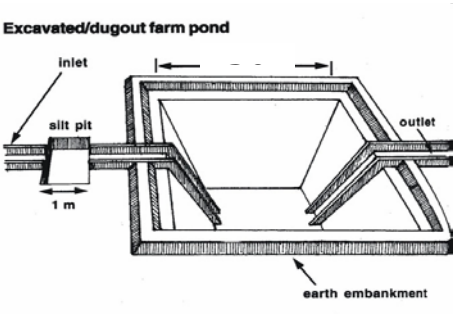
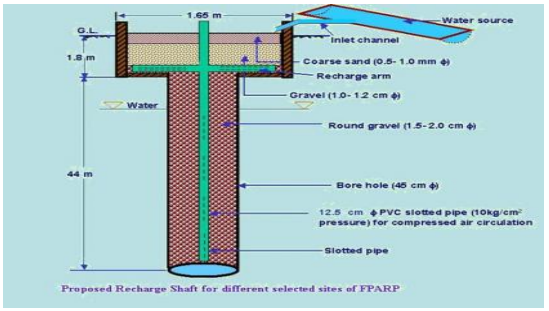
CENTRAL GROUND WATER BOARD

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





ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN OF MANDAWAR BLOCK, DISTRICT ALWAR, RAJASTHAN

Western Region, Jaipur
February, 2016

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLANBLOCK MANDAWAR, DISTRICT ALWAR

Plan at a Glance

1.	**Area of the Mandawar Block**	**577.26 Sq.Km.**
2.	**Area identified for Artificial Recharge**	**334.60 sq km**
3.	**Dynamic Ground Water Resources (as on 31.03.2011)**	
	Net Ground Water Availability	**64.81 MCM**
	Annual Ground Water Draft	**124.86 MCM**
	Stage of Ground Water Development	**192.67 %**
4.	**Runoff available in the block** **Volume of water recharged** **Volume of water conserved for other interventions**	**0.2106 MCM** **0.2106 MCM** **nil**
5.	**Volume of unsaturated aquifer zone available for recharge**	**1650.985 MCM**
6.	**Total number of structures to be proposed**	
	Recharge structures Existing village pond with recharge shaft/ well Percolation tank **Water Conservation** Farm pond	 **7 shafts in 7 Nos. of existing village ponds** **nil** **-**
	Expected Annual GW recharge	**0.1474 MCM**
	Provision for supplemental irrigation, thus reducing GW withdrawal for irrigation	**nil**
	Total recharge/ saving of ground water	**0.1474 MCM**
7.	**Estimated Cost** Artificial Recharge Plan Water conservation measures Piezometer construction Operation and maintenance	**0.4116 crore** 0.35 crore nil 0.042 crore 0.0196 crore

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN BLOCK MANDAWAR, DISTRICT ALWAR

1 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 **Mandawar Block, district Alwar** 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 **192.67 %.** 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 120 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.

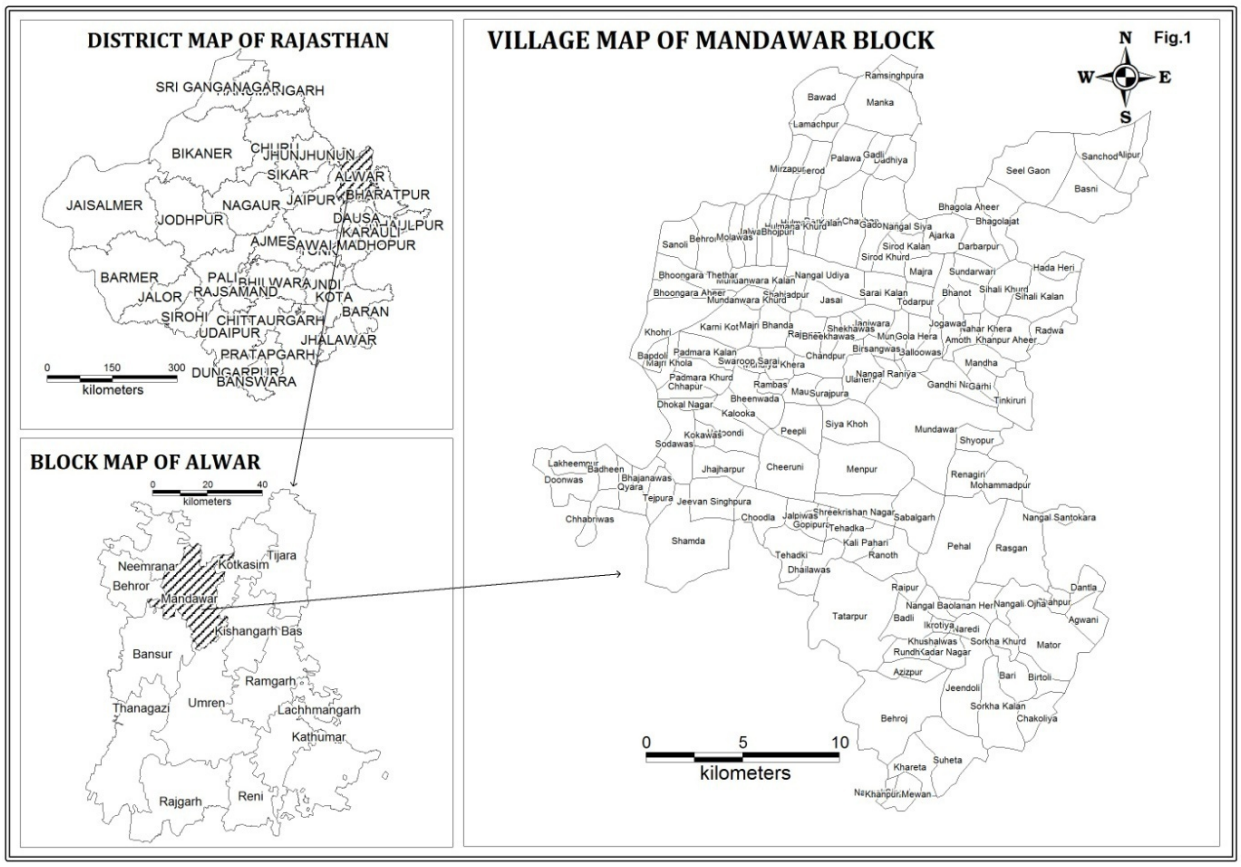
Location of the block

Mandawar Block of Alwar district falls in northern part of district and is located between North latitudes 27°40’48” & 28°02’24” and East longitudes76°20’35” & 76°39’58” and falls in Survey of India toposheet no 54A. The block covers an area of 577.26 Sq.km. The village wise map of Mandawar block is given in Figure below. The total population of the block is 231628 persons as per the 2011 census. It is comprised of 121648 males and 109980 female and population density is 401 persons/ sq.km. Location map is shown in **Fig.1**.

