Volume 2, Issue 5 May 2016 ISSN NO: 2454 - 2326

North Asian International Research Journal Consortium

North Asian International Research Journal

Of

Multidisciplinary

IRJIF IMPACT FACTOR: 3.52

NAIRJC JOURNAL PUBLICATION

North Asian International Research Journal Consortium

Welcome to NAIRJC

ISSN NO: 2454 - 2326

North Asian International Research Journal is a multidisciplinary research journal, published monthly in English, Hindi, Urdu all research papers submitted to the journal will be double-blind peer reviewed referred by members of the editorial board. Readers will include investigator in Universities, Research Institutes Government and Industry with research interest in the general subjects

Editorial Board

Address: - Dr. Ashak Hussain Malik House No. 221 Gangoo, Pulwama, Jammu and Kashmir, India - 192301, Cell: 09086405302, 09906662570, Ph. No: 01933-212815,
Email: nairjc5@gmail.com, info@nairjc.com **Website:** www.nairjc.com

IRJIF IMPACT FACTOR: 3.52

IMPLICATIONS OF TECHNOLOGY IN WATER MANAGEMENT: A CASE STUDY OF WESTERN RAJASTHAN

DR. TEJBIR SINGH RANA [1], MR. BHARAT RATNU [2] & DR. SUKHRAM [3]

Associate Professor of Geography [1], Assistant Professor of Geography [2], Assistant Professor of Sanskrit [3], Shivaji College, University of Delhi. Raja Garden, Ring Road- 110027

ABSTRACT

In contemporary world, man is bestowed with technology in varying intensities for the exploitation of resources without compromising the pristine entity of nature. Western Rajasthan has semi-arid to arid climate, sandy and poor humus soil, short rainy and long dry season, poor and brackish ground water which only to support the extensive farming for minimum subsistence. In the current past, the introduction of mechanization in agriculture has increased the pressure on both the land and water resources. The submersible tube wells replaced the conventional wells to extract the ground water for irrigating the crops. It increased the intensification in agriculture so that ground water depleted to its maximum and resulted into diminishing return in agriculture. This practice of pumping out the entire ground water with the help of modern technology leads to sustainability with decreasing carrying capacity of the region. The over utilization of water registered a convincing change in the social and economic life of the people with series of implications. The study deals with the role of technology where human economic greed leads to the over exploitation of water without considering the interest of generation to come and ignoring the convectional water resource management system in the water deficit region.

Keywords: ***Convectional, Cropping pattern, Groundwater, Hod, Nadi, Sustainability, Submersible pumps, Tractor-tanker.***

INTRODUCTION

Water is precious for the survival of life. Potable water is in dearth. Conserve water. Save rivers. Minimize the use of ground water. Switch-on to Rain water Harvesting.

How many times have you heard/read the phrases with a nonchalant face or debated about it with colleague and then sent it to junkyard of memory? **Each time!**

The easy access of technology to overcome the adversaries of nature in water deficit western Rajasthan resulted into over utilization of water in every sphere of life. Extracting groundwater with the help of submersible tube-wells has depleted the ground water table which accumulated in millions of years by completely pumping out from the sub-surface for commercialization and intensification of agriculture. This practice of over utilization of water in arid and semi-arid climate is not in accordance to the natural conditions. The human response in such conditions leads to sustainability and future generations are bound to face the consequences even for their minimal survival.

The introduction of tractor-tankers to supply the drinking water to each household at their door step at minimal price resulted into adoption of liberal attitude by the local people towards the water and large amount of water is wasted and drained into streets without channels. Conventionally, the local folks used to fetch drinking water in earthen pots on head from miles away; therefore they were very conservative about utilizing water in sequential manner. Simultaneously the use of water in various household activities like washing the floor and cloths also started which subsequently increased the consumption of water. The shift from manually fetching water to the tractor-tankers increased the water demand for various household activities. The rural people started discharging water into streets which get accumulated in front of each house, becoming the ideal breeding ground for mosquitoes resulting in plethora of diseases become rampant even in the rural remote villages of western Rajasthan.

