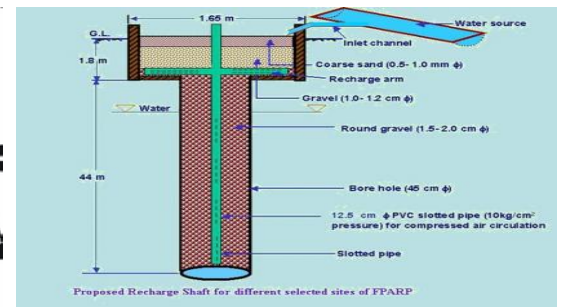
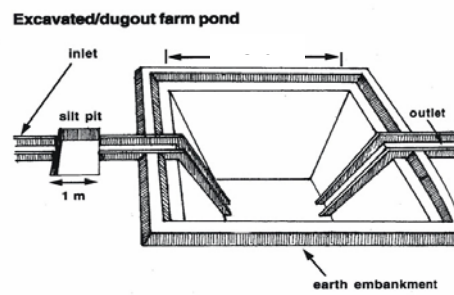




CENTRAL GROUND WATER BOARD
MINISTRY OF WATER RESOURCES,
RIVER DEVELOPMENT & GANGA REJUVANATION
GOVERNMENT OF INDIA



**ARTIFICIAL RECHARGE TO GROUND WATER AND
WATER CONSERVATION PLAN OF KEKRI BLOCK,
DISTRICT AJMER, RAJASTHAN**

Western Region, Jaipur
January, 2016

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN OF KEKRI BLOCK, DISTRICT AJMER

Plan at a Glance

1.	Area of the Kekri Block	985.92 sq.km.
2.	Area identified for Artificial Recharge	889.67 sq km
3.	Dynamic Ground Water Resources (as on 31.03.2011)	
	Net Ground Water Availability	55.7266 MCM
	Annual Ground Water Draft	85.2617 MCM
	Stage of Ground Water Development	153.00%
4.	Volume of water to be harnessed	0.8727 MCM
	Volume of water available for recharge	0.8727 MCM
	Volume of water available for conservation by other interventions	-
5.	Volume of unsaturated aquifer zone available for recharge	185.683 MCM
6.	Total number of structures to be proposed	
	Recharge structures Existing village pond with recharge shaft/ well	Numbers 29 shafts in 29 Nos. of existing village ponds
	Water Conservation Farm pond	-
	Expected Annual GW recharge	0.8727 MCM
	Provision for supplemental irrigation, thus reducing GW withdrawal for irrigation	0
	Total recharge/ saving of ground water	0.8727 MCM
7.	Estimated Cost Artificial Recharge Plan Piezometer construction Operation and maintenance	0.9744 crore 0.754 crore 0.174 crore 0.0464 crore

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN OF KEKRI BLOCK, DISTRICT AJMER

INTRODUCTION

The demand of fresh water for agriculture, drinking and industrial uses etc. has significantly increased due to population growth and socio-economic development. As surface water resources in the State of Rajasthan are meagre, the dependability on ground water resources in the State has increased substantially. This has resulted in over exploitation of ground water resources vis a vis depletion of ground water levels in various parts of the State.

The **Kekri Block, district Ajmer** is one of the over exploited blocks of Rajasthan and is under severe stress, as evident from the stage of ground water development, which has attained an alarming level of **153%**. In view of over exploitation of ground water resources in the block, ground water resources in the area are under continuous depletion. Thus there is urgent need for taking up suitable water management interventions based on integrated approach, which on one hand includes augmentation of ground water resources through appropriate techniques, and on the other hand requires the adoption of suitable water conservation measures, such as ensuring water use efficiency through creation of additional water storage facility, maintenance/ renovation of existing water bodies etc. Water awareness and capacity building of the stakeholders are also the important attributes of water management interventions as envisaged in the National Water Policy.

Artificial recharge to ground water is one of the most efficient, scientifically proven and cost effective technology to mitigate the problems of over exploitation of ground water resources. The technology serves as a means for restoring the depleted ground water storage, ameliorate the ground water quality problems and also enhance the sustainability of wells in the affected areas. A detailed knowledge of geology, hydrogeology, land use pattern, geomorphology and hydro-meteorological features are however, essential for selection of appropriate artificial recharge techniques as well as design and sites of ground water recharge structures.

As per directions of Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India and in pursuance to letter no 16-24/M(SML)/CGWB/ARP- OE Blocks/2015-6957, dated 13.7.2015 & 3.8.2015 & letter no 39(43)/TC/CHN/CGWB/2015-7929, dated 4.9.2015 from Central Headquarters, Central Ground Water Board, **the preparation of Artificial Recharge and Rainwater harvesting Plan for the Over exploited blocks in the State of Rajasthan has been taken up** on priority by the Western Region, Central Ground Water Board, Jaipur. Each Plan discusses the broad framework of ground water situation in the block, status of water availability (both surface and ground water), identification of feasible areas for interventions, feasibility of artificial recharge and other water conservation structures, their design considerations, numbers and cost estimates. The expected outcomes of the proposed interventions have also been elucidated in the report

The GIS layers used in the Plan include administrative (upto village level), Hydrogeology, Depth to Water level (pre and post monsoon), geomorphic, drainage, water bodies and the map of tentative locations of proposed interventions.

Methodology:

The methodology as adopted for the assessment of source water availability is as follows:

As per Ground Water Department, Government of Rajasthan direction the basin wise availability of surplus run off is calculated after taking into account 75 % dependability on the rain water for all uses. In furtherance, the sub basins with surplus run off available for recharge were taken into consideration.

The block area falling in particular sub basin was taken into account and a proportionate area of the sub-basin draining the block was calculated. Based on this area of sub-basin draining the block, proportionate surplus run off, in the block by the sub basin, for recharge was calculated.

Thus was calculated the final amount of surplus run off available for recharge in particular block by one particular sub-basin. The available run off was considered for Recharge through Recharge Shaft (@ 0.03 MCM) and Percolation tank (@ 0.2 MCM). If after allocating water for Recharge through Recharge Shaft, large amount of surface run off was left then the Water conservation through Farm Ponds, along with recharge through Percolation Tanks, was also taken into account.