Source wise Irrigated Area

The dug wells/ Tubewells are the only major source of irrigation in Mandawar Block. There is no area that falls under canal & pond irrigation. The wells irrigate total 362.32 Sq.Km. area in this Block.

Fig: 1

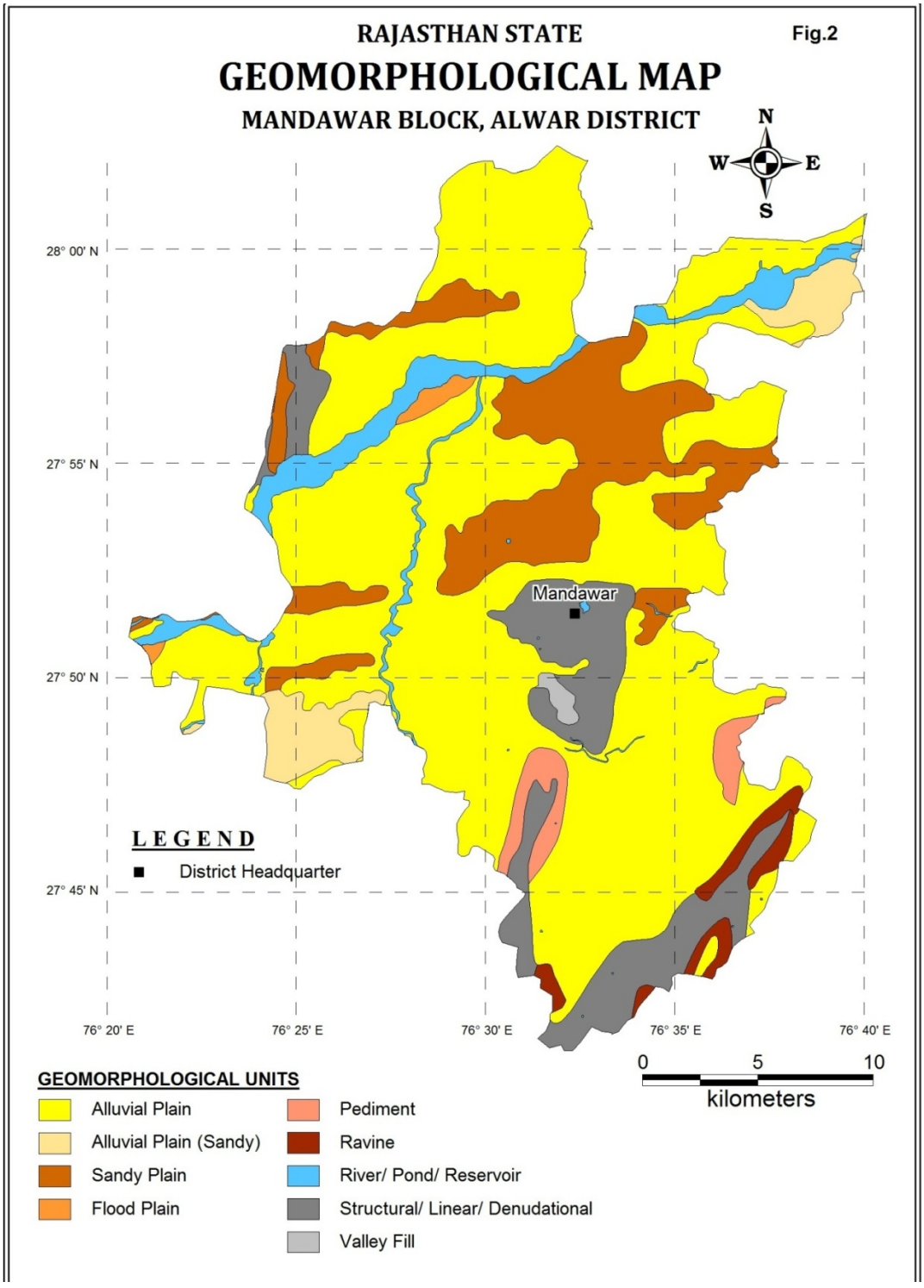


Physiography & Drainage

Physiographically (**Fig.2**), the block is characterized by plains. The minimum and maximum elevation of Block is 260.7 m and 609.4 m, respectively.

