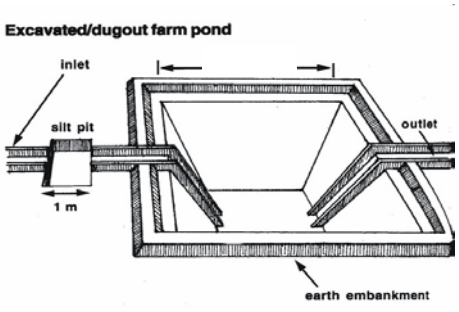
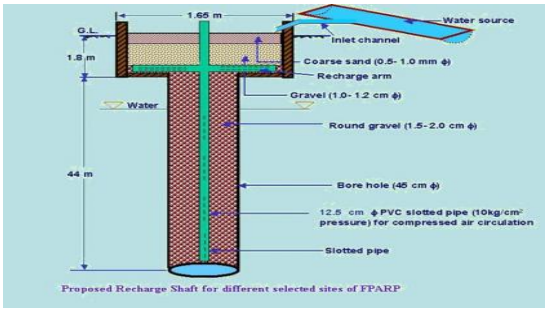
CENTRAL GROUND WATER BOARD

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





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

Western Region, Jaipur
April 2016

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

Plan at a Glance

1.	**Area of the Mandalgarh Block**	**1499.10 sq.km.**
2.	**Area identified for Artificial Recharge**	**1125.13 sq km**
3.	**Dynamic Ground Water Resources (as on 31.03.2011)**	
	Net Ground Water Availability	**60.9379 MCM**
	Annual Ground Water Draft	**76.9904 MCM**
	Stage of Ground Water Development	**126.34%**
4.	**Volume of water to be harnessed** **Volume of water available for recharge** **Volume of water available for conservation by other interventions**	**25.3729 MCM** **19.2 MCM** **6.17 MCM**
5.	**Volume of unsaturated aquifer zone available for recharge**	**27.574 MCM**
6.	**Total number of structures to be proposed**	
	Recharge structures Existing village pond with recharge shaft/ well Percolation Tank **Water Conservation** Farm pond	 140 shafts in 75 Nos. of existing village ponds 75 123 Nos.
	Expected Annual GW recharge	**13.468 MCM**
	Provision for supplemental irrigation, thus reducing GW withdrawal for irrigation	**4.298 MCM**
	Total recharge/ saving of ground water	**17.766 MCM**
7.	**Estimated Cost** Artificial Recharge Plan Water conservation measures Piezometer construction Operation and maintenance	**48.615 crore** 33.64 crore 12.30 crore 0.36 crore 2.315 crore

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN OF MANDALGARH 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 **Mandalgarh 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 **126.34%.** 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:

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.

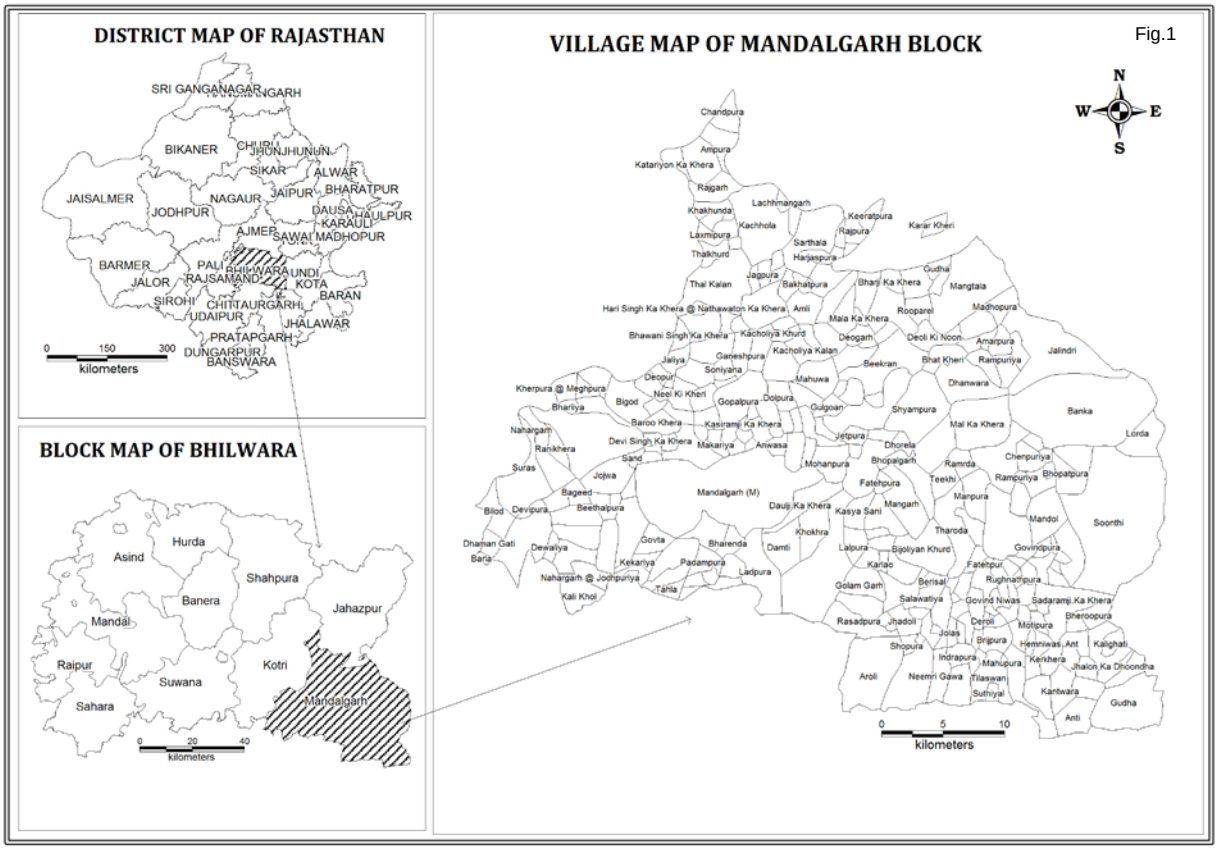
Location of the block

Mandalgarh Block of Bhilwara district falls under Over-Exploited category. It covers an area of 1499.10 sq. km. and falls in south-eastern part of Bhilwara district. It is located between North latitudes 25°01’ & 25°29’ and East longitudes 74°54’ & 75°27’. The total rural population of the Block is 239207 persons as per the 2011 census. It is comprised of 122123 males and 117084 females. Location map is shown in **fig 1**.

Source wise Irrigated Area

From a total area of 1499.10 sq.km, an area of 211.50 (14.11%) falls under irrigation. The dug wells/ Tube wells are the main source of irrigation in Mandalgarh Block. An area of 49.21 sq.km. is irrigated through canals and another 14.88 sq.km. area is irrigated through ponds. The wells irrigate total 118.35 sq.km. area in this Block.

Fig: 1



Physiography & Drainage

Physiographically, the block is characterized by presence of buried pediments of denudation origin and Plateau. The minimum and maximum elevation of Block is 324.4 m and 603.9 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 Banas & its tributaries in western half. The major part of block falls under Banas basin & some eastern part falls under Chambal basin. The map showing drainage and water bodies in the Mandalgarh block are shown in **fig 3**.