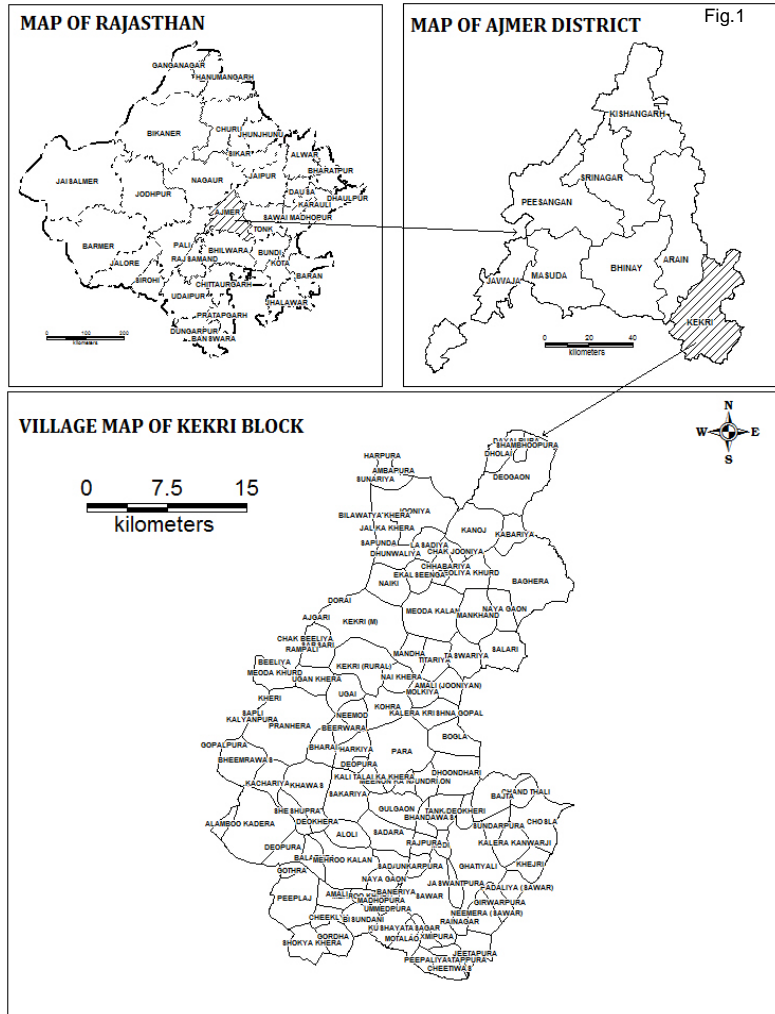
Besides the available run off the Average Water Level for the time span of ten years (Nov., 2005 to Nov. 2014) and the Decadal Water Level trend (Nov., 2005 to Nov. 2014) were also taken into account. The block showing average water level more than 5 m bgl and declining water level trend were considered as suitable for Artificial Recharge Plan.

Location of the block

The Kekri Block of Ajmer District, covering an area of 985.92 Sq. Km. falls in the south-eastern part of Ajmer District and is located between North latitudes 25°41' & 26°81' and East longitudes 75°00' & 75°21'. As per 2011 census, the total population of the Block is 160868 persons consisting of 81596 males & 79272 females. Location map is shown in fig 1.

Source wise Irrigated Area

Out of total area of 985.92 Sq.Km., an area of 64.15 (6.51%) falls under irrigation. The dug wells/ Tubewells are the main source of irrigation in Kekri Block. An area of 20.25 Sq.Km. falls under canal irrigation & another area of 16.35 Sq.Km. area is irrigated through ponds. The wells irrigate total 27.55 Sq.Km. area in this Block.

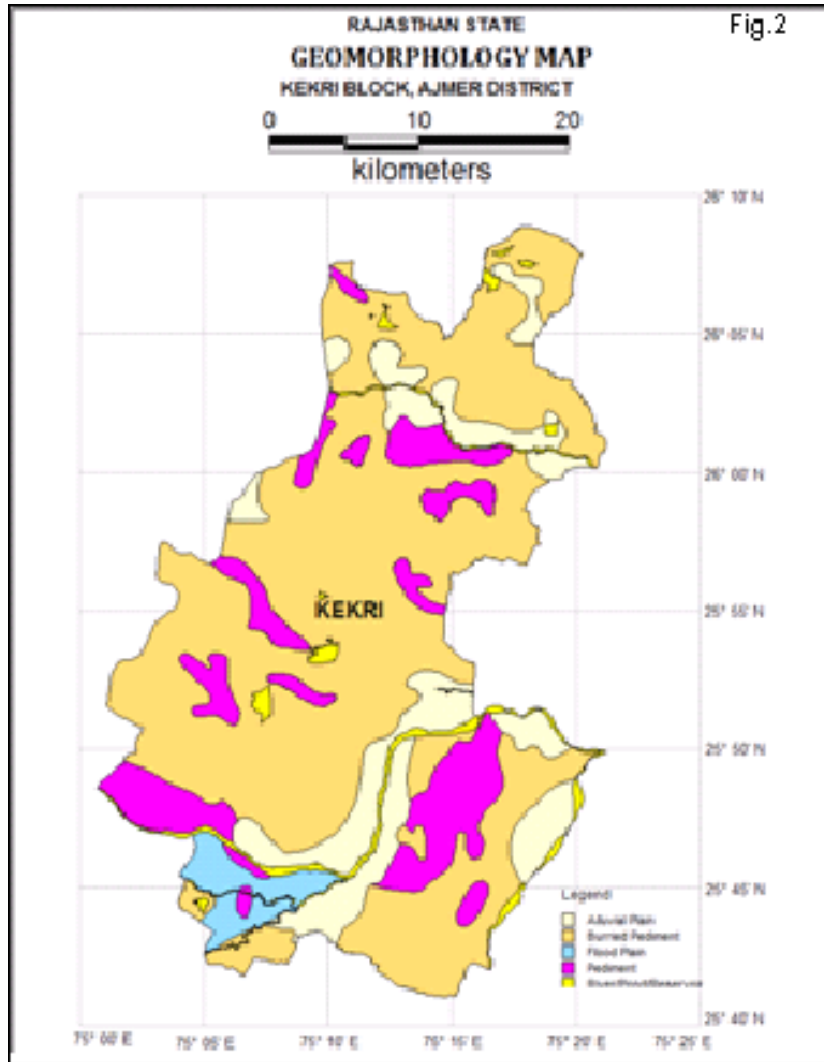


Physiography & Drainage

Physiographically, the block is characterized by presence of buried pediments of denudational origin, alluvial plains and flood plains. The minimum and maximum elevation of Block is 301.0 m amsl and 547.3 m amsl, respectively. The map showing various geomorphic units is presented in fig 2.

There is no perennial river flowing in this Block. It is drained by ephemeral Khari river in southern parts. The entire area of block falls under Banas river basin. The map showing drainage and water bodies in the Kekri block are shown in fig 3.