The seasonal river Sahibi flows through the Block from north west to south east direction and carry the runoff from the hills. There is no perennial river flowing in this Block. The major part of block falls under Sabi basin except some southern part that falls under Ruparail basin**. (Fig.3).**

Fig: 2

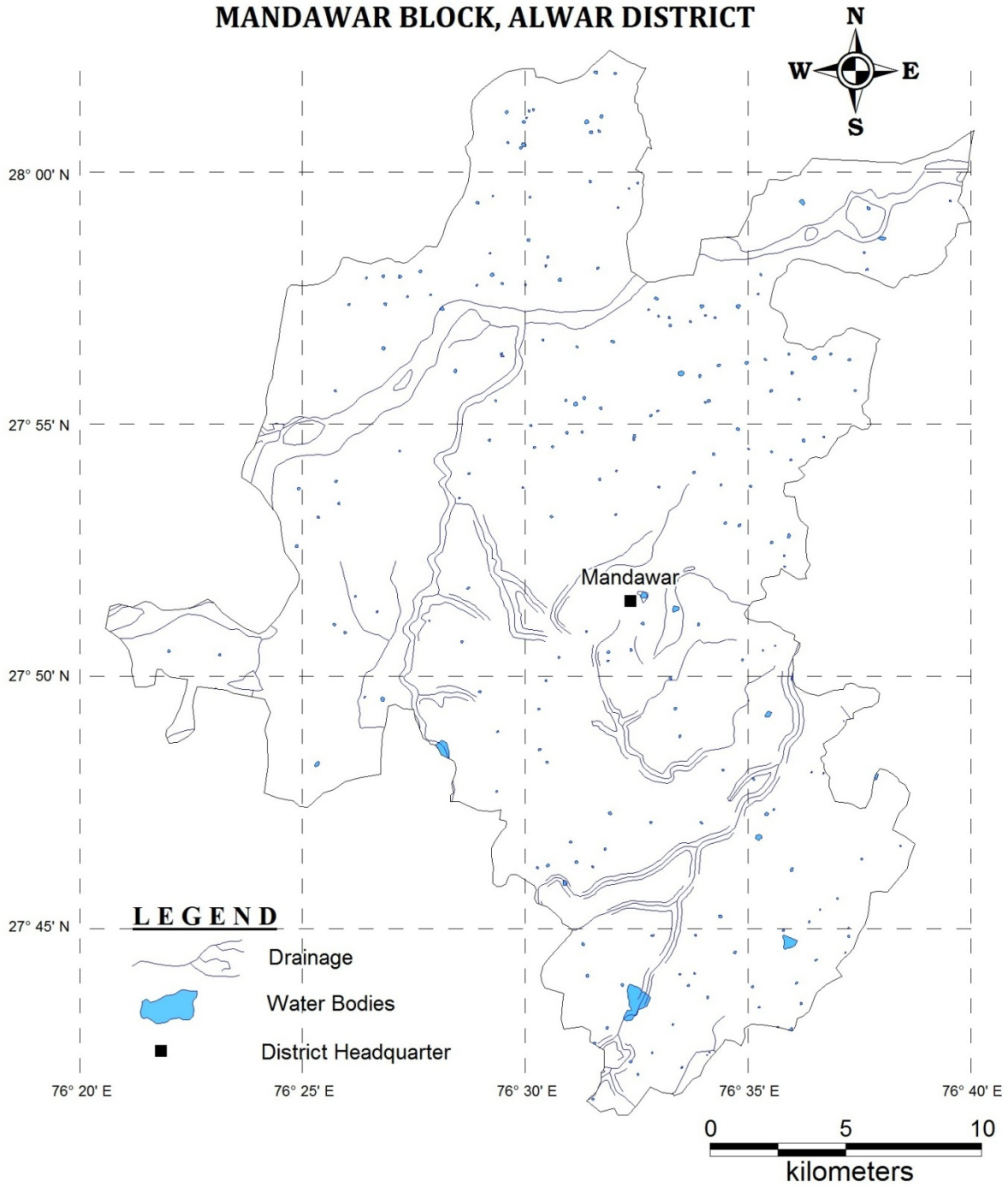

RAJASTHAN STATE
Fig.2
GEOMORPHOLOGICAL MAP
MANDAWAR BLOCK, ALWAR DISTRICT
N
W
E
S
28° 00' N
27° 55' N
27° 50' N
27° 45' N
Mandawar
LEGEND
District Headquarter
76° 20' E
76° 25' E
76° 30' E
76° 35' E
76° 40' E
0
5
10
kilometers
GEOMORPHOLOGICAL UNITS
Alluvial Plain
Alluvial Plain (Sandy)
Sandy Plain
Flood Plain
Pediment
Ravine
River/ Pond/ Reservoir
Structural/ Linear/ Denudational
Valley Fill

RAJASTHAN STATE

Fig.3

DRAINAGE & WATER BODIES MAP

MANDAWAR BLOCK, ALWAR DISTRICT



Rainfall

The climate of the block is semi arid. The Normal annual rainfall of block is 626.88mm. Failure of rains has observed several times. The available data of rainfall indicates that larger part of annual rainfall is received through SW monsoon during July to September. In March, there is transition to summers. The summer months of April to June are the hottest months and temperature upto 48°C is reached. From end of June to September, south western monsoon is received. The months of July and August are the wettest months, receiving about 70% of total annual rainfall. Winter season starts from November and lasts upto February. Average temperature during these months remains between 15° to 18°C, however from end of December to mid January, temperature remains in the range of 5° to 10°C.

Hydrogeology of the Area

Mandawar Block is mostly comprised of Quaternary alluviums underlain by Quartzites of Delhi Super group. Out of total geographical area of 577.26Sq. Km, areas of 545.78 Sq. Km. (94.55%) under older alluvium forms aquifer system (potential zone) in the block and remaining 31.48Sq. Km.(5.45%) area is represented by hills. The occurrence of ground water in the Block is mainly controlled by topographic features, physical characteristics and structural features present in the geological formations. Ground water in the area occurs under confined conditions in phreatic zones, semi-confined conditions in deeper zones and weathered & fractured portions of the hard rocks. Quartzites do not form important water bearing formation except in the fractured and brecciated quartzite at places. Alluviums form major potential aquifers in the Block. In general yield of wells tapping alluvial aquifers varies from 0.46 to 3.47 lps depending on the thickness of saturated granular zones and yield of the wells tapping hard rock aquifers in ranges from 0.58 to 0.23 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 20-50 m bgl range. **(Fig 4)**

The average decadal depth to water level is 32.32 m bgl for Pre monsoon & 29.42 m bgl for Post monsoon. In general, the depth to water level is 20 to 40 m bgl in most part of the block and southern part of the area is observed water level more than 40 m bgl The Map showing Depth to water level for May, 2014 and November, 2014 is shown in **Fig 5 & 6.**