Fig: 2

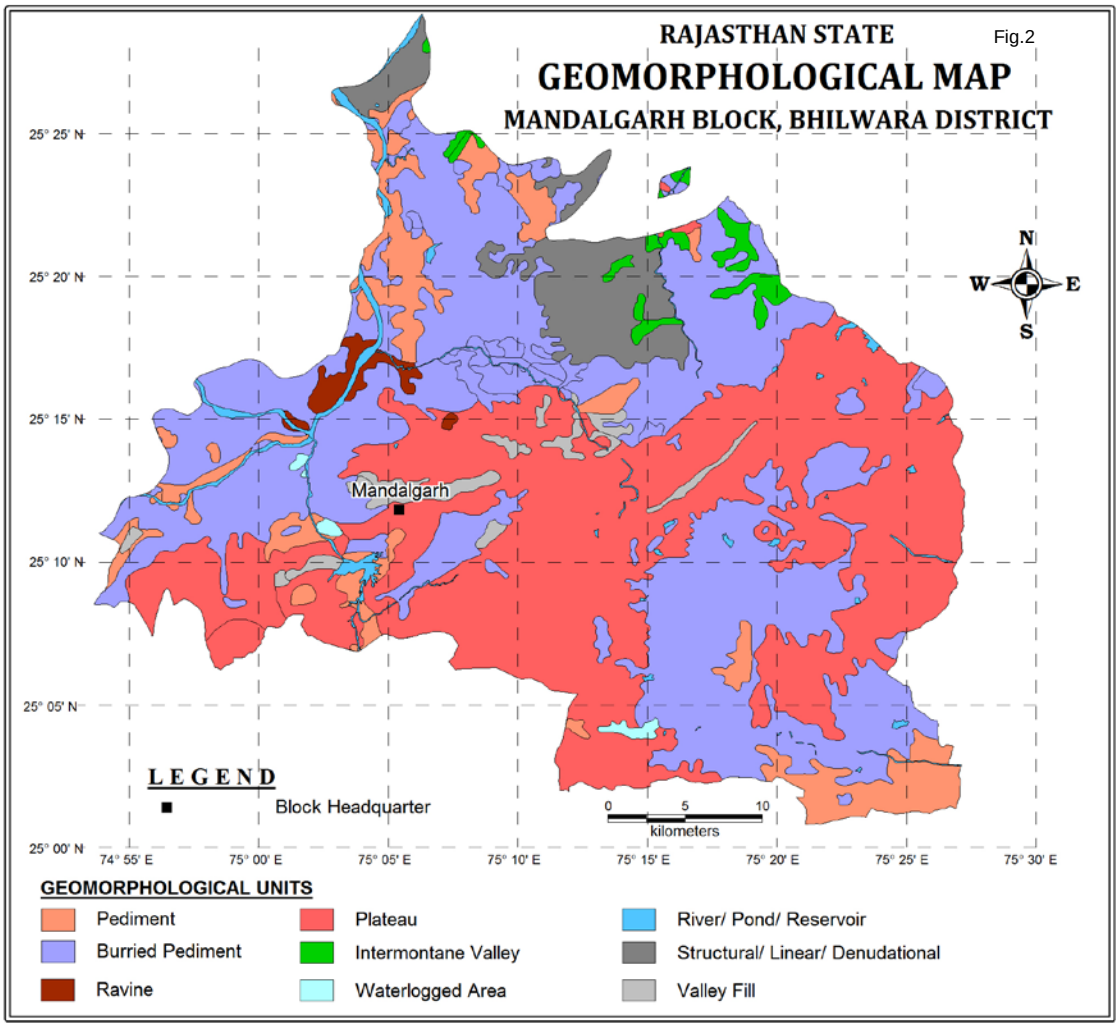
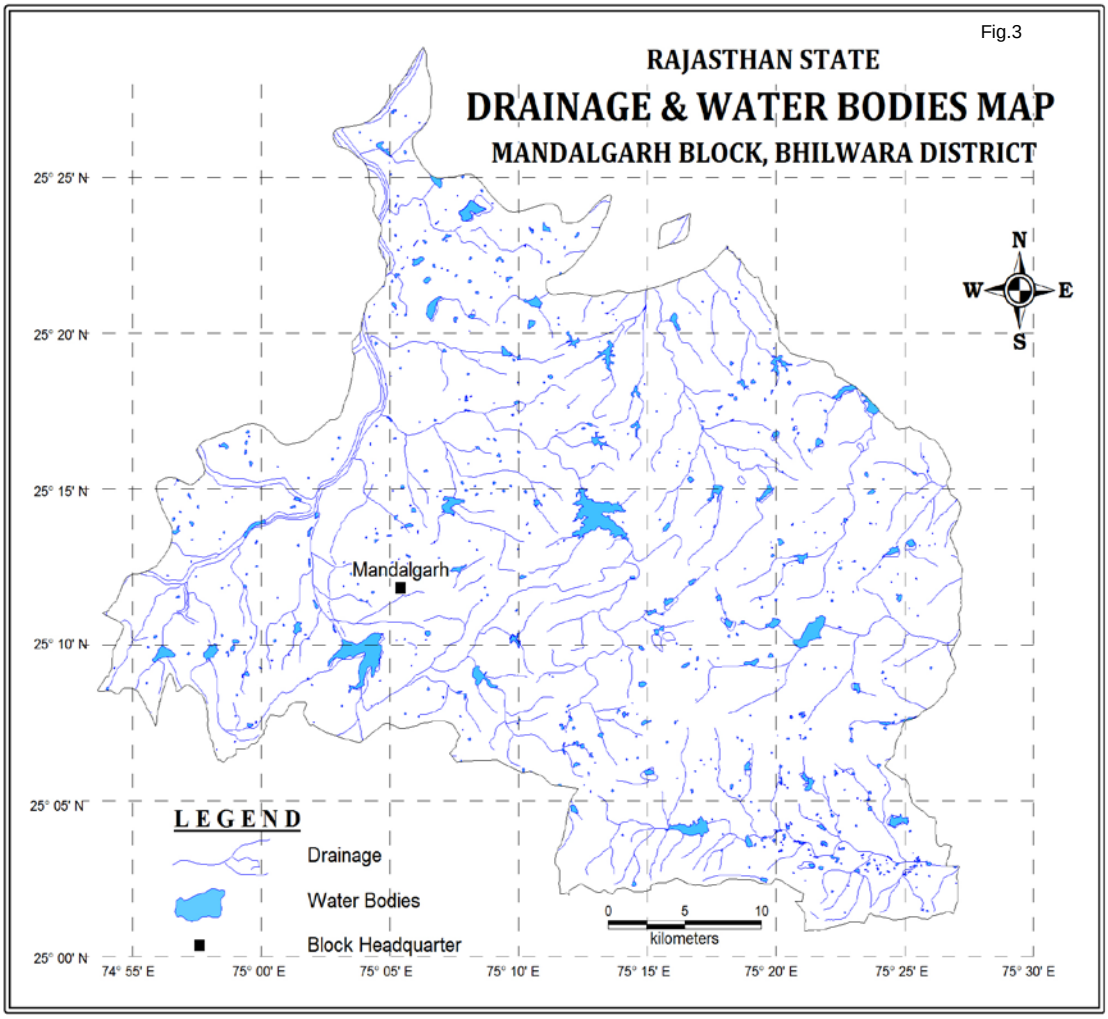

RAJASTHAN STATE
Fig.2
GEOMORPHOLOGICAL MAP
MANDALGARH BLOCK, BHILWARA DISTRICT
25° 25' N
25° 20' N
25° 15' N
25° 10' N
25° 05' N
25° 00' N
74° 55' E
75° 00' E
75° 05' E
75° 10' E
75° 15' E
75° 20' E
75° 25' E
75° 30' E
N
W
E
S
Mandalgarh
LEGEND
Block Headquarter
0
5
10
kilometers
GEOMORPHOLOGICAL UNITS
Pediment
Burried Pediment
Ravine
Plateau
Intermontane Valley
Waterlogged Area
River/ Pond/ Reservoir
Structural/ Linear/ Denudational
Valley Fill

Fig: 3



Rainfall

The climate of the block is semi arid. The Normal annual rainfall of block is 695 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 schist of Bhilwara Supergroup, sandstone and limestone of Vindhyan Supergroup. Out of total geographical area of 1499.10 Sq. Km, an area of 1032.73 Sq. Km. (68.89%) forms aquifer system (potential zone) in the block and remaining 466.37 Sq. Km.(31.11%) 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 and yield of wells tapping Sandstone varies from 0.46 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 2-5 and 5-10 and 10-20 m bgl range from west to east. **(Fig 4)**

The average decadal depth to water level is 14 m bgl for Pre monsoon & 8.22 m bgl for Post monsoon. In general, the depth to water level is between 5 to 10 and 10 & 20 mbgl in major part of Block. Depth to water level maps for May 2014 & November 2014 is shown in **fig 5 & 6**.

