
**केंद्रीय भूमि जल बोर्ड**

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

भारत सरकार

**Central Ground Water Board**

Department of Water Resources, River Development and Ganga Rejuvenation,
Ministry of Jal Shakti
Government of India

# AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

## CHHUIKHADAN BLOCK, RAJNANDGAON DISTRICT, CHHATTISGARH

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

# AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, CHHUIKHADAN BLOCK, RAJNANDGAON DISTRICT, CHHATTISGARH

## C O N T R I B U T O R S'


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# CHHUIKHADAN BLOCK, RAJNANDGAON DISTRICT

## 1. SALIENT INFORMATION

### 1.1 About the area:

| | |
|---|---|
| Name of the Block | Chhuikhadan |
| Area | 1012 Sq. km. |
| District | Rajnandgaon |
| State | Chhattisgarh |

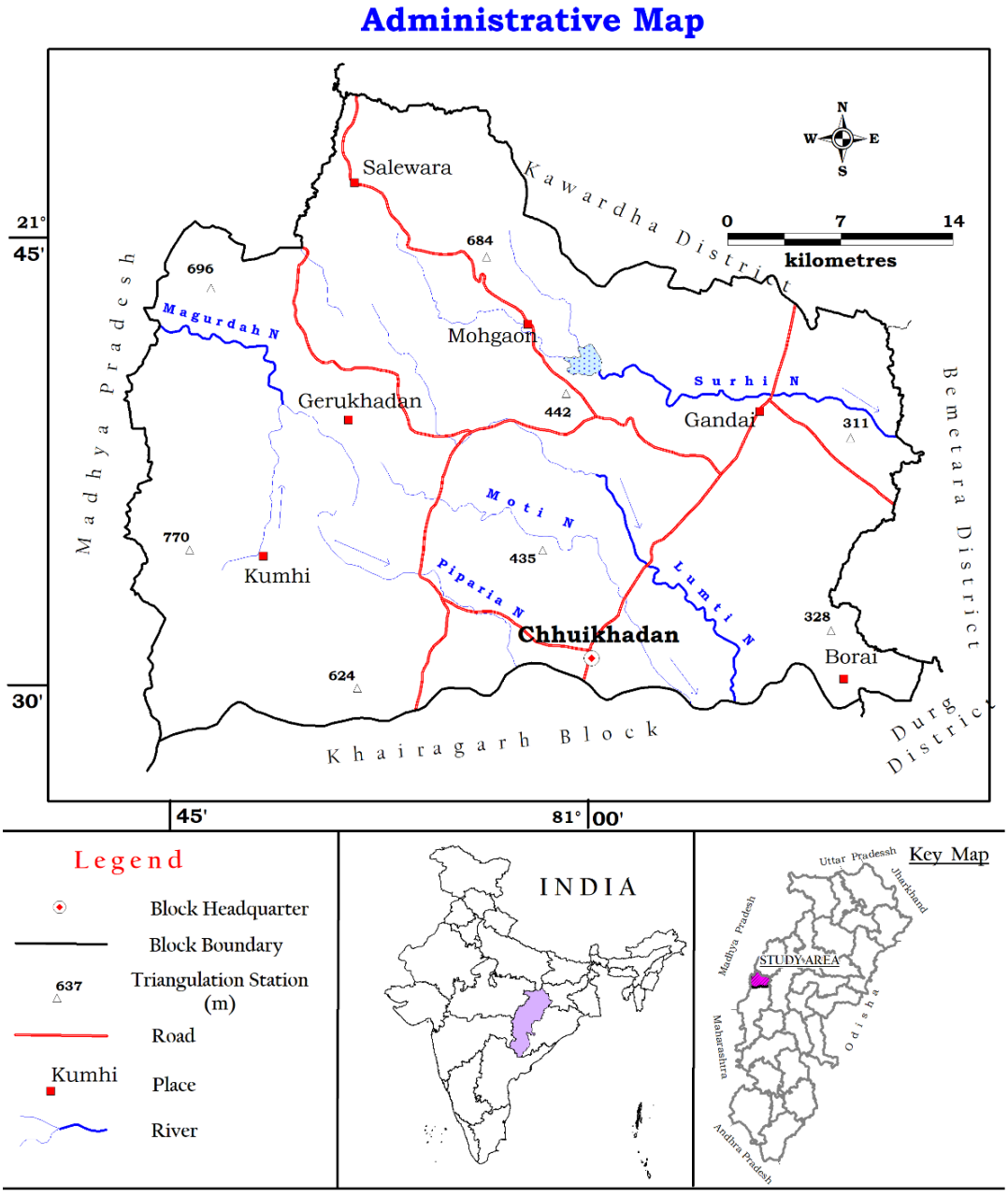



**Figure 1** Administrative Map

### 1.2 Population:

The total population of Chuikadan block as per 2011 Census is 176222 The population break up i.e. male, female, rural & urban is given below;

**Table 1** Population Break-up

| Block | Total population | Male | Female | Rural population | Urban population |
|---|---|---|---|---|---|
| Chuikadan | 176222 | 87398 | 88824 | 155851 | 20371 |

*Source: CG Census, 2011*

### 1.3 Population Growth rate:

The decadal growth rate of this block is 26.4 as per 2011 census.

### 1.4 Rainfall:

The study area receives rainfall mainly from south-west monsoon. It sets in third/fourth week of June and continues till mid-August/September with heaviest showers in the months of July and August. The months of July and August are the heaviest rainfall months and nearly 95% of the annual rainfall is received during June to September months. Average annual rainfall in the study area is (Average of the last five years i.e. 2012-13 to 2016-17) 937.68mm

**Table 2** Rainfall data in Chhuikhadan block (in mm)

| Year | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 |
|---|---|---|---|---|---|
| Monsoon rainfall | 1692.2 | 1622.3 | 1164.1 | 1250.1 | 1249.2 |

*Source: Statistical Hand Book Rajnandgaon District, 2016-17*

### 1.5 Agriculture and Irrigation:

Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season, it is done through ground water as well as partly through surface water like ponds and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are Paddy, Wheat and Gram. In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Chuikadan block is given in Table No. 3 (A, B, C, and D).