Fig: 4

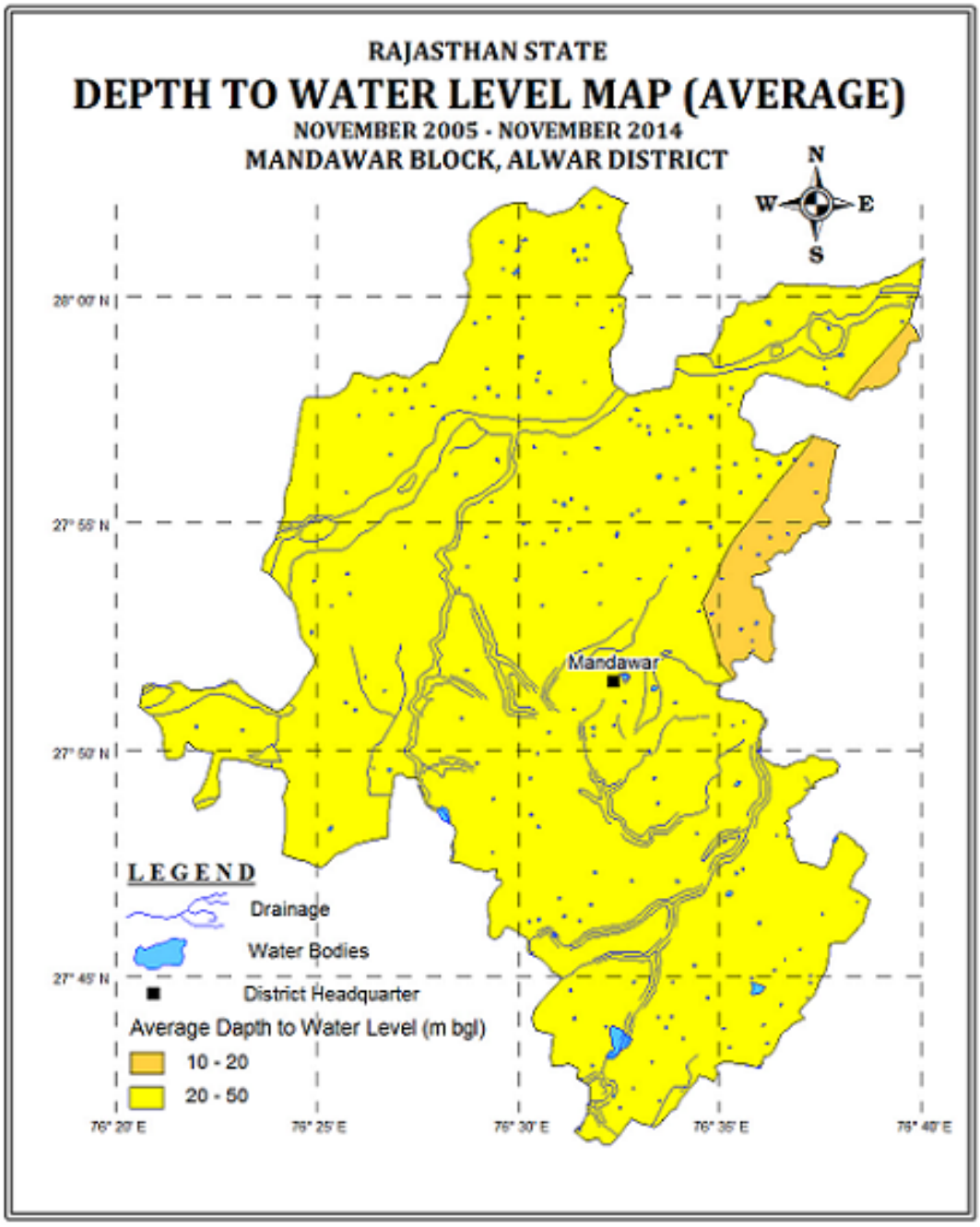

RAJASTHAN STATE
DEPTH TO WATER LEVEL MAP (AVERAGE)
NOVEMBER 2005 - NOVEMBER 2014
MANDAWAR BLOCK, ALWAR DISTRICT
N
W
E
S
28° 00' N
27° 55' N
27° 50' N
27° 45' N
Mandawar
LEGEND
Drainage
Water Bodies
District Headquarter
Average Depth to Water Level (m bgl)
10 - 20
20 - 50
76° 20' E
76° 25' E
76° 30' E
76° 35' E
76° 40' E

