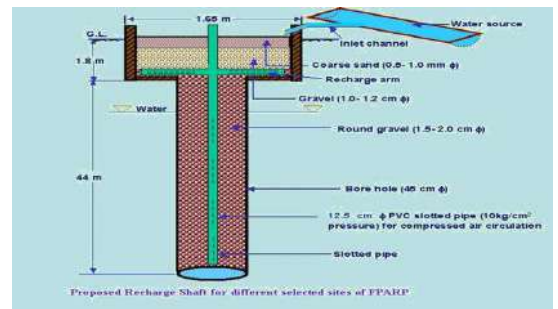
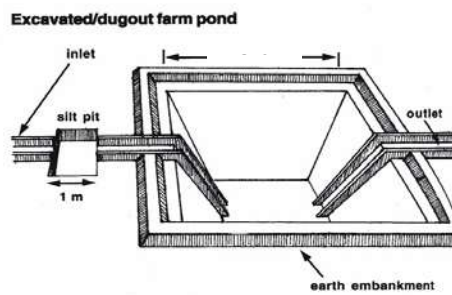




CENTRAL GROUND WATER BOARD
MINISTRY OF WATER RESOURCES,
RIVER DEVELOPMENT & GANGA REJUVENATION
GOVERNMENT OF INDIA



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

Western Region, Jaipur
April 2016

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

Plan at a Glance

1.	Area of the Shahpura Block	1159.30 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	56.0230 MCM
	Annual Ground Water Draft	66.9189 MCM
	Stage of Ground Water Development	119.45%
4.	Volume of water to be harnessed	0.7586 MCM
	Volume of water available for recharge	0.7586 MCM
	Volume of water available for conservation by other interventions	-
5.	Volume of unsaturated aquifer zone available for recharge	51.634 MCM
6.	Total number of structures to be proposed	
	Recharge structures Existing village pond with recharge shaft/ well	25 shafts in 25 Nos. of existing village ponds
	Water Conservation Farm pond	-
	Expected Annual GW recharge	0.531 MCM
	Provision for supplemental irrigation, thus reducing GW withdrawal for irrigation	-
	Total recharge/ saving of ground water	0.531 MCM
7.	Estimated Cost Artificial Recharge Plan Piezometer construction Operation and maintenance	0.7455 crore 0.65 crore 0.06 crore 0.0355 crore

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN OF SHAHPURA 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 **Shahpura 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 **119.45%**. 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.

