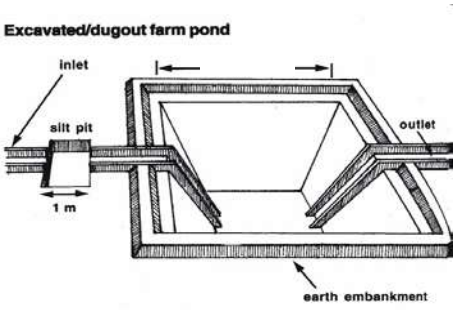
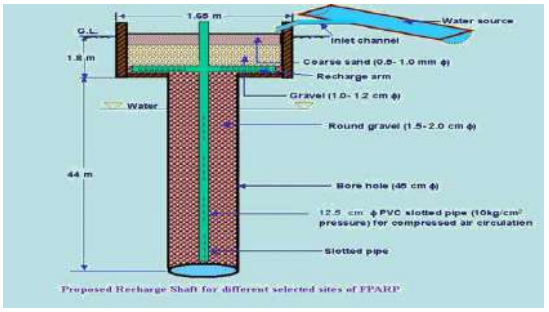
CENTRAL GROUND WATER BOARD

MINISTRY OF WATER RESOURCES,
RIVER DEVELOPMENT & GANGA REJUVENATION
GOVERNMENT OF INDIA





ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN OF KOTRI BLOCK, DISTRICT BHILWARA, RAJASTHAN

Western Region, Jaipur
April 2016

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN OF KOTRI BLOCK, DISTRICT BHILWARA

Plan at a Glance

1.	**Area of the Kotri Block**	**934.00 sq. km.**
2.	**Area identified for Artificial Recharge**	**898.31 sq km**
3.	**Dynamic Ground Water Resources (as on 31.03.2011)**	
	Net Ground Water Availability	**44.7900 MCM**
	Annual Ground Water Draft	**54.4349 MCM**
	Stage of Ground Water Development	**121.53%**
4.	**Volume of water to be harnessed** **Volume of water available for recharge** **Volume of water available for conservation by other interventions**	**4.66 MCM** **4.66 MCM** **Nil**
5.	**Volume of unsaturated aquifer zone available for recharge**	**67.912 MCM**
6.	**Total number of structures to be proposed**	
	Recharge structures Existing village pond with recharge shaft/ well **Water Conservation** Farm pond	**Numbers** **155 shafts in 155 Nos. of existing village ponds** **-**
	Expected Annual GW recharge	**3.262 MCM**
	Provision for supplemental irrigation, thus reducing GW withdrawal for irrigation	**nil**
	Total recharge/ saving of ground water	**3.262 MCM**
7.	**Estimated Cost** Artificial Recharge Plan Water conservation measures Piezometer construction Operation and maintenance	**4.723 crore** 4.03crore nil 0.468 crore 0.225 crore

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN OF KOTRI BLOCK, DISTRICT BHILWARA

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 **Kotri Block, district Bhilwara** 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 **121.53%.** 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 blocks showing average water level more than 5 m bgl and declining water level trend were considered suitable for Artificial Recharge Plan.

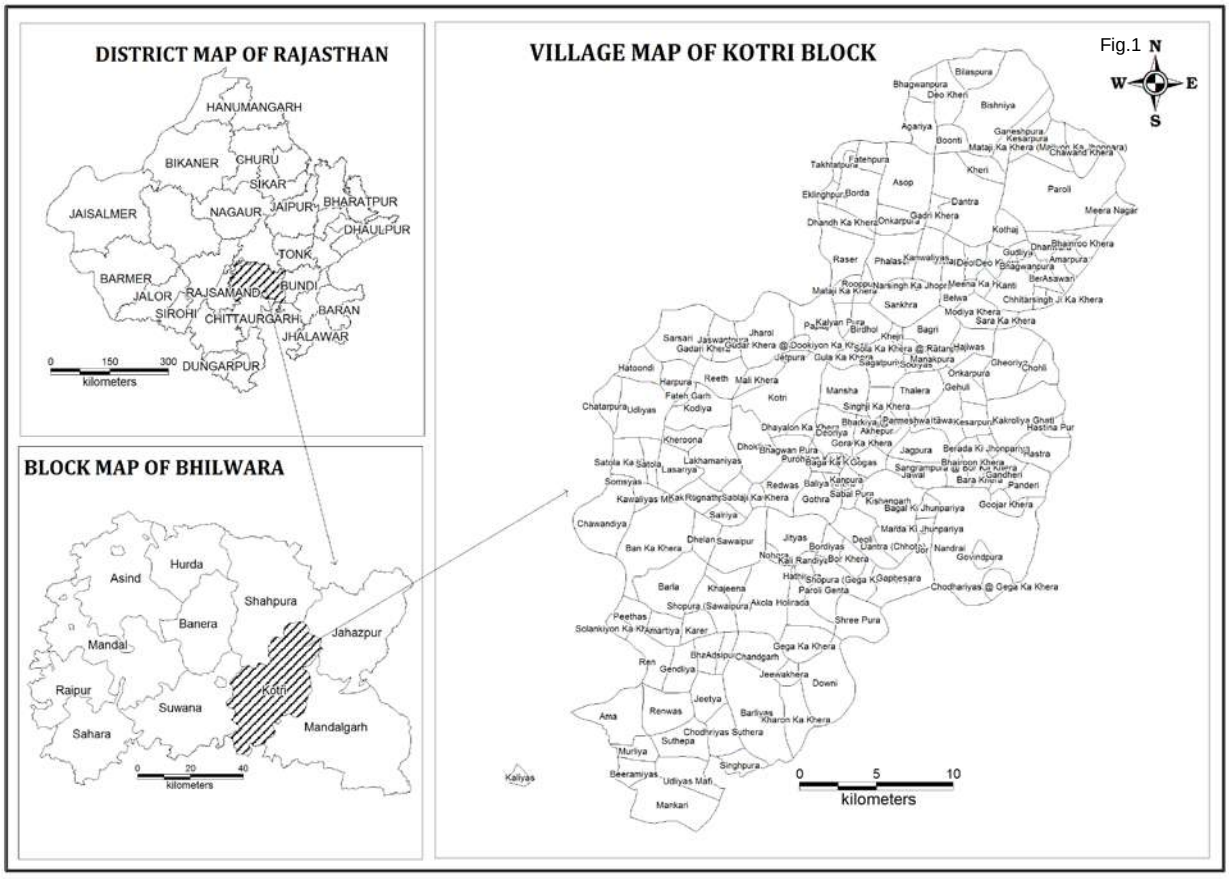
Location of the block

Kotri Block of Bhilwara district falls under Over-Exploited category. It covers an area of 934.00 Sq.Km. and falls in south-eastern part of Bhilwara district. It is located between North latitudes 25°09’ & 25°36’ and East longitudes 74°43’ & 75°07’. The total rural population of the Block is 174011 persons as per the 2011 census. It is comprised of 88526 males and 85485 females. Location map is shown in fig 1.

Source wise Irrigated Area

Out of total area of 934.00 Sq.Km., an area of 107.44 (11.50%) falls under irrigation. The dug wells/ tubewells are the main source of irrigation in Kotri Block. An area of 9.07 sq.km. fall under pond irrigation and an area of 10.34 sq.km. is irrigated through other sources. The wells irrigate total 88.03 sq.km. area in this Block.

