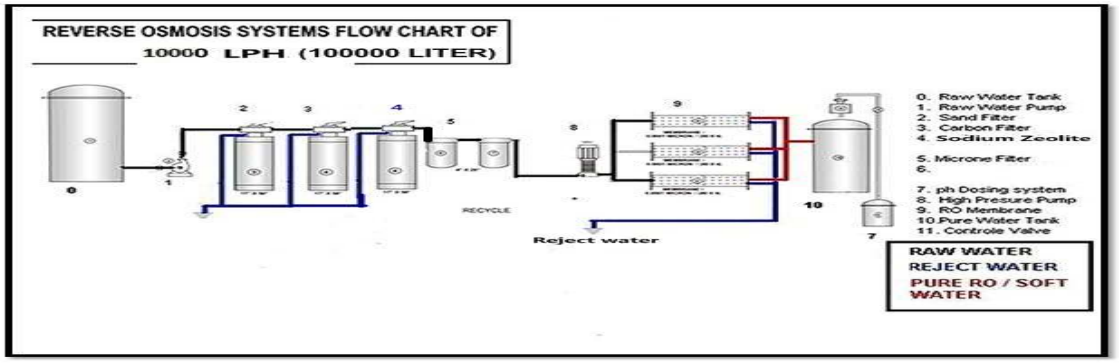


Fig. 3 shown Flow diagram of RO Plant Design at Village

DETAILS COSTING OF RO PLANT

Village name	Consumable Chemical & Sediment Cartridges per Annum in Rs (1)	Operation & Maintenance per Annum in Rs (2)	Total commissioning (1) +(2) = (3)	Per Month Electricity and Other Charges (4)	Total Electricity And Other Charges Per Annum (4) x (12)=(5)	Total Cost (add Rs 5500 Per Month for Membrane) (3)+(5)=(6)
Nana Ashota	3,50,000	2,50,000	6,00,000	7500	90,000	7,56,000

SUMMARY:

Capacity: 100000 liter per day
Installation cost: Rs 20, 75,000 /-
Maint. cost: Rs 7, 56,000/- per Annum
Land required: 50 sqmt RCC const.
Total men power: 2 No
Electric connection: 7 HP III phase

ISSN: 2277-9655
Impact Factor: 1.852

2): Thermal Distillation Process:

Shows a single-basin still the main features are the same for all solar stills. The solar radiation is transmitted through the glass or plastic cover and captured by a black surface at the bottom of the still. A shallow layer of water absorbs the heat which then produces vapour within the chamber of the still. This layer should be 20mm deep for best performance.

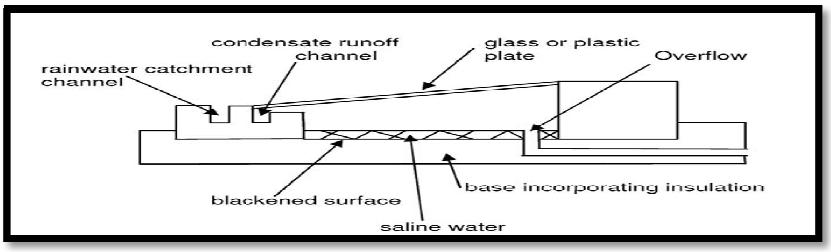


Fig4 Principle of Solar water Distillation Process

Calculation for solar drinking water:

- 4 liter required 1 sqmt of area

Then 100000 liter ? Sqmt required = (100000 x 1)/ (4) = 25000 sqmt

- 10000 sqmt required 1 ha

25000 sqmt required = (25000 x 1)/10000 = 2.5 ha

Summary:

- Capacity: 1,00,000 liter per day
- Installation cost: 1,75,00,000/- without subsidiary
- Installation cost: 1,05,00,000/- with subsidiary (40% subsidiary count)
- Size of panel : 120 cm x 60 cm
- Total area required: 2.5 ha (2500 sqmt)
- Per liter cost: Rs 0.06 per liter
- Maintenance cost: 1,00,000 /- per annum
- Men power requirement: 4 persons