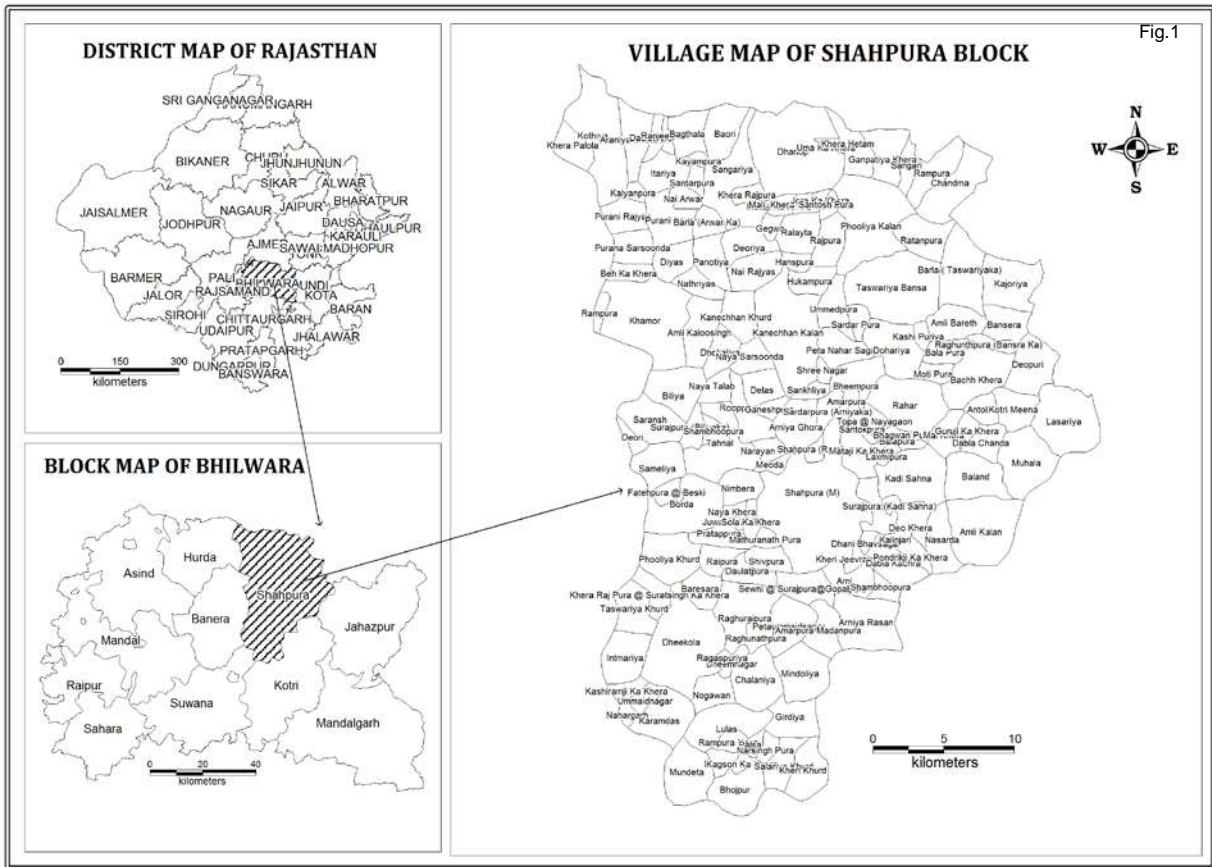
Location of the block

Shahpura Block of Bhilwara district falls under Over-Exploited category. It covers an area of 1159.30 Sq. Km. and falls in northeastern part of Bhilwara district. It is located between North latitudes 25°26' & 25°54' and East longitudes 74°44' & 75°07'. The total rural population of the Block is 176700 persons as per the 2011 census. It is comprised of 89868 males and 86832 females. Location map is shown in **fig 1**.

Source wise Irrigated Area

Out of total area of 1159.30 Sq.Km., an area of 108.63 (9.37%) falls under irrigation. The dug wells/ Tube wells are the main source of irrigation in Shahpura Block. An area of 7.28 Sq.Km. area falls under Canal irrigation and another 10.97 Sq.Km. area falls under pond irrigation. The wells irrigate total 90.38 Sq.Km. in this Block.

Fig: 1



Physiography & Drainage

Physiographically, the block is characterized by presence of buried pediments of denudation origin and alluvial plains. The minimum and maximum elevation of Block is 338.7 m and 489.0 m, respectively. The map showing various geomorphic units is presented in **fig 2**.

There is no perennial river flowing in this Block. Ephemeral Khari and Mansi rivers in northern parts drain it. The entire block falls under Banas river basin. The map showing drainage and water bodies in the Shahpura block are shown in **fig 3**.