Fig: 1



Physiography & Drainage

Physiographically, the block is characterized by presence of buried pediments of denudational origin and Plateau. The minimum and maximum elevation of Block is 322.1 m and 492.1 m, 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 Kothari & Berach rivers. The entire block falls under Banas river basin. The map showing drainage and water bodies in the Kotri block are shown in fig 3.

Fig: 2

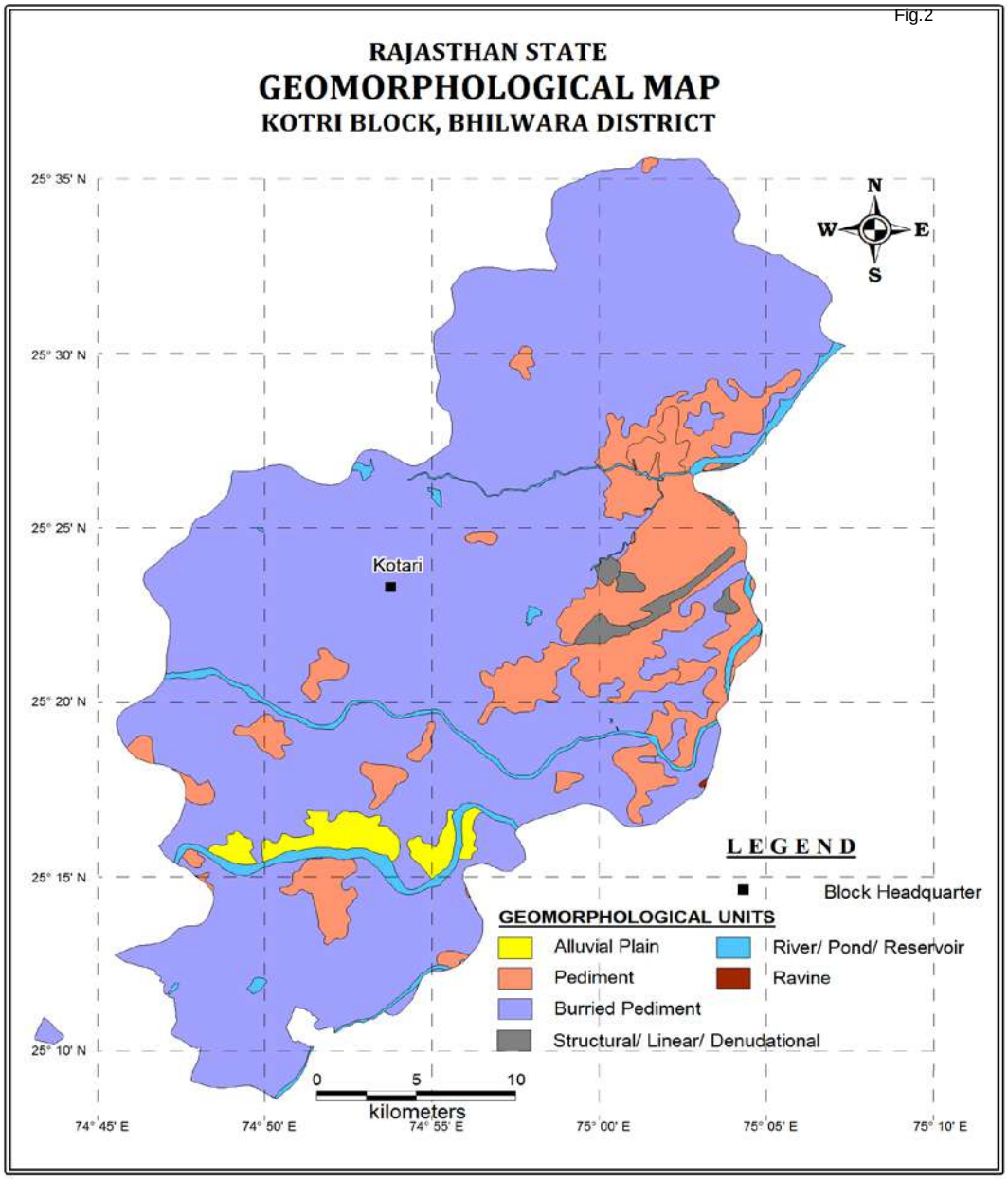


Fig.2
RAJASTHAN STATE
GEOMORPHOLOGICAL MAP
KOTRI BLOCK, BHILWARA DISTRICT
25° 35' N
25° 30' N
25° 25' N
25° 20' N
25° 15' N
25° 10' N
N
W
E
S
Kotari
LEGEND
Block Headquarter
GEOMORPHOLOGICAL UNITS
Alluvial Plain
Pediment
Burried Pediment
Structural/ Linear/ Denudational
River/ Pond/ Reservoir
Ravine
0
5
10
kilometers
74° 45' E
74° 50' E
74° 55' E
75° 00' E
75° 05' E
75° 10' E

