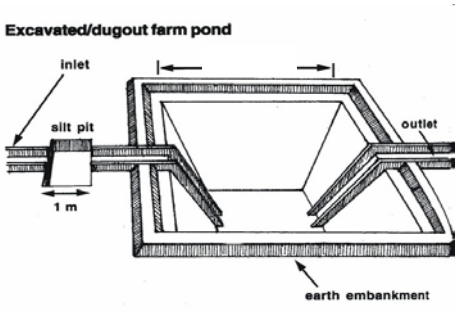
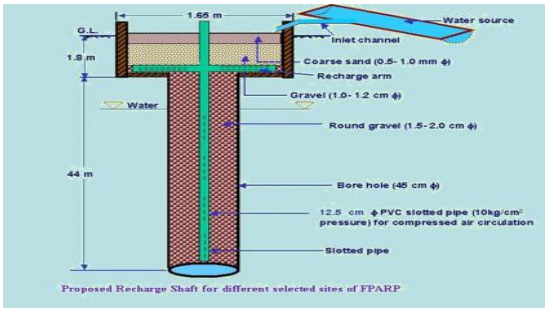
CENTRAL GROUND WATER BOARD

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





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

Western Region, Jaipur
April 2016

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

Plan at a Glance

1.	**Area of the Suwana Block**	**914.90 sq.km.**
2.	**Area identified for Artificial Recharge**	**890.01 sq km**
3.	**Dynamic Ground Water Resources (as on 31.03.2011)**	
	Net Ground Water Availability	**39.8571 MCM**
	Annual Ground Water Draft	**58.0420 MCM**
	Stage of Ground Water Development	**145.63%**
4.	**Volume of water to be harnessed** **Volume of water available for recharge** **Volume of water available for conservation by other interventions**	**5.3648 MCM** **5.3648 MCM** **-**
5.	**Volume of unsaturated aquifer zone available for recharge**	**94.519 MCM**
6.	**Total number of structures to be proposed**	
	Recharge structures Existing village pond with recharge shaft/ well **Water Conservation** Farm pond	 **179 shafts in 179 Nos. of existing village ponds** **-**
	Expected Annual GW recharge	**3.756 MCM**
	Provision for supplemental irrigation, thus reducing GW withdrawal for irrigation	**-**
	Total recharge/ saving of ground water	**3.756 MCM**
7.	**Estimated Cost** Artificial Recharge Plan Piezometer construction Operation and maintenance	**5.252 crore** 4.654 crore 0.348 crore 0.25 crore

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN OF SUWANA 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 **Suwana 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 **145.63%.** 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.

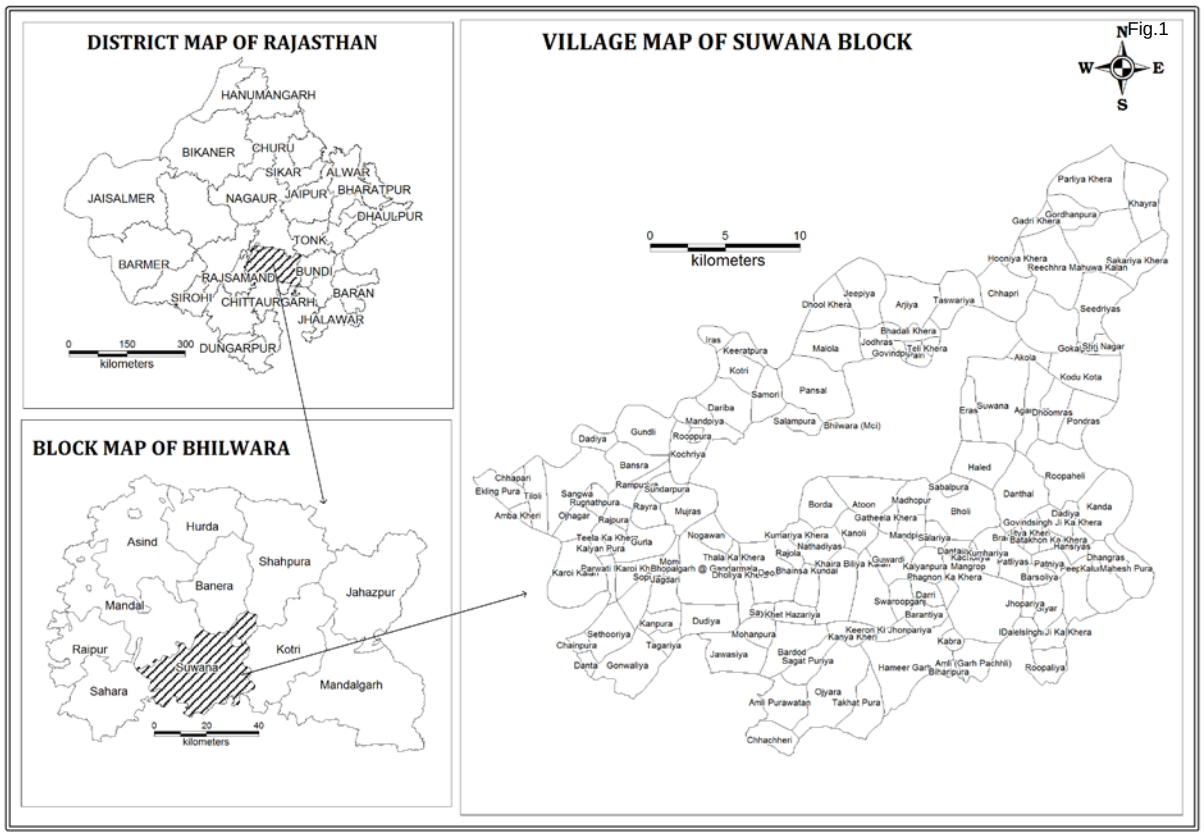
Location of the block

Suwana Block of Bhilwara district falls under Over-Exploited category. It covers an area of 914.90 Sq. Km. and falls in southern part of Bhilwara district. It is located between North latitudes 25°08’ & 25°30’ and East longitudes 74°21’ & 75°49’. The total rural population of the Block is 186600 persons as per the 2011 census. It is comprised of 94360 males and 92240 females. Location map is shown in **fig 1**.

Source wise Irrigated Area

Out of total area of 914.90 Sq.Km., an area of 51.61 (5.64%) falls under irrigation. The dug wells/ Tubewells are the main source of irrigation in Suwana Block. There is very little area of 0.65 Sq.Km. area that falls under pond irrigation. The wells irrigate total 50.96 Sq.Km. area in this Block

Fig:1



Physiography & Drainage

Physiographically, the block is characterized by presence of buried pediments of denudational origin, alluvial plains and Plateau. The minimum and maximum elevation of Block is 380.7 m and 550.7 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 map showing drainage and water bodies in the Suwana block are shown in **fig 3**.