Water Level Trend:

All the hydrographs are showing declining water level trends over last 10 years. Water level trend shows average decline of 0.25 m/year during pre monsoon and 0.12 m/year during post monsoon.
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 and 0 to 1 m/ year in ground water level is prevalent in the block. The map of Decadal Water Level Trend is shown in **fig. 7**

Fig: 4

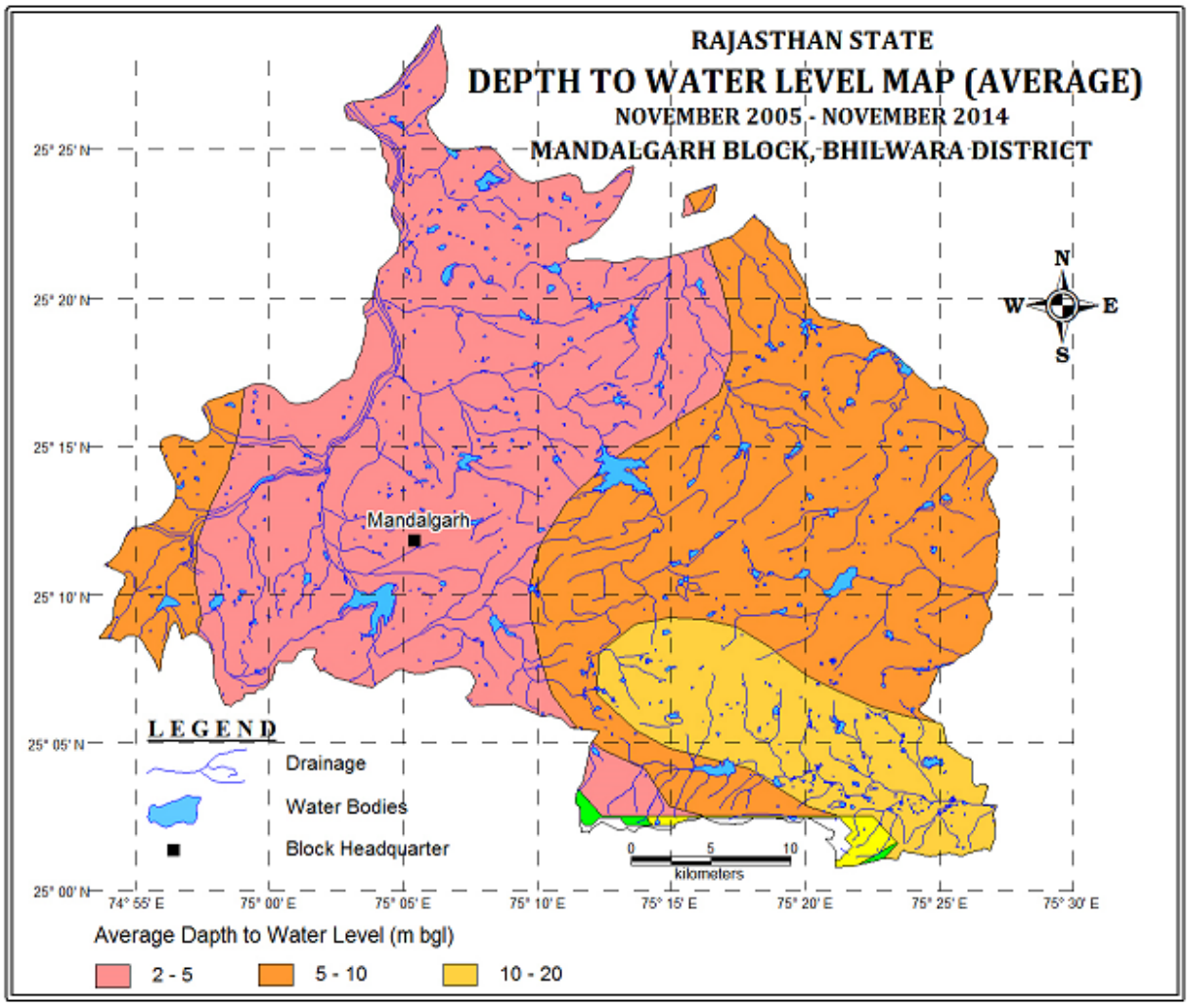

RAJASTHAN STATE
DEPTH TO WATER LEVEL MAP (AVERAGE)
NOVEMBER 2005 - NOVEMBER 2014
MANDALGARH BLOCK, BHILWARA DISTRICT
N
W
E
S
Mandalgarh
LEGEND
Drainage
Water Bodies
Block Headquarter
0 5 10
kilometers
25° 25' N
25° 20' N
25° 15' N
25° 10' N
25° 05' N
25° 00' N
74° 55' E
75° 00' E
75° 05' E
75° 10' E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