Fig: 3

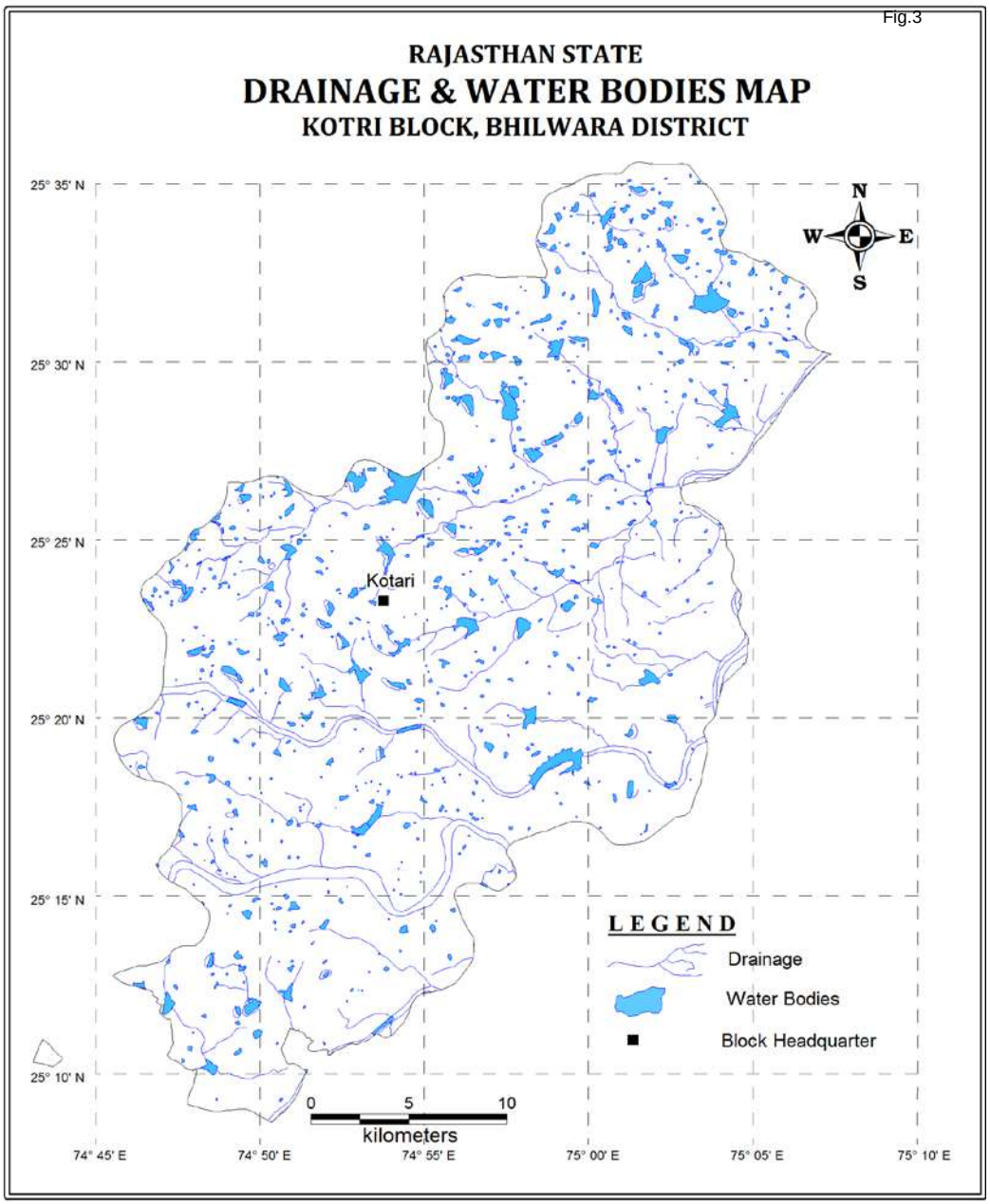


Fig.3
RAJASTHAN STATE
DRAINAGE & WATER BODIES MAP
KOTRI BLOCK, BHILWARA DISTRICT
25° 35' N
25° 30' N
25° 25' N
25° 20' N
25° 15' N
25° 10' N
74° 45' E
74° 50' E
74° 55' E
75° 00' E
75° 05' E
75° 10' E
N
W
E
S
Kotari
LEGEND
Drainage
Water Bodies
Block Headquarter
0
5
10
kilometers

Rainfall

The climate of the block is semi arid. The Normal annual rainfall of block is 719.20 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

The major water bearing formations in the Block are gneiss and schist of Bhilwara Supergroup overlain by thin cover of alluvium. Out of total geographical area of 934.00 Sq. Km, an area of 898.31 Sq. Km. (96.18%) forms aquifer system (potential zone) in the block and remaining 35.69 Sq. Km.(3.82%) area is represented by hills. Ground water occurs under unconfined to semi-confined condition. Extent, size, opening and inter-connection of joints, fissures and other plains of structural weakness control occurrence & movement of ground water. Muscovite schist often grades into gneiss. These have well-developed foliation and irregular joints and are intruded by granite, pegmatite and quartz veins. The contact between these intrusives and schists provides good channel for ground water circulation. In general yield of wells tapping Gneiss & Schist ranges from 0.29 to 0.58 lps.

Ground Water Level:

As per Average decadal depth to water level (from November, 2005 to November, 2014), the block majorly falls in water level range 60-70 and 70-80 m bgl range with the southern area showing 20-50 and 50-60 m bgl range. **(Fig 4)**

The average decadal depth to water level is 11.60 mbgl for Pre monsoon & 8.04 mbgl for Post monsoon. According to depth to water level maps of May 2014 & November 2014, the water level ranges between 5 to 10 and 10 to 20 m bgl in major part. The north western part shows shallow water level ranging 2-5 m bgl deep. The Map showing Depth to water level for May, 2014 and 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 0.26 m/year during pre monsoon and 0.13 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 majorly show trend of -1 to 0 and 0 to 1. The map of Decadal Water Level Trend is shown in **fig. 7**.

Fig: 4

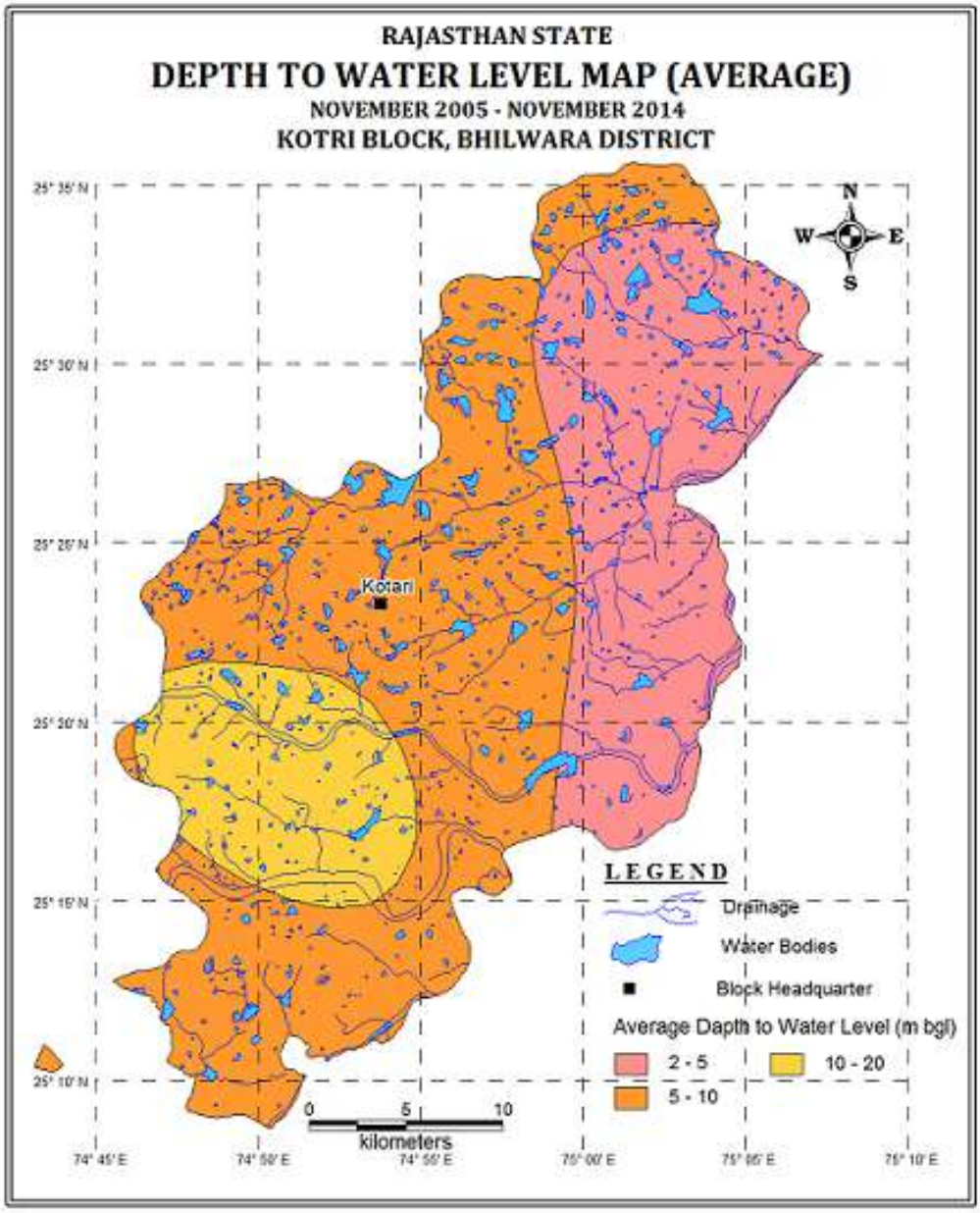

RAJASTHAN STATE
DEPTH TO WATER LEVEL MAP (AVERAGE)
NOVEMBER 2005 - NOVEMBER 2014
KOTRI BLOCK, BHILWARA DISTRICT
25° 35' N
25° 30' N
25° 25' N
25° 20' N
25° 15' N
25° 10' N
74° 45' E
74° 50' E
74° 55' E
75° 00' E
75° 05' E
75° 10' E
N
W
E
S
Kotari
LEGEND
Drainage
Water Bodies
Block Headquarter
Average Depth to Water Level (m bgl)
2 - 5
10 - 20
5 - 10
0
5
10
kilometers