Fig:2

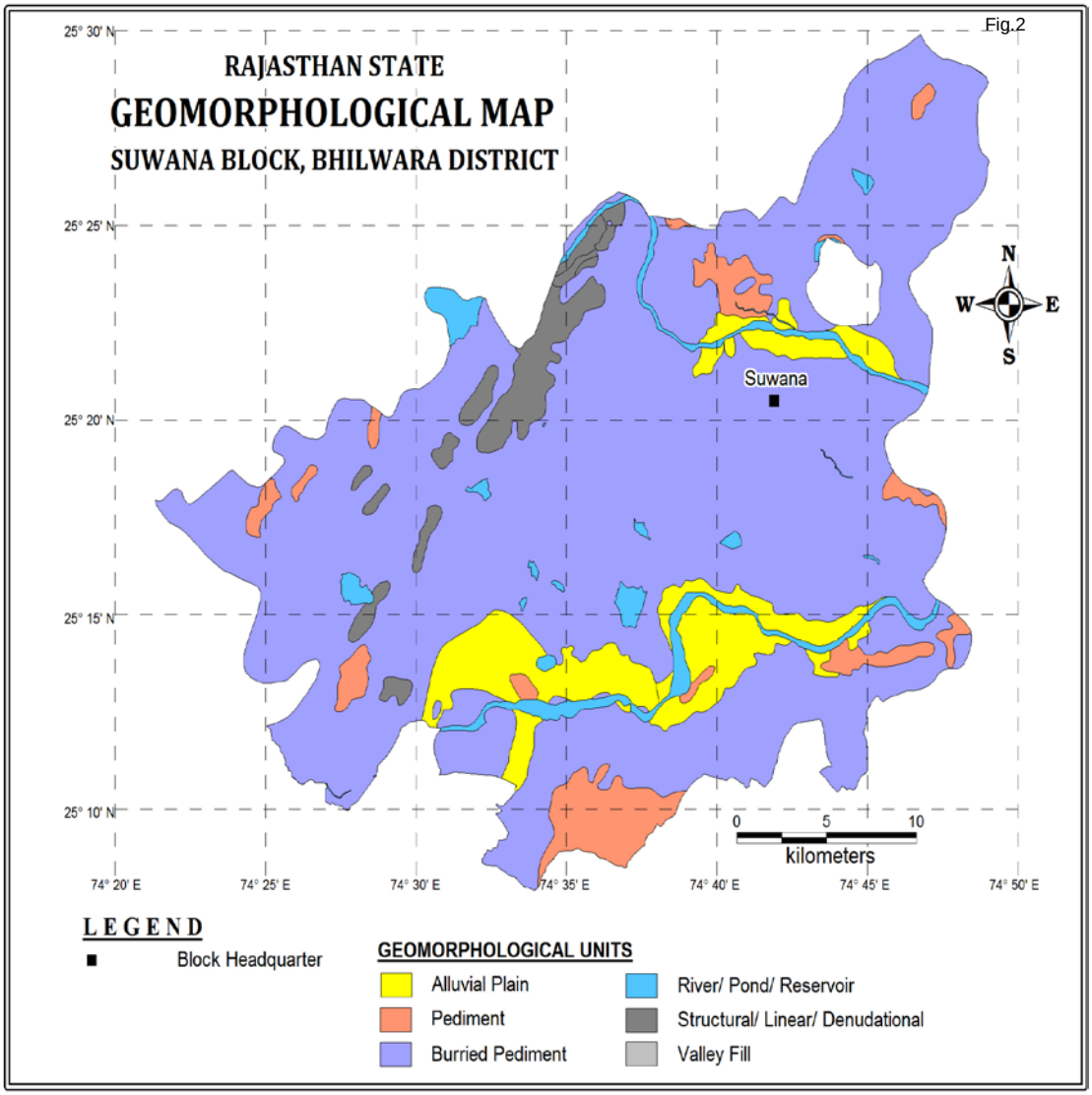
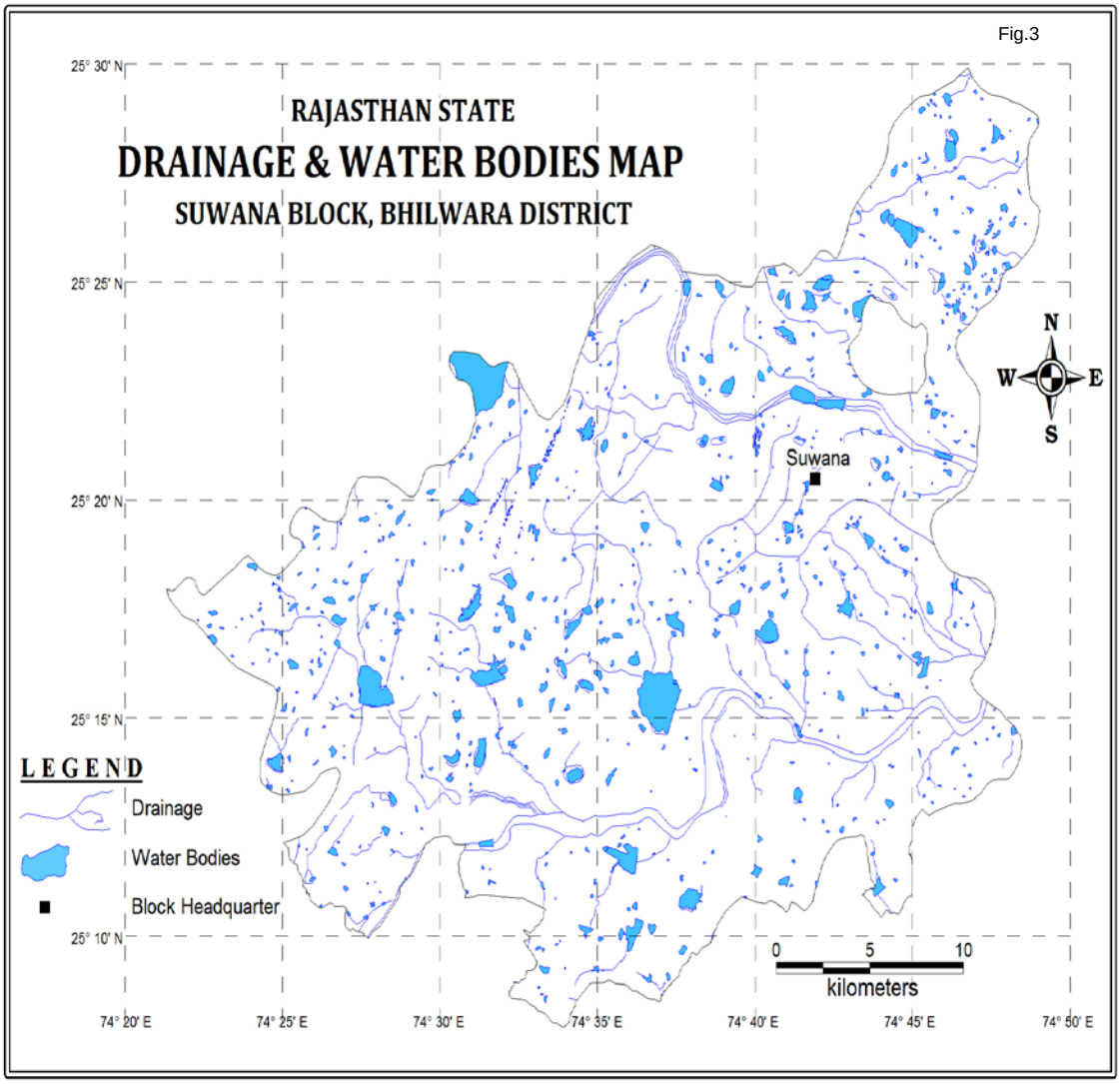