The supply of drinking water by the tractor-tankers to the door steps of each house resulted into the non-maintenance of common water bodies therefore catchment area of water bodies are being encroached upon by the human settlement and large number of conventional water bodies lost their identity. The social value of community participation for village common water bodies management become dismantled and resulted into the disappearance of such water bodies which were once the main source of water for drinking and livestock purposes. Subsequently, the pattern of human habitation also changed from wet point settlement to road side settlement as most of the convectional wells dried up. So housing locations shifted to road side where tractor-tanker could supply potable water without any hindrance.

The technology provided alternate sources of irrigation round the year therefore the intensity of submersible tube-wells increased manifold which changed the cropping pattern of the region. Some of the crops which require less

water with lesser remuneration as wheat, bajra, jowar, pulses, til, and gram etc. are being replaced by more water consuming crops with higher remuneration as cotton, mustard, vegetables, chilies and onion.

On the one hand, where use of technology resulted into depletion of ground water table while on the other hand, the village common water bodies are not managed properly. The MNREGA has been providing employment for digging and deepening the ponds which has led to removal of the finest clay from the bottom of the pond up to the level of porous soil. During rainy season these water bodies do accumulate the rain water but get dried out very soon due to the increased porosity of the soil in the bottom of the pond. Thus, pressure was mounted on already limited supply of water as regards with increasing demand bringing attention to the constant crisis between nature and development is getting intricate.

STUDY AREA

The project focuses on the preparation of inventory of water conservation techniques/approaches being practiced and presenting new techniques which can be implemented in Western Rajasthan. The region is arid to semiarid with low and erratic rainfall, high summer temperatures, low humidity and high-velocity wind causing an average potential vapor transpiration of 2,000 mm, a negative water balance and acute water deficit.

Table.1. Per Capita Water Availability in m^3.

Year	National Average	State Average of Rajasthan
2001	1820	840
2025 (projected)	1341	561
2050 (projected)	1140	439

Source: Ministry of water Resource.

The per capita availability of water is continuously decreasing as the quantum of water supply is almost constant while population size and consumption pattern is continuously increasing in the region. Droughts of varying intensity are a recurring phenomenon in the region. During 1901-2003, western Rajasthan experienced 20 moderate droughts (with 50% to 75% of the normal annual rainfall). The project work concentrates on recent field visits to parts of Jodhpur, Jaisalmer and Nagaur. All the villages have been chosen precisely for their distinguishing characteristics as follows:-

1. **Beetan:** A village in Merta tehsil, Nagaur district which supplied drinking and other domestic water from a nadi (village common water pond) through tractors-tankers. It reflects extraordinary community participation where three sq.km catchment area of the pond has been fenced with barbed wires and a security guard is deputed to check the desecration as the same water is used by all the villagers round the year. The ground water table of the village is more than 550ft. and with high fluoride contents making it non-potable.

2. **Chowkri Kalan:** A village in Pipar tehsil, Jodhpur district which is supplied water through a central tank filled in by IG Canal through pipelines/tankers. The village had minimal community participation for the conservation of common water bodies as villagers had regular water supply through tractor-tankers. Subsequently rain water harvesting techniques have diminished from the region where conventionally they were a regular practice. The ground water table of the village has depleted rapidly in the last few year to a depth of 350ft.

3. **Nedayi:** A village in Jaisalmer district on the margin of a distributary canal of IGC zero head. It is socially segregated on caste basis and thus displayed contrasting picture of habitation. The water sensitization and conservation is observable only among high castes. Water was being supplied directly from IGC through tankers as per demand without any delay and scarcity.

4. **Thaiyat:** Located in Jaisalmer district, this village is supplied water through a central tube well, reflected moderate community participation without any conservatory approach. The village is inhabited by Bhil tribes with some part of the agricultural land being acquired by Indian Army for security purposes. The proximity of Jaisalmer city provides employment in tertiary (tourism) sector to the villagers. For irrigational purposes a branch of IG Canal supplies water to the village farmland.

Table.2: The TDS (Total Dissolved Salt) of water as per different sources.

Village	Tube well	Rooftop rainwater harvesting	Nadi (pond)	IGC storage tank
Bitan	1680	83	108 to 120	Not in approach
Chokri kala	1800	Not practiced	Not managed	138
Nedayi	N.A.	Not practiced	Not managed	138 to 148
Thaiyat	847 to 898	Least practiced	Lost identity	N.A.