Fig: 5

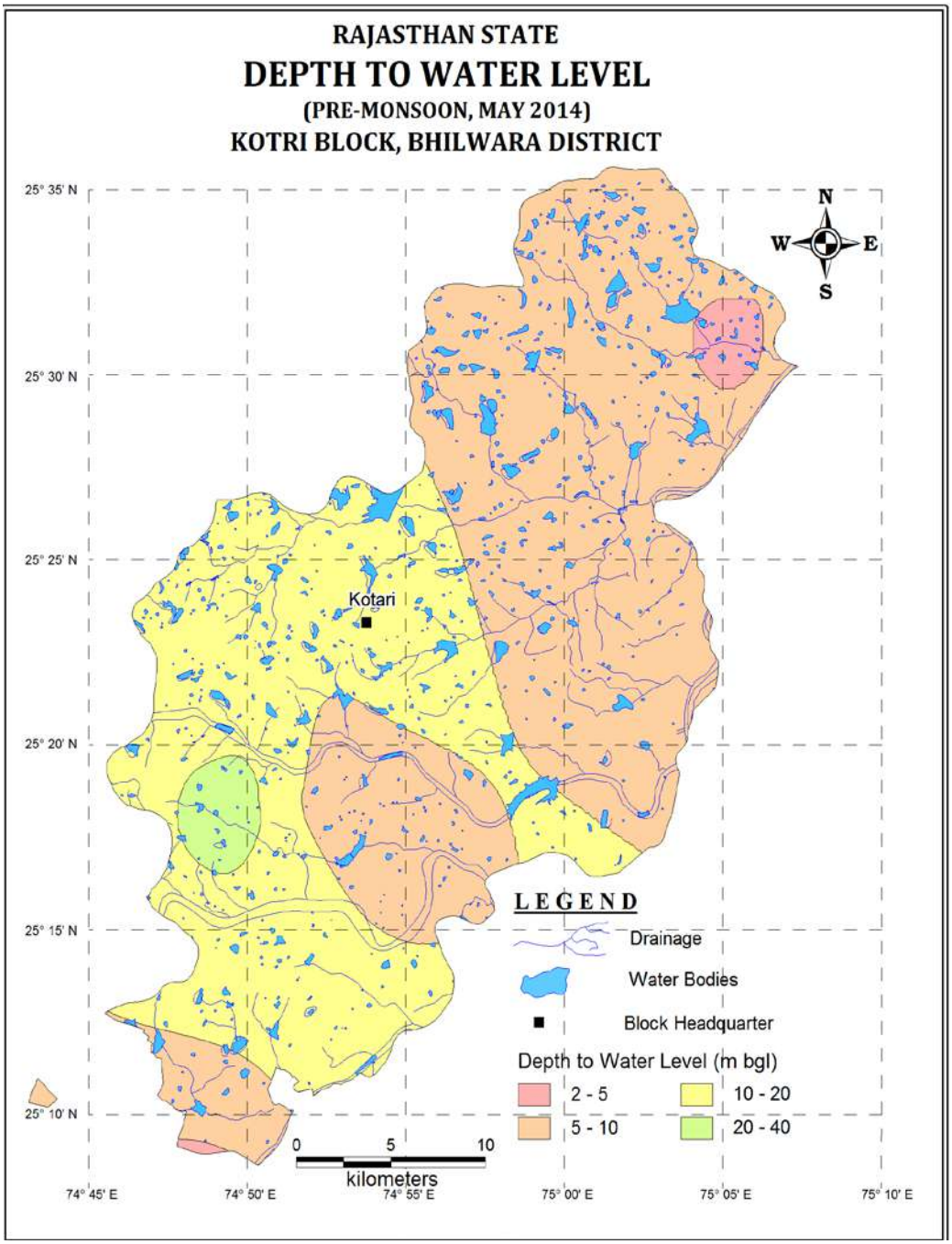

RAJASTHAN STATE
DEPTH TO WATER LEVEL
(PRE-MONSOON, MAY 2014)
KOTRI BLOCK, BHILWARA DISTRICT
25° 35' N
25° 30' N
25° 25' N
25° 20' N
25° 15' N
25° 10' N
74° 45' E
74° 50' E
74° 55' E
75° 00' E
75° 05' E
75° 10' E
N
W
E
S
Kotari
LEGEND
Drainage
Water Bodies
Block Headquarter
Depth to Water Level (m bgl)
2 - 5
5 - 10
10 - 20
20 - 40
0
5
10
kilometers

