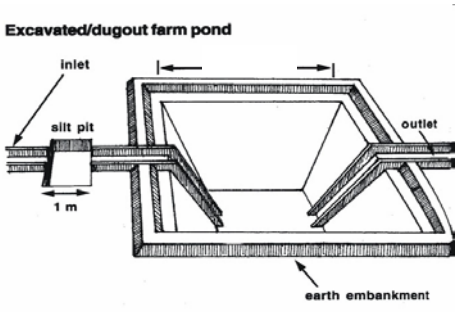
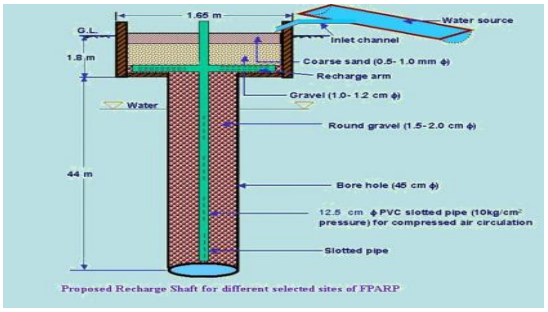
CENTRAL GROUND WATER BOARD

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





ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN OF OSIAN BLOCK, DISTRICT JODHPUR, RAJASTHAN

Western Region, Jaipur
April 2016

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN BLOCK OSIAN, DISTRICT JODHPUR

Plan at a Glance

1.	**Area of the Osian Block**	**2861.07 Sq.Km.**
2.	**Area identified for Artificial Recharge**	**2861.07 Sq.Km.**
3.	**Dynamic Ground Water Resources (as on 31.03.2011)**	
	Net Ground Water Availability	**53.14 MCM**
	Annual Ground Water Draft	**199.19 MCM**
	Stage of Ground Water Development	**374.87 %**
4.	**Volume of water to be harnessed** **Volume of water available for recharge** **Volume of water available for conservation by other interventions**	**0.6180 MCM** **0.54 MCM** **0.078**
5.	**Volume of unsaturated aquifer zone available for recharge**	**8239.882 MCM**
6.	**Total number of structures to be proposed**	
	Recharge structures **Existing village pond with recharge shaft/ well** **Percolation tank** **Water Conservation** **Farm pond**	**Numbers** **18 shafts in 17 Nos. of existing village ponds** **-** **2 Nos.**
	Expected Annual GW recharge	**0.378 MCM**
	Provision for supplemental irrigation, thus reducing GW withdrawal for irrigation	**0.055 MCM**
	Total recharge/ saving of ground water	**0.433 MCM**
7.	**Estimated Cost** Artificial Recharge Plan Water conservation measures Piezometer construction Operation and maintenance	**0.8085 crore** 0.468 crore 0.2 crore 0.102 crore 0.0385 crore

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN BLOCK OSIAN, DISTRICT JODHPUR

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 **Osian Block, district Jodhpur** 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 **374.87%.** 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.

1.1 Location of the block

The Osian Block covering an area of 2861.07 Sq. Km. falls in central part of Jodhpur District and is located between North latitudes 26°25' & 27°07' and East longitudes 72°31' & 73°12'. As per 2011 census, the total rural population of the Block is 376890 persons consisting of 196199 males & 180691 females. Location map is shown in fig 1.

1.2 Source wise Irrigated Area

Out of total area of 2861.07 Sq.Km., an area of 602.93 (21.07%) falls under irrigation. The dug wells/ Tubewells are the only major source of irrigation in Osian Block. There is no area that falls under canal & pond irrigation. The wells irrigate total 602.93 Sq.Km. areas in this Block.