Fig: 5

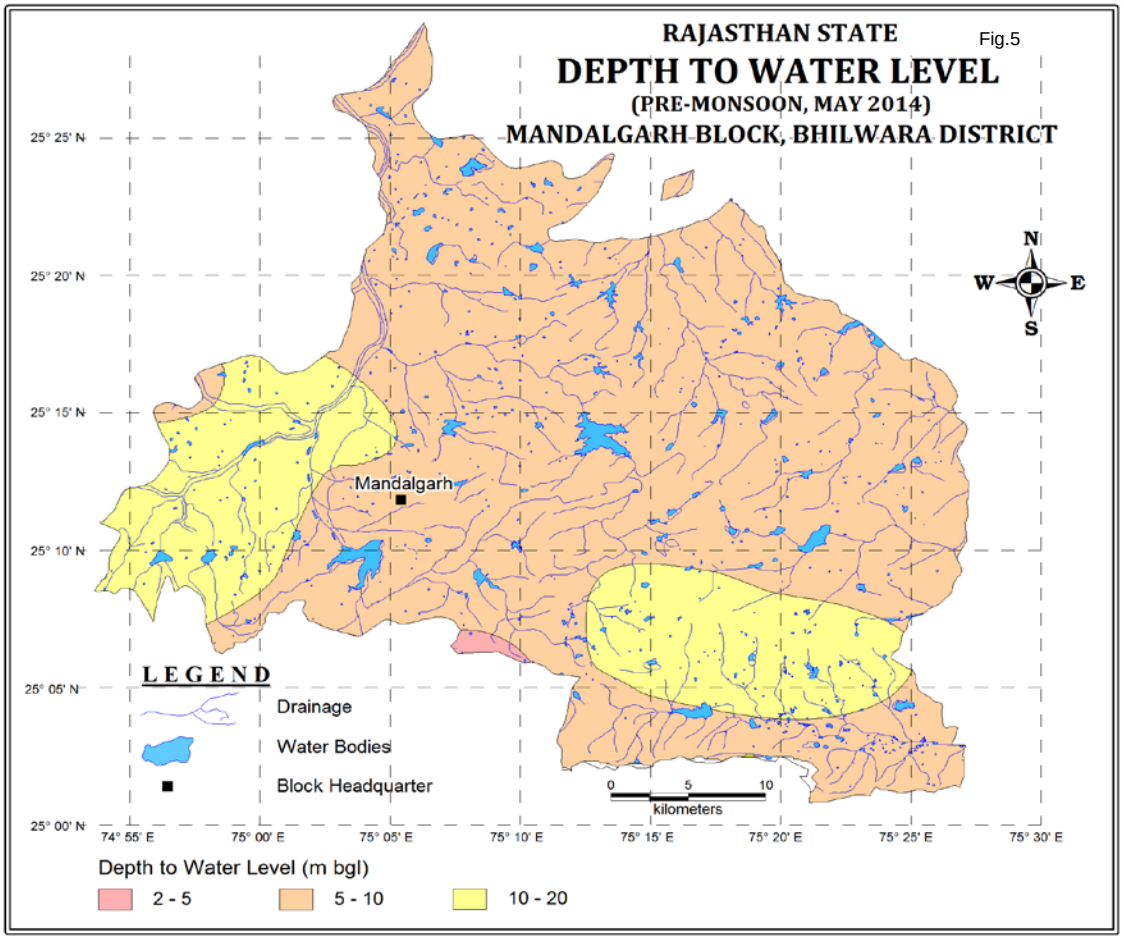

RAJASTHAN STATE
Fig.5
DEPTH TO WATER LEVEL
(PRE-MONSOON, MAY 2014)
MANDALGARH BLOCK, BHILWARA DISTRICT
25° 25' N
25° 20' N
25° 15' N
25° 10' N
25° 05' N
25° 00' N
74° 55' E
75° 00' E
75° 05' E
75° 10' E
75° 15' E
75° 20' E
75° 25' E
75° 30' E
N
W
E
S
Mandalgarh
LEGEND
Drainage
Water Bodies
Block Headquarter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

Fig: 6

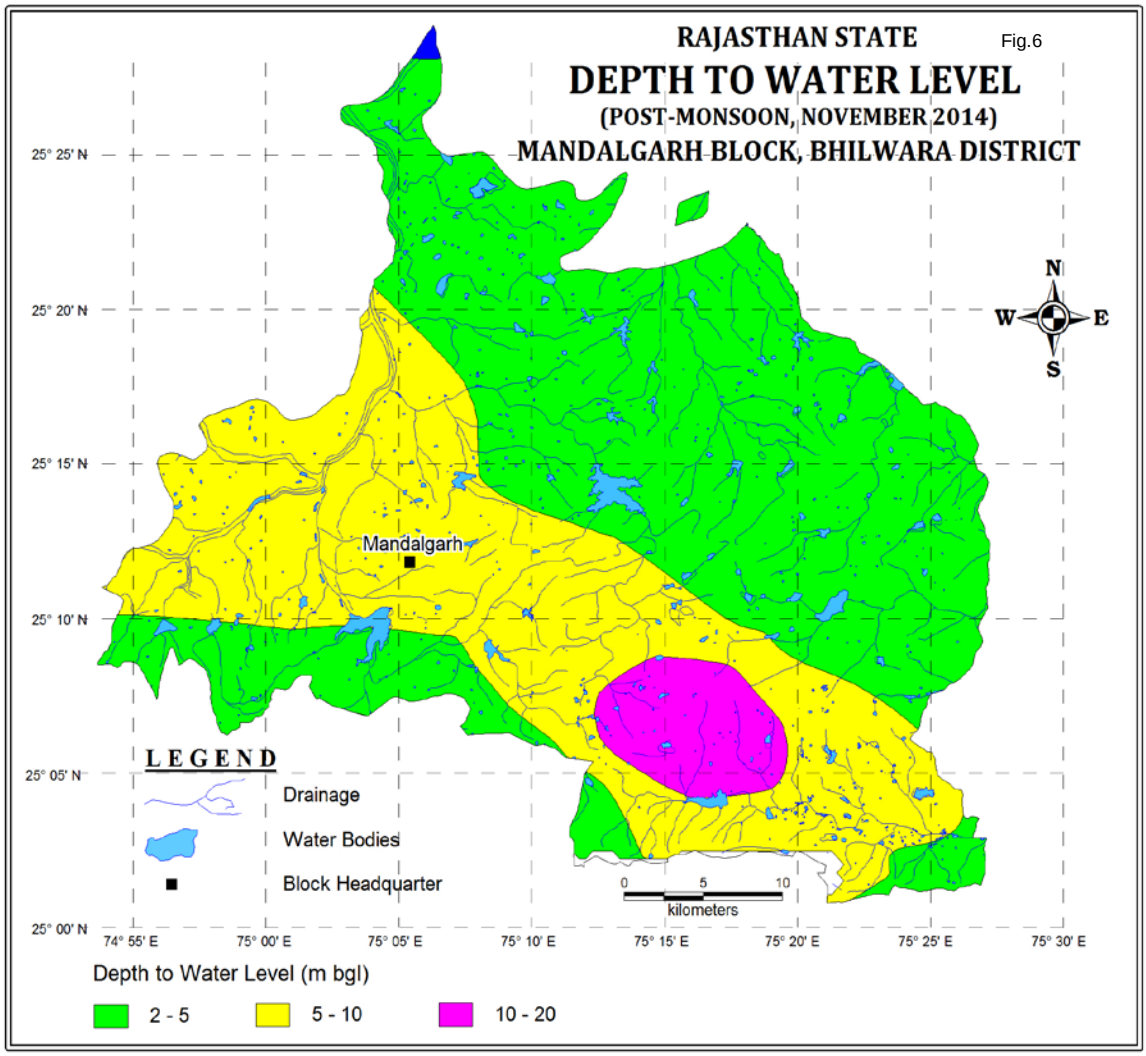
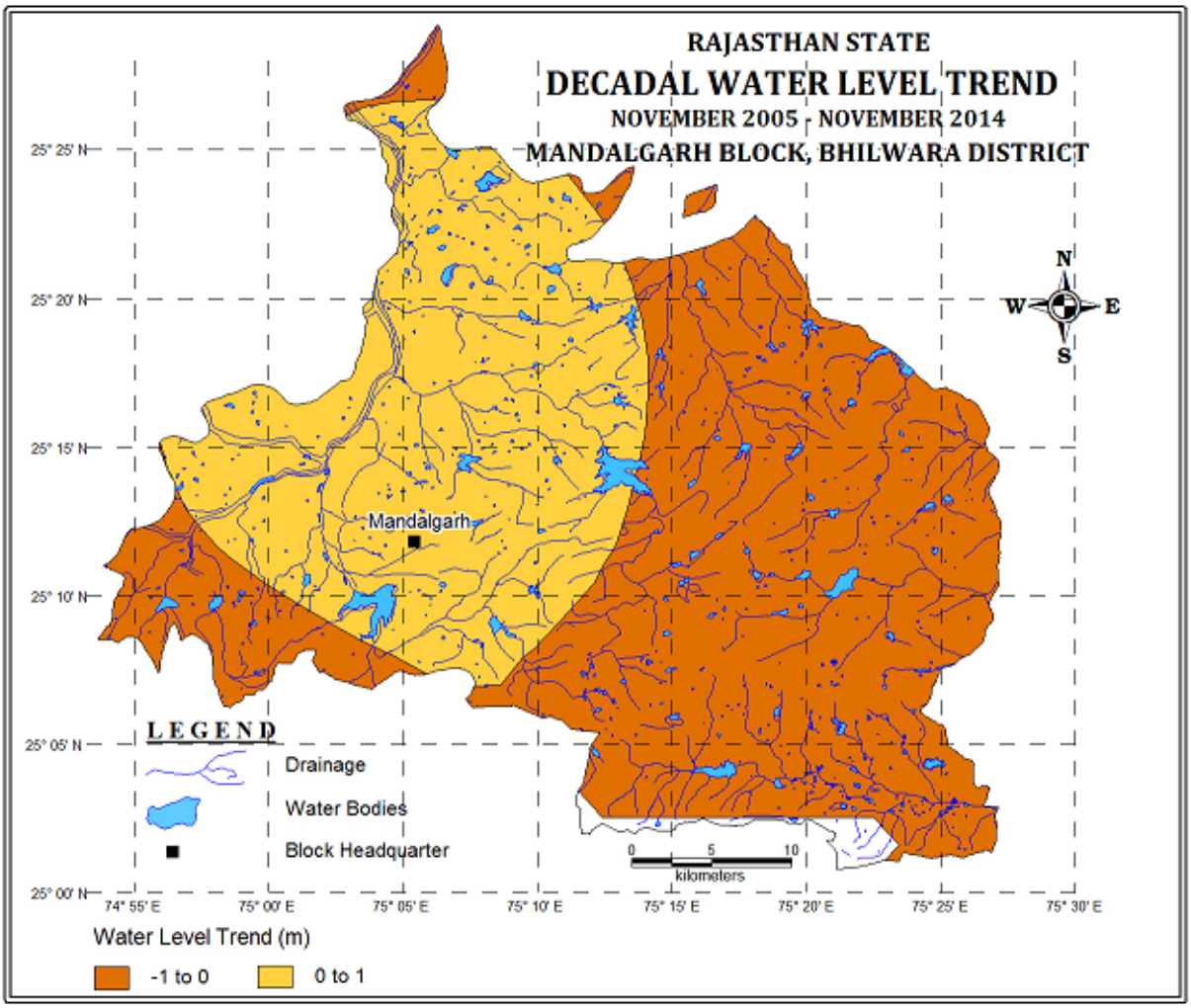