Fig: 6

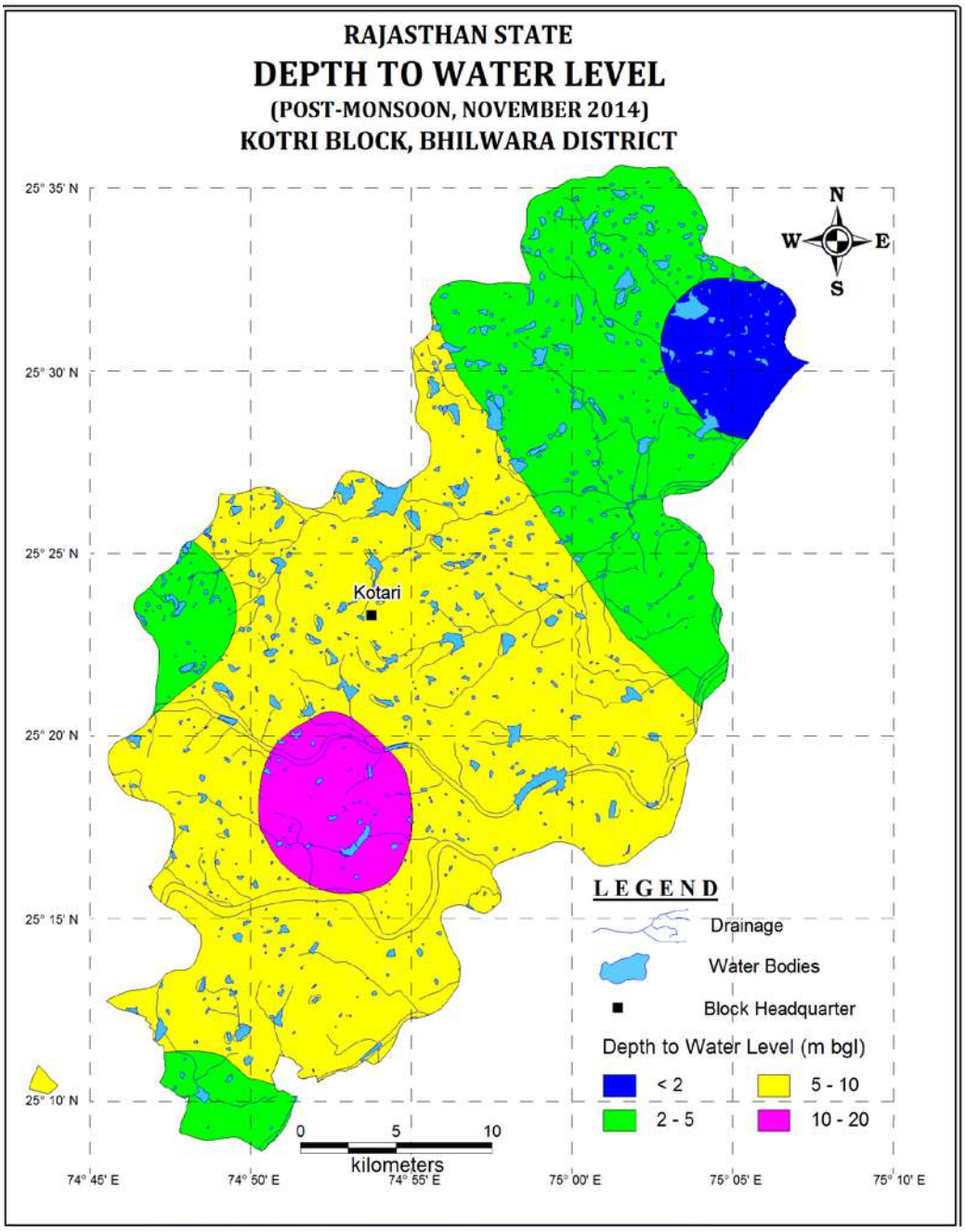
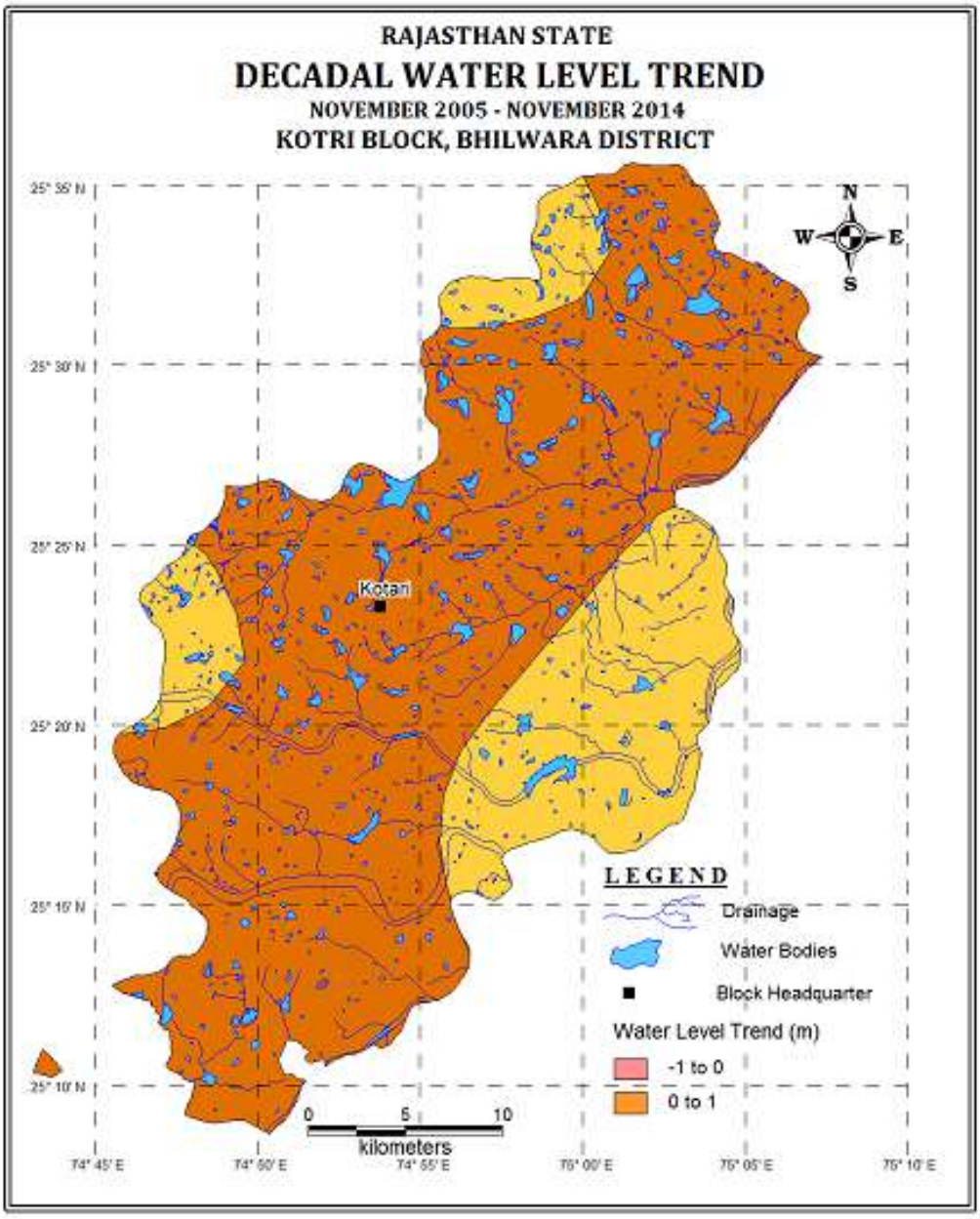

RAJASTHAN STATE
DEPTH TO WATER LEVEL
(POST-MONSOON, NOVEMBER 2014)
KOTRI BLOCK, BHILWARA DISTRICT
25° 35' N
25° 30' N
25° 25' N
25° 20' N
25° 15' N
25° 10' N
74° 45' E
74° 50' E
74° 55' E
75° 00' E
75° 05' E
75° 10' E
N
W
E
S
Kotari
0
5
10
kilometers
LEGEND
Drainage
Water Bodies
Block Headquarter
Depth to Water Level (m bgl)
< 2
2 - 5
5 - 10
10 - 20

Fig: 7


RAJASTHAN STATE
DECADAL WATER LEVEL TREND
NOVEMBER 2005 - NOVEMBER 2014
KOTRI BLOCK, BHILWARA DISTRICT
25° 35' N
25° 30' N
25° 25' N
25° 20' N
25° 15' N
25° 10' N
74° 45' E
74° 50' E
74° 55' E
75° 00' E
75° 05' E
75° 10' E
N
W
E
S
Kotari
0
5
10
kilometers
LEGEND
Drainage
Water Bodies
Block Headquarter
Water Level Trend (m)
-1 to 0
0 to 1

Subsurface Hydrogeology

As inferred from borehole data of the Kotri Block; Schist, Phyllite & Gneiss form the aquifers. However, the ground water in these only occurs in shallow weathered parts or fractures due to absence of primary porosity. The depth of drilling ranges from 25.9 to 187.6 m. bgl. The quality of ground water in the block is affected by high salinity & fluoride contamination.

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 4479ham and Annual Ground water draft is 5443.49ham. Stage of Ground water development has reached 121.53%.

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

Natural Discharge During Non Monsoon Period	410.06 ham
Net Annual Ground Water Availability	4479.00 ham
Annual Ground Water Draft	5443.49 ham
Net Ground water Availability for Future Irrigation Use	Nil
Stage of Ground Water Development	121.53%
Source: Ground Water Resource Assessment 31.03.2011	

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 4.66 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
BHILWARA	RJ07	**KOTRI**	RJ0705	934.000	898.310	hard rock	898.310	0.018

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)
7.320	4.320	67.912	Banas	4.6603	4.6603	155	0	0

Feasible Artificial Recharge and water conservation structures

A wide spectrum of techniques is in vougue, 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 934sq km practically 898.31sq 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

Kotri block is having ground water level between 10 & 20m below ground level and as per dynamic ground water resource estimation, the block is over exploited with stage of ground water development at 121.53%. The Kotri 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 deep in the block, the structures like ani-cuts and Check dams are not suitable and also their construction is regulated. Considering this aspect the proposal for Recharge Shaft/ Recharge wells have been firmed up in the present Plan which are the most suitable structures in Kotri block. In view of the availability of number of ponds in the block, percolation tanks are also not found feasible.