Fig: 1

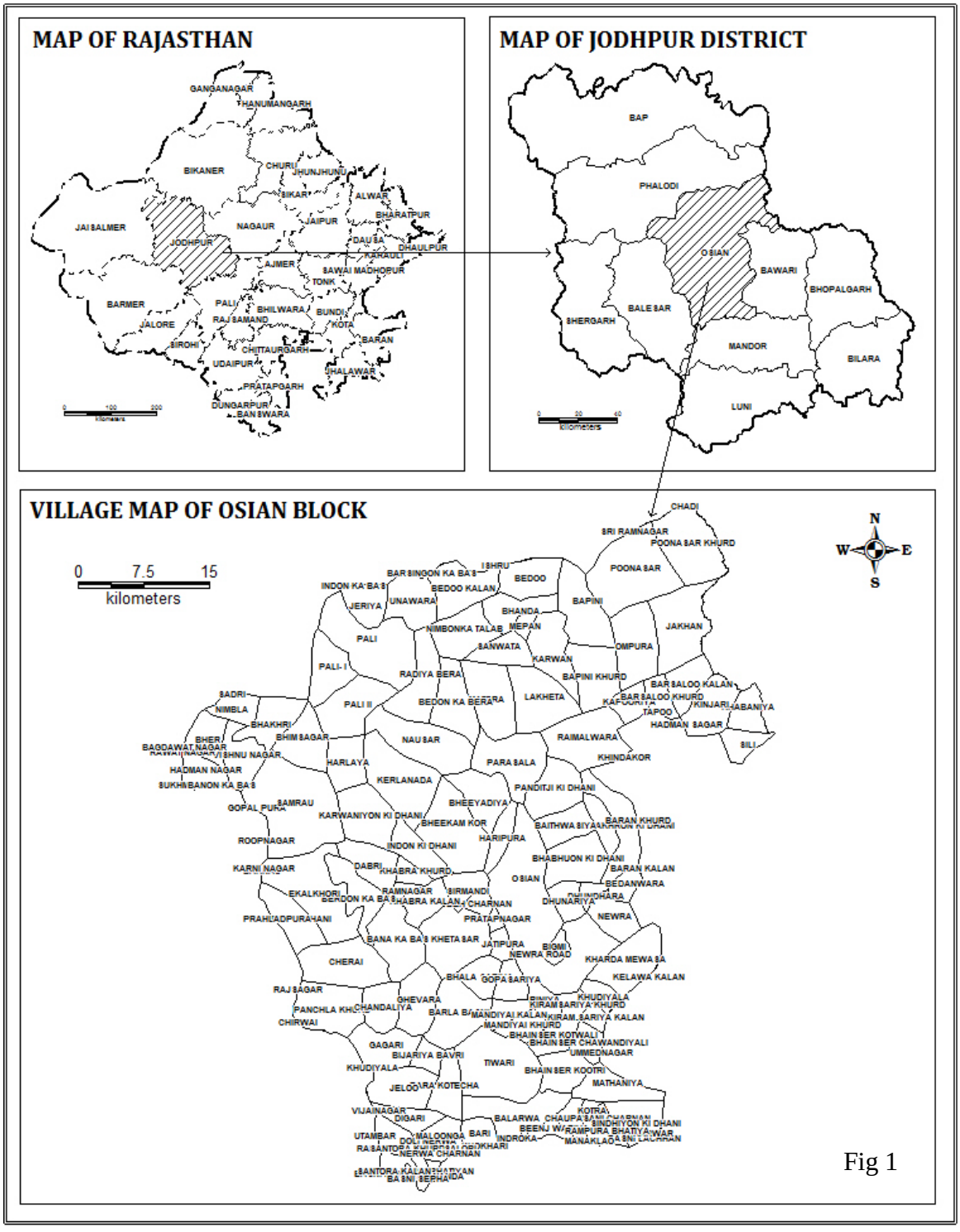

MAP OF RAJASTHAN
GANGANAGAR
HANUMANGARH
BIKANER
CHURU
JHUNJHUNU
SIKAR
ALWAR
BHARATPUR
JAISALMER
NAGAUR
JAIPUR
DAUSA
DHAULPUR
JODHPUR
KARAULI
AJMER
SAWAI MADHOPUR
TONK
BARMER
PALI
BHILWARA
BUNDI
JALORE
RAJSAMAND
KOTA
SIROHI
CHITTAURGARH
BARAN
UDAIPUR
JHALAWAR
PRATAPGARH
DUNGARPUR
BANSWARA
MAP OF JODHPUR DISTRICT
BAP
PHALODI
OSIAN
BAWARI
BHOPALGARH
BALESAR
SHERGARH
MANDOR
BILARA
LUNI
kilometers
VILLAGE MAP OF OSIAN BLOCK
0 7.5 15
kilometers
N
W
E
S
CHADI
SRI RAMNAGAR
POONASAR KHURD
POONASAR
ISHRU
BARSINDON KA BAS
BEDOO
INDON KA BAS
BEDOO KALAN
JERIYA
UNAWARA
BAPINI
BHANDA
NIMBONKA TALAB
MEPAN
JAKHAN
PALI
SANWATA
OMPURA
KARWAN
PALI-I
RADIYA BERA
BAPINI KHURD
BAR SALOO KALAN
SADRI
PALI II
BEDON KA BERA
LAKHETA
BAR SALOO KHURD
KINJARI
NIMBLA
TAPOO
BHAKHRI
HADMAN SAGAR
BHER
BHIM SAGAR
NAU SAR
RAIMALWARA
BAGDAWAT NAGAR
SILI
VISHNU NAGAR
HARLAYA
PARA SALA
KHINDAKOR
HADMAN NAGAR
SUKHIBANON KA BAS
KERLANADA
PANDITJI KI DHANI
SAMRAU
GOPAL PURA
BHEEYADIYA
KARWANIYON KI DHANI
BHEEKAM KOR
BARAN KHURD
ROOPNAGAR
HARIPURA
INDON KI DHANI
BHABHUON KI DHANI
KARNI NAGAR
DABRI
KHABRA KHURD
BARAN KALAN
OSIAN
BEDANWARA
EKALKHORI
RAMNAGAR
SIRMANDI
DHUNARIYA
BERDON KA BAS
KHABRA KALAN
CHARNAN
PRAHLADPURA HANI
PRATAPNAGAR
NEWRA
BANA KA BAS
KHETA SAR
JATIPURA
BIOMI
NEWRA ROAD
KHARDA MEWA SA
CHERAI
BHALA
GOPA SARIYA
KELAWA KALAN
RAJ SAGAR
GHEVARA
KHUDIYALA
KIRAM SARIYA KHURD
PANCHLA KHI
CHANDALIYA
BARLA BA
MANDIYAI KALAN
KIRAM SARIYA KALAN
CHIRWAI
MANDIYAI KHURD
BHAIN SER KOTWALI
BHAIN SER CHAWANDIYALI
GAGARI
UMMEDNAGAR
BIJARIYA BAVRI
TIWARI
KHUDIYALA
BHAIN SER KOOTRI
JELOORA KOTECHA
MATHANIYA
VIJAINAGAR
KOTRA
DIGARI
BALARWA
CHAUPA
SINDHIYON KI DHANI
BEENJ WA
RAMPURA BHATIYA WAR
UTAMBAR
MALOONGA
BARI
INDROKA
MANAKLAO
RASANTORA KHURD
NERWA CHARNAN
SANTORA KALAN
BHATIYAN BA
BERHADA

Fig 1

1.3 Physiography & Drainage

Physiographically (Fig 2), the block is characterized by presence of sandy plains of aeolian origin, dune valley complexes, eolian plains. The minimum and maximum elevation of Block is 229.6 m. amsl and 387.6 m. amsl, respectively.

There is no perennial and seasonal river flowing in this Block. The block does not fall under any river basin. The map showing drainage and water bodies in the Osian block is shown in fig 3.