(2) ***Narmada water supply:***

Drinking Water Supply Master Plan Based on Sardar Sarovar Narmada Canals was prepared in year 1996 and the implementation was started in July'1999. Under this project, it was planned to supply 3571 MLD (incl. industries) Narmada water to 8215 villages & 135 towns of 15 districts i.e. Amreli, Bhavnagar, Junagadh, Porbandar, Rajkot, Jamnagar

Problem for supply water through pipe line:

ISSN: 2277-9655
Impact Factor: 1.852

- Not sufficient water is available from Narmada pipe line means daily requirement of 50 MLD for ruler area of khambhalia Taluka but presently Narmada water supply only 20 MLD
- Upper part (ground level is high)from khambhalia village need more pumping station to construction in progress
- Need chlorination treatment to Narmada water
- Cost of Narmada water is app Rs 0.046 per litre with including cost of pumping and treatment of water
- Centralization control so depended on GWSSB or Control committee
- Pipe line is pass from 20 KM distance from the village

(4).Water harvesting in village:

Rainwater harvesting can be done at individual household level and at community level in both urban as well as rural areas. At household level, harvesting can be done through roof catchments, and at community level through ground catchments. Depending on the quantity, location and the intended use, harvested rainwater, it can be utilized immediately or after

Calculation of water harvesting:
S = R x A x Cr
S = Mean rainwater supply in m3, R = Mean annual rainfall in mm/year
A = Surface area of catchment in m2, Cr = Run-off coefficient = 0.8

Summary:

- Initial cost: Rs 1,65,000 /-
- Maintenance Cost: Nil
- Per 1000 liter cost is Rs 20
- Area Requirement : 25 SQMT
- Man power: Nil

Results and discussions:

Description	RO Plant	Solar water	Narmada water	Water harvesting
Cost per 1000 litre	Rs 30	Rs 60	Rs.50*	Rs. 20
Maintenance	YES	NO	YES	NO
Quality of output water	GOOD	EXCELLENT	FAIR	FAIR
Energy Requirement	YES	NO	YES	NO
Investment per 100000 litre/day	2075000	10600000	2500000	165000
Area req.	50 sqmt	2.5 ha	20 km pipe line network	Underground tank

*Including cost of pumping and treatment of water

Conclusion & Recommendation:

1. **Water Harvesting:** is very best suitable techno economic method in this region. This system is less costly, requires less maintenance, less initial cost but it depends annual rainfall and its uncertainty so this is not a reliable method.

- Individual storage of water is not possible for very dense and small houses. Initially Cost is very high for construction work.
- Many houses have very old pattern so water harvesting has been very difficult to implement in this village.
- Secondly, bacteria and virus are mostly present in the stored water so the use of water harvesting system is not possible without treatment of chlorination.

ISSN: 2277-9655
Impact Factor: 1.852

- **RO plant** : is next best suitable for this region but its cost and maintenance is very expensive and laborious.
- Mainly RO plant is suitable for small community and gives best result against TDS, Hardness of water and its purification some processes if modified or included will give best result for ground water.
- Its gives independency for control of water purification, liberty for quantity used and to change the process according to requirement.
- Cost depends on energy used by pump but if use of solar panel is made it will generate more energy and less cost production of RO Plant.
- This method is very easy to operate and hence it does not need any skilled operator.
- It gives independency for control of water purification, liberty for quantity used, changing process according to requirement.
- Cost has been depended on energy used by pump but if uses of solar panel and generated of energy which has best option to reduce cost in RO Plant.
- This method is very easy for operation so did not need any skill operator

- **Narmada pipe line:**
- water supply is the third and very effective method than above two methods because it requires less maintenance and assures reliable water supply
- Narmada receives water from Sardar Sarovar Dam which is more then 1000 KM distance so it requires huge effort to carry water through pipe line and during this process if any single fault occurs it will cause problem of water supply.
- No independence of village authority for water carrying system it totally depends on water control and supply authority.
- Narmada water supply saves cost treatment expenditure as it needs only chlorination treatment amount.

4. **Solar** :

Solar treatment is the fourth effective condition as it requires more space and its initial cost is very high.