Fig.2
RAJASTHAN STATE
GEOMORPHOLOGICAL MAP
SUWANA BLOCK, BHILWARA DISTRICT
25° 30' N
25° 25' N
25° 20' N
25° 15' N
25° 10' N
74° 20' E
74° 25' E
74° 30' E
74° 35' E
74° 40' E
74° 45' E
74° 50' E
N
W
E
S
Suwana
0
5
10
kilometers
LEGEND
Block Headquarter
GEOMORPHOLOGICAL UNITS
Alluvial Plain
Pediment
Burried Pediment
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 676.90mm (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 914.90 Sq. Km, an area of 890.01 Sq. Km. (97.28%) forms aquifer system (potential zone) in the block and remaining 24.89 Sq. Km. (2.72%) 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 5-10 and 10-20 m bgl range. **(Fig 4)**

The average decadal depth to water level is 12.96 m bgl for Pre monsoon & 9.85 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 0.36 m/year during pre monsoon and 0.33 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 m/ year in ground water level is prevalent in the block with some area showing fall in range of 0 to 1 m/year. The map of Decadal Water Level Trend is shown in **fig. 7**

Fig: 4

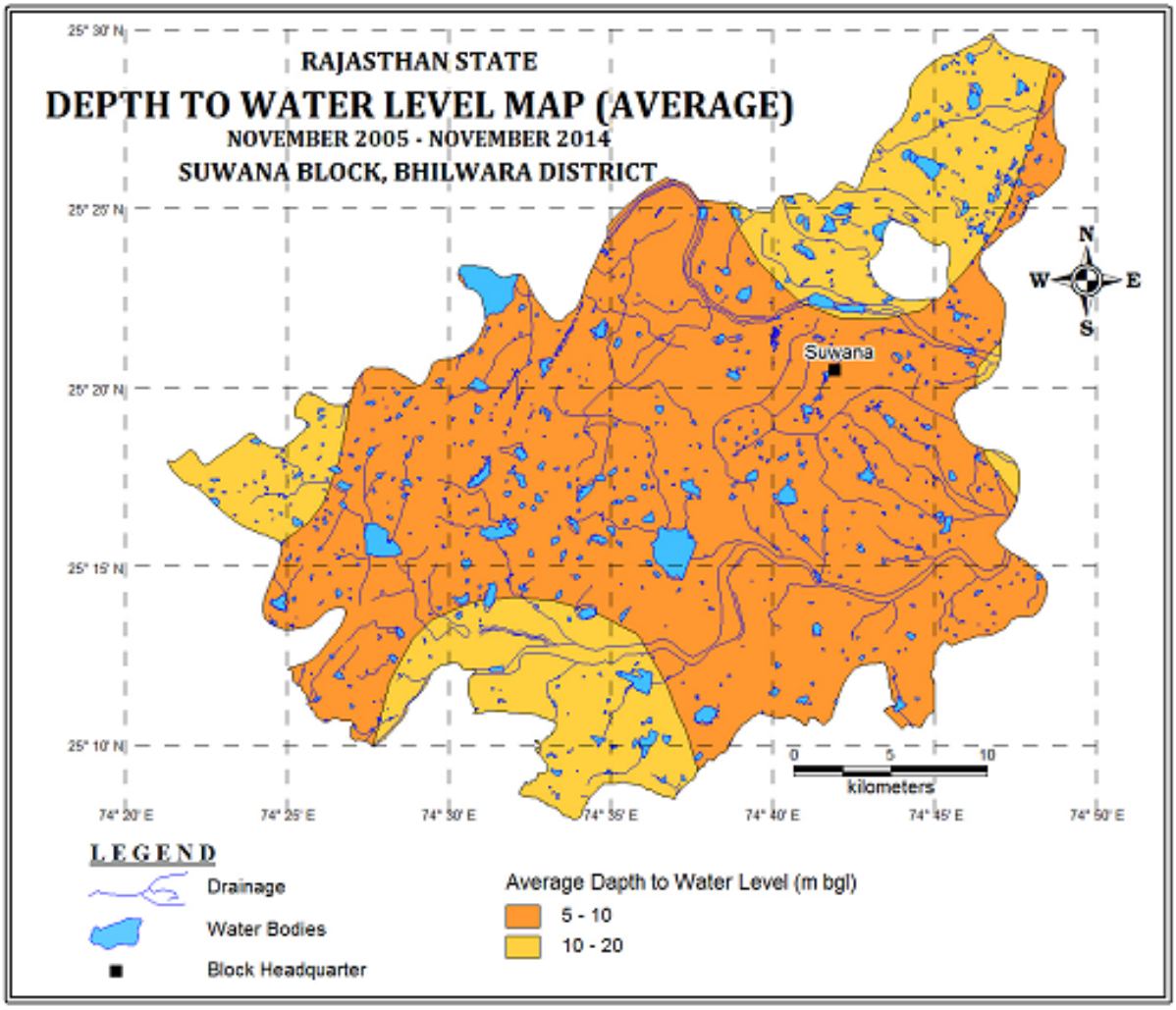

RAJASTHAN STATE
DEPTH TO WATER LEVEL MAP (AVERAGE)
NOVEMBER 2005 - NOVEMBER 2014
SUWANA BLOCK, BHILWARA DISTRICT
25° 30' N
25° 25' N
25° 20' N
25° 15' N
25° 10' N
74° 20' E
74° 25' E
74° 30' E
74° 35' E
74° 40' E
74° 45' E
74° 50' E
N
W
E
S
Suwana
0
5
10
kilometers
LEGEND
Drainage
Water Bodies
Block Headquarter
Average Depth to Water Level (m bgl)
5 - 10
10 - 20