Source: Local field survey.

METHODOLOGY

The study has been conducted on the basis of extensive field work, collection of first-hand information and primary data from the villagers, village Sarpanch through questionnaire method. The participatory approach was also applied to obtain precise information about inventory and prospects of water. The respondents were randomly selected on the basis of their economic and social compositions. Informal and formal interview methods have been used. Finally, the findings have been evolved on the basis of analysis of collected information. The villages for the survey were selected on the basis of their distinct source of water as pond, close to IG Canal, supply of tap water and a tribal dominated village.

RESULT AND DISSCUSSION

Implications of submersible pumps

The economy of western Rajasthan rests on availability of groundwater with most of the population engaged in agricultural activities which require substantial amounts of water for irrigational purposes. This ignited the revolution centering on the biggest boon and bane in terms of ground water retrieval i.e. introduction of tube-wells in the region. Commercialization of agriculture intensified in 1990s with focus on cultivation of cotton which is a highly water intensive crop. Tube wells proved to be the carrier behind the surge in productivity witnessed during the few years that cotton dominated agriculture domain. Now, intensification of agriculture because of easy access of water to crops for irrigation and to larger areas of cultivated land became the new phenomenon.

Water is pumped out through submersible pumps with pipes of diameter 8" to 12" varying from aquifer to aquifer. Usage of outer pipes with diameter of 1” and 2” allowed for the out flow of water with pressure so that carpet-irrigation with drip and sprinklers could be practiced by innovative farmers. The introduction of submersible installation is cheap and fast as tube well up to the depth of 500-700 feet installed within 2 days’ time in all types of rock structure.

In a bid to help farmers, subsidies on tube well installation were introduced by government earlier and at later stage the introduction of submersible to each farmland continuously encroached on vicinal acquire. Also, availability of electricity for most of the day allowed over extraction of ground water with the recharge falling much below the extraction. Overexploitation of water can be perceived through a steep decline in water table from 50ft in 1980 to 300 feet in 2000. During the same period the cropping pattern also shifted from food grain

crops (wheat) to cash crops (cotton) which require more water for irrigation. The famine crippled Rajasthan between 1997 to 2003, which left the farmers with no alternatives other than mercilessly extracting the groundwater particularly for cotton cultivation. During the same time state electricity board provided single phase electricity to every household and single phase submersible pump technology were also introduced so that all the farmers could extract water round the clock even on a cheaper cost. The three phase electricity was made available only for 6 to 8 hours a day while single phase electricity was made available round the clock so that water could be pumped out not just for 6 hours but during any time of the day. Simultaneously, population was increasing and demand of agricultural products was also increasing therefore commercialization of agriculture was inevitable. But as famine continued for longer period, groundwater depleted to such great depths that even after further digging, no signs of presence of water were seen. This forced farmers to shift from water intensive crops to minimal water consuming crops.

Then, the farmers started constructing temporary cum permanent artificial concrete tank or earthen ponds with a sheet of polythene of area measuring 100 sq. yard to 2000 sq. yard depending on the requirement and economic constraints of the farmers. These artificial water storage tanks are known as “Hod”. The state government also gives subsidy for the construction of such “Hods” used for harvesting the rain water. But farmers fill these “Hods” by extracting the ground water through submersible pumps which run round the clock for the purpose apart from harvesting rainwater. The submersible pumps as such cannot meet the demand of irrigation because of slow velocity of water but once the “Hod” is filled, that water is released with high velocity and discharged to irrigate the fields quickly as per the demand. Though these “Hods” are very useful and instrumental in increasing the intensification of cropping but simultaneously, they are also responsible for depleting the ground water table.

The situation has worsened to such magnitude that many villages like **Chowkri Kalan** have been classified as "Dead" for tube wells because groundwater level has reached to a very critical level. Here, installation of any new tube well is strictly prohibited by local administration but the power of money glistens above the law. Also, to limit the extraction of groundwater, three phase electricity is supplied only for 5-6 hours a day to the tube wells for irrigation. But to overcome this hitch, farmers started using single phase electricity for extracting the ground water with the help of submersible pumps for refilling the “Hods” which are meant for rain water harvesting. Thus, submersible pumps have aided in victory of greed over sustainability in the phase of nature and environment crisis.