Fig.2



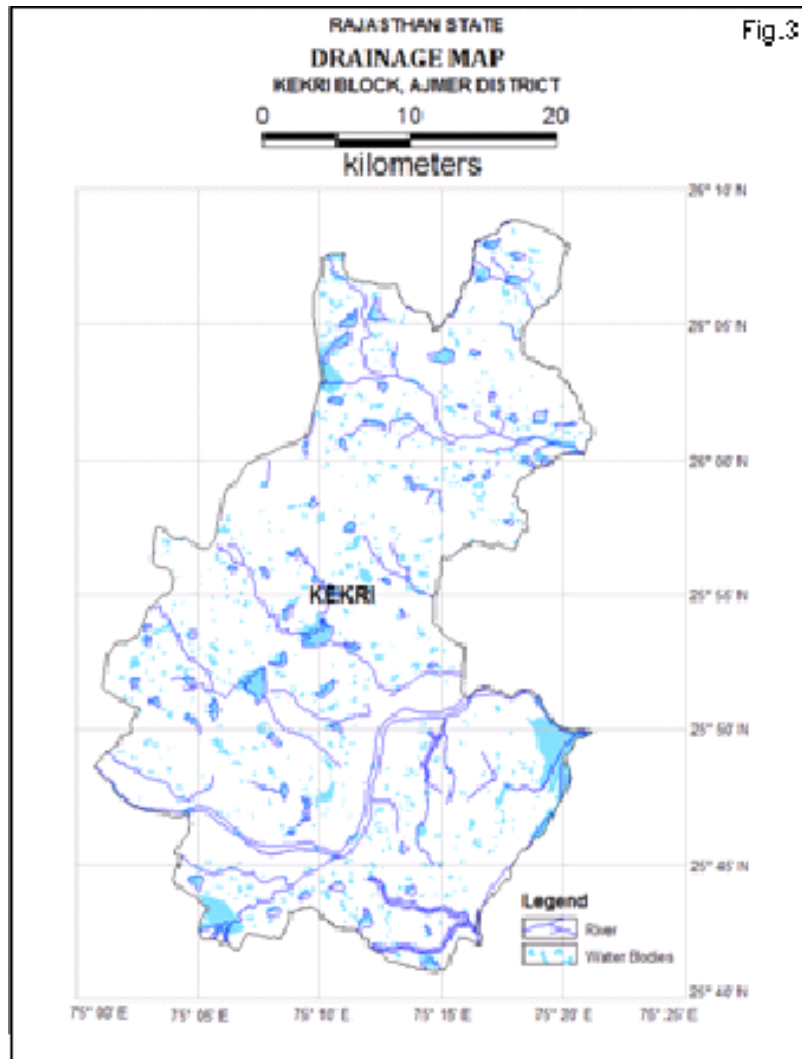


Fig-3

Rainfall

The climate of the block is semi arid. The Normal annual rainfall of block is 571.07 mm (IMD, 1901-70). The available data of rainfall indicates that larger part of annual rainfall is received through SW monsoon during July to September.

Hydrogeology of the Area

Unconsolidated Quaternary alluvium and hard rocks of Bhilwara Supergroup comprising of Gneiss represent the aquifer system of the block. Out of total geographical area of 985.92 Sq. Km, an area of 889.67 Sq. Km. (90.24%) forms aquifer system (potential zone) in the block and remaining 96.25 Sq. Km. (9.73%) area is represented by hills. Shallow thickness alluvial aquifers cover an area of 91.87 Sq. Km. (9.32%) and remaining 797.80 Sq. Km. (80.92%) is represented by hard rock aquifers comprising of Gneisses of Bhilwara Supergroup. Groundwater occurs under un-confined conditions in

alluvial aquifers as well as in hard rock aquifers. The thickness of alluvium is very shallow ranging from 25 to maximum of 42 m. Groundwater abstraction in alluvial areas is either through Dug Wells or Dug-cum Bore wells/Tube Wells drilled down to depth tapping both alluvial and hard rock aquifers. In hard rock aquifers, groundwater occurrence is controlled by thickness of weathered zone, size, continuity and interconnectivity of and fractured zones and other secondary porosities. Groundwater abstraction is mainly through Dug Wells and also through, Bore Wells at selected feasible locations. In general yield of wells tapping Gneiss varies from 0.35 to 1.04 lps.

Ground Water Level:

As per Average decadal depth to water level (from November, 2005 to November, 2014), the block falls in water level range 2-5 in Northern side and 5-10 in southern side. (Fig 4)

The average decadal depth to water level is 7.98 mbgl for Pre monsoon & 6.1 mbgl for Post monsoon. According to depth to water level map of May 2014, water level ranges between 2 to 5 & even less than 2 mbgl in northern half and 5 to 10 mbgl in southern half. According to depth to water level map of November 2014, water level ranging between 2 to 5 mbgl in major part, 5 to 10 mbgl in southern part and less than 2 mbgl in north eastern part have been observed. Depth to water level maps for May 2014 & November 2014 is shown in fig 5 & 6.

Water Level Trend:

The hydrographs of wells monitored by CGWB & GWD from 1997 to 2010 shows declining water level trend. A water level fall of 0.30 m/year during pre monsoon and 0.38 m/year during post monsoon has been observed for this period.

As per the Decadal Water level trend (from November, 2005 to November, 2014), the declining trend is visible in the block. The fall in the range of -1 to 0 in ground water level is prevalent in the block. The map of Decadal Water Level Trend is shown in fig. 7.

Subsurface Hydrogeology

As inferred from borehole data of the Kekri Block; Alluvium & Gneiss are the water bearing formations in this area. However, the ground water in Gneiss only occurs in shallow weathered parts or fractures due to absence of primary porosity. The depth of drilling is 13.2 mbgl in this block. The quality of ground water in Kekri block is affected by high salinity & fluoride contamination.