Fig: 2

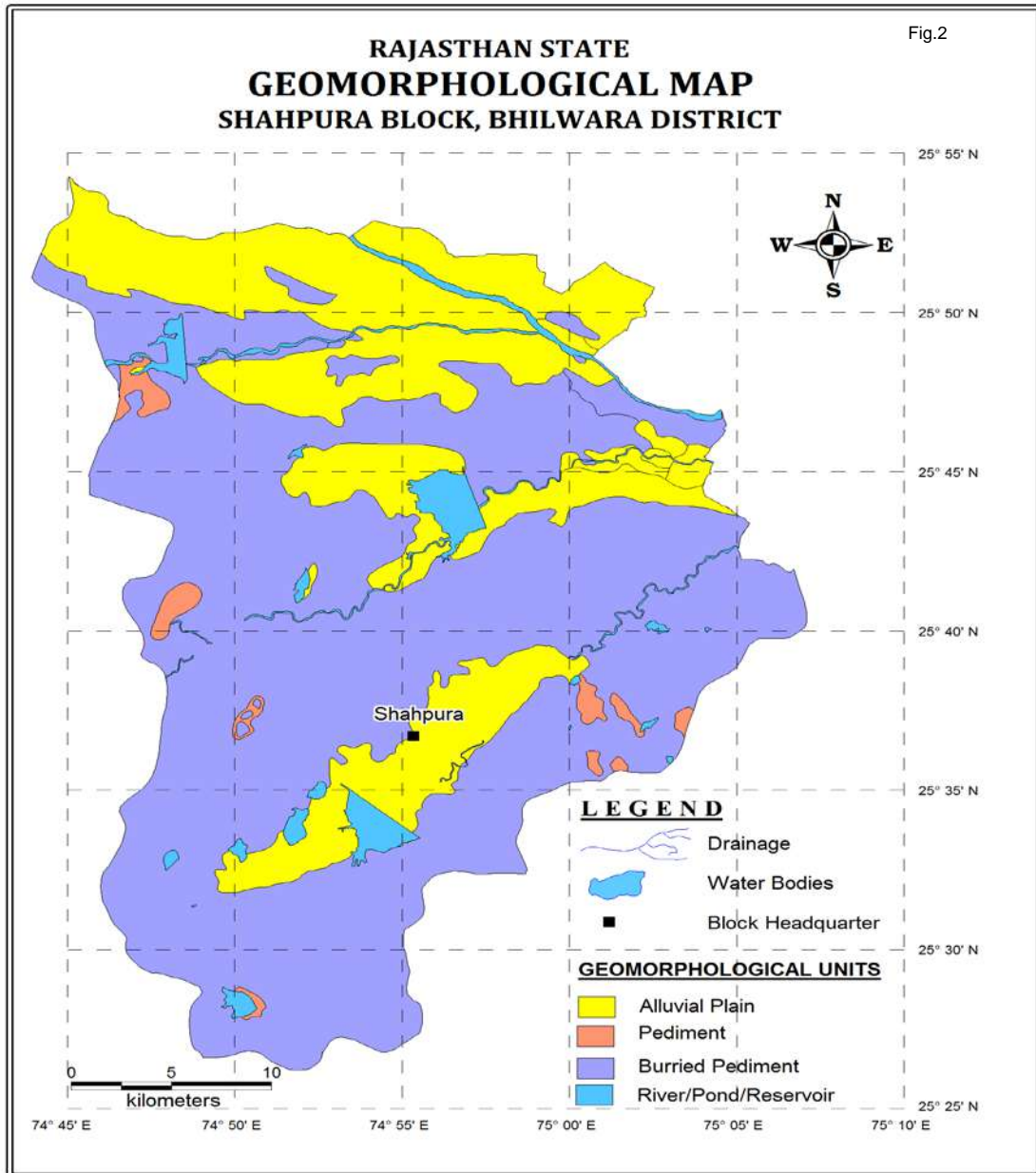
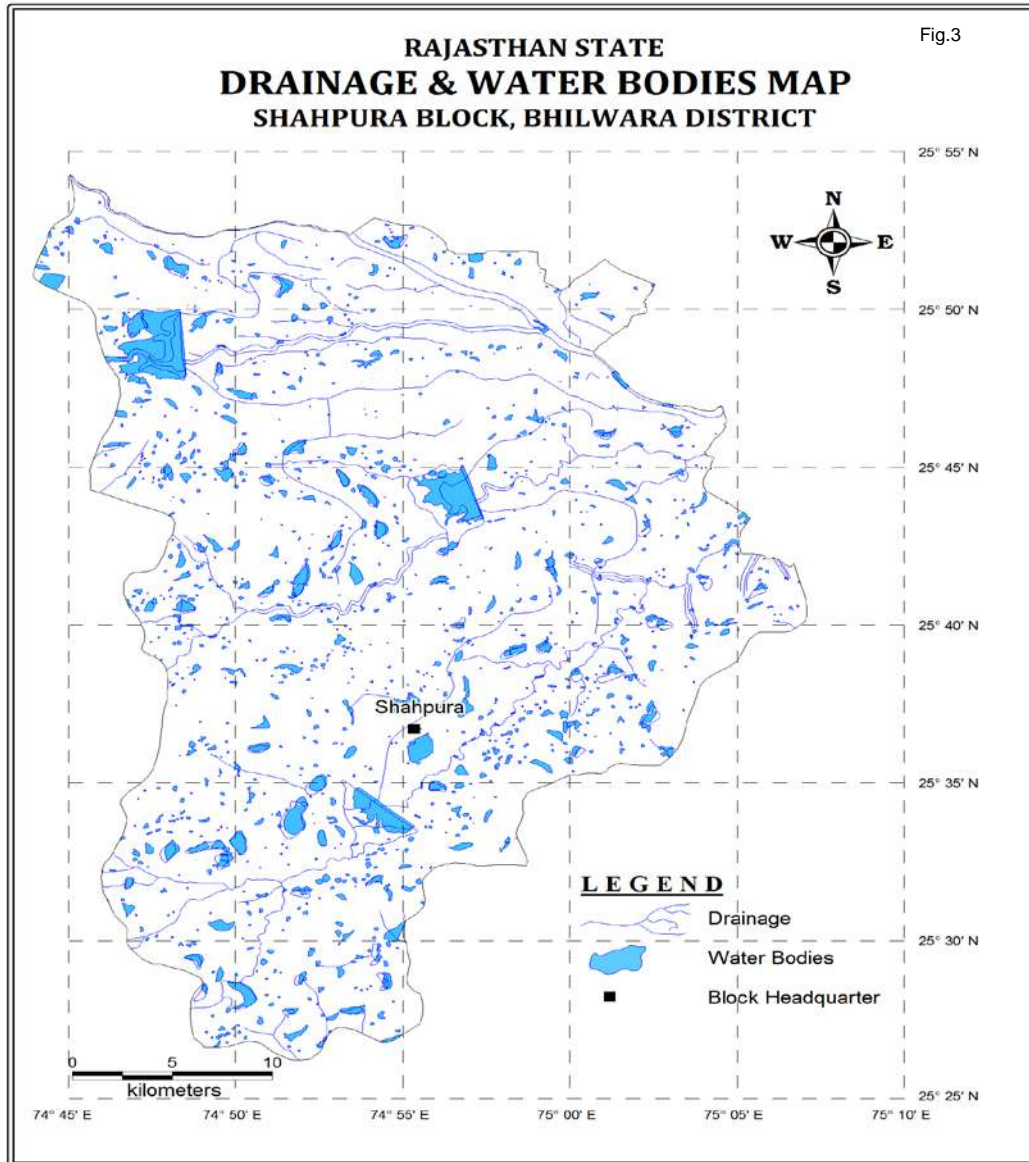


Fig: 3



Rainfall

The climate of the block is semi arid. The Normal annual rainfall of block is 620.50 mm (IMD, 1901-70). The available data of rainfall indicates that larger part of annual rainfall is received through SW monsoon during July to September.

Hydrogeology of the Area

The major water bearing formations in the Block are gneiss and schist of Bhilwara Supergroup, overlain by thin cover of alluvium. Out of total geographical area of 1159.30 Sq. Km, an area of 1125.13 Sq. Km. (97.05%) forms aquifer system (potential zone) in the block and remaining 34.17 Sq. Km. (2.95%) 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 intrusive and schist 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 2-5 and 5-10 m bgl range with patch of area in south-west showing 10 – 20 m bgl range. **(Fig 4)**

The average decadal depth to water level is 8.85 m bgl for Pre monsoon & 7.04 m bgl for Post monsoon. In general, the depth to water level is between 5 to 10 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 0.18 m/year during pre monsoon and 0.23 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