Fig: 2

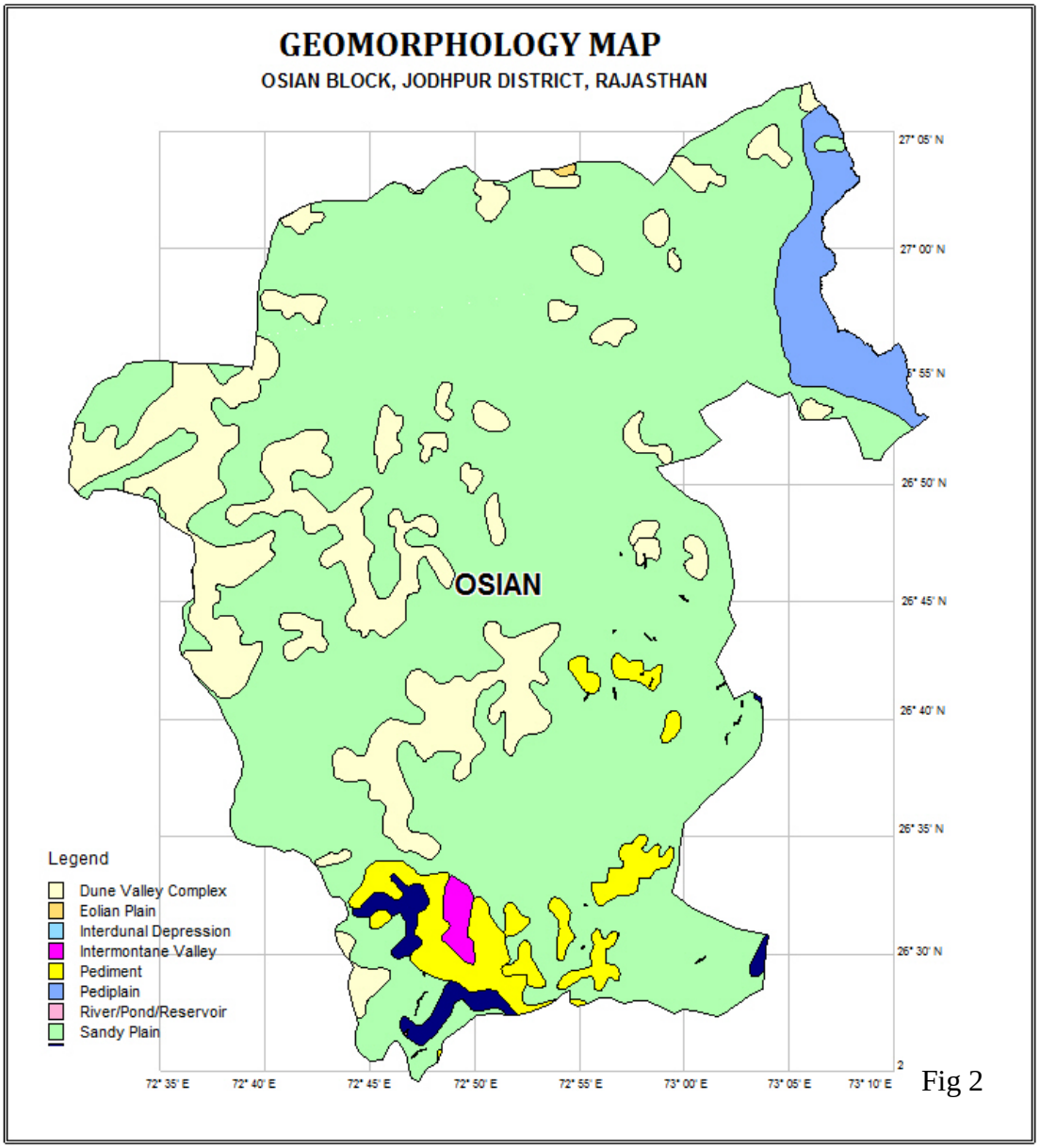


Fig 2

Fig: 3

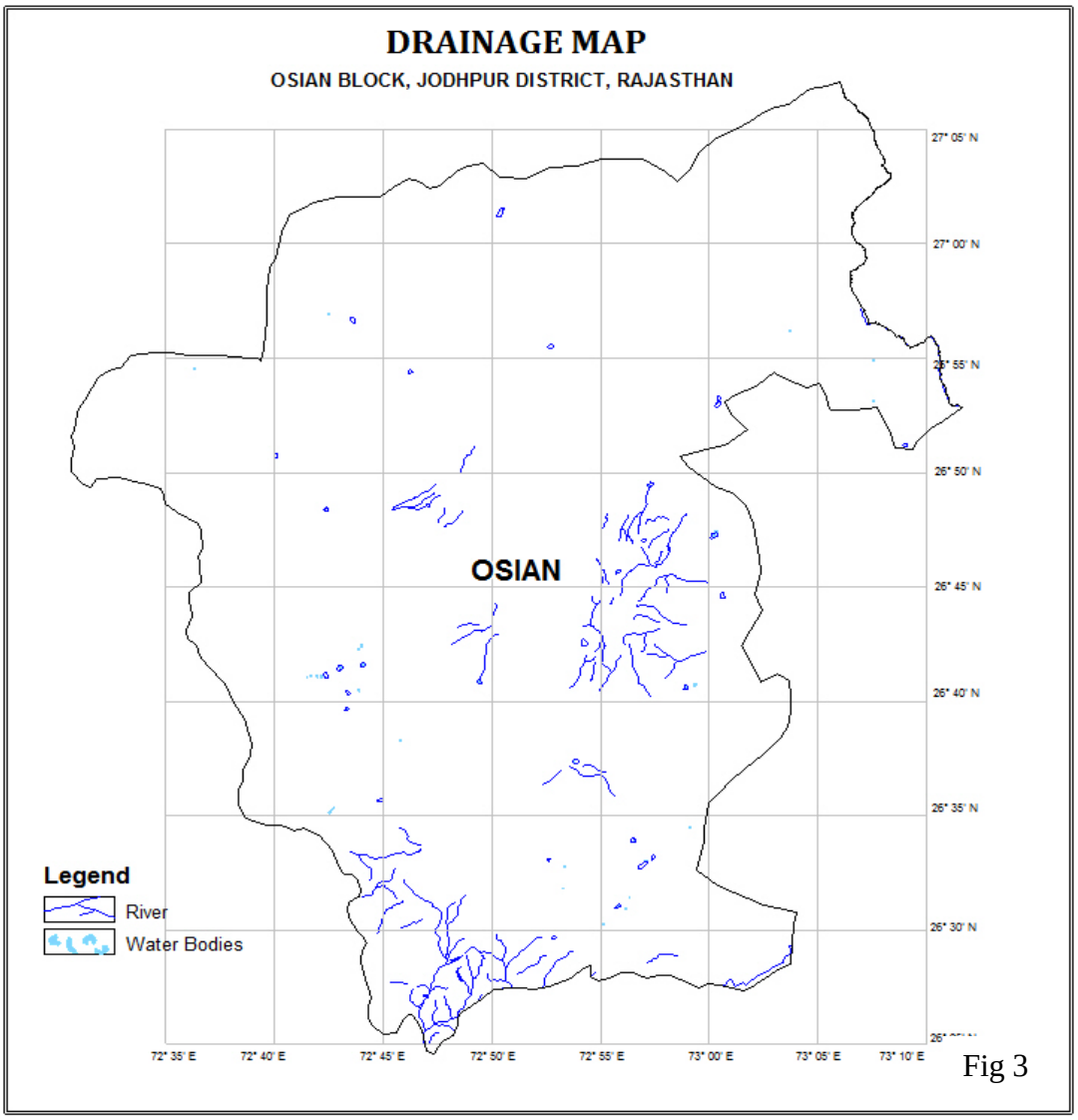


Fig 3

1.4 Rainfall

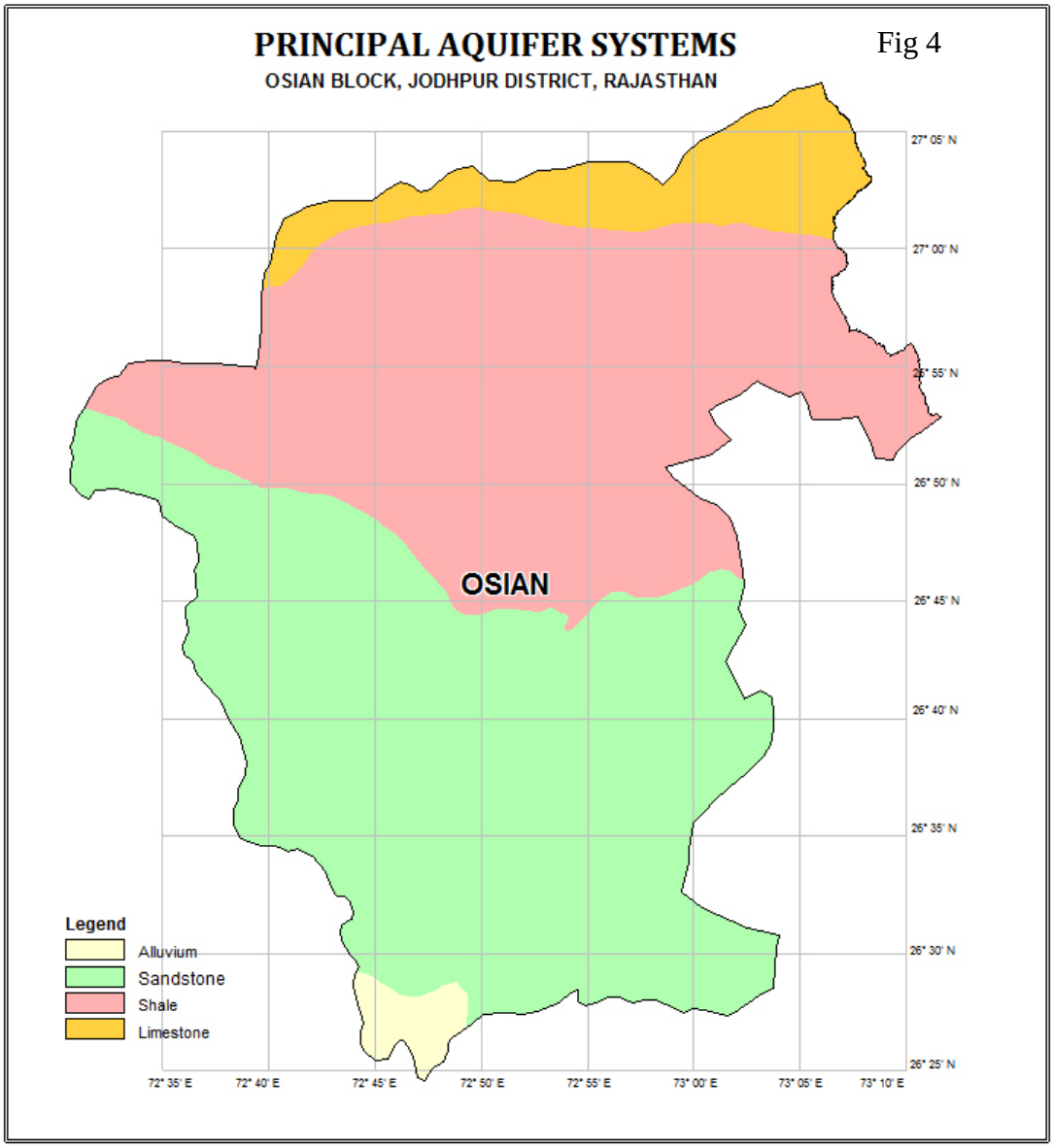
The climate of the block is semi arid. The Normal annual rainfall of block is 263.76mm. Failure of rains has observed several times. The available data of rainfall indicates that