RAJASTHAN STATE
Fig.6
DEPTH TO WATER LEVEL
(POST-MONSOON, NOVEMBER 2014)
MANDALGARH BLOCK, BHILWARA DISTRICT
25° 25' N
25° 20' N
25° 15' N
25° 10' N
25° 05' N
25° 00' N
74° 55' E
75° 00' E
75° 05' E
75° 10' E
75° 15' E
75° 20' E
75° 25' E
75° 30' E
N
W
E
S
Mandalgarh
LEGEND
Drainage
Water Bodies
Block Headquarter
0
5
10
kilometers
Depth to Water Level (m bgl)
2 - 5
5 - 10
10 - 20

Fig: 7



Subsurface Hydrogeology

As inferred from borehole data of the Mandalgarh Block; Schist, Sandstone & Limestone form the aquifers. However, the ground water in hard rocks only occurs in shallow weathered parts or fractures due to absence of primary porosity. The depth of drilling ranges from 14 to 178 mbgl and the average discharge ranges from 7.75 to

20.38 lps. Transmissivity value varies between 50 to 230 m^2/day. 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 6093.79ham and Annual Ground water draft is 7699.04ham. Stage of Ground water development has reached 126.34%.

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

Natural Discharge During Non Monsoon Period	677.08 ham
Net Annual Ground Water Availability	6093.79 ham
Annual Ground Water Draft	7699.04 ham
Net Ground water Availability for Future Irrigation Use	Nil
Stage of Ground Water Development	126.34%
Source: Ground Water Res ource 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 25.3729 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	Average DTW (mbgl) NOV 2013
BHILWARA	RJ07	**MANDALGARH**	RJ0706	1499.100	1032.730	hard rock	1032.730	0.015	4.780

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

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)	Remaining Surplus water for Farm Pond (FP)	No. of FP (0.05 MCM/ FP)
1.780	27.574	Banas	1.7422	1.0	33	0	0	0.7422	15
		Mej	23.6307	3.21	107	15.03	75	5.39	108
		total	**25.3729**	**4.21**	**140**	**15.03**	**75**	**6.1322**	**123**

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 1499.10 sq km practically 1032.73 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

Mandalgarh block is having ground water level between 5 & 10 and 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 126.34%. The Mandalgarh block is feasible for recharge due to presence of permeable zone above water table, favorable land slope and availability of water from rainfall.

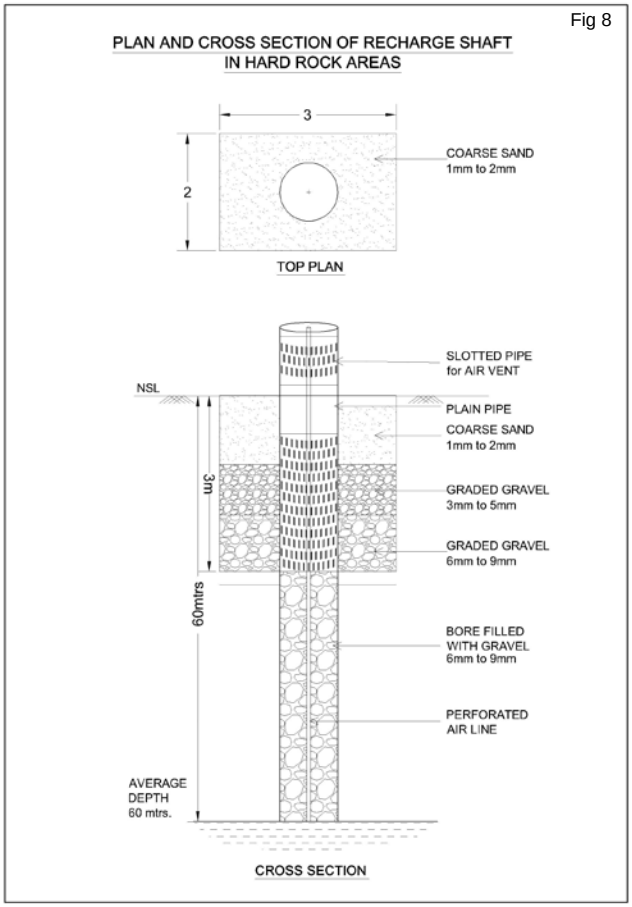
Generally the Artificial recharge structures suitable in this type of area are Check dams/ Anicuts/ Percolation tanks and Recharge Shafts/ Recharge wells. The construction of the structures like ani-cuts and Check dams is regulated. Considering this aspect the proposal for Recharge Shaft/ Recharge wells and Percolation tank have been firmed up in the present Plan as the most suitable structures in Mandalgarh block.

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.

Fig 8



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.
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.

Criteria for number of shafts

Village ponds having area <1 ha and > 25 ha has not been considered for construction of recharge shafts, one recharge shaft is proposed for pond area between 1 to 3 ha; 2 for 3 to 7 and 3 shafts for area 7 -10 ha and 4 for > 10 ha.