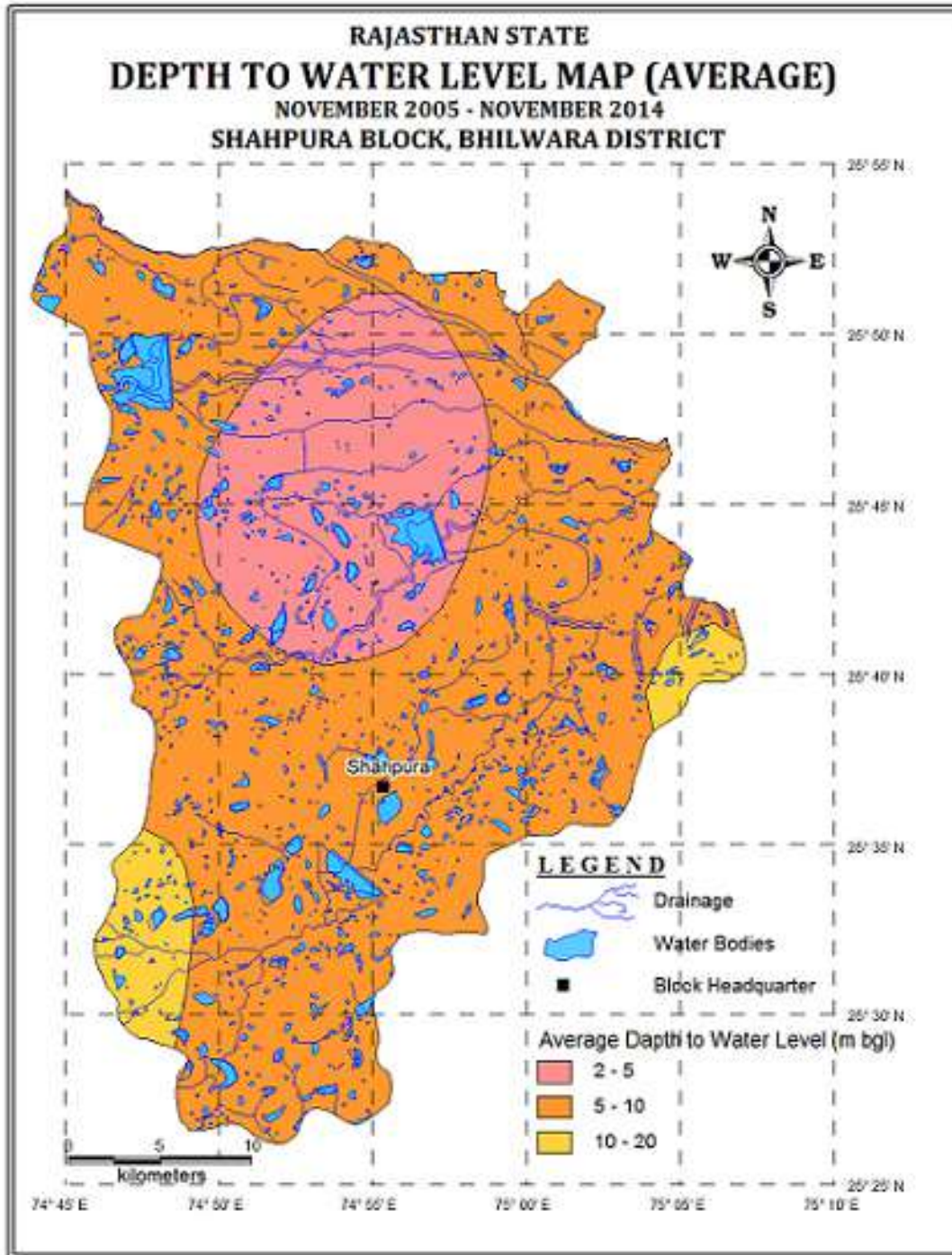


Fig: 5

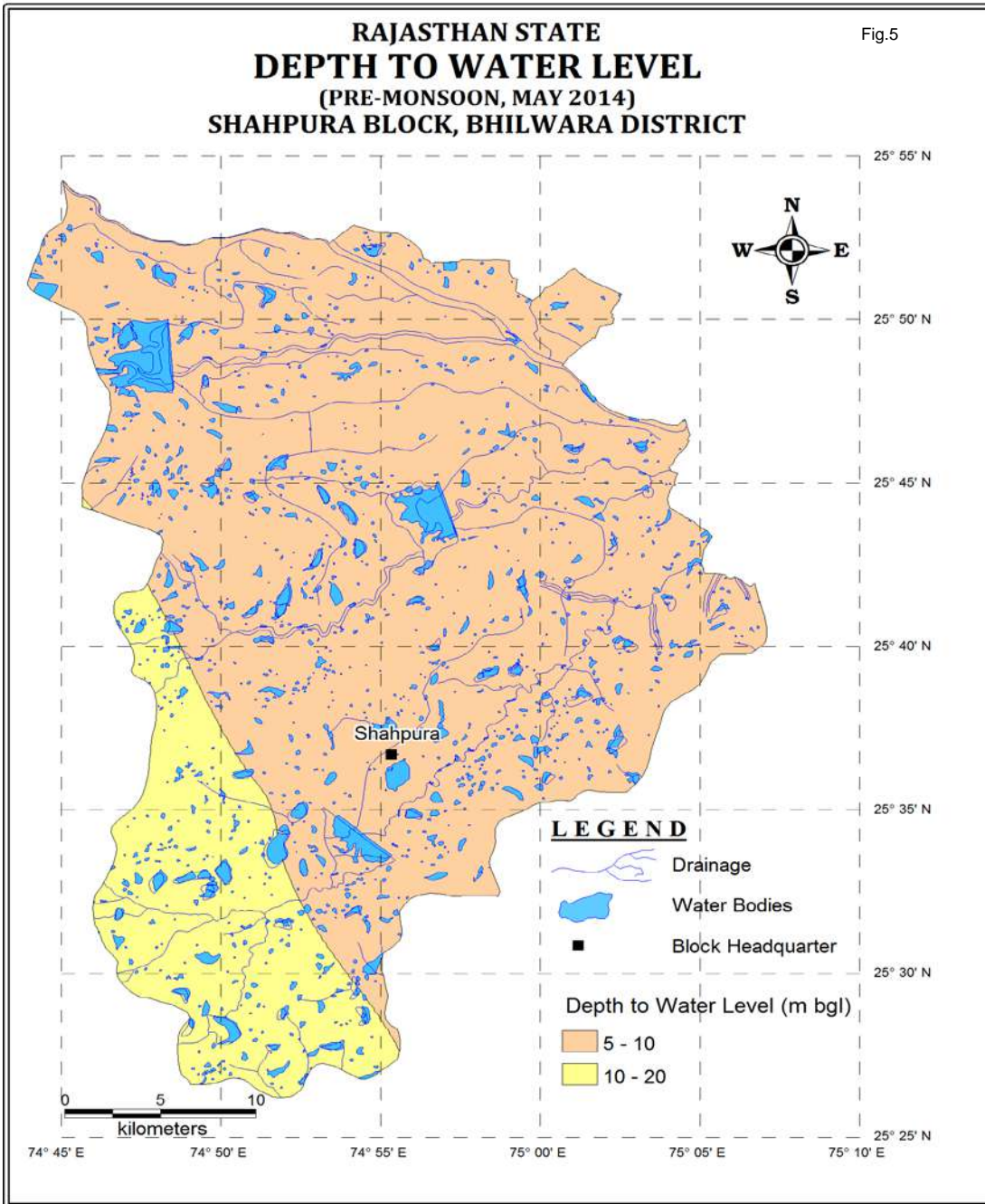


Fig: 6

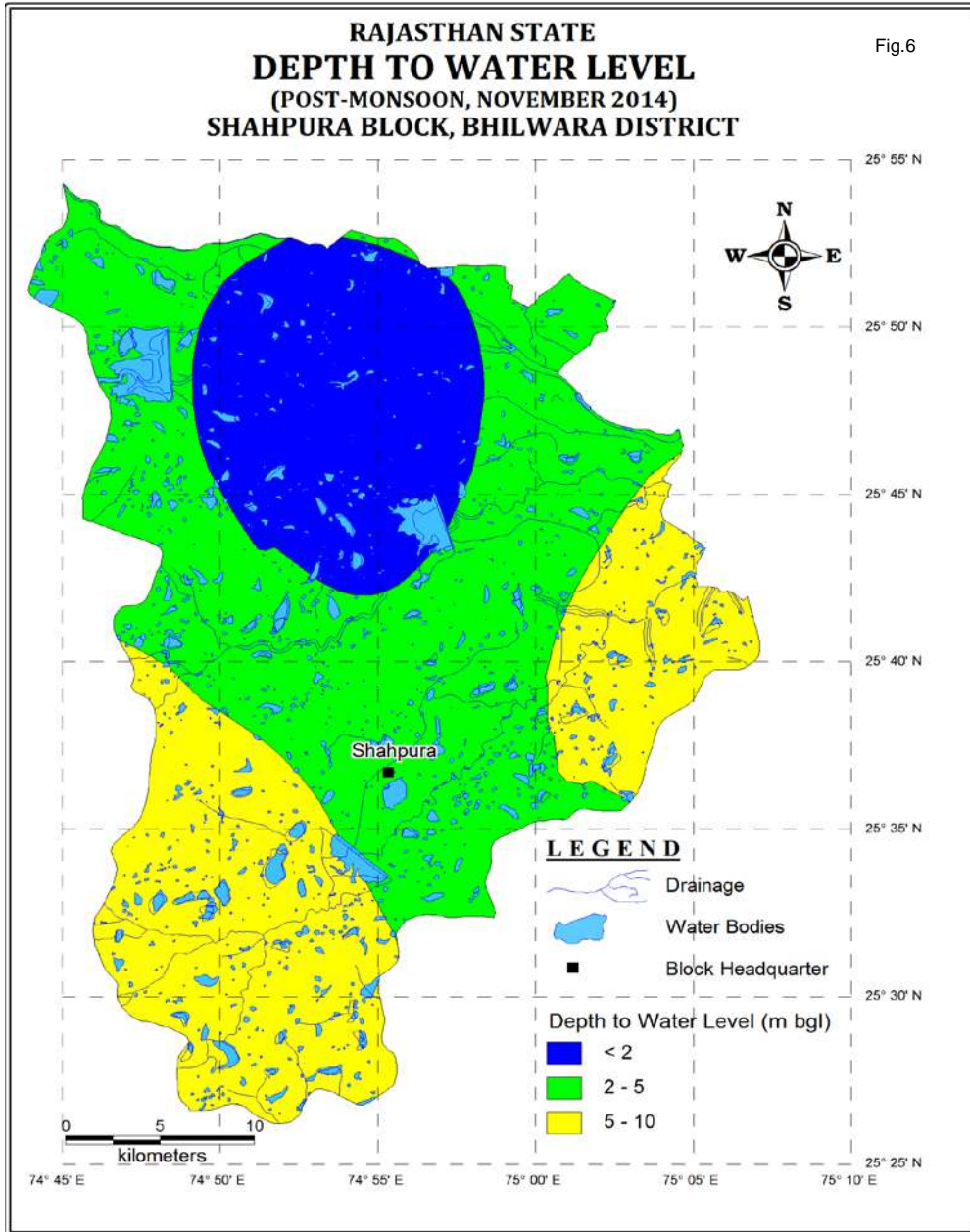
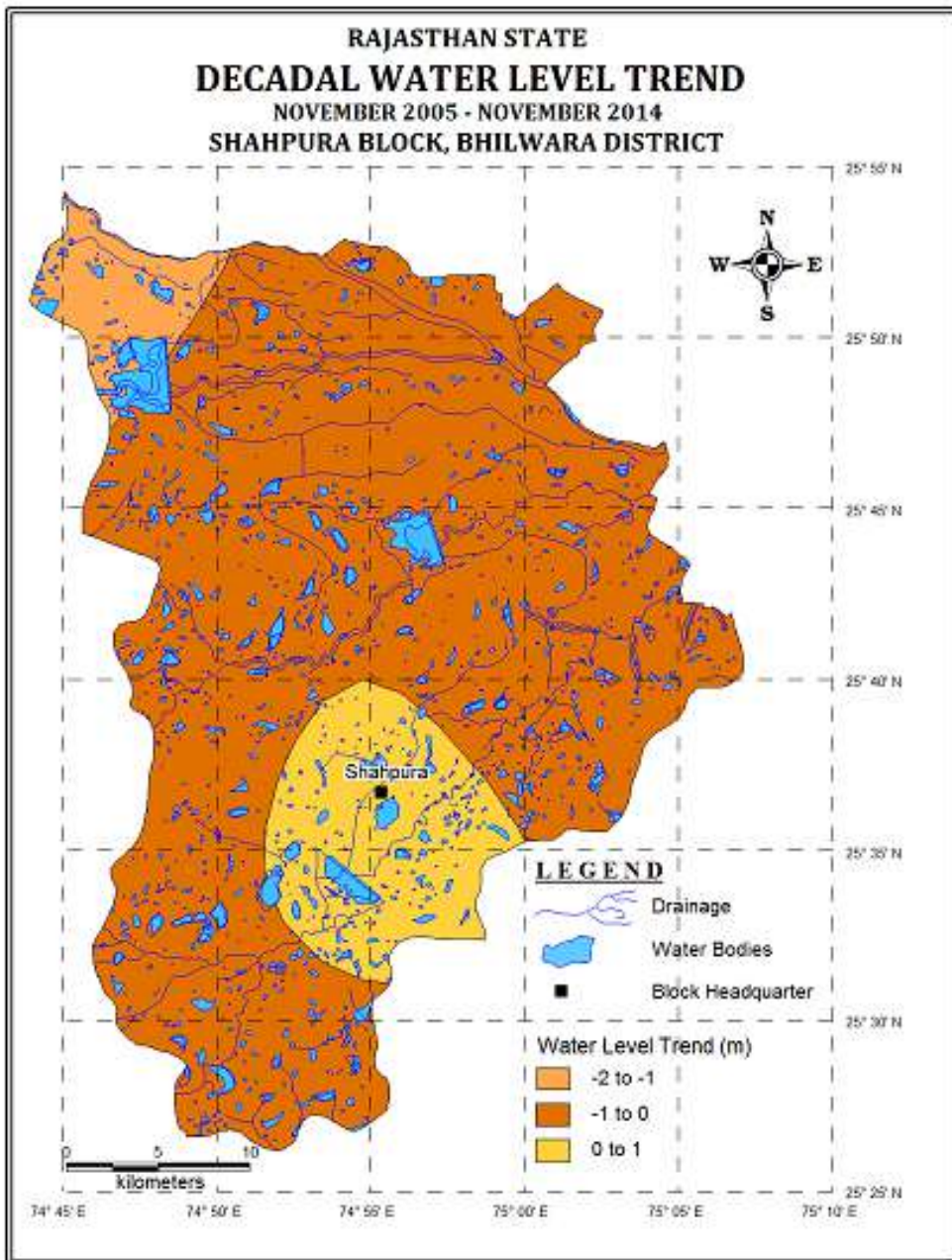


Fig: 7



Subsurface Hydrogeology

As inferred from borehole data of the Shahpura 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 13 to 26.2 mbgl and the average discharge ranges from 4.17 to 31.2 lps. Transmissivity value varies between 499 to 3108 m²/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 5602.30ham and Annual Ground water draft is 6691.88ham. Stage of Ground water development has reached 119.45%.