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.

1.5 Hydrogeology of the Area

Nagaur & Jodhpur Sandstone and Bilara Limestone are the major aquifers in the block. The entire area of block forms aquifer system (potential zone). Sandstones are generally hard and compact layered rocks with intermittent shale and clay layers. Softer and friable sandstone layers and patches do occur in these formations making it a good yielding aquifer tapped by open wells and bore wells. Sandstone is fine to medium grained, sometimes coarse to gritty and friable. In such formations, friable and soft nature often leads to formation of small cavities in saturated zones. This makes it a very good aquifer forming chief source of ground water in the area. A large number of light to medium duty bore wells have been constructed in such areas for irrigation and water supply purposes. Ground water in sandstone occurs under unconfined to semi-confined conditions. Bilara limestone is the most potential aquifer in the block. Siliceous and cherty limestone and dolomites with association of shale beds are quite common. Thickness of limestone varies from a few meters to more than 100 m. The yield of wells in both the areas varies largely because of considerable variation in limestone characters. Granites and Rhyolites form poor aquifers. Ground water occurs under unconfined conditions in secondary spaces in weathered and fractured zones. The fractures tend to die out with depth. In general yield of the wells tapping sandstone ranges from 0.35 to 2.08 and yield of Bilara Limestone ranges from 3.33 to 75.36 lps. The map showing aquifer system in the Osian block is shown in **Fig. 4**

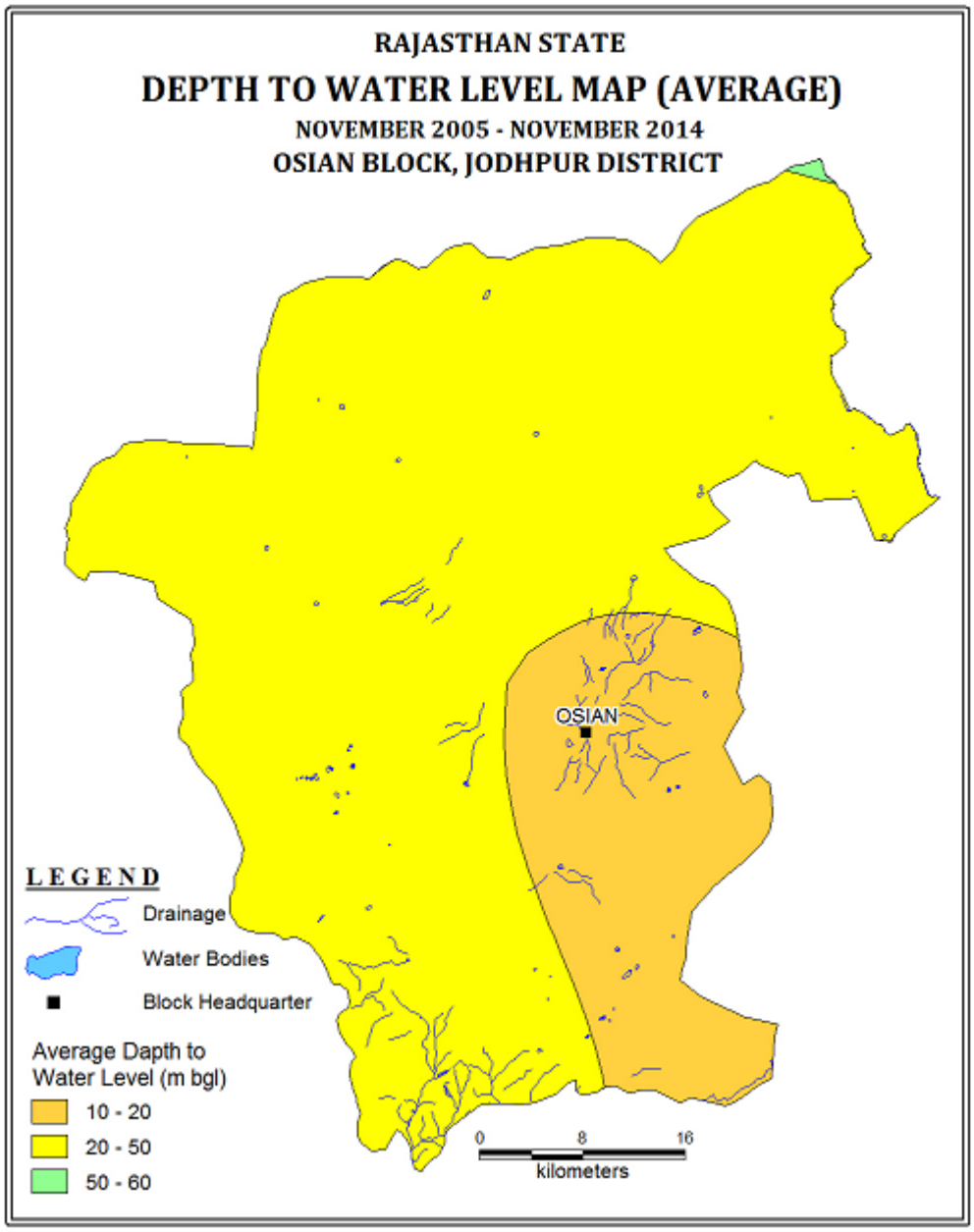
Fig: 4



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 with part in south-east showing range of 10 – 20 m bgl water level. **(Fig 5)**

Fig: 5



The average decadal depth to water level is 25.99 m bgl for Pre monsoon & 37.34 m bgl for Post monsoon. The average decadal depth to water level is 25.99 m bgl for Pre monsoon & 37.34 m bgl for Post monsoon. According to depth to water level map of May 2014, water level becomes ranges from 10-20 to 20- 40 and > 40 m bgl range from south to north. In some isolated pockets, it ranges between 5 to 10 mbgl. According to

depth to water level map of November 2014, water level is ranging between 20 to 40 m. bgl and more than 40 m. bgl in major part except some central & southern parts where it ranges between 10 to 20 m. bgl. Depth to water level maps for May 2014 & November 2014 is shown in **fig 6 & 7**.