# Drainage Map

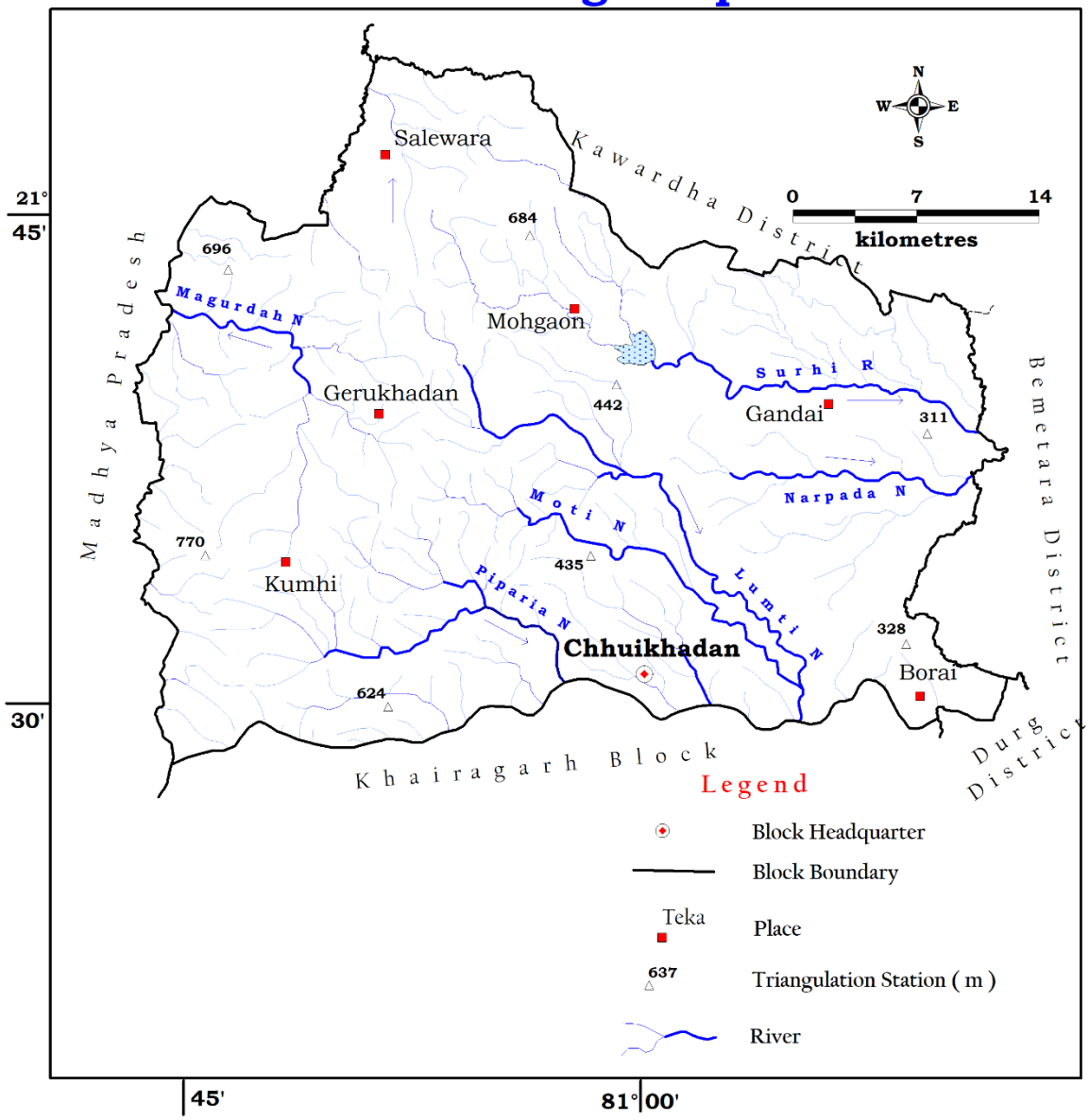



**Figure 2** Drainage Map

**Table 3(A)** Land use pattern (in ha)

| Block | Total geographical area | Revenue forest area | Area not available for cultivation | Non-agricultural & Fallow land | Agricultural Fallow land | Net sown area | Double cropped area | Gross cropped area |
|---|---|---|---|---|---|---|---|---|
| **Chuikhadan** | 74289 | 7163 | 8531 | 8883 | 4524 | 42786 | 19332 | 62118 |

**Table 3(B)** Cropping pattern (in ha)

| Block | Kharif | Rabi | Cereal | | | | Pulses | Tilhan | Fruits Vegetables | Reshe | Mirch Masala | Sugar-cane |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Wheat | Rice | Jowar & Maize | Others | | | | | | |
| **Chuikhadan** | 41048 | 21070 | 2196 | 29182 | 435 | 1 | 22360 | 6749 | 2961 | 0 | 42 | 50 |

**Table 3(C)** Area irrigated by various sources (in ha)

| No. of canal s (private and Govt.) | Irrigated area | No.of bore wells/ Tube wells | Irrigated area | No. Of dug wells | Irrigated area | No. of Talabs | Irrigated area | Irrigated area by other sources | Net Irrigated area | Gross irrigated area | % of irrigated area wrt. Net sown area |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 12537 | 1899 | 7899 | 848 | 533 | 14 | 82 | 28 | 21079 | 21079 | 49.26 |

**Table 3(D)** Contribution of Groundwater in Irrigation Pattern (ha)

| Block | Area irrigated through Borewell/ Tubewell | Area irrigated through Dugwell | Area irrigated through Groundwater | Net area irrigated through all sources | GW contribution in Irrigation (%) |
|---|---|---|---|---|---|
| **Chuikhadan** | 7899 | 533 | 8432 | 21079 | 40 |