Fig.1. Unmetalled Hod with plastic polythene above the surface to store the ground water for irrigation.

Fig.2. Metalled Hod below the surface to harvest rain water for irrigation and filled up by submersible pumps in dry season.

Table. 3. Ground Water depletion with the intensification of cash crops.

S.No.	Village	Year-1990	Year-2015	Reason
1	Chowkri Kala (Jodhpur)	70 feet	350+ feet	Cotton cultivation and submersible pumps
2	Bitan (Nagaur)	200 feet	550+ feet	Agricultural intensification of chilies, cotton and onion and increased number of submersible pumps.
3	Nedayi (Jaisalmer)	250 feet	450+ feet	Agricultural intensification of horticulture and vegetables. Rapid increase in the number of tube well installation.
4	Thaiyat (Tribal Village-Jaisalmer)	350 feet	400+ feet	Losing the agriculture land to Indian Army. Bhil tribal village with extensive farming of wheat, vegetables and Bajra.

Fetching the water on head versus tractor-tanker supply

The supply of water through tractor-tankers has increased the per capita consumption of water and more liberal attitude towards water by the local people in comparison to the situation where demand of water is not met by fetching water on head from distant locations. A tractor-tanker supplies 6000 liters of water at a time and each household requires approximately 2 to 3 tankers of water per month. The cost of door step supply of water of one tanker ranges from Rs. 300-600. The easy supply of water in a water deficit region fades the sentimental value attached with the resource and it mutes the importance of the conventional water conservation techniques from the region. People become ignorant or lazy towards conserving natural water because of the viable tanker water supply**.** The assured supply of water through submersible pumps for irrigation has increased crop intensification that has consequently decreased fallow land which served as a pasture land for cattle therefore the cost of the green and crude fodder has increased manifold. The rearing cost of livestock has increased tremendously making the economic dependency on livestock to decline rapidly in the region.

Table.4. The increasing fodder price for the cattle.

Animal Fodder	During 2000's. Rate (Rs./kg)	During 2015. Rate (Rs. /kg)
Jowar- Kutti- dry and crude fodder.	4	15
Bajra- Kutti dry and crude fodder	3	10
Binola- cotton seed.	11	28
Khal-mustard	8	20
Khal- til	10	30
Loong- Dry khejri leaves.	2	15

Source: Local field survey

Before the introduction of tractor-tankers, the local women-folk used to bring potable water in earthen pots (MATKA) on their heads from varying distances. The habitations which were far away from the water source used to face a great set of difficulties in acquiring even a little amount of water. Even the nearby settlements had to undergo physical labour in order to get water. This difficulty in fetching potable water increased value of water for the ones toiling for it. So, people minimized water wastage and maximized water usage by adoptiong suitable techniques.

Fig.3. Women fetching potable water on head from distant Nadi.

With the advent of technology, acquiring water through tankers became an easier task. Now people do not have to go and fetch water by themselves. All they have to do is to pay for a tanker and get sufficient amount of water easily. This ease of water availability has reduced the sentimental value of water for people. Now less of the conventional water harvesting techniques are practiced in the region. The wastage of water is far more in comparison to the earlier times.

Fig.4 Tractor-tanker fetching water for drinking and other household purpose from Nadi. (Common village water pond)

Fig.5. Cow drinking water from same Nadi.

Table.5. The changing trends of water consumption with the introduction of tankers.

Water utilized	Per capita per day Water consumption (While Fetching water on head in earthen pots)	Per Capita per day Water consumption (After the tractor-tanker or tapwater supply)
Drinking	3-4Liter.	3-4 Liter.
Non-Drinking Household	20 Liter.	50 Liter.
Washing, bathing and flushing	20 Liter	60 Liter.
Livestock	Negligible	200 Liter. (stall-feeding)

Source: Based on field survey.

With high amount of water being pumped out from the village common water bodies (nadi's), therefore, the existence of these centuries old conventional water bodies is under serious threat. The rate of their recharge is quite less than the rate of pumping out by tankers. This results into severe long lasting environmental implications as follows–

1. Lowering of the ground water table.
2. Reduction in soil moisture, micro-organisms and fertility.
3. Scarcity of water for the animals, particularly milch cattle's.
4. Increased chances of drying out of conventional water sources permanently.
5. Social conflicts over sharing common water.