Fig: 6

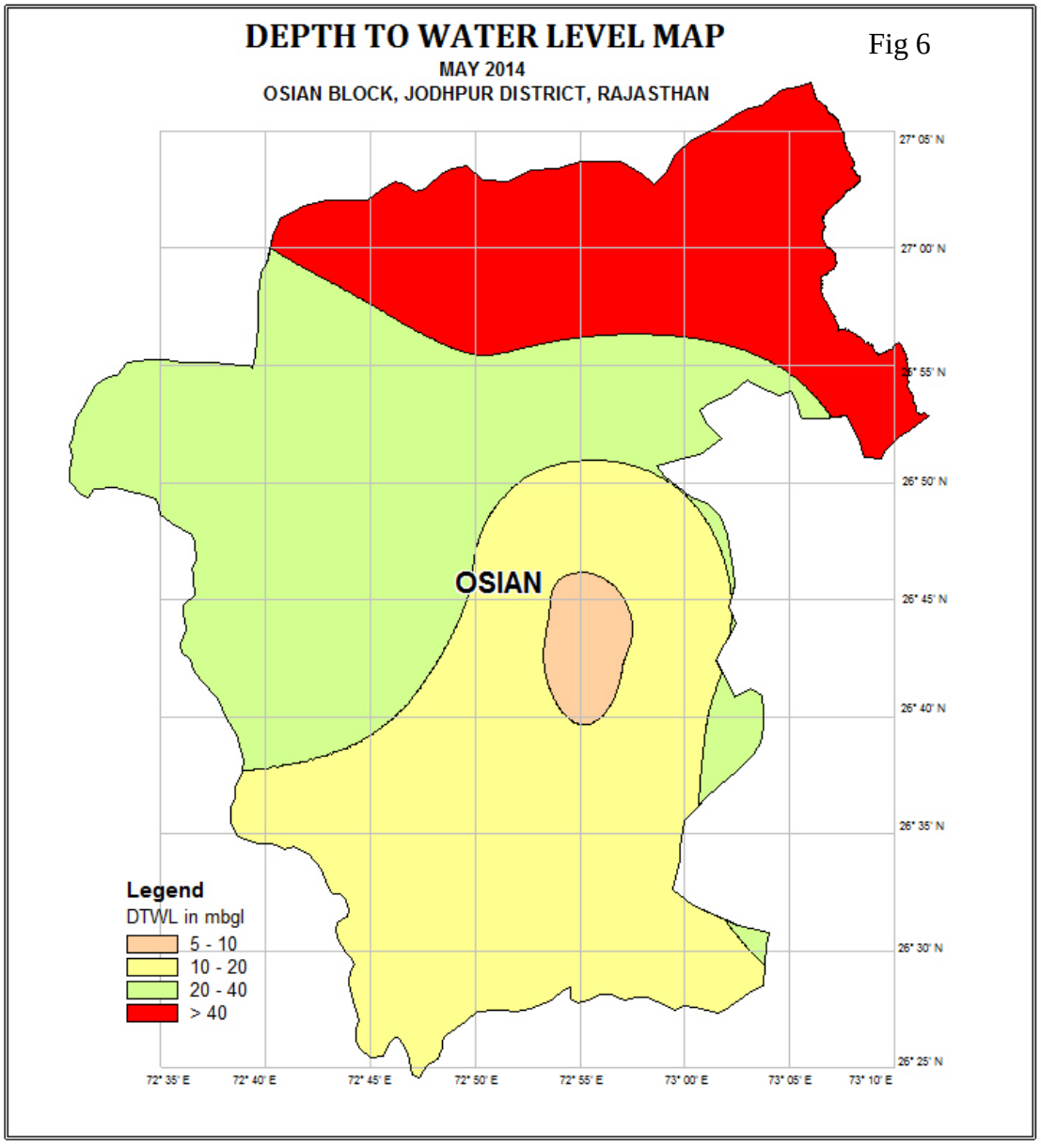
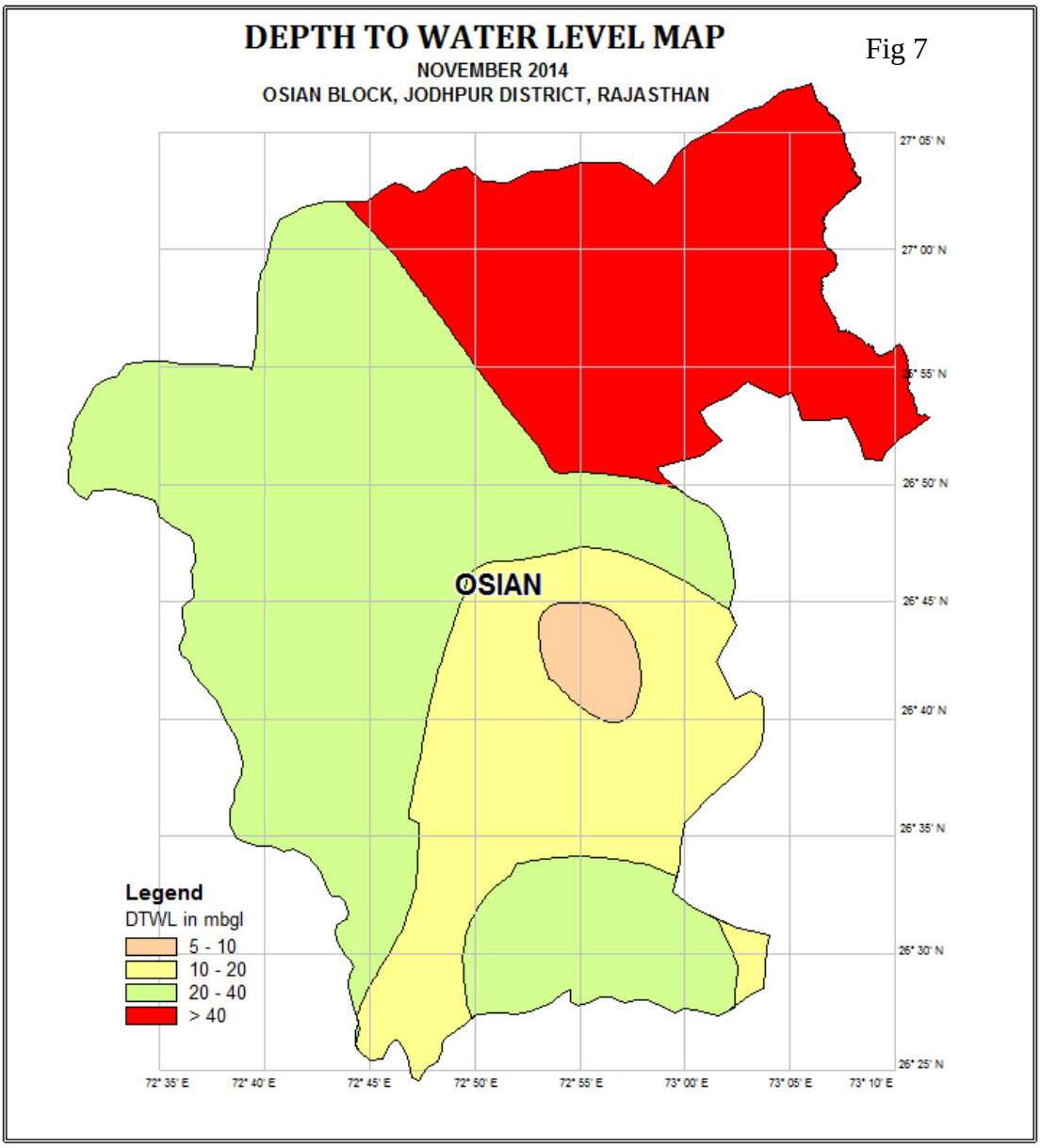