Details of Ground Water Recharge Measures

Existing Village Pond with recharge shaft/wells

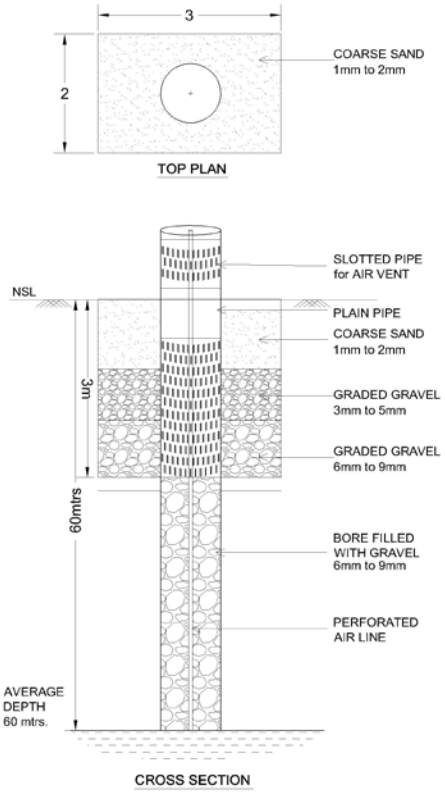
Almost all the villages in the State of Rajasthan have one or two village ponds & other ponds. With time, these ponds get silted & hardly any water percolates downward. Also, any excess water coming into the pond goes away as a run off due to limited storage capacity. This surplus runoff can very well 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 8. 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.

Fig 8



3. 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.

Tentative Locations for Recharge Shaft:

The tentative location of villages for construction of recharge shaft/well in existing village pond and their cost estimates are shown in Fig 9 and Table 3. The plan proposes construction of 155 recharges shafts/ wells in 155 identified existing village ponds at an estimated cost of 668lacs. The block also has area with shallow water level (<5 m), which is not recommended for artificial recharge.

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

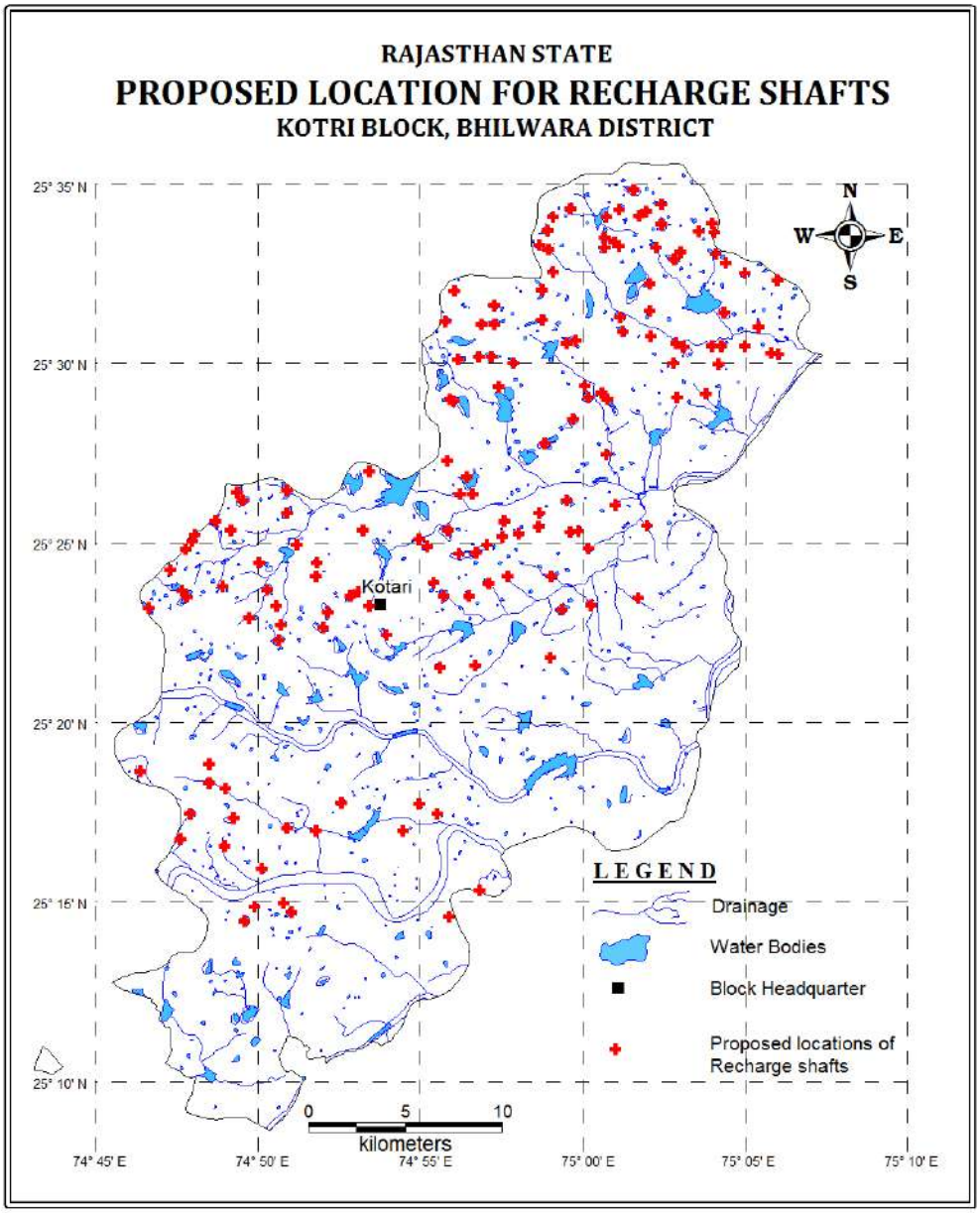
S No.	Village	Long	Lat	Pond area (ha)	Formation	No of Shafts	Unit cost (Rs in lac)	Total cost (Rs in lac)
1	Asop	74.979	25.534	1.667	Hard_rock	1	2.6	2.6
2	Akola	74.876	25.296	8.319	Hard_rock	1	2.6	2.6
3	Paroli	75.071	25.508	2.918	Hard_rock	1	2.6	2.6
4	Paroli	75.070	25.500	11.408	Hard_rock	1	2.6	2.6
5	Bhagwanpura	74.985	25.568	3.865	Hard_rock	1	2.6	2.6
6	Gadri Khera	75.001	25.490	1.018	Hard_rock	1	2.6	2.6
7	Baga Ka Khera	74.927	25.359	8.888	Hard_rock	1	2.6	2.6
8	Bagri	74.992	25.437	11.929	Hard_rock	1	2.6	2.6
9	Bagri	74.978	25.430	6.295	Hard_rock	1	2.6	2.6
10	Kanwaliyas	74.995	25.474	3.054	Hard_rock	1	2.6	2.6
11	Ganeshpura	75.059	25.561	4.411	Hard_rock	1	2.6	2.6
12	Ganeshpura	75.067	25.561	1.865	Hard_rock	1	2.6	2.6
13	Ban Ka Khera	74.808	25.314	5.948	Hard_rock	1	2.6	2.6
14	Ban Ka Khera	74.808	25.305	11.510	Hard_rock	1	2.6	2.6
15	Ban Ka Khera	74.817	25.303	4.862	Hard_rock	1	2.6	2.6
16	Ban Ka Khera	74.799	25.291	8.160	Hard_rock	1	2.6	2.6
17	Ban Ka Khera	74.794	25.279	6.114	Hard_rock	1	2.6	2.6
18	Mataji Ka Khera (Maliyon	75.068	25.551	1.974	Hard_rock	1	2.6	2.6
19	Barla	74.821	25.289	5.372	Hard_rock	1	2.6	2.6
20	Barla	74.816	25.276	4.236	Hard_rock	1	2.6	2.6