Fig: 5

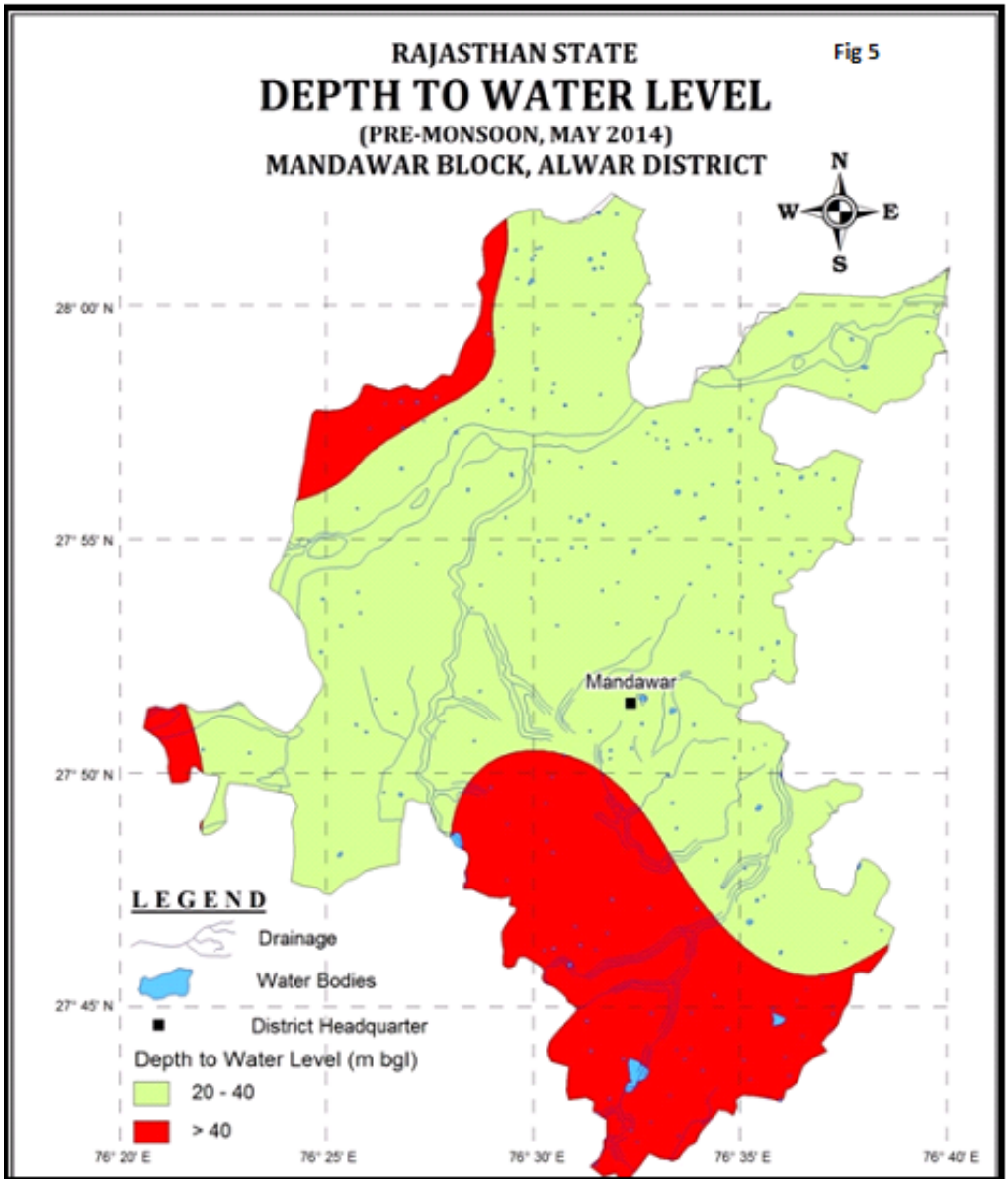
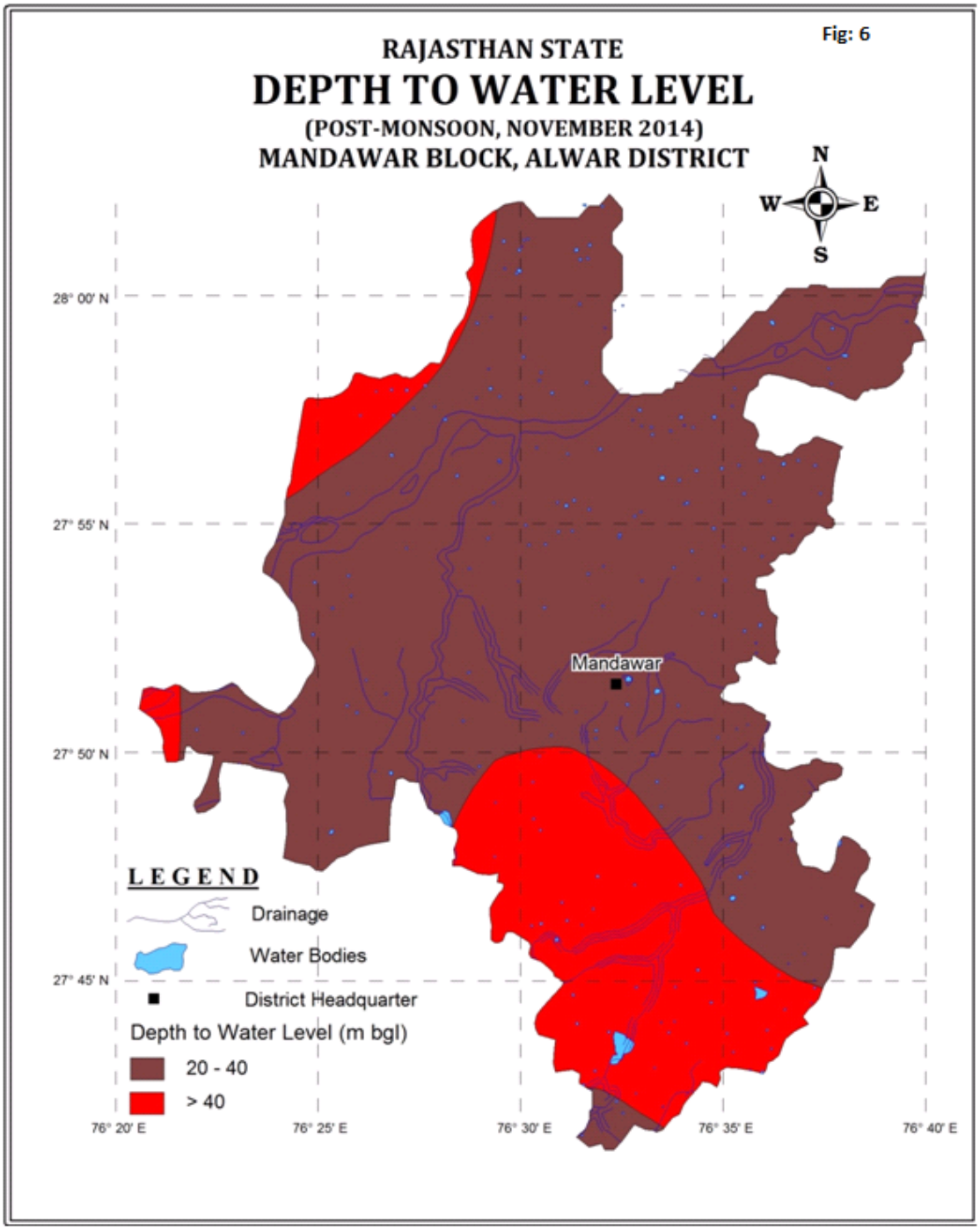