- Solar needs natural resources which are available in plenty in this region. This method is very cheap as it incurs only one time installation cost but it requires huge and flat land which is not found in the village because of many mining sites around it.
- Solar panel is badly affected by the moisture and soil dust present in the sea wind caused during the mine excavation process .this harmful agents stick on solar glass panel and reduce its efficiency. Hence, maintenance of cleaning solar panel has to be carried out very often.
- No other energy is required hence it reduces human effort

Finally the best option to use the method is R O Plant will give best result in this village

RO Plant Model:

- Conclusion can shown that RO Plant is very appropriate for this village and finally we decided to developed one mode which same protato type which will construct at village for purify water .
- This model is very effective and carried out many test in the laboratory which understand that design of each units are suitable according to their criteria and check result of output with we predicated and also find efficiency of model.

Following practical are performed in the laboratory:

1. MPN
2. Total Dissolved solid
3. Total Hardness
4. PH

- This four test samples have collected from following points

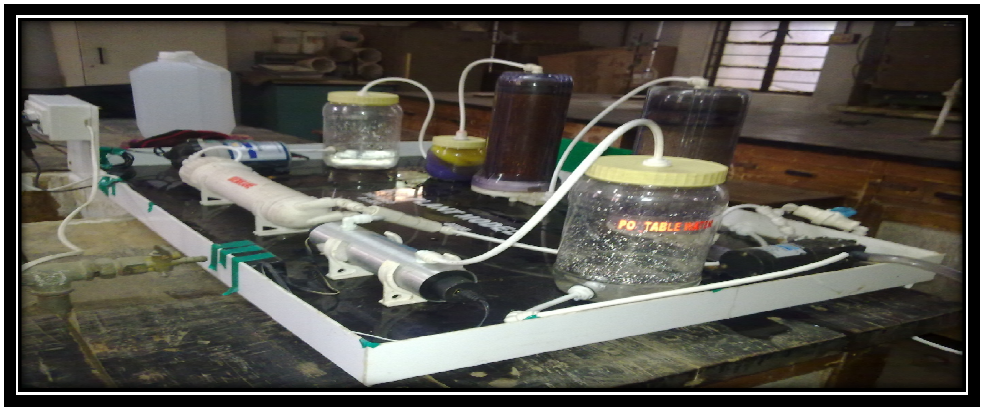
ISSN: 2277-9655
Impact Factor: 1.852

- Initial point – start point
- Intermediate – after softening
- Final point – after UV

Comparison for Input & Output water:
(TESTED AND CERTIFIED BY GWSSB LAB AT JAMNAGAR)

Sr. no	Description	Permissible Mg/l	Input Mg/l	Out put Mg/l	Efficiency in percentage
1	DISSOLVED SOLIDS	2000	7024	561	92.01 %
2	PH	6 to8	6.68	8	----
3	TOTAL HARDNESS	600	3144	140	76.66 %
4	CALCIUM (AS Ca) mg/l	200	661	133	69.74 %
5	MAGNESSIUM (AS Mg) mg/l	100	373	40	89.27 %
6	CHLORIDES (AS Cl) mg/l	1000	2148	540	74.86 %
7	SULPHATES (AS SO4) mg/l	400	524	110	79.00 %
8	NITRATES (AS NO3) mg/l	45	112.96	30	73.44 %
9	FLORIDES (AS F) mg/l	1.5	0.18	0.2	5%
10	ALKALINITY (AS CaCO3)	600	160	175	0.09%

Model photograph:



References

1. Baseline survey on salinity in coastal areas of Jamnagar, Gujarat (2008)
2. Coastal Area Development Programme
   a. *Ensuring water security and promoting safe sanitation in the coastal Villages of Gujara*

ISSN: 2277-9655
Impact Factor: 1.852

3. Assessment of Ground water Hazards in Coastal Belt of Jamnagar Dist. Gujarat
4. Ground water Recharge of Costal Area
5. Irrigation and water supply by arora
6. Ground water scenario of India 2009-10, ministry of water resources
7. Planning Commission, 2002, India Assessment: Water supply and sanitation