Fig: 7

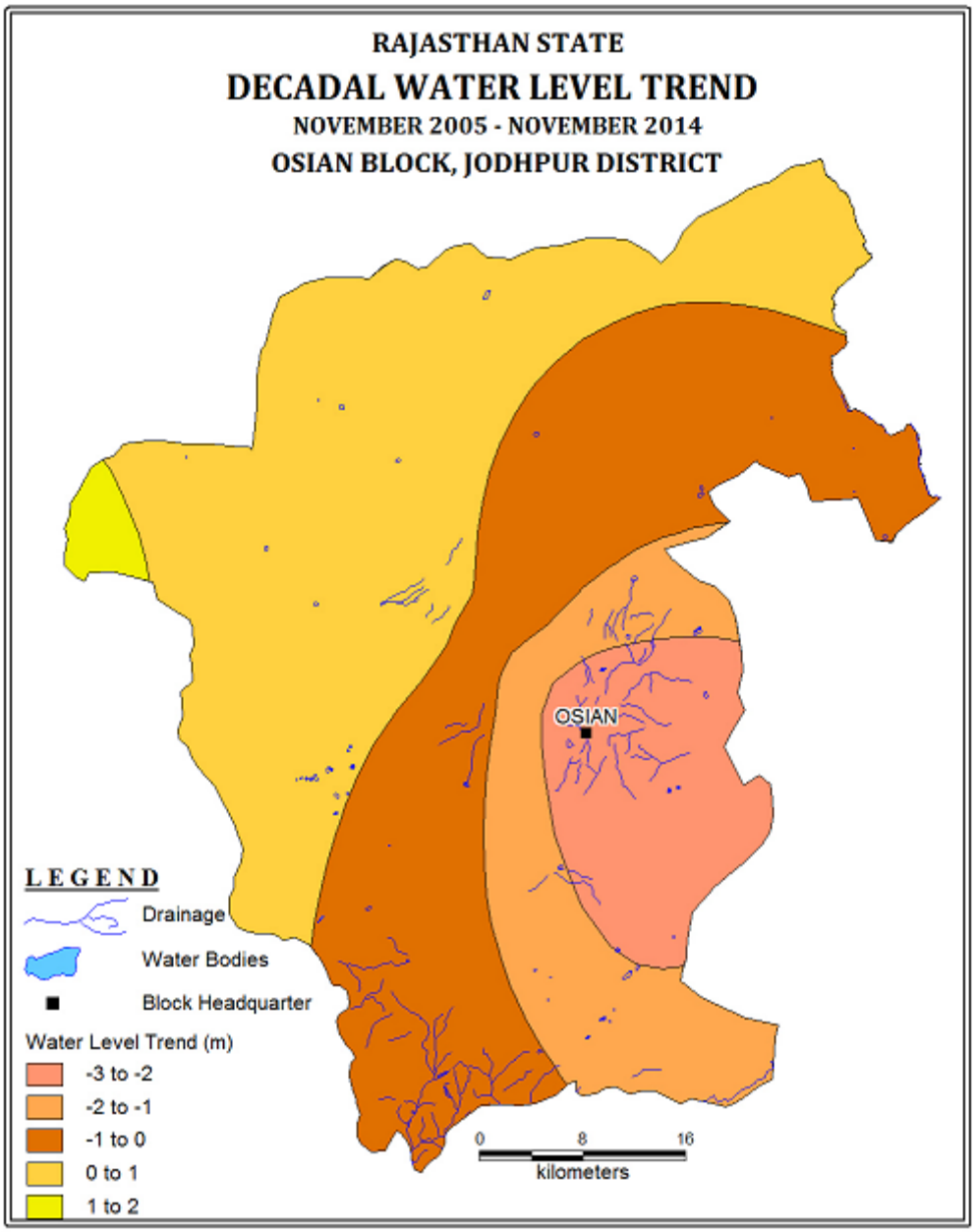


Water Level Trend:

All the hydrographs are showing declining water level trends over last 10 years. Water level trend shows average decline of 0.40 m/year during pre monsoon and 0.49 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 -3 to -2, -2 to -1, -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. 8**

Fig: 8



1.6 Subsurface Hydrogeology

As inferred from borehole data of the Osian Block; Sandstone & Limestone are the principal aquifers in the block. The depth of drilling ranges from 80.1 to 225.0 mbgl and the average discharge ranges from 0.87 to 5.83 lps. The quality of water has 2 major problems, i.e., Salinity & Fluoride.

1.7 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 5313.62 ham and Annual Ground water draft is 19919.25 ham. Due to this excessive draft over recharge, stage of Ground water development has reached 374.87%.

Table 1: Ground Water Availability, Utilization and Stage of Development Block Osian, District Jodhpur

Natural Discharge During Non Monsoon Period	590.40 ham
Net Ground Water Availability	5313.62 ham
Annual Ground Water Draft	19919.25 ham
Net Ground water Availability for Future Irrigation Use	0 ham
Stage of Ground Water Development	374.87%
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 0.6180 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
JODHPUR	RJ22	**OSIAN**	RJ2207	2861.07	2861.07	hard rock	2861.07	0.040

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 Farm Pond (FP)	No. of FP (0.05 MCM/ FP)
75	72	8239.882	Luni	0.6180	0.54	18	0.078	2

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, entire block area of 2861.07 sq km 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

Osian block is having ground water level about 40m below ground level and as per dynamic ground water resource estimation, the block is over exploited with stage of ground water development at 374.87 %. The Osian 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 as the most suitable structures in Osian block.