RAJASTHAN STATE
Fig 5
DEPTH TO WATER LEVEL
(PRE-MONSOON, MAY 2014)
MANDAWAR BLOCK, ALWAR DISTRICT
N
W
E
S
28° 00' N
27° 55' N
27° 50' N
27° 45' N
Mandawar
LEGEND
Drainage
Water Bodies
District Headquarter
Depth to Water Level (m bgl)
20 - 40
> 40
76° 20' E
76° 25' E
76° 30' E
76° 35' E
76° 40' E

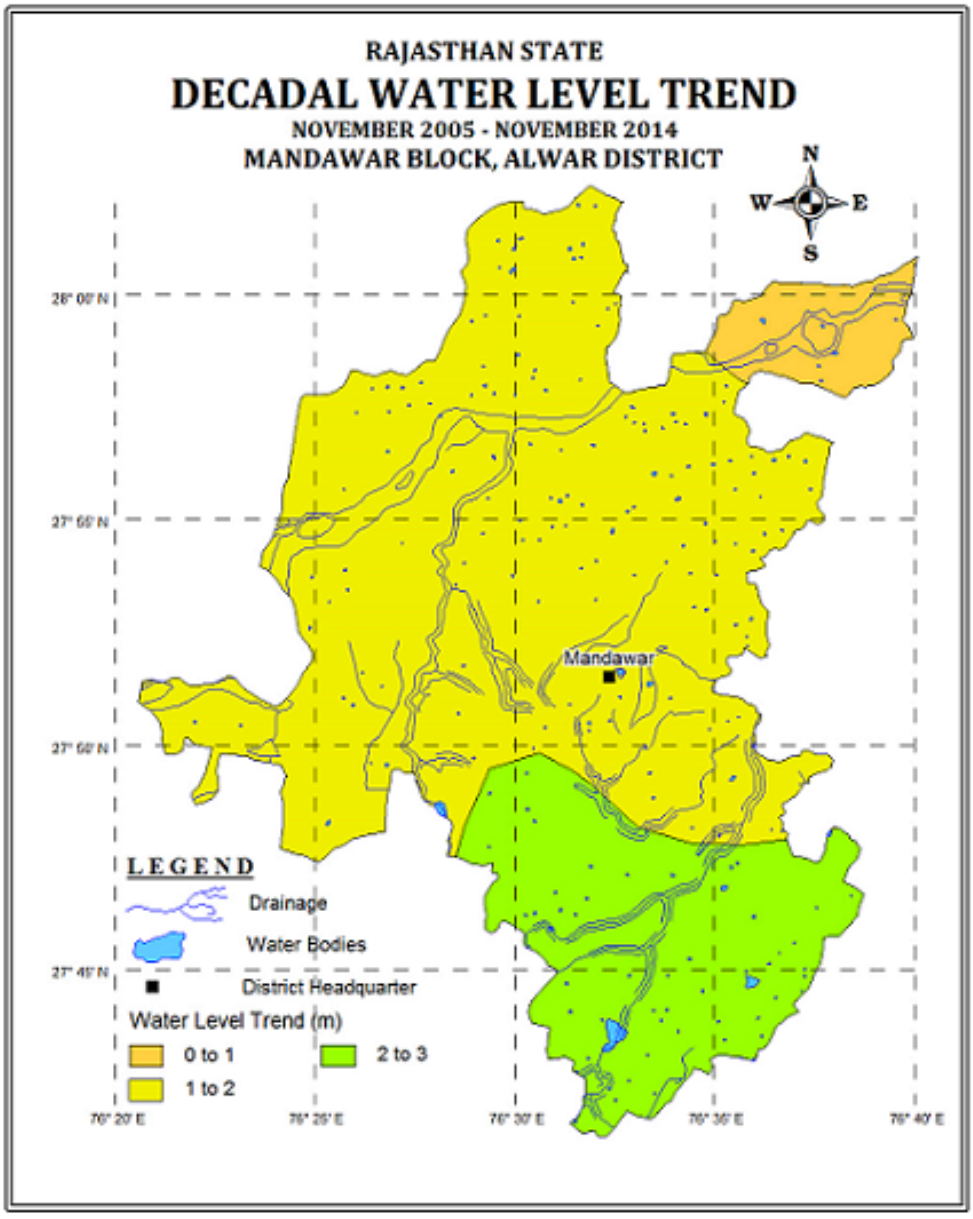
Fig: 6



Water Level Trend: All the hydrographs are showing declining water level trends over last 10 years. At these monitoring stations water level fall varying from 1.59 to 2.40 m/year during pre monsoon and 1.49 to 1.60 m/year during post monsoon has been observed.

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 1-2 m and as high as 2-3 m/ year in ground water level is prevalent in the block. The map of Decadal Water Level Trend is shown in fig. 7.

Fig: 7



Subsurface Hydrogeology

As inferred from borehole data of the Mandawar Block; Older Alluvium forms the potential aquifers. However, the ground water in Quartzite only occurs in shallow weathered parts or fractures due to absence of primary porosity. The depth of drilling ranges from 61.5 to 131.15 mbgl and the average discharge ranges from 3.67 to 13.33 lps. The quality of water has 2 major problems, i.e., Salinity &Fluoride. Transmissivity value varies between 45to130 m^2/day.

Dynamic Ground Water Resource

The Ground Water Resources for the block are given in Table 1 as per 31.03.2011 Ground Water Resource Assessment. The Net Ground water Availability of Block is 6480.62ham and Annual Ground water draft is 12486.42 ham. Due to this excessive draft over recharge, stage of Ground water development has reached 192.67 %.