Fig: 5

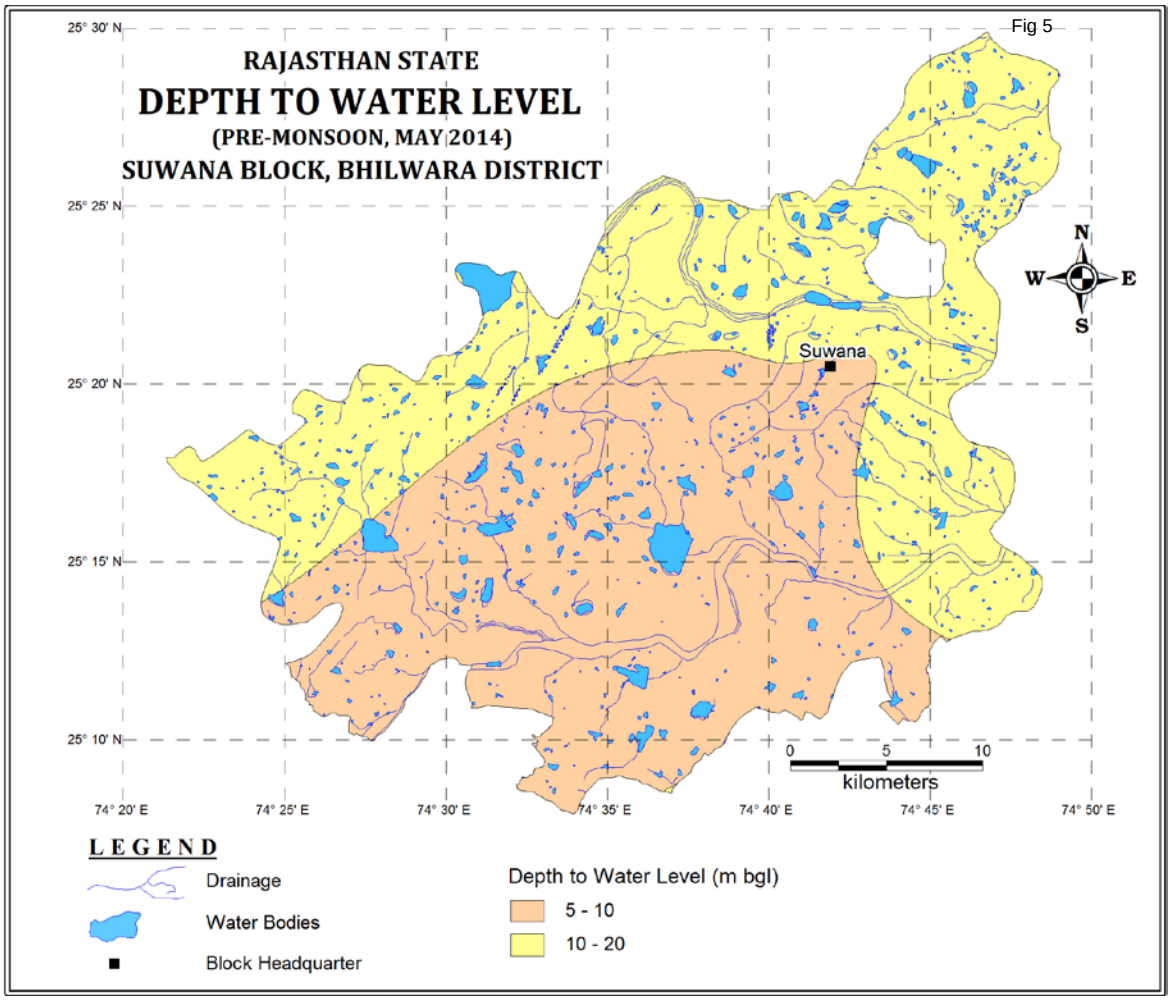


Fig 5
RAJASTHAN STATE
DEPTH TO WATER LEVEL
(PRE-MONSOON, MAY 2014)
SUWANA BLOCK, BHILWARA DISTRICT
25° 30' N
25° 25' N
25° 20' N
25° 15' N
25° 10' N
74° 20' E
74° 25' E
74° 30' E
74° 35' E
74° 40' E
74° 45' E
74° 50' E
N
W
E
S
Suwana
0
5
10
kilometers
LEGEND
Drainage
Water Bodies
Block Headquarter
Depth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

Fig: 6

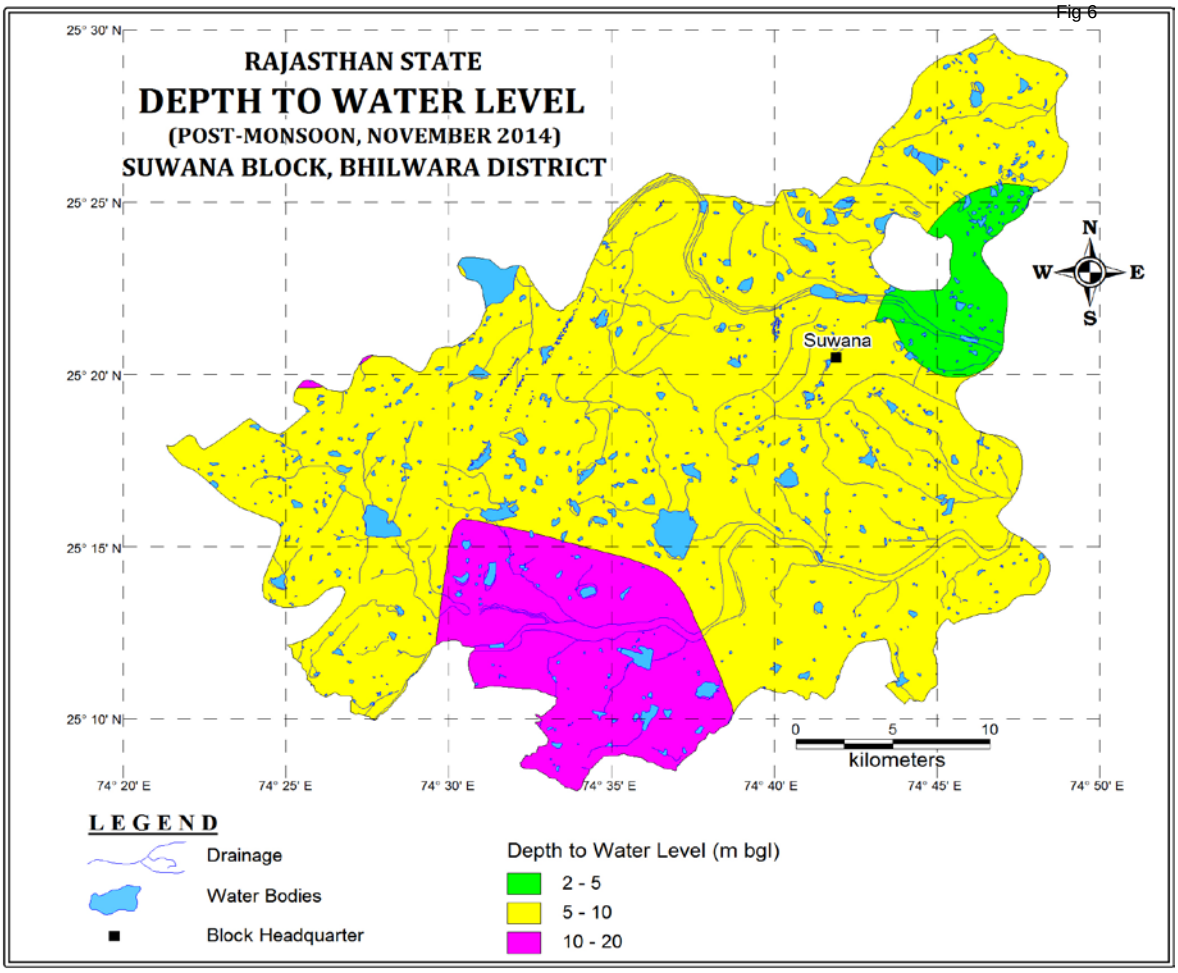
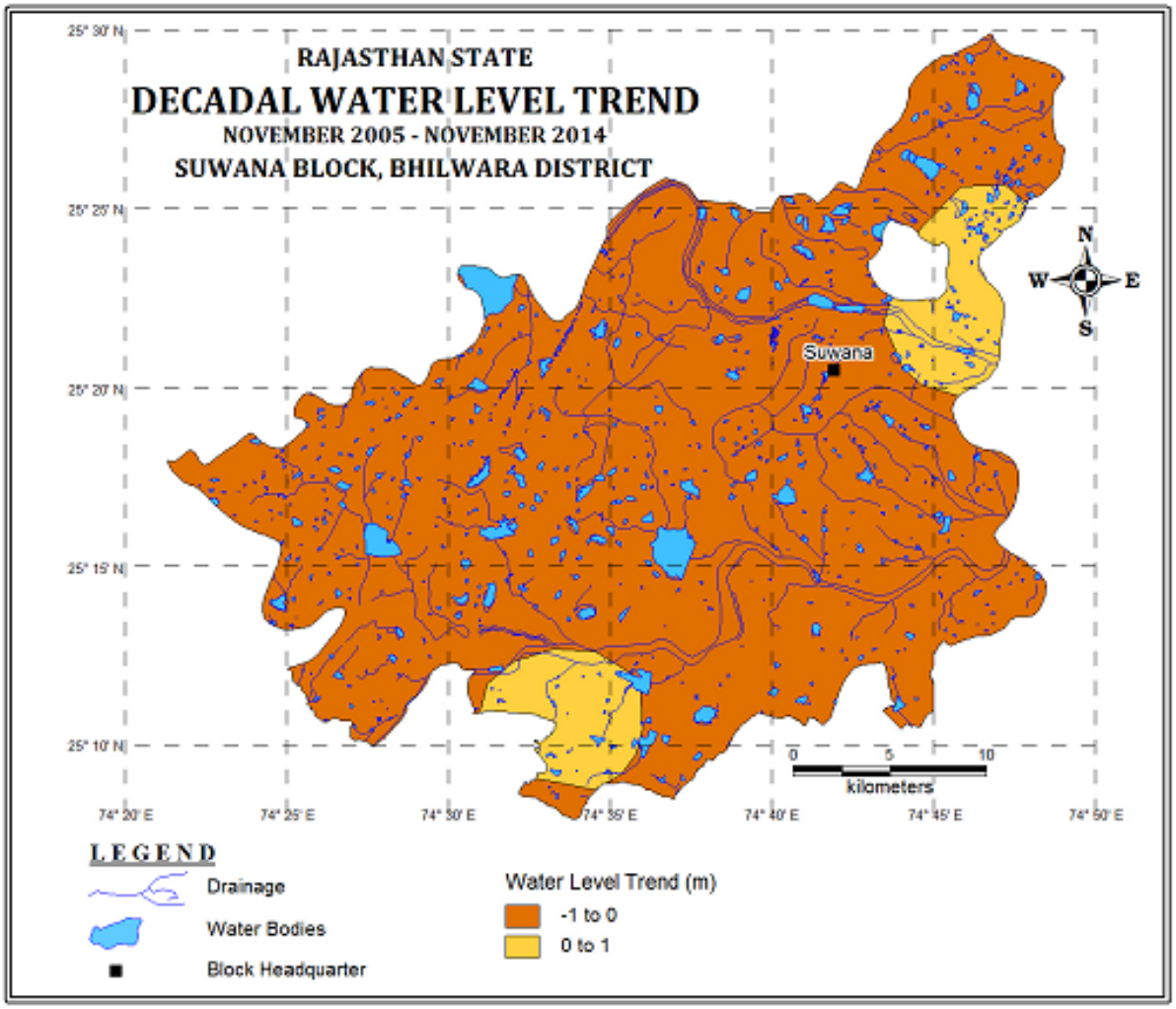