21	Dantra	75.010	25.486	1.532	Hard_rock	1	2.6	2.6
22	Belwa	75.012	25.458	3.558	Hard_rock	1	2.6	2.6
23	Sagatpuriya	74.951	25.416	2.188	Hard_rock	1	2.6	2.6
24	Chawand Khera	75.099	25.539	2.645	Hard_rock	1	2.6	2.6
25	Agariya	74.984	25.543	1.364	Hard_rock	1	2.6	2.6
26	Gadri Khera	74.991	25.510	1.188	Hard_rock	1	2.6	2.6
27	Agariya	74.982	25.553	1.034	Hard_rock	1	2.6	2.6
28	Bhakliya	74.847	25.250	4.590	Hard_rock	1	2.6	2.6
29	Bhakliya	74.851	25.245	15.102	Hard_rock	1	2.6	2.6
30	Mataji Ka Khera	74.930	25.455	3.576	Hard_rock	1	2.6	2.6
31	Ganeshpura	75.050	25.552	2.333	Hard_rock	1	2.6	2.6
32	Chawandiya	74.773	25.311	4.271	Hard_rock	1	2.6	2.6
33	Dantra	75.013	25.484	1.844	Hard_rock	1	2.6	2.6
34	Dhanwara	75.063	25.486	1.844	Hard_rock	1	2.6	2.6
35	Borda	74.947	25.503	1.411	Hard_rock	1	2.6	2.6
36	Borda	74.936	25.502	1.256	Hard_rock	1	2.6	2.6
37	Dhayalon Ka Khera	74.899	25.374	6.571	Hard_rock	1	2.6	2.6
38	Dantra	75.020	25.515	2.417	Hard_rock	1	2.6	2.6
39	Mataji Ka Khera (Maliyon	75.073	25.547	8.089	Hard_rock	1	2.6	2.6
40	Dhokliya	74.869	25.384	15.663	Hard_rock	1	2.6	2.6
41	Dhokliya	74.867	25.377	12.549	Hard_rock	1	2.6	2.6
42	Chawand Khera	75.083	25.542	1.375	Hard_rock	1	2.6	2.6
43	Downi	74.931	25.243	3.663	Hard_rock	1	2.6	2.6
44	Gendliya	74.832	25.248	4.686	Hard_rock	1	2.6	2.6
45	Gendliya	74.827	25.241	15.203	Hard_rock	1	2.6	2.6
46	Kothaj	75.048	25.484	1.047	Hard_rock	1	2.6	2.6
47	Modiya Khera	75.017	25.434	2.701	Hard_rock	1	2.6	2.6
48	Gheoriya	75.033	25.425	8.366	Hard_rock	1	2.6	2.6
49	Asop	74.979	25.520	2.213	Hard_rock	1	2.6	2.6
50	Gogas	74.945	25.360	4.651	Hard_rock	1	2.6	2.6
51	Kakroliya Ghati	75.028	25.391	2.353	Hard_rock	1	2.6	2.6
52	Ganeshpura	75.034	25.537	7.948	Hard_rock	1	2.6	2.6
53	Paroli	75.083	25.508	1.284	Hard_rock	1	2.6	2.6
54	Paroli	75.090	25.517	19.961	Hard_rock	1	2.6	2.6
55	Paplaj	74.931	25.423	1.042	Hard_rock	1	2.6	2.6
56	Paplaj	74.916	25.419	1.513	Hard_rock	1	2.6	2.6
57	Gula Ka Khera	74.937	25.412	9.490	Hard_rock	1	2.6	2.6
58	Hajiwas	75.003	25.414	8.811	Hard_rock	1	2.6	2.6
59	Harpura	74.834	25.407	7.483	Hard_rock	1	2.6	2.6
60	Hatoondi	74.796	25.414	2.122	Hard_rock	1	2.6	2.6
61	Hatoondi	74.799	25.418	3.077	Hard_rock	1	2.6	2.6
62	Holirada	74.908	25.283	7.743	Hard_rock	1	2.6	2.6
63	Borda	74.948	25.518	3.446	Hard_rock	1	2.6	2.6
64	Itawa	75.004	25.388	10.049	Hard_rock	1	2.6	2.6
65	Fatehpura	74.955	25.527	4.083	Hard_rock	1	2.6	2.6
66	Jaswantpura	74.848	25.431	1.178	Hard_rock	1	2.6	2.6

67	Jaswantpura	74.854	25.416	5.229	Hard_rock	1	2.6	2.6
68	Dantra	75.019	25.522	10.316	Hard_rock	1	2.6	2.6
69	Kheri	75.034	25.524	1.321	Hard_rock	1	2.6	2.6
70	Borda	74.953	25.503	2.119	Hard_rock	1	2.6	2.6
71	Borda	74.954	25.518	1.695	Hard_rock	1	2.6	2.6
72	Agariya	74.982	25.562	4.440	Hard_rock	1	2.6	2.6
73	Onkarpura	74.964	25.500	1.614	Hard_rock	1	2.6	2.6
74	Dantra	75.035	25.513	5.939	Hard_rock	1	2.6	2.6
75	Jagpura	74.983	25.363	1.288	Hard_rock	1	2.6	2.6
76	Karer	74.835	25.266	6.706	Hard_rock	1	2.6	2.6
77	Khajeena	74.863	25.283	3.897	Hard_rock	1	2.6	2.6
78	Birdhol	74.941	25.447	1.882	Hard_rock	1	2.6	2.6
79	Kheroona	74.844	25.371	16.620	Hard_rock	1	2.6	2.6
80	Bilaspura	75.026	25.580	1.727	Hard_rock	1	2.6	2.6
81	Kodiya	74.838	25.395	14.974	Hard_rock	1	2.6	2.6
82	Kodiya	74.843	25.388	4.889	Hard_rock	1	2.6	2.6
83	Deo Kheri	75.012	25.568	2.530	Hard_rock	1	2.6	2.6
84	Kodiya	74.829	25.382	4.512	Hard_rock	1	2.6	2.6
85	Udliyas	74.795	25.394	3.316	Hard_rock	1	2.6	2.6
86	Bishniya	75.011	25.554	3.242	Hard_rock	1	2.6	2.6
87	Bhagwanpura	74.993	25.572	2.620	Hard_rock	1	2.6	2.6
88	Kodiya	74.845	25.378	3.961	Hard_rock	1	2.6	2.6
89	Sarsari	74.820	25.423	1.843	Hard_rock	1	2.6	2.6
90	Kotri	74.902	25.397	12.494	Hard_rock	1	2.6	2.6
91	Kotri	74.885	25.394	4.881	Hard_rock	1	2.6	2.6
92	Kotri	74.881	25.392	15.137	Hard_rock	1	2.6	2.6
93	Jharol	74.887	25.423	1.523	Hard_rock	1	2.6	2.6
94	Kotri	74.891	25.387	5.750	Hard_rock	1	2.6	2.6
95	Paroli	75.048	25.509	23.536	Hard_rock	1	2.6	2.6
96	Bishniya	75.011	25.558	9.964	Hard_rock	1	2.6	2.6
97	Bishniya	75.016	25.556	24.087	Hard_rock	1	2.6	2.6
98	Bilaspura	75.018	25.572	1.388	Hard_rock	1	2.6	2.6
99	Bishniya	75.038	25.554	6.209	Hard_rock	1	2.6	2.6
100	Ganeshpura	75.066	25.565	23.413	Hard_rock	1	2.6	2.6
101	Manakpura	74.998	25.422	5.753	Hard_rock	1	2.6	2.6
102	Manakpura	74.994	25.422	6.119	Hard_rock	1	2.6	2.6
103	Mansha	74.945	25.412	15.333	Hard_rock	1	2.6	2.6
104	Sarsari	74.823	25.440	1.765	Hard_rock	1	2.6	2.6
105	Mansha	74.924	25.398	7.544	Hard_rock	1	2.6	2.6
106	Mansha	74.929	25.392	16.433	Hard_rock	1	2.6	2.6
107	Jharol	74.891	25.450	2.562	Hard_rock	1	2.6	2.6
108	Mansha	74.941	25.392	7.277	Hard_rock	1	2.6	2.6
109	Takhtatpura	74.930	25.519	1.646	Hard_rock	1	2.6	2.6
110	Chhaprel	75.003	25.484	1.026	Hard_rock	1	2.6	2.6
111	Onkarpura	74.957	25.489	1.277	Hard_rock	1	2.6	2.6
112	Parmeshwar Pura	74.990	25.386	23.194	Hard_rock	1	2.6	2.6