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

Natural Discharge During Non Monsoon Period	544.21 ham
Net Annual Ground Water Availability	5602.30 ham
Annual Ground Water Draft	6691.88 ham
Net Ground water Availability for Future Irrigation Use	0 ham
Stage of Ground Water Development	119.45%
<i>Source: Ground Water Resource Assessment 31.03.2011</i>	

Need for artificial recharge and water conservation plan

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

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

Surface water availability

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

Accordingly about 0.7586 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	SHAHPURA	RJ0709	1159.300	1125.130	hard rock	1125.13

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

Sp Yield	Average DTW (mbgl) NOV 2013	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)
6.060	3.060	51.643	Banas	0.7586	0.7586	25

Feasible Artificial Recharge and water conservation structures

A wide spectrum of techniques is in vogue, which are being implemented to recharge the ground water reservoir, conserve the utilizable rainfall and enhance the water use efficiency. Based on prevailing field conditions, out of total block area of 1159.30 sq km practically 1125.13 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

Shahpura block is having ground water level between 5 & 10m below ground level and as per dynamic ground water resource estimation, the block is over exploited with stage of ground water development at 119.45%. The Shahpura block is feasible for recharge

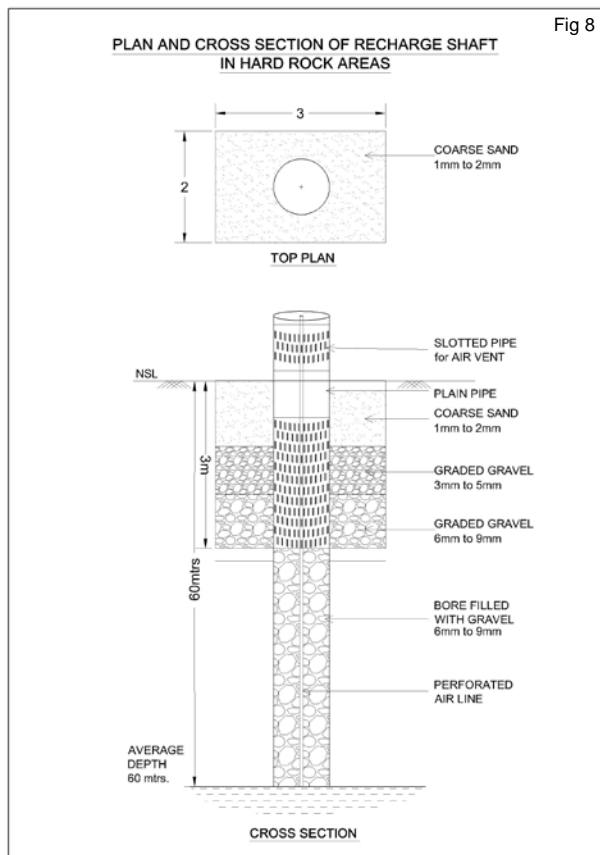
due to presence of permeable zone above water table, favorable land slope and availability of water from rainfall.

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 Shahpura block. In view of the availability of number of ponds in the block, percolation tanks are also not found feasible.

Details of Ground Water Recharge Measures

Existing Village Pond with recharge shaft/wells

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



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

The model design of recharge well has been worked out in consultation with Ground Water Department, Government of Rajasthan and presented in Fig 8. The major features required are:

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

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.

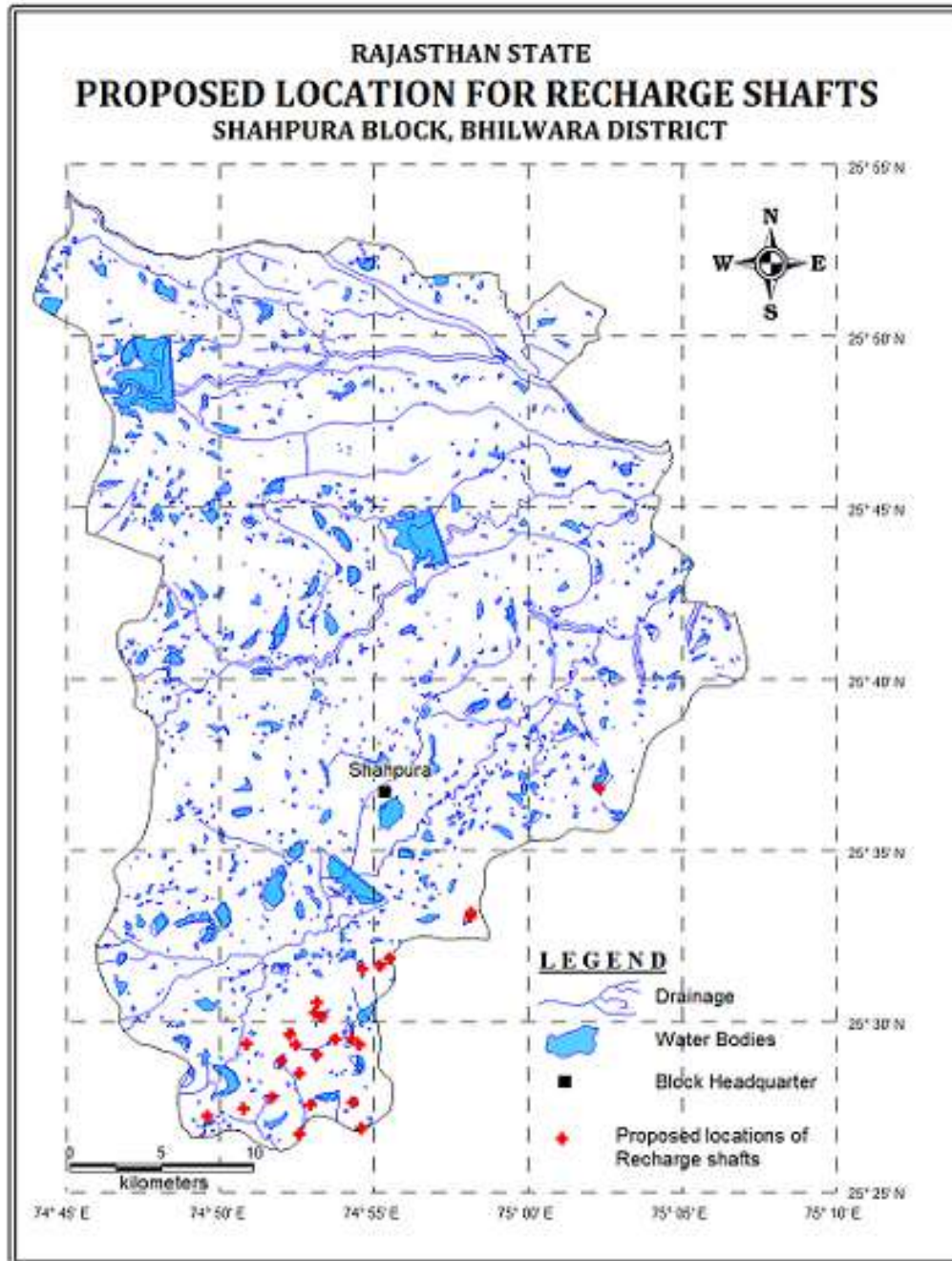
The tentative location of villages for construction of recharge shaft/well in existing village pond and their cost estimates are shown in Fig 9 and Table 3. The plan proposes construction of 25 recharges shafts/ wells in 25 identified existing village ponds at an estimated cost of 65 lacs.