Fig 6
RAJASTHAN STATE
DEPTH TO WATER LEVEL
(POST-MONSOON, NOVEMBER 2014)
SUWANA BLOCK, BHILWARA DISTRICT
25° 30' N
25° 25' N
25° 20' N
25° 15' N
25° 10' N
74° 20' E
74° 25' E
74° 30' E
74° 35' E
74° 40' E
74° 45' E
74° 50' E
N
W
E
S
Suwana
0
5
10
kilometers
LEGEND
Drainage
Water Bodies
Block Headquarter
Depth to Water Level (m bgl)
2 - 5
5 - 10
10 - 20

Fig: 7



Subsurface Hydrogeology

As inferred from borehole data of the Suwana 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 132 to 200.85 mbgl and the average discharge ranges from 1 to 8.07 lps. 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 3985.71ham and Annual Ground water draft is 5804.20ham. Stage of Ground water development has reached 145.63%.

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

Natural Discharge During Non Monsoon Period	442.86 ham
Net Annual Ground Water Availability	3985.71 ham
Annual Ground Water Draft	5804.20 ham
Net Ground water Availability for Future Irrigation Use	122.24 ham
Stage of Ground Water Development	145.63%
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 5.3648 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)
BHILWARA	RJ07	**SUWANA**	RJ0710	914.900	890.010	hard rock	890.010

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

Sp Yield	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)
0.015	10.080	7.080	94.519	Banas	5.3648	5.3648	179

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 914.90 sq km practically 890.01 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

Suwana 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 145.63%. The Suwana 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 and have been firmed up in the present Plan are the most suitable structures in Suwana block. In view of the availability of number of ponds in the block, percolation tanks are also not found feasible.

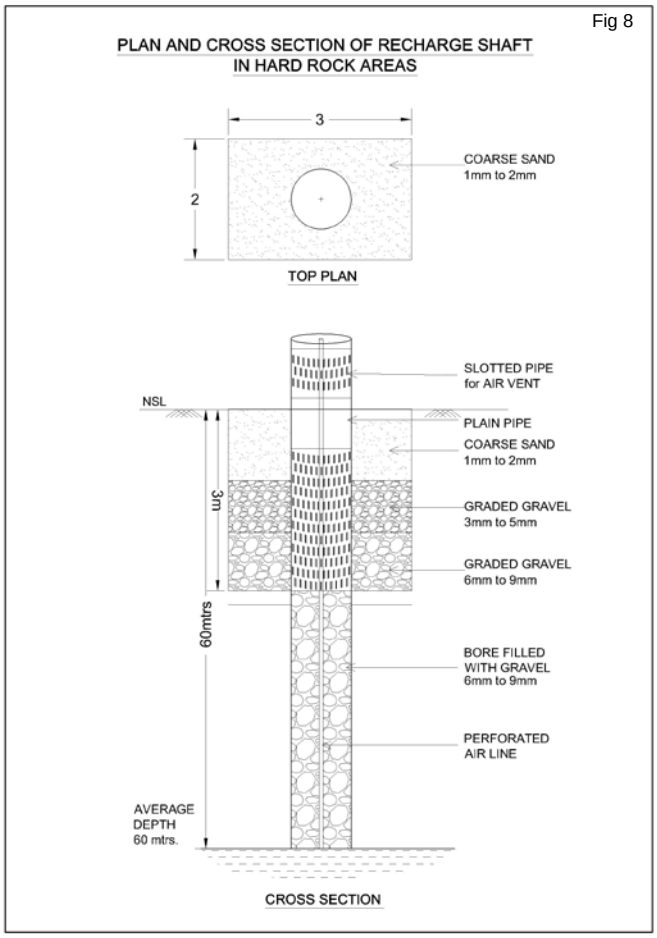
Details of Ground Water Recharge Measures

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.

Fig 8



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.

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 179 recharges shafts/ wells in 184 identified existing village ponds at an estimated cost of 465.4 lacs.