Tentative Locations for Recharge Shafts:

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 140 recharges shafts/ wells in 75 identified existing village ponds at an estimated cost of 364 lacs. 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	Amarpura	75.318	25.308	5.0675	Hard_rock	2	2.60	5.20
2	Rasadpura	75.194	25.092	1.8970	Hard_rock	1	2.60	2.60
3	Banka	75.423	25.259	2.5049	Hard_rock	1	2.60	2.60
4	Banka	75.392	25.258	4.4846	Hard_rock	2	2.60	5.20
5	Banka	75.361	25.275	14.2496	Hard_rock	4	2.60	10.40
6	Banka	75.355	25.271	1.8284	Hard_rock	1	2.60	2.60
7	Barodiya	75.333	25.279	11.4696	Hard_rock	4	2.60	10.40
8	Banka	75.396	25.249	8.2287	Hard_rock	3	2.60	7.80
9	Bijoliyan Khurd	75.247	25.146	11.9877	Hard_rock	4	2.60	10.40
10	Dalsingh Ji Ka Khera	75.312	25.306	13.2353	Hard_rock	4	2.60	10.40
11	Dalsingh Ji Ka Khera	75.307	25.299	3.0798	Hard_rock	2	2.60	5.20
12	Lorda	75.421	25.221	16.6821	Hard_rock	4	2.60	10.40
13	Rasadpura	75.204	25.103	6.6202	Hard_rock	2	2.60	5.20
14	Dhanwara	75.286	25.286	2.0278	Hard_rock	1	2.60	2.60
15	Dhanwara	75.286	25.283	1.6440	Hard_rock	1	2.60	2.60

16	Golam Garh	75.195	25.123	5.3049	Hard_rock	2	2.60	5.20
17	Hameeriya	75.262	25.230	12.9601	Hard_rock	4	2.60	10.40
18	Jalindri	75.342	25.307	3.1931	Hard_rock	2	2.60	5.20
19	Jalindri	75.365	25.292	1.4365	Hard_rock	1	2.60	2.60
20	Jalindri	75.345	25.282	2.5721	Hard_rock	1	2.60	2.60
21	Jalindri	75.327	25.268	1.5034	Hard_rock	1	2.60	2.60
22	Jalindri	75.366	25.285	1.5236	Hard_rock	1	2.60	2.60
23	Golam Garh	75.199	25.134	1.2713	Hard_rock	1	2.60	2.60
24	Kharipur	75.249	25.125	10.7583	Hard_rock	3	2.60	7.80
25	Sukhpura	75.237	25.130	1.1504	Hard_rock	1	2.60	2.60
26	Kharipur	75.235	25.130	4.4129	Hard_rock	2	2.60	5.20
27	Khatwara	74.953	25.246	2.9297	Hard_rock	1	2.60	2.60
28	Banka	75.378	25.233	4.1119	Hard_rock	2	2.60	5.20
29	Baroondni	74.931	25.171	2.3765	Hard_rock	1	2.60	2.60
30	Soonthi	75.410	25.218	23.5848	Hard_rock	4	2.60	10.40
31	Rasadpura	75.196	25.109	1.5700	Hard_rock	1	2.60	2.60
32	Bijoliyan Khurd	75.274	25.156	8.4362	Hard_rock	3	2.60	7.80
33	Salawatiya	75.268	25.125	1.1907	Hard_rock	1	2.60	2.60
34	Mal Ka Khera	75.293	25.230	1.2566	Hard_rock	1	2.60	2.60
35	Salawatiya	75.263	25.115	1.1736	Hard_rock	1	2.60	2.60
36	Golam Garh	75.200	25.127	4.6292	Hard_rock	2	2.60	5.20
37	Kharipur	75.231	25.132	2.3463	Hard_rock	1	2.60	2.60
38	Golam Garh	75.202	25.122	2.1158	Hard_rock	1	2.60	2.60
39	Jolas	75.279	25.089	0.0000	Hard_rock	0	2.60	0.00
40	Golam Garh	75.220	25.119	6.6686	Hard_rock	2	2.60	5.20
41	Chenpuriya	75.336	25.222	10.1556	Hard_rock	3	2.60	7.80
42	Jaleri	75.208	25.113	5.2806	Hard_rock	2	2.60	5.20
43	Mangarh	75.240	25.203	3.9462	Hard_rock	2	2.60	5.20
44	Mangarh	75.253	25.184	11.1275	Hard_rock	3	2.60	7.80
45	Mangarh	75.259	25.176	6.6597	Hard_rock	2	2.60	5.20
46	Mangarh	75.256	25.174	8.1098	Hard_rock	3	2.60	7.80
47	Mangarh	75.246	25.165	5.8709	Hard_rock	2	2.60	5.20
48	Meghpura	75.304	25.300	3.4112	Hard_rock	2	2.60	5.20
49	Rasadpura	75.228	25.089	1.4412	Hard_rock	1	2.60	2.60
50	Nahargarh	74.955	25.232	4.3453	Hard_rock	2	2.60	5.20
51	Jaleri	75.195	25.111	1.5897	Hard_rock	1	2.60	2.60
52	Phoolan	75.264	25.190	17.8424	Hard_rock	4	2.60	10.40
53	Phoolan	75.259	25.183	1.4370	Hard_rock	1	2.60	2.60
54	Ramchandraji Ka Khera	75.331	25.303	1.5074	Hard_rock	1	2.60	2.60
55	Ranikhera	74.959	25.240	1.7858	Hard_rock	1	2.60	2.60
56	Saipeepla	75.305	25.317	2.6402	Hard_rock	1	2.60	2.60
57	Banka	75.431	25.259	1.3625	Hard_rock	1	2.60	2.60
58	Jaleri	75.205	25.114	3.7379	Hard_rock	2	2.60	5.20
59	Jhadoli	75.251	25.098	13.8969	Hard_rock	4	2.60	10.40
60	Jaleri	75.214	25.107	3.2557	Hard_rock	2	2.60	5.20

61	Jhadoli	75.243	25.106	1.4713	Hard_rock	1	2.60	2.60
62	Shyampura	75.278	25.255	7.5234	Hard_rock	3	2.60	7.80
63	Soonthi	75.412	25.193	1.1195	Hard_rock	1	2.60	2.60
64	Soonthi	75.411	25.129	1.1416	Hard_rock	1	2.60	2.60
65	Soonthi	75.415	25.126	2.9900	Hard_rock	1	2.60	2.60
66	Soonthi	75.409	25.125	1.6838	Hard_rock	1	2.60	2.60
67	Soonthi	75.413	25.192	8.8657	Hard_rock	3	2.60	7.80
68	Suras	74.943	25.234	2.3582	Hard_rock	1	2.60	2.60
69	Suras	74.945	25.228	11.4177	Hard_rock	4	2.60	10.40
70	Suras	74.946	25.192	2.1162	Hard_rock	1	2.60	2.60
71	Tharoda	75.282	25.159	2.7225	Hard_rock	1	2.60	2.60
72	Teekhi	75.279	25.200	8.8141	Hard_rock	3	2.60	7.80
73	Undaron Ka Khera	75.297	25.294	2.7500	Hard_rock	1	2.60	2.60
74	Undaron Ka Khera	75.295	25.290	1.0725	Hard_rock	1	2.60	2.60
75	Undaron Ka Khera	75.305	25.287	1.3362	Hard_rock	1	2.60	2.60
				Total		140		364

2. Percolation tanks

Percolation tanks are among the most common runoff harvesting structures in India. A percolation tank can be defined as an artificiallly created surface water body submerging a highly permeable land area so that the surface runoff is made percolate and recharge the ground water storage. These are not provide with sluices or outlests for discharging water from tank for irrigation or other purposes. They may, however, be provided with arrangements for spilling away the surplus water that may enter the tank so as to avoid over-topping of the tank bund. It is possible to have more than one percolation tank in a catchment if sufficient surplus runoff is available and the site characxterisitcs favor recahrge through such structures. Under the plan, 75 Nos. percolation tanks (200mx200mx1.5m) in the vicinity of respective villages. Location of percolation tanks is given in **Fig 9 and Table 4**.