113	Paroli Genta	74.916	25.295	4.643	Hard_rock	1	2.6	2.6
114	Paroli Genta	74.925	25.291	3.855	Hard_rock	1	2.6	2.6
115	Paroli	75.100	25.504	4.429	Hard_rock	1	2.6	2.6
116	Paroli	75.073	25.524	18.814	Hard_rock	1	2.6	2.6
117	Reeth	74.864	25.408	5.681	Hard_rock	1	2.6	2.6
118	Hatoondi	74.801	25.420	2.716	Hard_rock	1	2.6	2.6
119	Reeth	74.863	25.401	3.648	Hard_rock	1	2.6	2.6
120	Paroli	75.096	25.505	13.079	Hard_rock	1	2.6	2.6
121	Paroli	75.067	25.508	24.825	Hard_rock	1	2.6	2.6
122	Paroli	75.052	25.508	12.490	Hard_rock	1	2.6	2.6
123	Paroli	75.047	25.500	3.161	Hard_rock	1	2.6	2.6
124	Sagatpuriya	74.960	25.427	7.568	Hard_rock	1	2.6	2.6
125	Sagatpuriya	74.967	25.421	5.011	Hard_rock	1	2.6	2.6
126	Sagatpuriya	74.959	25.420	4.100	Hard_rock	1	2.6	2.6
127	Agariya	74.978	25.555	3.883	Hard_rock	1	2.6	2.6
128	Kalyan Pura	74.937	25.439	2.530	Hard_rock	1	2.6	2.6
129	Birdhol	74.944	25.439	1.345	Hard_rock	1	2.6	2.6
130	Kotri	74.920	25.415	1.174	Hard_rock	1	2.6	2.6
131	Sarsari	74.826	25.436	1.722	Hard_rock	1	2.6	2.6
132	Sagatpuriya	74.962	25.401	4.197	Hard_rock	1	2.6	2.6
133	Bishniya	75.029	25.568	4.183	Hard_rock	1	2.6	2.6
134	Ganeshpura	75.047	25.548	1.456	Hard_rock	1	2.6	2.6
135	Bishniya	75.032	25.570	1.759	Hard_rock	1	2.6	2.6
136	Bishniya	75.040	25.565	6.063	Hard_rock	1	2.6	2.6
137	Bishniya	75.040	25.574	17.959	Hard_rock	1	2.6	2.6
138	Bishniya	75.019	25.554	1.740	Hard_rock	1	2.6	2.6
139	Dantra	74.996	25.511	6.938	Hard_rock	1	2.6	2.6
140	Shopura (Sawaipura)	74.849	25.284	5.994	Hard_rock	1	2.6	2.6
141	Shree Pura	74.947	25.255	4.860	Hard_rock	1	2.6	2.6
142	Shree Pura	74.947	25.255	4.860	Hard_rock	1	2.6	2.6
143	Singhji Ka Khera	74.952	25.398	10.217	Hard_rock	1	2.6	2.6
144	Takhtatpura	74.934	25.534	1.889	Hard_rock	1	2.6	2.6
145	Raser	74.932	25.483	1.786	Hard_rock	1	2.6	2.6
146	Sola Ka Khera @ Ratanpur	74.977	25.424	4.984	Hard_rock	1	2.6	2.6
147	Sarsari	74.848	25.441	2.878	Hard_rock	1	2.6	2.6
148	Raser	74.934	25.482	2.279	Hard_rock	1	2.6	2.6
149	Thalera	74.984	25.401	16.736	Hard_rock	1	2.6	2.6
150	Sarsari	74.812	25.427	2.112	Hard_rock	1	2.6	2.6
151	Kanwaliyas	74.981	25.463	2.266	Hard_rock	1	2.6	2.6
152	Chatarpura	74.789	25.404	2.771	Hard_rock	1	2.6	2.6
153	Udliyas	74.815	25.397	5.963	Hard_rock	1	2.6	2.6
154	Chatarpura	74.777	25.387	1.444	Hard_rock	1	2.6	2.6
155	Udliyas	74.797	25.392	17.408	Hard_rock	1	2.6	2.6
				Total		155		403

Fig: 9


RAJASTHAN STATE
PROPOSED LOCATION FOR RECHARGE SHAFTS
KOTRI BLOCK, BHILWARA DISTRICT
25° 35' N
25° 30' N
25° 25' N
25° 20' N
25° 15' N
25° 10' N
74° 45' E
74° 50' E
74° 55' E
75° 00' E
75° 05' E
75° 10' E
N
W
E
S
Kotari
LEGEND
Drainage
Water Bodies
Block Headquarter
Proposed locations of Recharge shafts
0
5
10
kilometers

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 78 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 4.723 cr, which includes Rs 4.03 cr for ground water recharge activities, 0.468 cr for ground water monitoring (Piezometer construction) and Rs 0.225 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 4.723 Crores**.

Table 4: Cost of the recharge structures

Cost Recharge Shaft Rs in crs (Unit cost Rs 0.026 cr for hard rock)
Hard rock – 4.03

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	155	4.66	2.6	403	3.262
Impact assessment & Monitoring						
Piezometer	Up to 80 m bgl	78		0.6	46.8	
Impact assessment will be carried out by implementing agency						
O & M - 5% of total cost of the scheme					22.49	
TOTAL					**472.29**	
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	1st phase	2th Phase	3rd Phase	4th Phase	5th Phase	6th Phase	7th Phase	8th 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 Kotri block, Bhilwara envisages gainful utilization of 3.262 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 113.28% from the existing 121.53%. The projected status of ground water resources and utilization scenario is presented in table 7.

Table 7: Projected Status of Groundwater Resource & Utilization							
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 %)**
44.79	3.262	48.052	54.4349	0	54.4349	121.53	113.28

- 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.