Details of Ground Water Recharge Measures

1. Existing Village Pond with recharge shaft/wells

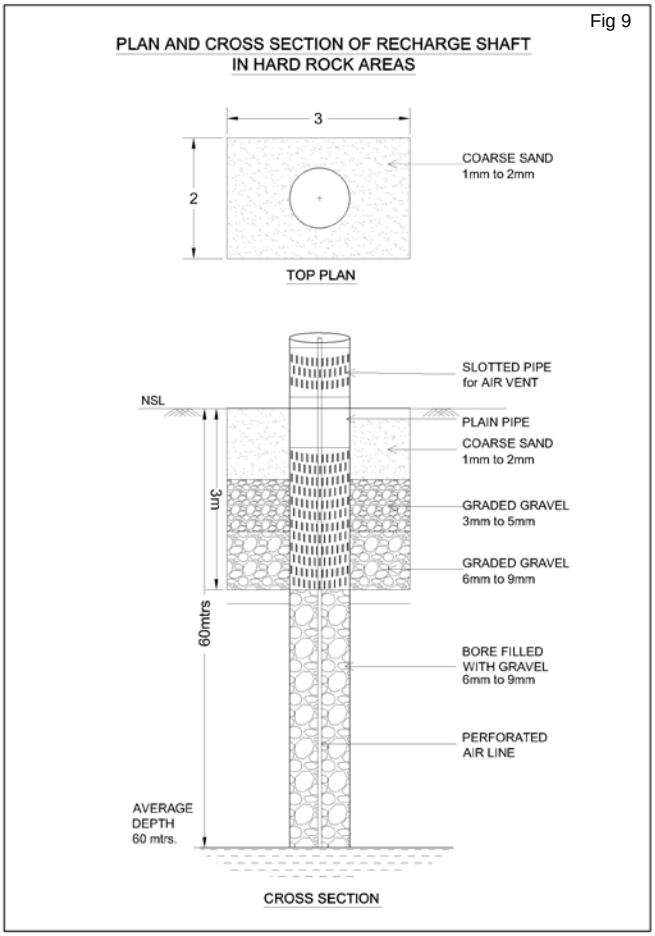
Almost all the villages in the State of Rajasthan have one or two village ponds & other ponds. With time, these ponds get silted & hardly any water percolates downward. Also, any excess water coming into the pond goes away as a run off due to limited storage capacity. This surplus runoff can very well 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 9. 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.

Fig 9



Criteria for number of shafts

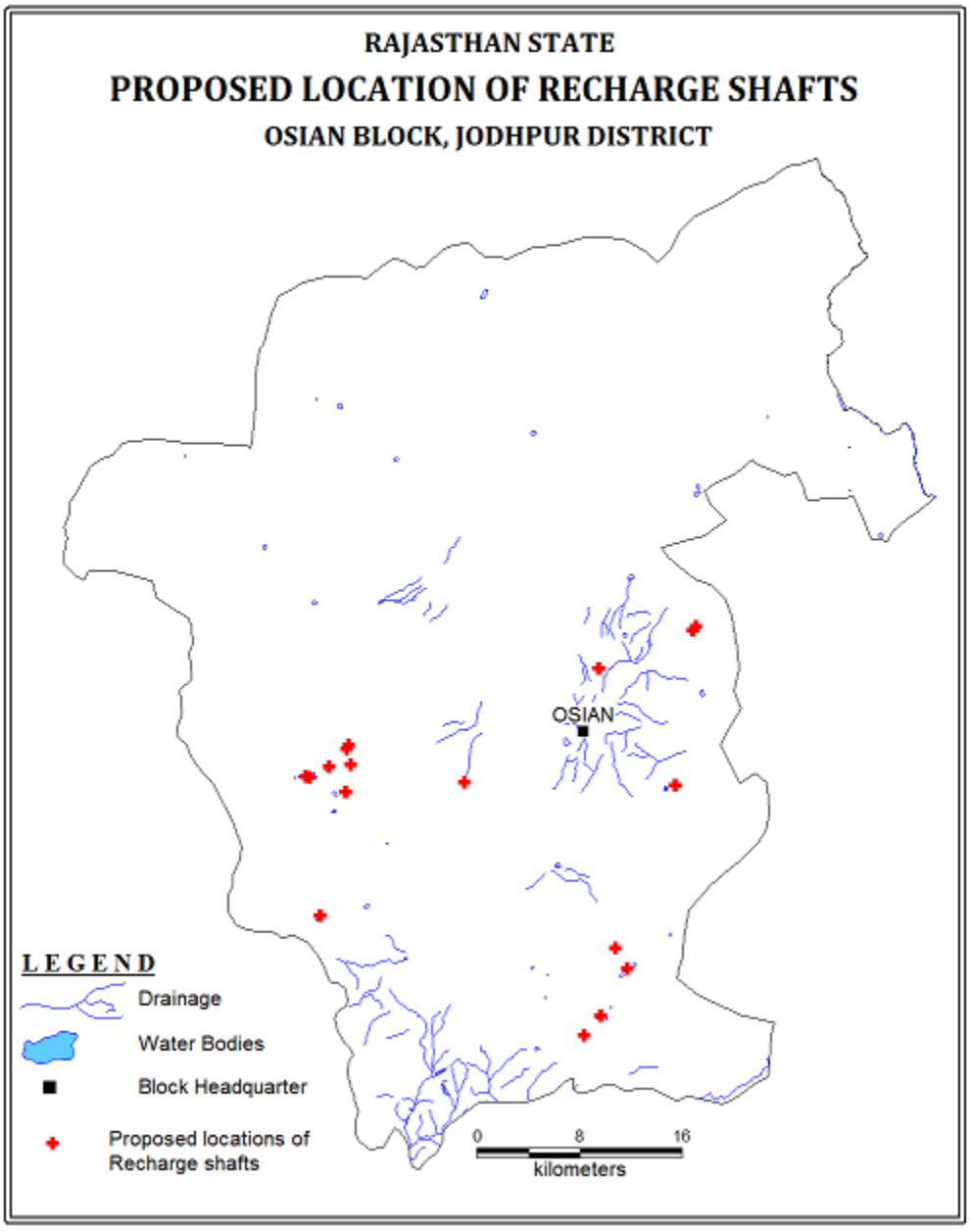
Village ponds having area <1 ha and > 25 ha has not been considered for construction of recharge shafts, one recharge shaft is proposed for pond area between 1 to 5 ha; 2 for 5 to 7.5 ha, 3 for 7.5 to 10 and 4 shafts for >10 ha.

The tentative location of villages for construction of recharge shaft/well in existing village pond and their cost estimates are shown in Fig 10 and Table 3. The plan proposes construction of 18 recharges shafts/ wells in 17 identified existing village ponds at an estimated cost of 46.8 lacs.