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	Khayra	74.800	25.444	2.229	Hard_rock	1	2.6	2.6
2	Sakariya Khera	74.803	25.438	4.885	Hard_rock	1	2.6	2.6
3	Mahuwa Kalan	74.790	25.436	6.819	Hard_rock	1	2.6	2.6
4	Sakariya Khera	74.794	25.434	5.361	Hard_rock	1	2.6	2.6
5	Sakariya Khera	74.793	25.429	5.761	Hard_rock	1	2.6	2.6
6	Sakariya Khera	74.800	25.423	7.301	Hard_rock	1	2.6	2.6
7	Sakariya Khera	74.794	25.421	3.841	Hard_rock	1	2.6	2.6
8	Sakariya Khera	74.790	25.427	3.049	Hard_rock	1	2.6	2.6
9	Mahuwa Kalan	74.788	25.431	7.324	Hard_rock	1	2.6	2.6
10	Mahuwa Kalan	74.782	25.432	4.485	Hard_rock	1	2.6	2.6
11	Mahuwa Kalan	74.783	25.424	8.187	Hard_rock	1	2.6	2.6
12	Mahuwa Kalan	74.779	25.421	11.956	Hard_rock	1	2.6	2.6
13	Seedriyas	74.765	25.416	15.656	Hard_rock	1	2.6	2.6
14	Seedriyas	74.769	25.412	2.571	Hard_rock	1	2.6	2.6
15	Seedriyas	74.773	25.407	13.196	Hard_rock	1	2.6	2.6
16	Seedriyas	74.769	25.407	3.982	Hard_rock	1	2.6	2.6
17	Seedriyas	74.777	25.403	4.930	Hard_rock	1	2.6	2.6
18	Seedriyas	74.783	25.411	1.987	Hard_rock	1	2.6	2.6
19	Seedriyas	74.790	25.414	5.335	Hard_rock	1	2.6	2.6
20	Ekling Pura	74.378	25.285	3.204	Hard_rock	1	2.6	2.6
21	Amba Kheri	74.380	25.280	9.877	Hard_rock	1	2.6	2.6
22	Ekling Pura	74.380	25.290	4.907	Hard_rock	1	2.6	2.6
23	Ojhagar	74.414	25.261	2.198	Hard_rock	1	2.6	2.6
24	Ojhagar	74.422	25.271	15.914	Hard_rock	1	2.6	2.6
25	Karoi Kalan	74.418	25.253	4.174	Hard_rock	1	2.6	2.6
26	Sangwa	74.415	25.282	2.058	Hard_rock	1	2.6	2.6
27	Sangwa	74.421	25.292	6.837	Hard_rock	1	2.6	2.6
28	Ojhagar	74.432	25.268	2.388	Hard_rock	1	2.6	2.6
29	Ojhagar	74.436	25.270	3.368	Hard_rock	1	2.6	2.6

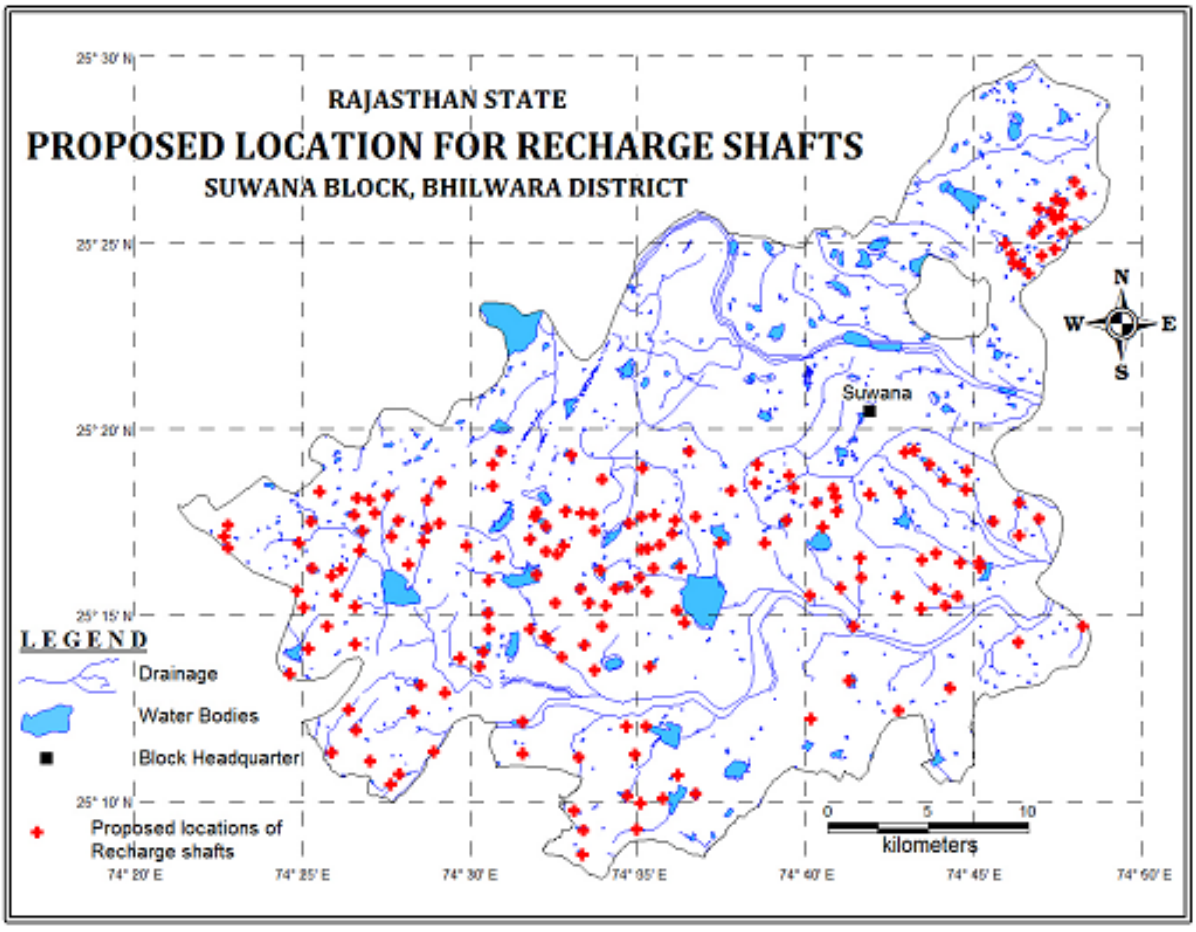
30	Rajpura	74.445	25.279	7.542	Hard_rock	1	2.6	2.6
31	Rampuriya	74.447	25.288	21.296	Hard_rock	1	2.6	2.6
32	Sangwa	74.442	25.295	13.743	Hard_rock	1	2.6	2.6
33	Kalyan Pura	74.443	25.254	2.014	Hard_rock	1	2.6	2.6
34	Kalyan Pura	74.434	25.259	1.964	Hard_rock	1	2.6	2.6
35	Karoi Kalan	74.429	25.245	2.615	Hard_rock	1	2.6	2.6
36	Sangwa	74.426	25.305	2.001	Hard_rock	1	2.6	2.6
37	Sangwa	74.444	25.302	2.624	Hard_rock	1	2.6	2.6
38	Bansra	74.450	25.301	2.206	Hard_rock	1	2.6	2.6
39	Bansra	74.453	25.296	4.231	Hard_rock	1	2.6	2.6
40	Rampuriya	74.461	25.285	2.928	Hard_rock	1	2.6	2.6
41	Rampuriya	74.465	25.292	5.292	Hard_rock	1	2.6	2.6
42	Rayra	74.469	25.273	3.443	Hard_rock	1	2.6	2.6
43	Rayra	74.477	25.283	3.796	Hard_rock	1	2.6	2.6
44	Sundarpura	74.479	25.289	11.593	Hard_rock	1	2.6	2.6
45	Bansra	74.459	25.304	9.125	Hard_rock	1	2.6	2.6
46	Rampuriya	74.479	25.301	5.128	Hard_rock	1	2.6	2.6
47	Sundarpura	74.485	25.291	2.156	Hard_rock	1	2.6	2.6
48	Bansra	74.485	25.310	3.269	Hard_rock	1	2.6	2.6
49	Mujras	74.498	25.281	2.852	Hard_rock	1	2.6	2.6
50	Nogawan	74.514	25.276	2.607	Hard_rock	1	2.6	2.6
51	Nogawan	74.509	25.265	2.001	Hard_rock	1	2.6	2.6
52	Bhilwara (Mci)	74.511	25.308	3.420	Hard_rock	1	2.6	2.6
53	Bhilwara (Mci)	74.511	25.317	2.515	Hard_rock	1	2.6	2.6
54	Mandpiya	74.515	25.323	10.383	Hard_rock	1	2.6	2.6
55	Karoi Kalan	74.420	25.235	2.995	Hard_rock	1	2.6	2.6
56	Karoi Kalan	74.411	25.223	4.065	Hard_rock	1	2.6	2.6
57	Karoi Kalan	74.443	25.237	8.811	Hard_rock	1	2.6	2.6
58	Sethooriya	74.440	25.208	3.433	Hard_rock	1	2.6	2.6
59	Sethooriya	74.443	25.198	11.428	Hard_rock	1	2.6	2.6
60	Kanpura	74.472	25.207	9.638	Hard_rock	1	2.6	2.6
61	Jagdari	74.476	25.219	12.327	Hard_rock	1	2.6	2.6
62	Kanpura	74.487	25.215	1.952	Hard_rock	1	2.6	2.6
63	Bhopalgarh @ Gandarmala	74.495	25.231	1.965	Hard_rock	1	2.6	2.6
64	Bhopalgarh @ Gandarmala	74.505	25.227	6.395	Hard_rock	1	2.6	2.6
65	Bhopalgarh @ Gandarmala	74.507	25.234	22.461	Hard_rock	1	2.6	2.6
66	Bhopalgarh @ Gandarmala	74.510	25.243	2.582	Hard_rock	1	2.6	2.6
67	Bhopalgarh @ Gandarmala	74.509	25.251	16.484	Hard_rock	1	2.6	2.6
68	Thala Ka Khera	74.530	25.243	4.809	Hard_rock	1	2.6	2.6
69	Jawasiya	74.526	25.202	16.091	Hard_rock	1	2.6	2.6
70	Danta	74.431	25.188	3.764	Hard_rock	1	2.6	2.6
71	Gonwaliya	74.451	25.185	3.326	Hard_rock	1	2.6	2.6
72	Gonwaliya	74.461	25.174	2.337	Hard_rock	1	2.6	2.6
73	Gonwaliya	74.465	25.179	2.574	Hard_rock	1	2.6	2.6
74	Gonwaliya	74.482	25.189	2.357	Hard_rock	1	2.6	2.6
75	Jawasiya	74.526	25.188	2.777	Hard_rock	1	2.6	2.6