Depletion of common water bodies

In the recent past conventional open water bodies have been depleted to a large extent and this has directly influenced the increase in demand of water in the region. Earlier, Nadi used to be the lifeline of any village for all drinking, livestock and non-drinking purposes. In due course of time water became available at doorsteps through tractor-tanker water supply. Extraction of water from Nadi went unchecked, with no maintenance at community level availing it's over exploitation so much so that this water is now being used only for cattle. Due to high rate of evaporation in the area also depletes the water level in Nadi rapidly. Cattle are no longer taken to Nadi instead people prefer to feed them in their houses with tanker water supply. This has increased the water usage of individual households.

Fig.6. Poor maintenance of common water body, (Nadi), near Jodhpur after advent of supply by tanker

Table.6. Depletion of Common water bodies.

S. No.	Village	No. of common water-bodies	No. of maintained water-bodies	No.of water bodies with full or partly filled with water in December
1.	Chowkri kala – Jodhpur	4	2	1
2.	Beaten – Nagaur	2	1	1
3.	Nedai – Jaisalmer near IG Canal	2	1	-
4.	Thaiyat – Jaisalmer tribal village	4	1	-

Source: -Based on field survey.

The soil in the region is mainly classified as sandy and loamy with high porosity of water. Increased seepage, low and scanty rains, decline in catchment area with disappearing feeding channels of the Nadi and high rate of evaporation in summer season have declined the level of water in Nadi's. Almost all the conventional wells were utilized for water with electrified tube-wells where extraction exceeded recharge of water. As the water table dropped, water could no longer be used for irrigational and other drinking purposes and therefore deeper tube wells were dug further depleting the aquifers. Most of the wells run dry due to negligible recharge and over-exploitation. People are becoming more dependent on tap water and conventional wells have gone in oblivion. Each household has become individual water supply point instead of common water supply point. This change in practice of water supply from conventional wells to tractor-tanker supply also altered the sensitized perception of people towards water.

Role of MNREGA in Restoration of common water bodies

MNREGA assures the rural employment to the down trodden section of society on the one hand and up gradation of local infrastructure to increase the economic carrying capacity of the region on the other hand. In the same light, Pipar region of Jodhpur district also provided employment under MNREGA particularly to the rural poor women folk for their better livelihood. The labour involves digging, widening and deepening the conventional local water bodies known as Nadi's. These Nadi's which have been storing the water since hundreds of years accumulate the finest clayey material at its bottom so that the base of pond is as impervious layer. By removing

that finest clayey material for deepening the Nadi has increased the porosity of water body and decreased its water retention capacity. Therefore, MNREGA's social upliftment efforts turned into a curse for the region and decreased the carrying capacity of region with long lasting environmental implications. To overcome the implications of seepage problem of Nadi deepening, following steps should be taken -

1. Demarcation and protection of catchment area from human and industrial encroachment.
2. To conserve and stabilize the water channels for feeding the Nadi.
3. To protect the Nadi's water from seepage and porosity, a thick layer of impervious clayey material may be added or redeposited after deepening the Nadi.
4. Further, a lamina / layer of polythene or tarpaulin maybe installed at the bottom of Nadi after removing the earthen material from it to increase its water retention capacity.
5. The immediate surrounding embankments of the Nadi should be planted with trees. The saplings of local environment friendly trees and bushes should be planted to decrease the rate of water evaporation and increase the green foliage of the region with hydrophytes and xerophytes as per the need.

Fig.7. MNREGA workers digging out clayey material from common water body (Nadi) for deepening and increasing the capacity of the pond at Siyara village, Pipar, Jodhpur.

Seasonal flash floods and ground water recharge.