Fig: 4

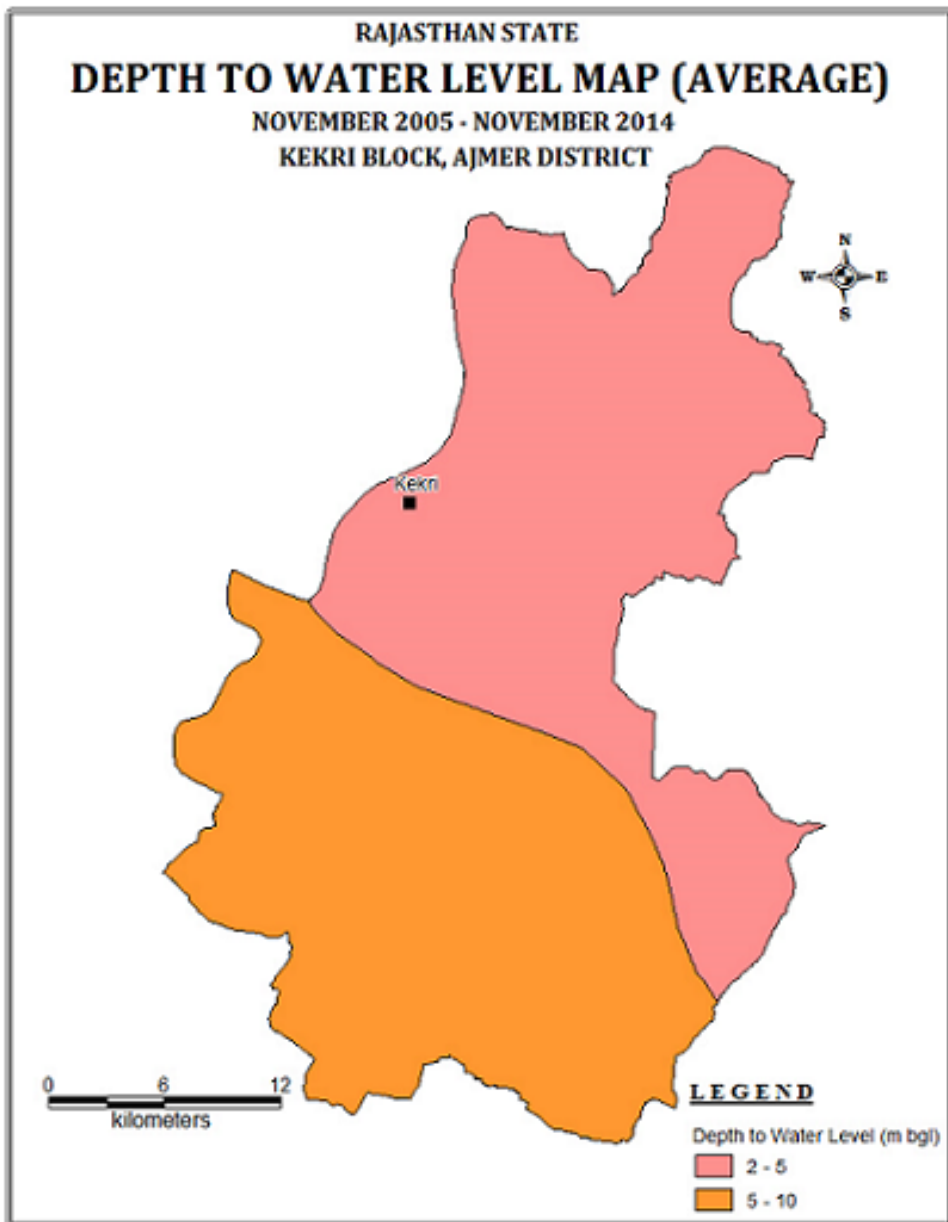


Fig: 5

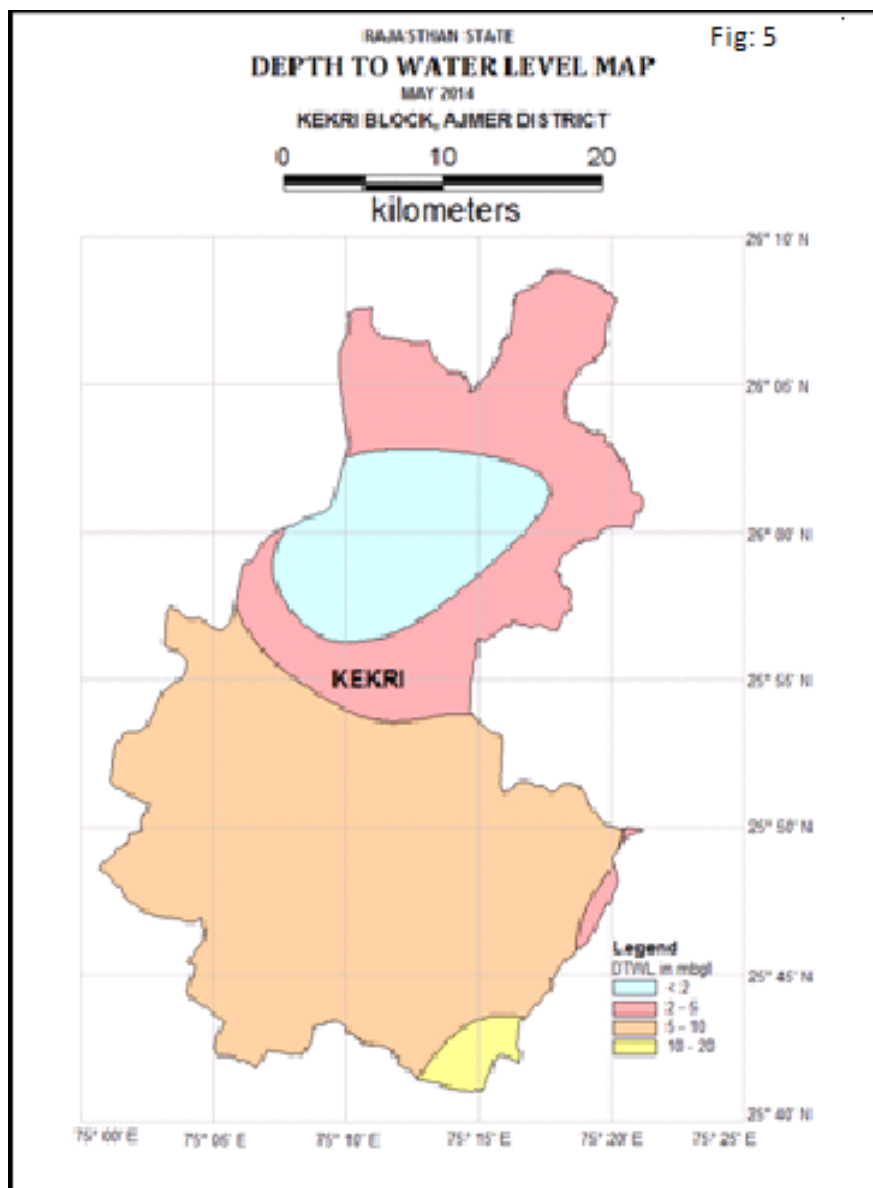


Fig: 6

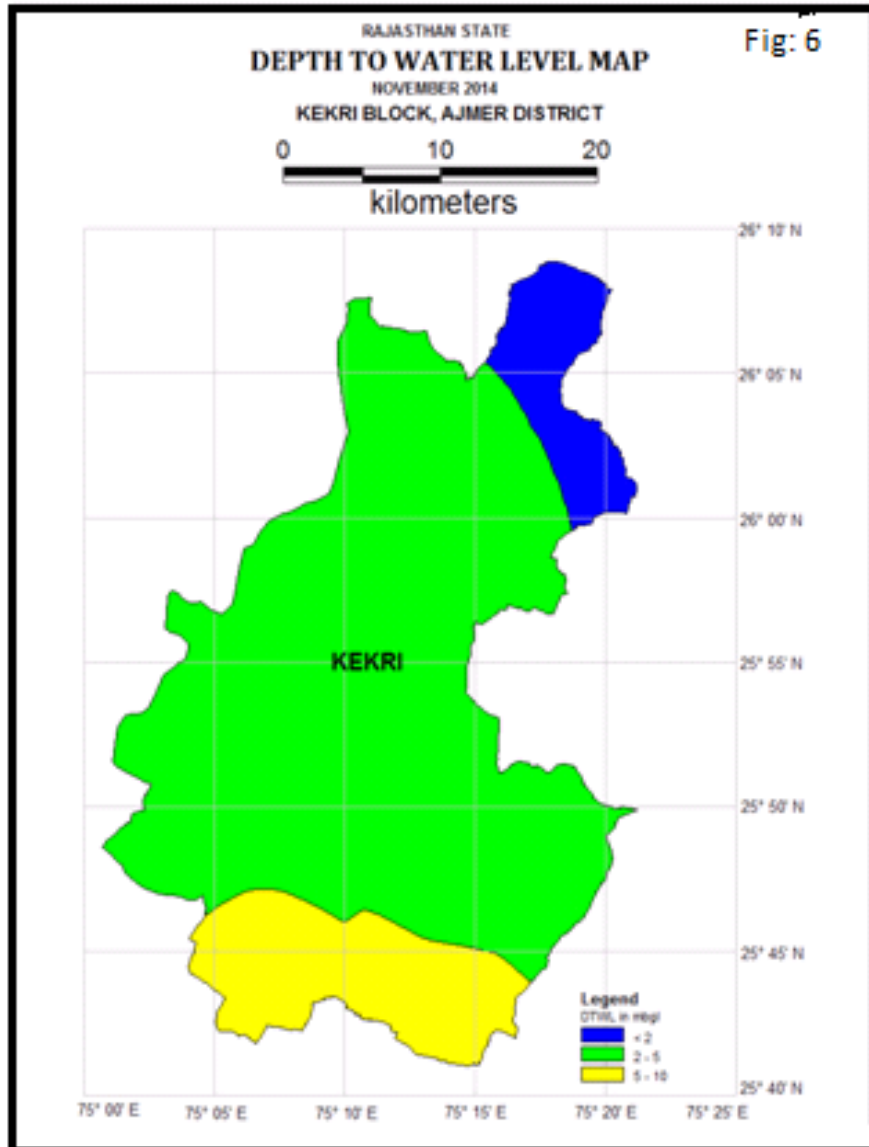
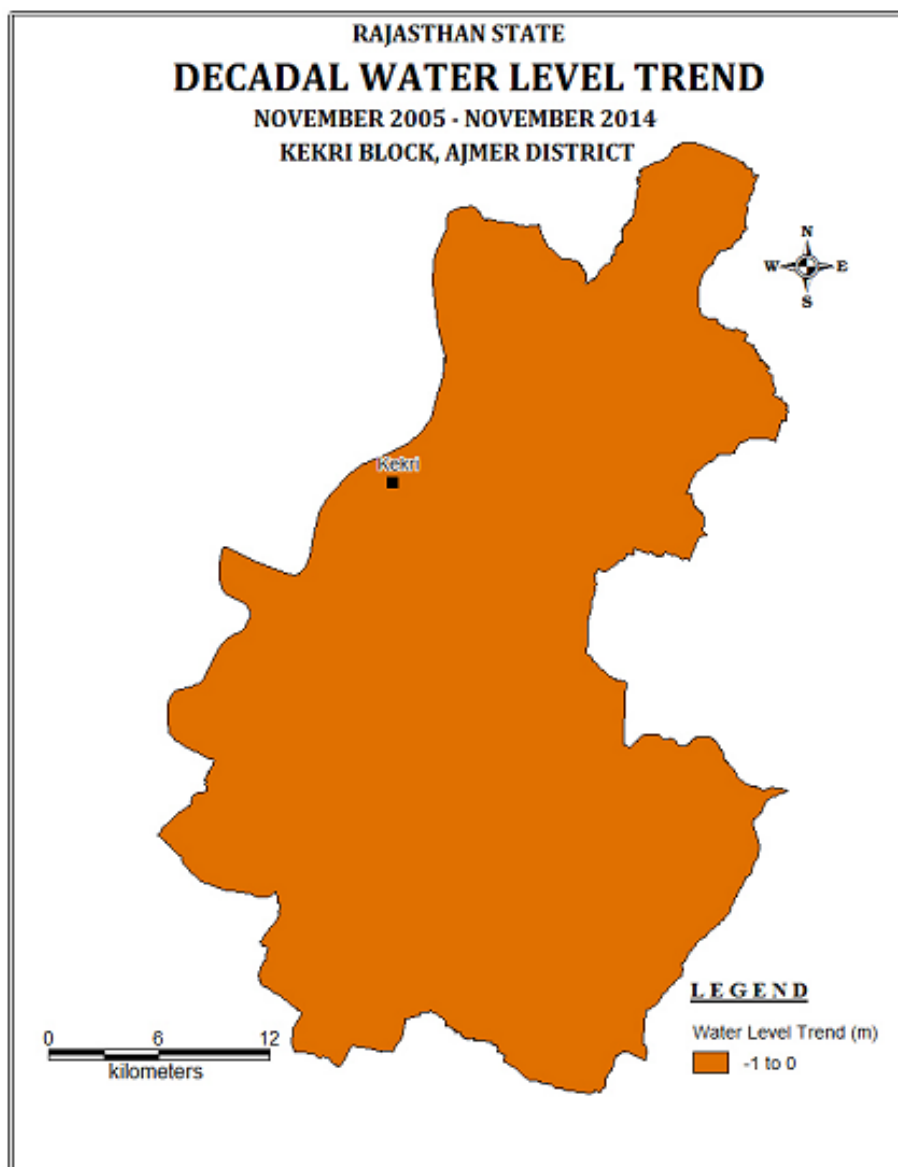


Fig: 7



Dynamic Ground Water Resource

The status of ground water resources of the block is presented in table 1. The annual Net Ground water Availability in the block is 5572.66ham and Annual Ground water draft is 8526.17ham. Stage of Ground water development has reached 153%.

Table 1: Ground Water Availability, Utilization and Stage of Development Kekri Block, Ajmer District (As on 31.3.2011)

Natural Discharge During Non Monsoon Period	412.20 ham
Net Annual Ground Water Availability	5572.66 ham
Annual Ground Water Draft	8526.17 ham
Net Ground water Availability for Future Irrigation Use	Nil
Stage of Ground Water Development	153.00%
<i>Source: Ground Water Resource Assessment 31.03.2011</i>	

Need for artificial recharge and water conservation plan

The present artificial recharge and water conservation Plan aims to mitigate the problems of continuous decline in water levels over the area through techniques of artificial recharge utilizing surplus rainwater based on scientific manner for optimal results. The broad scope of the recharge plan is as follows:

- Establishing efficacy of integrated approach through various artificial recharge and water conservation techniques. Intervention is proposed in cluster mode basis wherever feasible to have a better impact.
- Enhancing water use efficiency for controlling excessive ground water draft, especially for irrigation purposes.
- Ensuring sustainability of ground water abstraction structures and improvement in quality of ground water.

Surface water availability

As per the studies carried out by Water Resources Department, Govt of Rajasthan there is hardly any surplus water available for further development at 75% dependability. However, after taking into account the availability of source water in the basins of Rivers flowing in the State proportionate amount of surplus runoff available in particular block by particular sub basin was calculated.

Accordingly about 0.8727 MCM has been considered for recharge plan in the block. Optimum utilization of rainwater runoff depends on availability of land, feasible conditions, etc. Surface water availability, allocation and number of structures are presented in table 2.