Table 1: Ground Water Availability, Utilization and Stage of Development Mandawar Block, AlwarDistrict

Natural Discharge During Non Monsoon Period	720.07 ham
Net Ground Water Availability	6480.62 ham
Annual Ground Water Draft	12486.42 ham
Net Ground water Availability for Future Irrigation Use	0 ham
Stage of Ground Water Development	192.67%
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 0.2106 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
ALWAR	RJ02	**MANDAWAR**	RJ0211	577.260	545.780	alluvium	545.780	0.100

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)
33.250	30.250	1650.985	Dohan	0.2106	0.2106	7	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 577.26sq km practically 545.78 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

Mandawar block is having ground water level mostly ranges 20 to 40m below ground level and as per dynamic ground water resource estimation, the block is over exploited with stage of ground water development at **192.67** %. The Mandawar 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 these aspect the proposal for Recharge Shaft/ Recharge wells have been firmed up in the present Plan are the most suitable structures in Mandawar block.

Details of Ground Water Recharge Measures

1. Existing Village Pond with recharge shaft/wells

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

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

The model design of recharge well has been worked out in consultation with Ground Water Department, Government of Rajasthan and presented in Fig 8a & 8b. 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 2.5 ha. Therefore, more number of such Recharge wells are envisaged for larger ponds.

Fig 8a

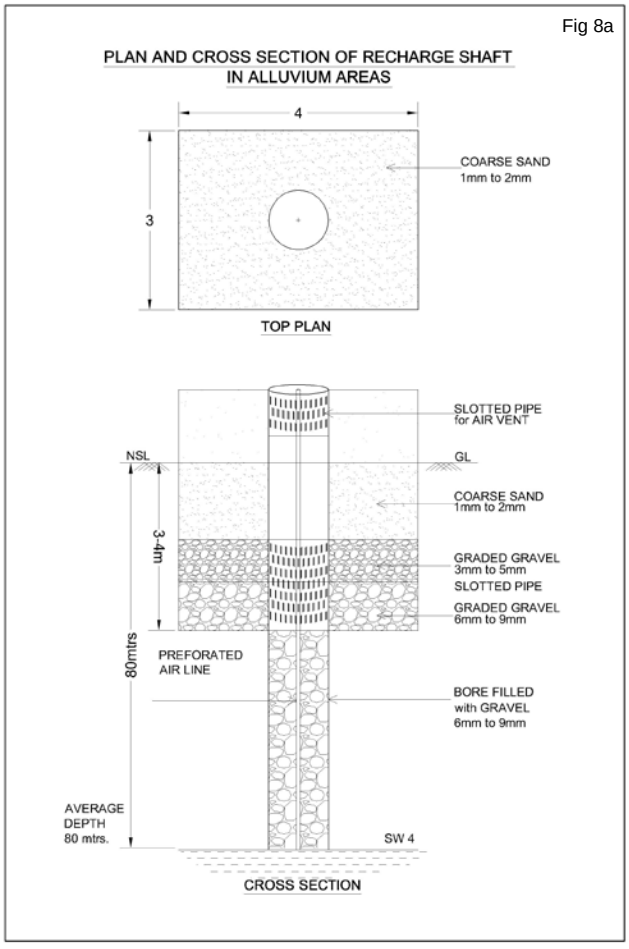
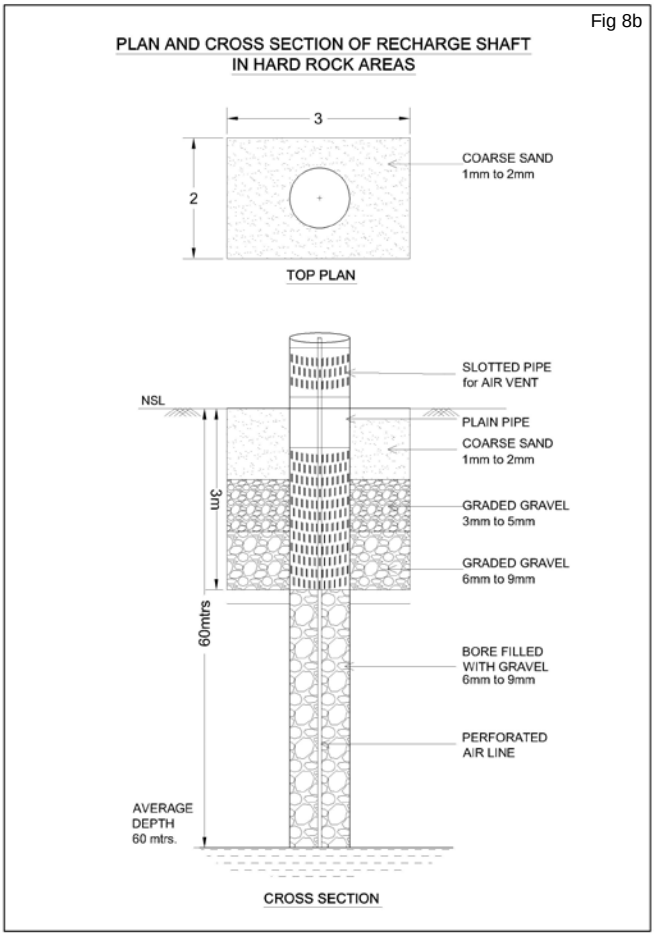


Fig 8b



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 7 recharges shafts/ wells in 7 identified existing village ponds at an estimated cost of 35 lacs.