76	Bardod	74.578	25.200	2.047	Hard_rock	1	2.6	2.6
77	Sagat Puriya	74.587	25.200	3.539	Hard_rock	1	2.6	2.6
78	Sagat Puriya	74.582	25.188	2.036	Hard_rock	1	2.6	2.6
79	Bardod	74.554	25.186	3.888	Hard_rock	1	2.6	2.6
80	Amli Purawatan	74.552	25.162	2.801	Hard_rock	1	2.6	2.6
81	Amli Purawatan	74.556	25.154	11.516	Hard_rock	1	2.6	2.6
82	Chhachheri	74.556	25.143	2.924	Hard_rock	1	2.6	2.6
83	Ojyara	74.578	25.169	15.293	Hard_rock	1	2.6	2.6
84	Ojyara	74.583	25.154	4.610	Hard_rock	1	2.6	2.6
85	Ojyara	74.585	25.166	3.336	Hard_rock	1	2.6	2.6
86	Ojyara	74.596	25.168	8.437	Hard_rock	1	2.6	2.6
87	Ojyara	74.603	25.178	5.279	Hard_rock	1	2.6	2.6
88	Takhat Pura	74.612	25.170	12.730	Hard_rock	1	2.6	2.6
89	Bhilwara (Mci)	74.532	25.294	5.802	Hard_rock	1	2.6	2.6
90	Bhilwara (Mci)	74.533	25.296	2.078	Hard_rock	1	2.6	2.6
91	Bhilwara (Mci)	74.538	25.290	23.610	Hard_rock	1	2.6	2.6
92	Bhilwara (Mci)	74.530	25.284	6.903	Hard_rock	1	2.6	2.6
93	Bhilwara (Mci)	74.533	25.268	12.211	Hard_rock	1	2.6	2.6
94	Deoli	74.542	25.256	6.285	Hard_rock	1	2.6	2.6
95	Dholiya Khera	74.537	25.240	4.557	Hard_rock	1	2.6	2.6
96	Deoli	74.539	25.239	3.442	Hard_rock	1	2.6	2.6
97	Deoli	74.546	25.231	2.073	Hard_rock	1	2.6	2.6
98	Deoli	74.557	25.236	7.374	Hard_rock	1	2.6	2.6
99	Deoli	74.562	25.225	3.073	Hard_rock	1	2.6	2.6
100	Khaira Bad	74.589	25.227	12.212	Hard_rock	1	2.6	2.6
101	Deoli	74.566	25.245	4.568	Hard_rock	1	2.6	2.6
102	Rajola	74.559	25.255	8.807	Hard_rock	1	2.6	2.6
103	Deoli	74.555	25.262	11.653	Hard_rock	1	2.6	2.6
104	Bhilwara (Mci)	74.543	25.277	4.130	Hard_rock	1	2.6	2.6
105	Bhilwara (Mci)	74.538	25.278	5.222	Hard_rock	1	2.6	2.6
106	Bhilwara (Mci)	74.546	25.281	10.872	Hard_rock	1	2.6	2.6
107	Bhilwara (Mci)	74.547	25.297	8.412	Hard_rock	1	2.6	2.6
108	Bhilwara (Mci)	74.555	25.296	2.959	Hard_rock	1	2.6	2.6
109	Bhilwara (Mci)	74.561	25.295	2.209	Hard_rock	1	2.6	2.6
110	Bhilwara (Mci)	74.562	25.288	3.870	Hard_rock	1	2.6	2.6
111	Kumariya Khera	74.565	25.270	19.377	Hard_rock	1	2.6	2.6
112	Kumariya Khera	74.572	25.261	3.237	Hard_rock	1	2.6	2.6
113	Rajola	74.567	25.254	3.801	Hard_rock	1	2.6	2.6
114	Kumariya Khera	74.578	25.262	21.392	Hard_rock	1	2.6	2.6
115	Nathadiyas	74.584	25.267	10.802	Hard_rock	1	2.6	2.6
116	Borda	74.591	25.271	3.468	Hard_rock	1	2.6	2.6
117	Nathadiyas	74.588	25.260	4.141	Hard_rock	1	2.6	2.6
118	Khaira Bad	74.603	25.252	5.805	Hard_rock	1	2.6	2.6
119	Khaira Bad	74.606	25.247	5.860	Hard_rock	1	2.6	2.6
120	Kanoli	74.604	25.271	21.710	Hard_rock	1	2.6	2.6
121	Borda	74.594	25.281	7.694	Hard_rock	1	2.6	2.6