Seasonal or ephemeral flash floods are in-situ floods which occur in a region where rainfall occurs beyond the capacity of its water discharge channel. These occur once or twice in a decade. The most recent one occurred around 3rd August, 2015 when Rajasthan experienced widespread torrential rainfall in most of its districts. The situation was grim particularly in western districts of Rajasthan i.e.Jalore, Jhalawar, Baran, Sirohi, Barmer and Dungarpur districts. Heavy rainfall in or around the districts is common reason for seasonal floods. Before 2015 such floods occurred in 2007 and in early 90's, following the trend and pattern of occurrence in around once in every decade or so. Rajasthan is characterized by arid and semi-arid climate and it suffers from recurring droughts. The last drought in Rajasthan being in the year 1997, which lasted for around 6 years.

Jodhpur district and its surrounding region experienced in-situ flash floods due to torrential rain in the region in August, 2008 with series of environment friendly implications. The benefits of such flash flood were experienced continuously for three years aiding in the form of intensification of agriculture. But continuous and non-sustainable retrieval of water led to drying up of well which subsequently affected the intensive nature of agriculture.

Implications of flash flood on the environment:

a. Recharged the ground water table which rejuvenated the dried up convectional wells.
b. Recharge of local natural water bodies as nadi, pond, reservoir and low lying lakes continuously for three years without water loss.
c. Ephemeral and seasonal Jozri and other rivers get rejuvenated and water of Rajasthan reached up to Rann of Kutchhandre-stabilized the lost course of river channel.
d. The illegal human encroachments on and along the natural water bodies and its sources were also washed out by the flash flood. It naturally cleared the encroachment of temporary or permanent built-up for human and livestock from the land meant for common water bodies.
e. The pasture land, range land and village common land registered the rapid increase in grass and forest coverage which provided an incentive to increase the livestock population.
f. The flash floods increased soil moisture to the extent that raising the crops continuously for three years became possible and cropping diversity and intensification was observed extensively.

Fig.8. Check Dams on an ephemeral river Jojri, near Chowkri kala, Pipar, Jodhpur

Change in cropping pattern in Western Rajasthan

Cropping pattern refers to proportion of area under different crops in a definite period of time. This pattern depends on crop growing geo-climatic conditions and there after the availability of market and profit criteria. Major changes have been seen in cropping pattern in last decade. Wheat (food-grain) and mustard (oilseeds), onion (Vegetable) and cotton (Cash Crop) are highly cultivated crops because of their higher MSP (Minimum Support price). Commercial crops like Gram, Chilies, Husk (Isabgol), Pulses, Til etc. are also cultivated at large extent. The existing cropping pattern in western Rajasthan like Bitan (Nagaur), Chowkrikalan (Jodhpur), Nedayi andThaiyyat (Jaiselmer) is highly skewed towards cash or profitable crops rather than drought resistant convectional food grain crops as Bajra, Millets and Pulses etc. Such intensive cropping pattern has both pros and cons that resulted into green revolution which ensured food security through increased production due to increased investment and mechanization.

Fig.9. Storage of chemical fertilizers at a farmer's tube well for intensification of cropping at Borunda, Jodhpur.

The intensive cropping pattern requires more water for irrigation which leads to depletion of ground water table and increases the chances of drought and failure of crops like mustard, onion, cotton, cumin etc. Indiscriminate usage of fertilizers and pesticides increases the soda city and decreases the micro-organisms in the soil so that it is converted into the saline soil which is totally dependent on chemical fertilizers.

Table.7. Change in cropping pattern after the introduction of submersible tube wells.

Kharif Crops(1990's)	Changed to (2015)		Rabi crops (1990's)	Changed to (2015)
Bajra	Cotton		Gram	Mustard
Jowar	Linseed		Wheat	Onion
Pulses	Husk (Isabgol)		Chilly	Carrot
Moth	Gwar		Barley	Tomato
Millet	Spinach		Arhar	Cummins seed

Source: based on the field visit survey.

Role of community participation in common water management

In Bitan village (Nagaur), there is a common water body i.e. "nadi" for the villagers with population of approx. 2700. This nadi is maintained, managed, protected and conserved with the collective efforts of village gram panchayat. Water is supplied from nadi through tractor-tankers to the door step of each household where it fills up the particular household's underground metalled tanks. Around Rs. 350-400 are charged per tractor-tanker with a capacity of 6000 Litres. Each household requires two to three tractor-tankers of water per month and the number increases in summer season.

Fig.13. Tractor-tanker to supply potable water for domestic purpose from Nadi- pond.