Table 3: Tentative locations 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	Thob	73.003	26.788	1.492	1	Hard rock	2.6	2.6
2	Thob	73.006	26.790	3.129	1	Hard rock	2.6	2.6
3	Osian	72.929	26.761	1.856	1	Hard rock	2.6	2.6
4	Berdon Ka Bas	72.733	26.707	1.985	1	Hard rock	2.6	2.6
5	Berdon Ka Bas	72.732	26.704	1.743	1	Hard rock	2.6	2.6
6	Bana Ka Bas	72.735	26.694	2.447	1	Hard rock	2.6	2.6
7	Bana Ka Bas	72.731	26.675	1.538	1	Hard rock	2.6	2.6
8	Ekalkhori	72.699	26.685	2.197	1	Hard rock	2.6	2.6
9	Ekalkhori	72.703	26.685	3.056	1	Hard rock	2.6	2.6
10	Ekalkhori	72.718	26.692	2.806	1	Hard rock	2.6	2.6
11	Panchla Khurd	72.711	26.588	6.253	2	Hard rock	2.6	5.2
12	Bhainser Kotwali	72.943	26.565	1.461	1	Hard rock	2.6	2.6
13	Bhainser Kootri	72.951	26.551	1.953	1	Hard rock	2.6	2.6
14	Bhainser Kootri	72.931	26.518	1.078	1	Hard rock	2.6	2.6
15	Balarwa	72.918	26.504	2.573	1	Hard rock	2.6	2.6
16	Khetasar	72.824	26.681	1.936	1	Hard rock	2.6	2.6
17	Newra Road	72.989	26.679	3.382	1	Hard rock	2.6	2.6
		Total			18			46.8

Fig: 10


RAJASTHAN STATE
PROPOSED LOCATION OF RECHARGE SHAFTS
OSIAN BLOCK, JODHPUR DISTRICT
OSIAN
LEGEND
Drainage
Water Bodies
Block Headquarter
Proposed locations of Recharge shafts
0
8
16
kilometers

Conservation Measures

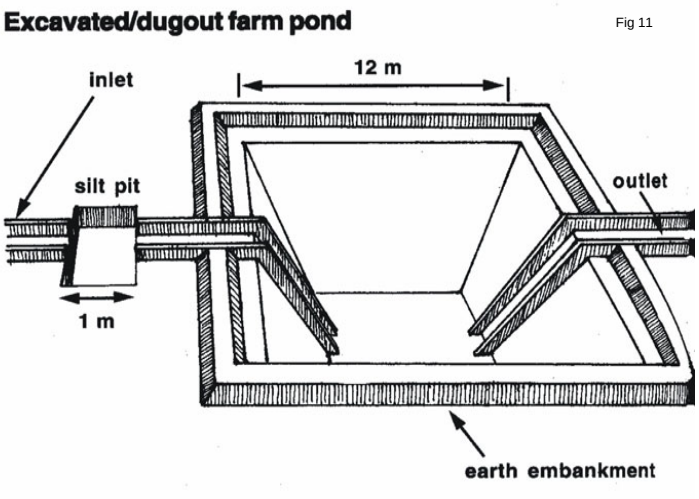
As mentioned earlier the present Plan occurs on integrated approach of interventions, which includes both recharge measures as well as conservation of water while the recharge interventions have been discussed. The proposed conservation measures discussed below includes conservation of farm ponds, revival,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

A. Farm Ponds

A farm pond is a large hole dug out in the earth, usually square or rectangular in shape, which harvests rainwater and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond. The size and depth depend on the amount of land available, the type of soil, the farmer's water requirements, the cost of excavation, and the possible uses of the excavated earth. Water from the farm pond is conveyed to the fields manually, by pumping, or by both methods. Pictorial diagram of farm pond is shown in fig 11.

Advantages of Farm Ponds

- They provide water to start growing crops, without waiting for rain to fall.
- They provide irrigation water during dry spells between rainfalls. This increases the yield, the number of crops in one year, and the diversity of crops that can be grown.
- Bunds can be used to raise vegetables and fruit trees, thus supplying the farm household with an additional source of income and of nutritious food.
- Farmers are able to apply adequate farm inputs and perform farming operations at the appropriate time, thus increasing their productivity and their confidence in farming.
- They check soil erosion and minimize siltation of waterways and reservoirs.



- They supplies water for domestic purposes and livestock
- They promote fish rearing.
- They recharge the ground water.

- They improve drainage.
- The excavated earth has a very high value and can be used to enrich soil in the fields, leveling land, and constructing farm roads

It is proposed to construct 2 farm ponds as per the specification of Govt. of Rajasthan (30 x 30 x 1.5 m). These farm ponds can accommodate about 0.078 MCM of runoff rainfall considering 3 fillings. Farm ponds can be constructed in the village at feasible location. Dimension of the farm pond depends on land holdings.

B. Revival, repair of water bodies

The existing ponds and tanks in loose their storage capacity as well as the natural ground water recharge through these water bodies has also become negligible due to siltation and encroachment by farmers for agriculture purposes. There are several such villages where ponds/ tanks are in dilapidated condition. These existing village tanks, which are normally silted and damaged, can be modified to serve as recharge structure in case these are suitably located to serve as percolation tanks. Through desilting, coupled with providing proper waste weir, the village tanks can be converted into recharge structure.

Impact Assessment and Monitoring

Assessment of impact of the artificial recharge schemes implemented is essential to assess the efficacy of structures constructed. It helps in identification of cost-effective recharge mechanisms for optimal recharge into the ground water system. It also helps to make necessary modifications in site selection, design and construction of structures in future. The monitoring system should be designed judiciously to monitor impact of these structures individually as well as collectively. Demarcation of the zone of influence of the artificial recharge structure is one of the main objectives of monitoring.

It is proposed to utilize the existing data available with the Government of Rajasthan and CGWB baseline data. For assessment of the impact of proposed measures additional data will be generated by construction of the piezometer at suitable and strategic sites.

It is proposed to construct 17 piezometer, 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 .8085 cr, which includes Rs 0.468 cr for ground water recharge activities, Rs 0.2 cr (Farm ponds), 0.102 cr for ground water monitoring (Piezometer construction) and Rs 0.0385 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 0.8085 Crores**.

Table 4: Cost of the recharge structures

Cost of Farm Pond in Rs (Unit cost Rs 0.1 cr)	Cost Recharge Shaft Rs in crs (Unit cost Rs 0.05 cr for alluvium and Rs 0.026 cr for hard rock)
0.2	Hard rock -0.468

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	Hard rock: Depth –60m, Dia 10-12"with filter pit	18	0.54	2.6	46.8	0.378
Water Conservation Activities						
Farm Pond (3 fillings)	(30 m x 30m x 1.5 m) 900 sq.m or 0.1 ha	2	0.078	10	20	0.055
Impact assessment & Monitoring						
Piezometer	Up to 80 m bgl	17		0.6	10.2	
Impact assessment will be carried out by implementing agency						
O & M - 5% of total cost of the scheme					3.85	
TOTAL					**80.85**	

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 Osian block, Jodhpur envisages gainful utilization of 0.378 MCM of surplus monsoon runoff for recharging of depleted aquifer system. Besides this, the proposed intervention would also lead to reduction of

pre-existing ground water draft by 0.055 MCM annually through construction of farm ponds.

With the additional recharge and water conservation interventions as proposed in the Plan, it is anticipated that with enhanced recharge and reduction in ground water draft, the stage of ground water development will reduce to 372.13% from the existing 374.87%. 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 %)
53.1352	0.378	53.5132	199.1925	0.055	199.1375	374.87	372.13

- 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.