Table 2: Source water for artificial recharge and number of recharge structure

District	District code	Block	Block code	Area of Block (Sq.km.)	Potential area suitable for recharge (Sq.km.)	Type of Aquifer	Area feasible for artificial recharge (Sq km)	Sp Yield
AJMER	RJ01	KEKRI	RJ0104	985.920	889.670	alluvium	91.870	0.120
AJMER	RJ01	KEKRI				hard rock	797.800	0.015

Table 2 (contd): Source water for artificial recharge and number of recharge structure

Average DTW (mbgl) NOV 2013	Thickness of unsaturated zone 3 m below ground level (m)	Volume of sub surface storage space available for artificial recharge (MCM)	Sub Basin	Surplus available in the block (in Mm3)	Surplus water used in Recharge Shaft (RS)	No. of RS 0.03 MCM/RS	Remaining Surplus water for Percolation tank (PT)	No. of PT (0.2 MCM/PT)
12.570	9.570	105.504	Sodra	0.0022	0.0022	0	0	0
9.700	6.700	80.179	Banas	0.8705	0.8705	29	0	0
				0.8727	0.8727	29	0	0

Feasible Artificial Recharge and water conservation structures

A wide spectrum of techniques is in vogue, which are being implemented to recharge the ground water reservoir, conserve the utilizable rainfall and enhance the water use efficiency. Based on prevailing field conditions, out of total block area of 985.92 sq km practically 889.67 sq km area is feasible for implementing recharge measures. Based on available information about the area such as ground water scenario, hydrogeology, hydrology, topography, rainfall pattern, drainage, soil cover, utilizable rainfall etc. scope for various interventions has been studied and assessment of suitable areas, tentative design and costs of structures has been worked out in the present plan.

Identification of feasible areas

Kekri block is having ground water level between 5 & 10m below ground level and as per dynamic ground water resource estimation, the block is over exploited with stage of ground water development at 153%. The Kekri block is feasible for recharge due to

presence of permeable zone above water table, favorable land slope and availability of water from rainfall.

Generally the Artificial recharge structures suitable in this type of area are Check dams/ Anicuts/ Percolation tanks and Recharge Shafts/ Recharge wells. Since the ground water levels are quite shallow in some are and deep in other area of the block, the structures like ani-cuts and Check dams are not suitable and also their construction is regulated. Considering these aspect the proposal for Recharge Shaft/ Recharge wells has been firmed up in the present Plan are the most suitable structures in Kekri block.

Details of Ground Water Recharge Measures

1. Existing Village Pond with recharge shaft/wells

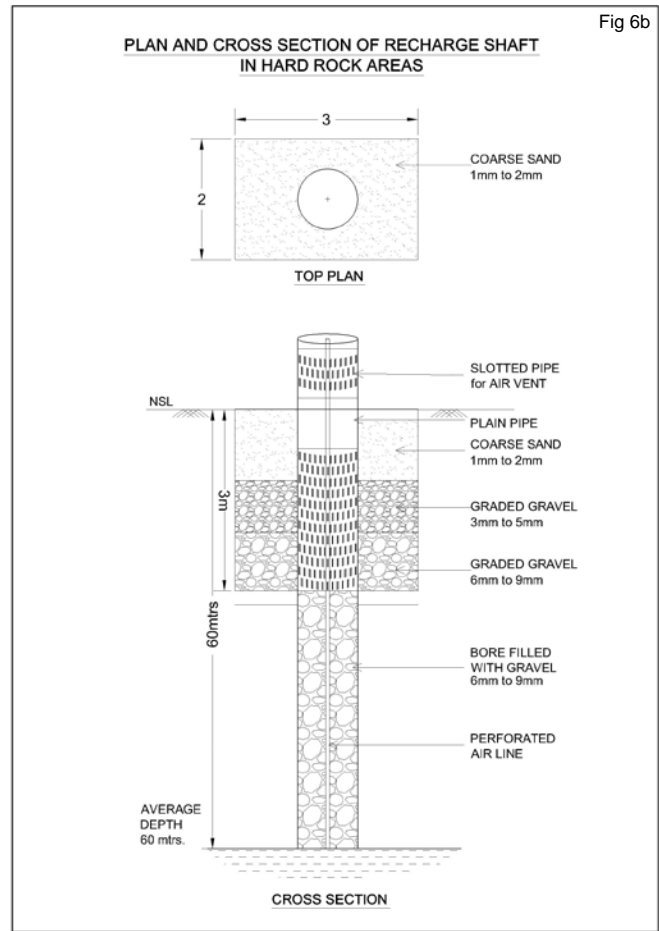
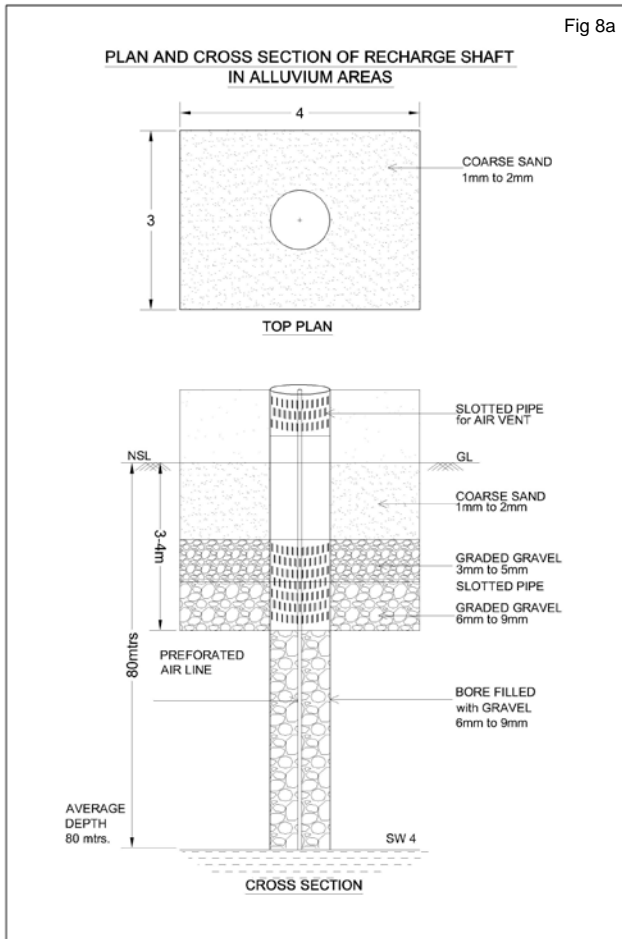
Almost all the villages in the State of Rajasthan have one or two village ponds & other ponds. With time, these ponds get silted & hardly any water percolates downward. Also, any excess water coming into the pond goes away as a run off due to limited storage capacity. This surplus runoff can very well be utilized for recharging the ground water and also for enhancing conservation of water that can be further used for irrigation, thereby saving ground water withdrawal. Since natural recharge from these ponds is limited due to siltation and ground water levels are deep, the most effective ground water structure considered under the Plan is Recharge Shaft/ Recharge well constructed within the pond itself.