In Bitan village, 11 tractor-tankers have been permitted by Gram Panchayat to supply water from nadi to the villagers of Bitan village only and not to the outsiders (the water of nadi is for the exclusive use of the residents of Bitan village only). Each tractor-tanker makes 10 to 12 rounds per day. Therefore, (11X12X6000=792000) approx. 8 lakh litres of water is drawn from the nadi to meet the demand of the villagers each day. With community participation the catchment area of this nadi has been increased in recent past by clearing surrounding vegetation like *angrezi-babool* (acacia porosopisjuliflora) which is ecological enemies as they don't allow grass and other vegetation to grow in their vicinal proximity. Planting the hydrophytes on the margins of the nadi will reduce the evaporation and planting the Xerophytes in the catchment periphery will increase the biomass of the region. The catchment area of the village common land which feeds the nadi by collecting and storing water has been also fenced with barbed wire and also a care taker has been deputed by village panchayat to maintain the sanctity of water in nadi and its catchment from animals and human. Only cows are allowed to drink water directly from Nadi and not the buffalo. This nadi has seasonal variation to supply the drinking water as it dried up during summer months before the monsoon. So, then the villagers of Bitan don't get water from nadi for 2-3 months, hence water during these days is brought from Merta road which is 11 km far at higher rates ranging from Rs.800 to Rs.1000 per tractor-tanker.

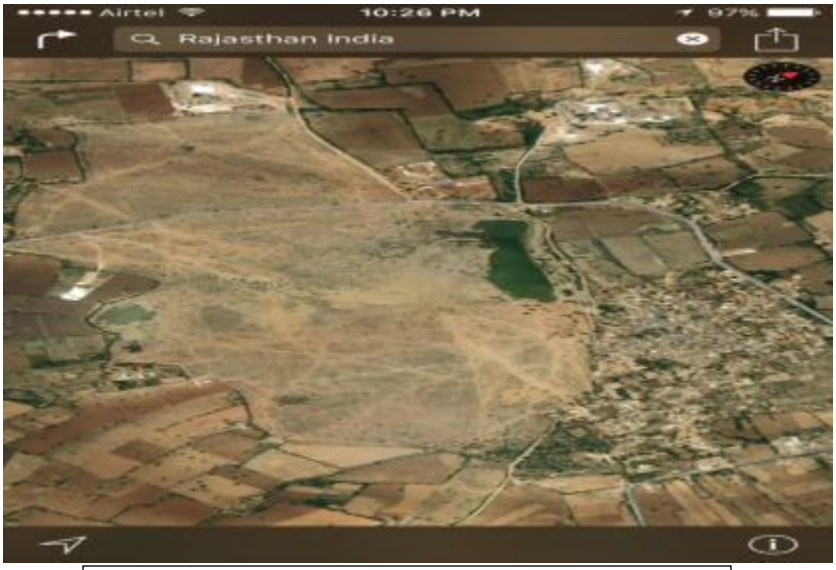

Fig.10. Village Map of Beetan, Nagaur.

In Khijuryon Ki dhani, Chowkri Kalan (Pipar, Jodhpur) water is made available through pipes from IG canal and stored in a big tank known as tanka. Arrival of water through pipeline iscommunicated to neighbours but instead of conserving water, it is being wasted because of its easy access through open tap and little administrative control.

In Thaiyat village, Jaisalmer which is inhabited by Bhil tribe, a tubewell has been installed by the state govt., from where water is being supplied through pipelines. Here, 2-3 household shave constructed an underground tank to store water in collaboration which is an example of community participation. A common cemented tanka has been constructed by village community to store and make water available for cattle and livestock of the village round the year.

Fig.11. Village Map Nedayi, Jaisalmer

Fig.12. Village Map Thaiyat, Jaisalmer

On the basis of availability of local resources, site, situation and community participation, some localised water conservation and management techniques have evolved. The villages where piped water has not yet reached have developed the mechanism of harvesting the rain water which is substantial for them round the year. While the villages where piped water has reached, the role of community in water management is no more in practice.