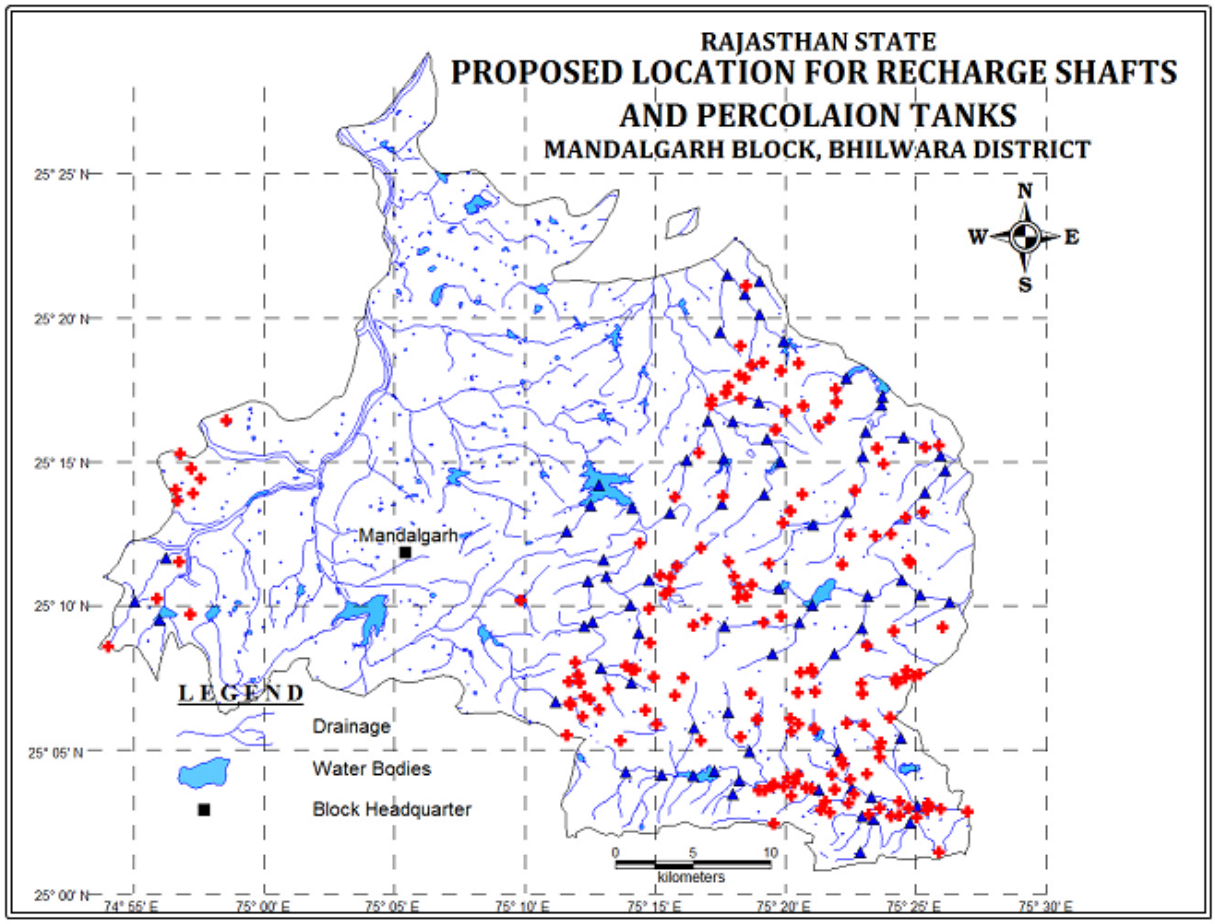
Table 4: Tentative location of village proposed for percolation tank

SN	District	Block	Village	Longitude	Latitude
1.	Bhilwara	Mandalgarh	Mangtala	25.358	75.296
2.	Bhilwara	Mandalgarh	Madhopura	25.335	75.317
3.	Bhilwara	Mandalgarh	Mal Ka Khera	25.252	75.294
4.	Bhilwara	Mandalgarh	Dhanwara	25.274	75.284
5.	Bhilwara	Mandalgarh	Jujarpur	25.236	75.214
6.	Bhilwara	Mandalgarh	Dhorela	25.223	75.236
7.	Bhilwara	Mandalgarh	Patiyal	25.184	75.219
8.	Bhilwara	Mandalgarh	Patiyal	25.167	75.234
9.	Bhilwara	Mandalgarh	Lalpura	25.157	75.210
10.	Bhilwara	Mandalgarh	Chenpuriya	25.214	75.351

11.	Bhilwara	Mandalgarh	Jalindri	25.283	75.395
12.	Bhilwara	Mandalgarh	Jalindri	25.299	75.372
13.	Bhilwara	Mandalgarh	Lorda	25.245	75.435
14.	Bhilwara	Mandalgarh	Soonthi	25.181	75.408
15.	Bhilwara	Mandalgarh	Soonthi	25.172	75.386
16.	Bhilwara	Mandalgarh	Deonagar	25.154	75.382
17.	Bhilwara	Mandalgarh	Mandol	25.167	75.350
18.	Bhilwara	Mandalgarh	Beejoliya Kalan (Ct)	25.157	75.342
19.	Bhilwara	Mandalgarh	Tharoda	25.155	75.294
20.	Bhilwara	Mandalgarh	Brijpura	25.082	75.310
21.	Bhilwara	Mandalgarh	Indrapura	25.071	75.288
22.	Bhilwara	Mandalgarh	Pachyanpura	25.069	75.254
23.	Bhilwara	Mandalgarh	Tilaswan	25.066	75.304
24.	Bhilwara	Mandalgarh	Ummedpura	25.045	75.382
25.	Bhilwara	Mandalgarh	Anti	25.043	75.389
26.	Bhilwara	Mandalgarh	Gudha	25.041	75.413
27.	Bhilwara	Mandalgarh	Gudha	25.051	75.417
28.	Bhilwara	Mandalgarh	Kantwara	25.061	75.376
29.	Bhilwara	Mandalgarh	Kerkhera	25.083	75.367
30.	Bhilwara	Mandalgarh	Soonthi	25.173	75.420
31.	Bhilwara	Mandalgarh	Soonthi	25.169	75.438
32.	Bhilwara	Mandalgarh	Uttamnagar	25.221	75.372
33.	Bhilwara	Mandalgarh	Banka	25.253	75.432
34.	Bhilwara	Mandalgarh	Shyampura	25.251	75.270
35.	Bhilwara	Mandalgarh	Dhanwara	25.273	75.300
36.	Bhilwara	Mandalgarh	Mal Ka Khera	25.263	75.321
37.	Bhilwara	Mandalgarh	Jalindri	25.288	75.395
38.	Bhilwara	Mandalgarh	Jalindri	25.320	75.332
39.	Bhilwara	Mandalgarh	Mal Ka Khera	25.231	75.320
40.	Bhilwara	Mandalgarh	Kasya Sani	25.181	75.207
41.	Bhilwara	Mandalgarh	Mohanpura	25.210	75.193
42.	Bhilwara	Mandalgarh	Anando Ka Khera	25.225	75.209
43.	Bhilwara	Mandalgarh	Rasadpura	25.111	75.186
44.	Bhilwara	Mandalgarh	Tilaswan	25.058	75.299
45.	Bhilwara	Mandalgarh	Neemri Gawa	25.068	75.274
46.	Bhilwara	Mandalgarh	Chandji Ki Kheri	25.096	75.275
47.	Bhilwara	Mandalgarh	Anti	25.024	75.381
48.	Bhilwara	Mandalgarh	Veekam Pura	25.139	75.325
49.	Bhilwara	Mandalgarh	Bijoliyan Khurd	25.151	75.240
50.	Bhilwara	Mandalgarh	Banka	25.253	75.383
51.	Bhilwara	Mandalgarh	Banka	25.250	75.330