The above mentioned recharge well has been designed in a manner that maximum surplus water would likely to be utilized for recharge as well as sufficient water is retained in the pond for local use.

The model design of recharge well has been worked out in consultation with Ground Water Department, Government of Rajasthan and presented in Fig 6a & 6b. The major features required are:

1. The well should have sufficient diameter for recharge- 10 to 12 inch diameter well with bottom screen/ opening just above the highest ground water level.
2. The well should have screen/ opening at the top, which should be at least 1.5m above the bed level of the pond.

- The upper opening should be surrounded with filter pack comprising graded filter media of medium, coarse sand & gravel, so that the Recharge well does not get silted.



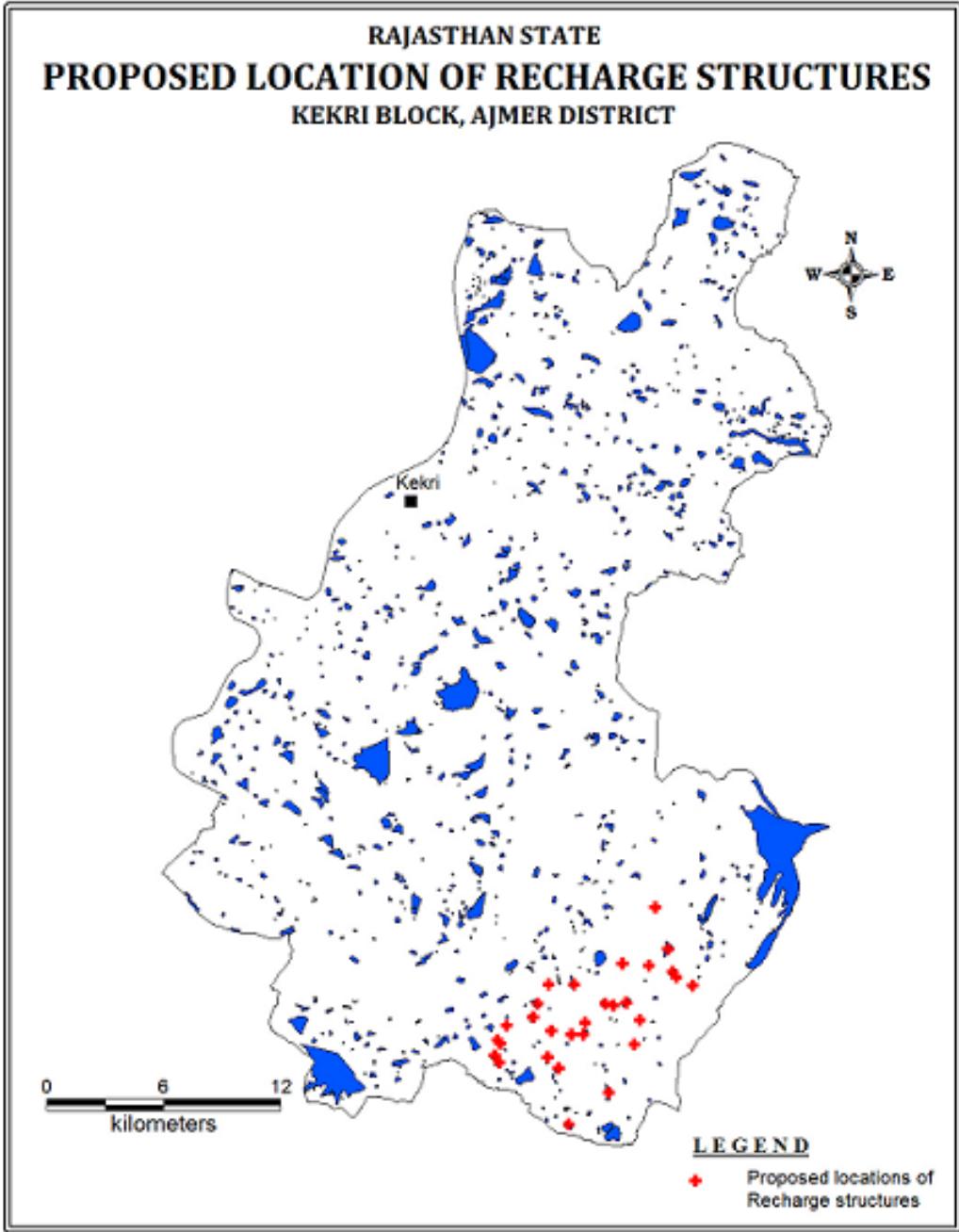
The opening for inflow to the well has been proposed at 1.5m above Bed level of pond. This is necessary to ensure that the pond retains sufficient water for use by local consumers. However, this may necessitate further deepening of pond itself so that the pond is 3-4 m deep. A Single well as discussed above would be suitable for a pond upto area of about 5ha. Therefore, more number of such Recharge wells is envisaged for larger ponds.

The tentative location of villages for construction of recharge shaft/well in existing village pond and their cost estimates are shown in Fig 8 and Table 3. The plan proposes construction of 29 recharges shafts/ wells in 29 identified existing village ponds at an estimated cost of 610lacs.

Table 3: Tentative locations of village for village pond with recharge shaft

S No	Village	Long	Lat	Pond area (ha)	Formation	No of Shafts	Unit cost (Rs in lac)	Total cost (Rs in lac)
1	Jaswantpura	75.243	25.749	2.239	Hard_rock	1	2.6	2.6
2	Sawar	75.209	25.759	2.271	Hard_rock	1	2.6	2.6
3	Girwarpura	75.275	25.762	2.486	Hard_rock	1	2.6	2.6
4	Udaisagar	75.209	25.725	2.504	Hard_rock	1	2.6	2.6
5	Sawar	75.211	25.737	2.570	Hard_rock	1	2.6	2.6
6	Laxmipura	75.214	25.720	2.707		1	2.6	2.6
7	Sawar	75.221	25.736	2.730		1	2.6	2.6
8	Ghatiyali	75.264	25.794	3.140	Hard_rock	1	2.6	2.6
9	Girwarpura	75.283	25.758	3.722	Hard_rock	1	2.6	2.6
10	Sawar	75.228	25.741	3.837	Hard_rock	1	2.6	2.6
11	Kushayata	75.188	25.740	4.063	Hard_rock	1	2.6	2.6
12	Ghatiyali	75.261	25.767	4.130	Hard_rock	1	2.6	2.6
13	Kushayata	75.183	25.733	4.204	Hard_rock	1	2.6	2.6
14	Ghatiyali	75.247	25.768	4.209	Hard_rock	1	2.6	2.6
15	Kushayata	75.184	25.722	4.981	Soft_rock	1	2.6	2.6
16	Pratappura	75.240	25.709	4.997	Hard_rock	1	2.6	2.6
17	Kushayata	75.182	25.726	5.107	Hard_rock	1	2.6	2.6
18	Girwarpura	75.273	25.764	5.356	Hard_rock	1	2.6	2.6
19	Peepaliya	75.219	25.694	5.416	Hard_rock	1	2.6	2.6
20	Kushayata	75.185	25.731	6.127	Hard_rock	1	2.6	2.6
21	Neemera (Sawar)	75.256	25.742	6.920	Hard_rock	1	2.6	2.6
22	Sawar	75.222	25.759	7.576	Hard_rock	1	2.6	2.6
23	Neemera (Sawar)	75.253	25.731	7.924	Hard_rock	1	2.6	2.6
24	Jaswantpura	75.238	25.750	8.925	Hard_rock	1	2.6	2.6
25	Sawar	75.201	25.743	9.448	Hard_rock	1	2.6	2.6
26	Ghatiyali	75.249	25.750	10.108	Hard_rock	1	2.6	2.6
27	Sawar	75.227	25.736	10.322	Hard_rock	1	2.6	2.6
28	Sawar	75.204	25.750	11.023	Hard_rock	1	2.6	2.6
29	Ghatiyali	75.270	25.775	20.262	Hard_rock	1	2.6	2.6
Total						29		75.4