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	Lulas	74.848	25.489	8.138	Hard_rock	1	2.6	2.6
2	Lulas	74.871	25.494	9.153	Hard_rock	1	2.6	2.6
3	Lulas	74.874	25.488	5.150	Hard_rock	1	2.6	2.6
4	Narsingh Pura	74.886	25.484	16.476	Hard_rock	1	2.6	2.6
5	Rampura Naya	74.866	25.481	19.527	Hard_rock	1	2.6	2.6
6	Palsa	74.876	25.475	5.948	Hard_rock	1	2.6	2.6
7	Salariya Khurd	74.882	25.459	11.826	Hard_rock	1	2.6	2.6
8	Bhojpur	74.876	25.445	11.878	Hard_rock	1	2.6	2.6
9	Bhojpur	74.861	25.463	15.533	Hard_rock	1	2.6	2.6
10	Bhojpur	74.846	25.457	9.956	Hard_rock	1	2.6	2.6
11	Kheri Khurd	74.905	25.460	10.421	Hard_rock	1	2.6	2.6
12	Girdiya	74.908	25.488	4.924	Hard_rock	1	2.6	2.6
13	Girdiya	74.904	25.491	10.079	Hard_rock	1	2.6	2.6
14	Girdiya	74.896	25.491	5.676	Hard_rock	1	2.6	2.6
15	Chalaniya	74.886	25.509	7.230	Hard_rock	1	2.6	2.6
16	Girdiya	74.885	25.504	8.174	Hard_rock	1	2.6	2.6
17	Girdiya	74.888	25.502	10.925	Hard_rock	1	2.6	2.6
18	Mindoliya	74.910	25.526	9.435	Hard_rock	1	2.6	2.6
19	Mindoliya	74.920	25.527	11.791	Hard_rock	1	2.6	2.6
20	Mindoliya	74.925	25.531	7.558	Hard_rock	1	2.6	2.6
21	Arniya Rasan	74.969	25.553	4.986	Hard_rock	1	2.6	2.6
22	Arniya Rasan	74.968	25.551	5.436	Hard_rock	1	2.6	2.6
23	Amlia Kalan	75.039	25.613	13.771	Hard_rock	1	2.6	2.6
24	Kheri Khurd	74.910	25.448	15.607	Hard_rock	1	2.6	2.6

25	Mundeta	74.827	25.454	6.117	Hard_rock	1	2.6	2.6
				Total		25		65

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

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

Financial Outlay of the Plan

The total estimated cost of the Plan is 0.7455 cr, which includes Rs 0.65 cr for ground water recharge activities, Rs 0.06 cr for ground water monitoring (Piezometer construction) and Rs 0.0355 cr towards operation and maintenance charges. The tentative cost estimates of the various activities of the Plan are shown in Table 4 & 5. The unit rates are as followed by the Govt. of Rajasthan (BSR). The total estimated cost of the project is **Rs 0.7455 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 – 0.65

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	25	0.7586	2.6	65	0.531
Impact assessment & Monitoring						
Piezometer	Up to 80 m bgl	10		0.6	6	
<i>Impact assessment will be carried out by implementing agency</i>						
O & M - 5% of total cost of the scheme					3.55	
TOTAL					74.55	
<i>Note: Type, number and cost of structure may vary according to site after ground verification</i>						

Time Schedule

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

Table 6: Time Schedule

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

Expected Benefits or outcome of the Plan

Ground water recharge and water conservation Plan of Shahpura block, Bhilwara envisages gainful utilization of 0.531 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 118.37% from the existing 119.45%. The projected status of ground water resources and utilization scenario is presented in table 7.

Net G.W. Availability (mcm)	Additional Recharge from RWH & conservation (mcm)	Total Net G.W. Availability after intervention (Ham)	Existing G.W Draft for all purpose (ham)	Saving of Ground water through projects (ham)	Net GW draft after interventions (ham)	Present stage of G.W. development (%)	Projected stage of G.W. Dev. (in %)
56.023	0.531	56.554	66.9189	-	66.9189	119.45	118.37

- 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.