52.	Bhilwara	Mandalgarh	Hameeriya	25.220	75.259
53.	Bhilwara	Mandalgarh	Lorda	25.232	75.422
54.	Bhilwara	Mandalgarh	Mangtala	25.355	75.317
55.	Bhilwara	Mandalgarh	Banka	25.264	75.409
56.	Bhilwara	Mandalgarh	Beejoliya Kalan (Ct)	25.177	75.329
57.	Bhilwara	Mandalgarh	Golam Garh	25.131	75.215
58.	Bhilwara	Mandalgarh	Lalpura	25.155	75.204
59.	Bhilwara	Mandalgarh	Mangarh	25.181	75.246
60.	Bhilwara	Mandalgarh	Mal Ka Khera	25.226	75.292
61.	Bhilwara	Mandalgarh	Gopalpura	25.105	75.297
62.	Bhilwara	Mandalgarh	Aroli	25.070	75.231
63.	Bhilwara	Mandalgarh	Ummedpura	25.056	75.388
64.	Bhilwara	Mandalgarh	Kerkhera	25.061	75.355
65.	Bhilwara	Mandalgarh	Kachhi Pura	25.139	75.365
66.	Bhilwara	Mandalgarh	Banka	25.267	75.385
67.	Bhilwara	Mandalgarh	Mangtala	25.325	75.292
68.	Bhilwara	Mandalgarh	Undaron Ka Khera	25.285	75.316
69.	Bhilwara	Mandalgarh	Mangtala	25.347	75.307
70.	Bhilwara	Mandalgarh	Kasya Sani	25.193	75.217
71.	Bhilwara	Mandalgarh	Resunda	25.090	75.407
72.	Bhilwara	Mandalgarh	Kharipur	25.122	75.235
73.	Bhilwara	Mandalgarh	Bilod	25.169	74.917
74.	Bhilwara	Mandalgarh	Baroondni	25.159	74.933
75.	Bhilwara	Mandalgarh	Suras	25.194	74.937

Fig: 9


RAJASTHAN STATE
PROPOSED LOCATION FOR RECHARGE SHAFTS
AND PERCOLAION TANKS
MANDALGARH BLOCK, BHILWARA DISTRICT
N
W
E
S
25° 25' N
25° 20' N
25° 15' N
25° 10' N
25° 05' N
25° 00' N
74° 55' E
75° 00' E
75° 05' E
75° 10' E
75° 15' E
75° 20' E
75° 25' E
75° 30' E
Mandalgarh
LEGEND
Drainage
Water Bodies
Block Headquarter
0
5
10
kilometers

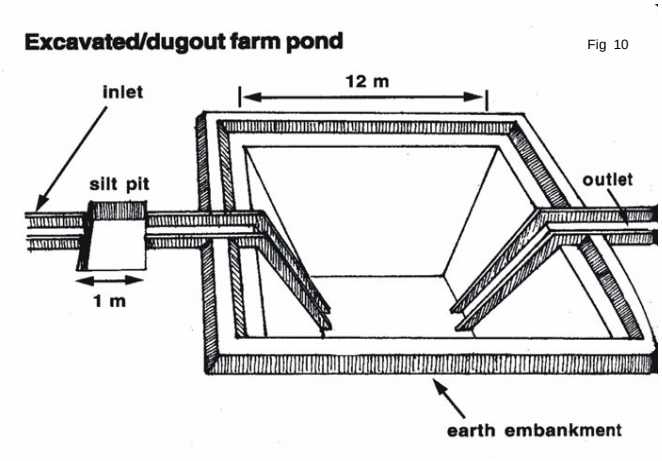
Conservation Measures

As mentioned earlier the present Plan occurs on integrated approach of interventions, which includes both recharge measures as well as conservation of water while the recharge interventions have been discussed. The proposed conservation measures discussed below includes conservation of farm ponds, revival, repair of existing water bodies, etc.

A. Farm Ponds

A farm pond is a large hole dug out in the earth, usually square or rectangular in shape, which harvests rainwater and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond. The size and depth depend on the amount of land available, the type of soil, the farmer's water requirements, the cost of excavation, and the possible uses of the excavated earth. Water from the farm pond is conveyed to the fields manually, by pumping, or by both methods. Pictorial diagram of farm pond is shown in fig 10.

Advantages of Farm Ponds



- They provide water to start growing crops, without waiting for rain to fall.
- They provide irrigation water during dry spells between rainfalls. This increases the yield, the number of crops in one year, and the diversity of crops that can be grown.
- Bunds can be used to raise vegetables and fruit trees, thus supplying the farm household with an additional source of income and of nutritious food.
- Farmers are able to apply adequate farm inputs and perform farming operations at the appropriate time, thus increasing their productivity and their confidence in farming.
- They check soil erosion and minimize siltation of waterways and reservoirs.
- They supplies water for domestic purposes and livestock
- They promote fish rearing.
- They recharge the ground water.
- They improve drainage.
- The excavated earth has a very high value and can be used to enrich soil in the fields, leveling land, and constructing farm roads

It is proposed to construct 123 farm ponds as per the specification of Govt. of Rajasthan (30 x 30 x 1.5 m). These farm ponds can accommodate about 6.17 MCM of runoff rainfall considering 3 fillings. Farm ponds can be constructed in the village at feasible location. Dimension of the farm pond depends on land holdings.

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 60 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 48.615 cr, which includes Rs 33.64 cr for ground water recharge activities, Rs 12.30 cr (Farm ponds), 0.36 cr for ground water monitoring (Piezometer construction) and Rs 2.315 cr towards operation and maintenance charges. The tentative cost estimates of the various activities of the Plan are shown in Table 5 & 6. The unit rates are as followed by the Govt. of Rajasthan (BSR). The total estimated cost of the project is **Rs 48.615 Crores**.

Table 5: 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)
30	12.30	Hard rock – 3.64

Table 6: 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	140	4.21	2.6	364	2.947
Percolation tanks (3 fillings)	200m*200m*1.5 m	75	15.03	40	3000	10.521
Water Conservation Activities						
Farm Pond (3 fillings)	(30 m x 30m x 1.5 m)	123	6.14	10	1230	4.298
Impact assessment & Monitoring						
Piezometer	Up to 80 m bgl	60		0.6	36	
Impact assessment will be carried out by implementing agency						
O & M - 5% of total cost of the scheme					231.5	
TOTAL					**4861.5**	
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 7.

Table 7: 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 Mandalgarh block, Bhilwara envisages gainful utilization of 13.468 MCM of surplus monsoon runoff for recharging of depleted aquifer system. Besides this, the proposed intervention would also lead to reduction of pre-existing ground water draft by 4.298 MCM annually through construction of farm ponds.

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 97.70% from the existing 126.34%. The projected status of ground water resources and utilization scenario is presented in table 8.

Table 8: 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 %)**
60.9379	13.468	74.4059	76.9904	4.298	72.6924	126.34	97.70

- 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.