122	Borda	74.588	25.280	4.983	Hard_rock	1	2.6	2.6
123	Borda	74.585	25.279	3.599	Hard_rock	1	2.6	2.6
124	Borda	74.579	25.291	12.956	Hard_rock	1	2.6	2.6
125	Borda	74.585	25.294	9.337	Hard_rock	1	2.6	2.6
126	Borda	74.591	25.295	2.147	Hard_rock	1	2.6	2.6
127	Atoon	74.601	25.287	5.319	Hard_rock	1	2.6	2.6
128	Atoon	74.602	25.292	2.814	Hard_rock	1	2.6	2.6
129	Atoon	74.612	25.294	2.217	Hard_rock	1	2.6	2.6
130	Atoon	74.624	25.282	3.891	Hard_rock	1	2.6	2.6
131	Madhopur	74.646	25.282	6.138	Hard_rock	1	2.6	2.6
132	Bhilwara (Mci)	74.609	25.323	12.390	Hard_rock	1	2.6	2.6
133	Bhilwara (Mci)	74.629	25.306	2.059	Hard_rock	1	2.6	2.6
134	Bhilwara (Mci)	74.641	25.309	2.741	Hard_rock	1	2.6	2.6
135	Bhilwara (Mci)	74.643	25.317	2.986	Hard_rock	1	2.6	2.6
136	Bhilwara (Mci)	74.658	25.313	4.194	Hard_rock	1	2.6	2.6
137	Bhilwara (Mci)	74.660	25.307	4.293	Hard_rock	1	2.6	2.6
138	Madhopur	74.657	25.292	22.701	Hard_rock	1	2.6	2.6
139	Sabalpura	74.672	25.300	9.134	Hard_rock	1	2.6	2.6
140	Haled	74.680	25.306	2.116	Hard_rock	1	2.6	2.6
141	Haled	74.681	25.303	3.048	Hard_rock	1	2.6	2.6
142	Sabalpura	74.682	25.296	6.525	Hard_rock	1	2.6	2.6
143	Sabalpura	74.675	25.289	4.826	Hard_rock	1	2.6	2.6
144	Bholi	74.693	25.276	2.545	Hard_rock	1	2.6	2.6
145	Haled	74.698	25.304	2.590	Hard_rock	1	2.6	2.6
146	Danthal	74.713	25.305	2.626	Hard_rock	1	2.6	2.6
147	Roopaheli	74.728	25.317	19.018	Hard_rock	1	2.6	2.6
148	Agarpura	74.720	25.324	4.801	Hard_rock	1	2.6	2.6
149	Suwana	74.716	25.323	2.212	Hard_rock	1	2.6	2.6
150	Roopaheli	74.735	25.310	4.710	Hard_rock	1	2.6	2.6
151	Roopaheli	74.746	25.314	7.798	Hard_rock	1	2.6	2.6
152	Roopaheli	74.746	25.306	3.166	Hard_rock	1	2.6	2.6
153	Roopaheli	74.759	25.292	12.266	Hard_rock	1	2.6	2.6
154	Roopaheli	74.772	25.300	7.612	Hard_rock	1	2.6	2.6
155	Kanda	74.782	25.293	2.597	Hard_rock	1	2.6	2.6
156	Kanda	74.773	25.286	2.773	Hard_rock	1	2.6	2.6
157	Dadiya	74.752	25.274	8.640	Hard_rock	1	2.6	2.6
158	Govindsingh Ji Ka Khera	74.753	25.271	6.164	Hard_rock	1	2.6	2.6
159	Mahesh Pura	74.804	25.245	7.582	Hard_rock	1	2.6	2.6
160	Batakhon Ka Khera	74.742	25.258	3.835	Hard_rock	1	2.6	2.6
161	Salariya	74.669	25.259	2.898	Hard_rock	1	2.6	2.6
162	Bholi	74.684	25.262	7.541	Hard_rock	1	2.6	2.6
163	Bholi	74.694	25.267	5.633	Hard_rock	1	2.6	2.6
164	Mangrop	74.690	25.245	9.074	Hard_rock	1	2.6	2.6
165	Patliyas	74.712	25.258	9.022	Hard_rock	1	2.6	2.6
166	Jitya Kheri	74.724	25.275	2.033	Hard_rock	1	2.6	2.6
167	Patliyas	74.724	25.253	3.457	Hard_rock	1	2.6	2.6

168	Patniya	74.736	25.254	2.210	Hard_rock	1	2.6	2.6
169	Jitya Kheri	74.731	25.262	1.979	Hard_rock	1	2.6	2.6
170	Govindsingh Ji Ka Khera	74.731	25.278	2.482	Hard_rock	1	2.6	2.6
171	Govindsingh Ji Ka Khera	74.743	25.273	2.468	Hard_rock	1	2.6	2.6
172	Kalundiya	74.772	25.238	5.005	Hard_rock	1	2.6	2.6
173	Siyar	74.738	25.217	10.696	Hard_rock	1	2.6	2.6
174	Mangrop	74.713	25.207	4.256	Hard_rock	1	2.6	2.6
175	Mangrop	74.688	25.221	20.073	Hard_rock	1	2.6	2.6
176	Kabra	74.669	25.204	4.494	Hard_rock	1	2.6	2.6
177	Bhilwara (Mci)	74.550	25.322	14.797	Hard_rock	1	2.6	2.6
178	Bhilwara (Mci)	74.566	25.311	2.164	Hard_rock	1	2.6	2.6
179	Bhilwara (Mci)	74.586	25.316	2.856	Hard_rock	1	2.6	2.6
					Total	179		465.4

Fig: 9



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 58 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 5.252 cr, which includes Rs 4.654 cr for ground water recharge activities, 0.348 cr for ground water monitoring (Piezometer construction) and Rs 0.25 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 5.252 Crores**.

Table 4: Cost of the recharge structures

Cost Recharge Shaft Rs in crs (Unit cost Rs 0.05 cr for alluvium and Rs 0.026 cr for hard rock)
Hard rock – 4.654

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	179	5.365	2.6	465.4	3.756
Impact assessment & Monitoring						
Piezometer	Up to 80 m bgl	58		0.6	34.8	
Impact assessment will be carried out by implementing agency						
O & M - 5% of total cost of the scheme					25.01	
TOTAL					**525.21**	
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 Suwana block, Bhilwara envisages gainful utilization of 3.756 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 133.09% from the existing 145.63%. 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 %)**
39.8571	3.756	43.6131	58.042	-	58.042	145.63	133.09

- 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.