Wet point habitation to road side settlement:

Before the introduction of mechanization in farm sector, people preferred to reside near water bodies like well, pond or river. With the increase in population size, influence of technology and availability of resources for constructing metalled houses, location of settlements has shifted from wet point to roadside locations. This is due to the fact that habitation along the roadside increases connectivity of the people and then it is easier to collect the drinking water from tractor-tankers whereas irrigational network is managed with submersible pumps. Most of the farmers have individual submersible pump which extract underground water round the clock and store it in artificial tanks (Hods) or anicuts where water is available all the time with the farmer and gives a sense of security to farmers.

Role of modern technology such as submersible pump in extracting underground water for irrigation and drinking purposes, tractors for transporting water and for agricultural purposes, light weight trucks for transporting good or farm products to the city have hugely benefitted agriculture. That's why people tend to stay away from the convectional wet-point settlement and prefer to stay near the road for fast connectivity.

Fig.14. Tractor-tanker supplying the water at door step of each house-holds tank.

Also because of easy and cheaper availability of localized building material resources like limestone and sandstone, people tend to stay away from wet point locations and build their house permanently along the side of roads with modern facilities.

Fig.15. Easy and cheaper availability of localized building material resources like limestone and sandstone.

Fig.16. Shifting housing accommodation near the road (wet point to dry point settlement).

Along the side of roads, urbanization starts developing with the influence factor of transport network and technology. Thus, the change of settlement location has become a common practice and resulted in a phenomenon where conventional households near the wet point are lying vacant and modern weather resistant houses have been constructed near the road side which has increased the comfort level and connectivity of the people.

CONCLUSION

To feed the increased number of population on fixed natural resources, the use of technology, farm mechanization and agricultural intensification is inevitable where the genesis of crisis between development and environment takes places. Technology and conventional knowledge tend to ramble in opposite directions creating an imbalance and haphazard pattern of development in the region. Western Rajasthan presents the same situation where initial tendency of seizing each opportunity presented by sudden introduction of technology crusaded conventional methods of conserving water out of people's lives. But this couldn't sustain for long as the shortcomings soon caught up with the benefits. The present generation has been left devoid of resources to base their aspirations on, thus leading to high rates of out migrations. Thus, Western Rajasthan still remains underdeveloped in patches and the future looks bleak unless technical knowledge collaborates with conventional knowledge to primarily ensure presence of the most essential and scarce resource of region i.e. water. Exploitation of water has to be kept in check by reviving conventional conservative practices and the productivity has to be maximized with due concern towards environment. There is also a need to shift the economical dependency of population towards secondary and tertiary activities from primary activities mainly farming so that pressure on land decreases. The effort has to come from each sector of society as development needs to be inclusive and sustainable with regards to the available resources and natural conditions.

Aerated roots become stilt to support the banyan tree at Chokri Khurd, Pipar, Jodhpur.

IInd Row- Left to Right: Mr. Jeevan (Local Resident), Md. Aasim Ali, Pranjal Singh, Mahima Sokhanda

Ist Row - Left to Right: N. Bragy Singh, Dr. Sukhram (Investigator), Mr. Bharat Ratnu (Investigator), Dr. Tejbir Singh Rana (Principal Investigator) , Shreiya Mohan, Vibhati Singh, Dristhi, Prashanti Nagar, Kritika Malhotra, Aditi Gupta,

ACKNOWLEDGMENTS

N. Bragy Singh, Md. Aasim Ali, Vibhati Singh, Mahima Sokhanda, Shrieya Mohan from B.A. (Hons.) Geography – VI Semester, Dristhi, Pranjal Singh from B.A. (Hons.) Geography – IV Semester and Aditi Gupta, Prashanti Nagar, Kritika Malhotra from B.Sc. (Hons.) Botany – VI Semester, Shivaji College, University of Delhi have contributed in this Article.

REFERENCES

All work is based on Primary Survey and Field work observations.

Publish Research Article

Dear Sir/Mam,

We invite unpublished Research Paper,Summary of Research Project,Theses,Books and Book Review for publication.

Address:- Dr. Ashak Hussain Malik House No-221, Gangoo Pulwama - 192301 Jammu & Kashmir, India
Cell: 09086405302, 09906662570,
Ph No: 01933212815
Email: nairjc5@gmail.com, info@nairjc.com
Website: www.nairjc.com