Fig 8



B. Revival, repair of water bodies

The existing ponds and tanks in loose their storage capacity as well as the natural ground water recharge through these water bodies has also become negligible due to siltation and encroachment by farmers for agriculture purposes. There are several such villages where ponds/ tanks are in dilapidated condition. These existing village tanks, which are normally silted and damaged, can be modified to serve as recharge structure in case these are suitably located to serve as percolation tanks. Through desilting, coupled with providing proper waste weir, the village tanks can be converted into recharge structure.

Impact Assessment and Monitoring

Assessment of impact of the artificial recharge schemes implemented is essential to assess the efficacy of structures constructed. It helps in identification of cost-effective recharge mechanisms for optimal recharge into the ground water system. It also helps to make necessary modifications in site selection, design and construction of structures in future. The monitoring system should be designed judiciously to monitor impact of these structures individually as well as collectively. Demarcation of the zone of influence of the artificial recharge structure is one of the main objectives of monitoring.

It is proposed to utilize the existing data available with the Government of Rajasthan and CGWB baseline data. For assessment of the impact of proposed measures additional data will be generated by construction of the piezometer at suitable and strategic sites.

It is proposed to construct 29 piezometer, one in each village, at suitable locations for monitoring of water levels, in the vicinity of proposed recharge structure. The depth of the piezometer may vary from 60 to 80 mbgl. This will help in assessing the impact of the project implementation.

Since the implantation of the Plan involves institutional framework, it is proposed to constitute State Level Technical Coordination Committee (SLTCC) and District Level Technical Coordination Committee (DLTCC) for proper monitoring and review of the implementation of the Plan.

Financial Outlay of the Plan

The total estimated cost of the Plan is 0.9744 cr, which includes Rs 0.754 cr for ground water recharge activities, 0.174 cr for ground water monitoring (Piezometer construction) and Rs 0.0464 cr towards operation and maintenance charges. The tentative cost estimates of the various activities of the Plan are shown in Table 4 & 5. The unit rates are as followed by the Govt. of Rajasthan (BSR). The total estimated cost of the project is **Rs 0.975 Crores**.

Table 4: Cost of the recharge structures

Cost of Percolation Tank in Rs in crs (Unit cost Rs 0.4 cr)	Cost of Farm Pond in Rs (Unit cost Rs 0.1 cr)	Cost Recharge Shaft Rs in crs (Unit cost Rs 0.05 cr for alluvium and Rs 0.026 cr for hard rock)
0	0	Hard rock – 0.754

Table 5: Tentative cost of different activities

Feasible Artificial Recharge & Water Conservation structures/ activities	Tentative Design	Quantity (in nos. or area in sq. m)	Rainwater harvested (mcm)	Tentative unit cost (in Rs lakh)	Total tentative cost (in Rs lakh)	Expected Annual GW recharge/ conservation (mcm)
Recharge Structures/ Activities						
Recharge shaft within the pond /tanks	Hard rock: Depth –60m, Dia 10-12”with filter pit	29	0.8727	2.6	75.4	0.611
Sub total					75.4	0.611
Impact assessment & Monitoring						
Piezometer	Up to 80 m bgl	29		0.6	17.4	
<i>Impact assessment will be carried out by implementing agency</i>						
O & M - 5% of total cost of the scheme					4.64	
TOTAL					97.44	

Note: Type, number and cost of structure may vary according to site after ground verification

Time Schedule

The project is to be implemented in two years, however impact assessment will be carried out for five years. A time schedule for different activities is given in table 6.

Table 6: Time Schedule

Steps	1 st phase	2 th Phase	3 rd Phase	4 th Phase	5 th Phase	6 th Phase	7 th Phase	8 th Phase
Constitution of State Level Technical Coordination Committee (SLTCC) and District Level Technical Coordination Committee (DLTCC)								
Arranging meeting of SLTCC for provision available under the scheme, request to implementing agencies for submission of DPR								
Scrutiny, recommendations & approval of AR Projects / Schemes in DLTCC & SLTCC								
Forwarding the DPR to Central Ground Water Board (CHQ), New Delhi for approval and issuing of sanction from the Ministry								
Meeting of TCC(CHQ) and release of sanction of funds								
Construction of artificial recharge structures & Monitoring of water levels in the area locally								
Completion and Utilisation certificate								
Impact Assessment and submission of report								

Expected Benefits or outcome of the Plan

Ground water recharge and water conservation Plan of Kekri block, Ajmer envisages gainful utilization of 0.611 MCM of surplus monsoon runoff for recharging of depleted aquifer system.

With the additional recharge and water conservation interventions as proposed in the Plan, it is anticipated that with enhanced recharge and reduction in ground water draft, the stage of ground water development will reduce to 151.34 % from the existing 153%. The projected status of ground water resources and utilization scenario is presented in table 7.

Net G.W. Availability (mcm)	Additional Recharge from RWH & conservation (mcm)	Total Net G.W. Availability after intervention (Ham)	Existing G.W Draft for all purpose (ham)	Saving of Ground water through projects (ham)	Net GW draft after interventions (ham)	Present stage of G.W. development (%)	Projected stage of G.W. Dev. (in %)
55.7266	0.611	56.3376	85.2617	0	85.2617	153	151.34

- The implementation of the project would result in additional recharge. The other tangible/ non-tangible benefits of the project are:
 - Recharging the ground water will help in arresting the rapid decline in ground water resources and will also ensure improvement in quality of ground water by way of dilution.
 - Proposed structures and measures will also enhance the ground water potential and would ensure sustainability of ground water resources.
 - Surface runoff water stored or harnessed can be used as supplemental irrigational resources and will reduce the stress on the ground water.
 - Besides, it will also help in reducing the amount and spate of storm water being drained by river and controlling soil erosion.