Fig: 9

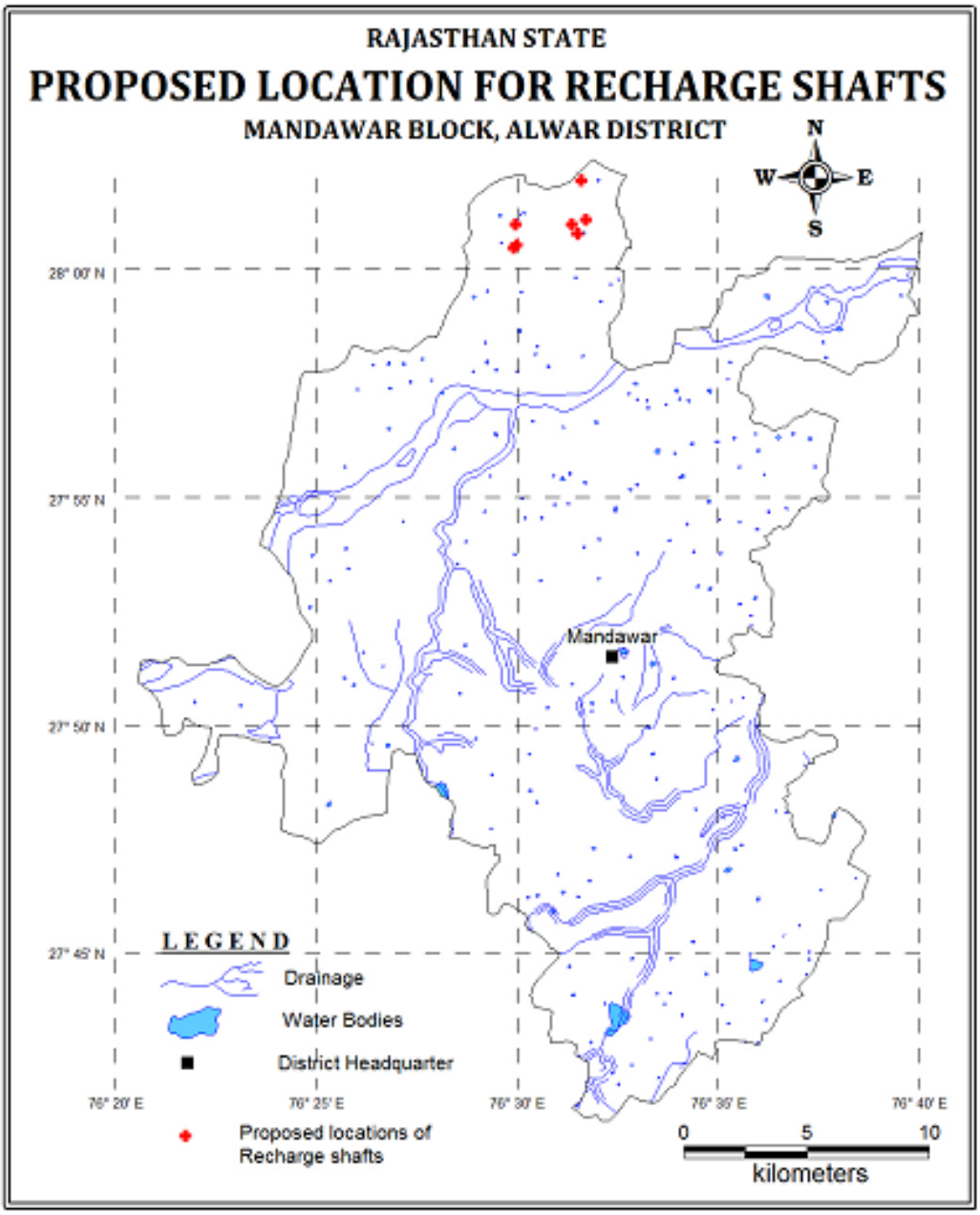


Table 3: Tentative location of village for village pond with recharge shaft.

S.N	Village	Long	Lat	Pond Area (Ha)	No of Shaft	Formation	Unit cost (Rs in lac)	Cost of Shaft (Rs in lac)
1	Bawad	76.499	28.016	1.310	1	Soft_rock	5	5
2	Lamachpur	76.500	28.009	1.820	1	Soft_rock	5	5
3	Manka	76.523	28.016	1.680	1	Soft_rock	5	5
4	Manka	76.528	28.018	1.120	1	Soft_rock	5	5
5	Manka	76.525	28.013	1.070	1	Soft_rock	5	5
6	Lamachpur	76.498	28.008	1.820	1	Soft_rock	5	5
7	Ramsinghpura	76.526	28.033	1.120	1	Soft_rock	5	5
					7			**35**

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 7 piezometer, at suitable locations for monitoring of water levels, in the vicinity of proposed recharge structure. The depth of the piezometer may vary from 40 to 60mbgl. This will help in assessing the impact of the project implementation.

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

Financial Outlay of the Plan

The total estimated cost of the Plan is 0.4116 cr, which includes Rs 0.35 cr for ground water recharge activities, 0.042 cr for ground water monitoring (Piezometer construction) and Rs 0.0196 cr towards operation and maintenance charges. The tentative cost estimates of the various activities of the Plan are shown in Table 4 & 5.
The tentative cost for different activities is given in table 5. The unit rates are as followed by the Govt. of Rajasthan (BSR). The total estimated cost of the project is **Rs 0.4116 Crores**.

Table 4: Cost of the recharge structures

Cost Recharge Shaft Rs in crs (Unit cost Rs 0.05 cr)
0.35

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	Alluvium – Depth 80m, Dia: 10-12" with filter pit	7	0.2106	5	35	0.1474
Sub total					35	0.1474
Impact assessment & Monitoring						
Piezometer	Up to 80 m bgl	6		0.6	4.2	
Impact assessment will be carried out by implemneting agency						
O & M - 5% of total cost of the scheme					1.96	
TOTAL					**41.16**	

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 Mandawar block, Alwar envisages gainful utilization of 0.1474 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 192.67% from the existing 192.24%. 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 (Ham)	Additional Recharge from RWH & conservation (mcm)	Total Net G.W. Availability after intervention (mcm)	Existing G.W Draft for all purpose (mcm)	Saving of Ground water through projects (mcm)	Net GW draft after interventions (mcm)	Present stage of G.W. development (%)	Projected stage of G.W. Dev. (in %)
64.8062	0.1474	64.9536	124.8642	0	124.8642	192.67	192.24

- 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.