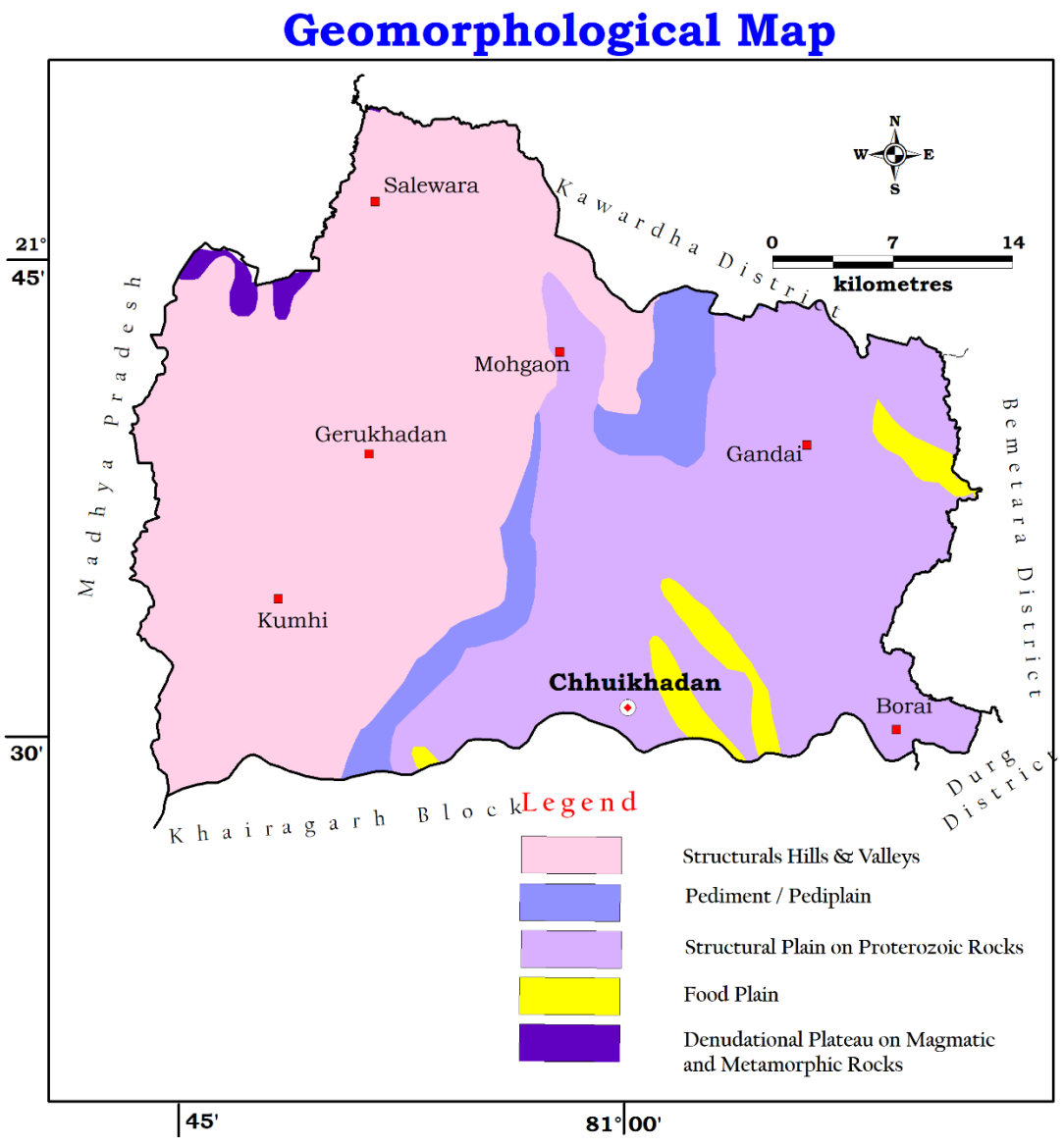



**Figure 3** Geomorphological Map

### 1.6 Groundwater Resource Availability:

Based on the resource assessment made, the resource availability in Chuikhadan block is given in the Table No. 4.

**Table 4** Ground Water Resources of Chhuikhadan block in Ham

| Name of Block | Ground Water Recharge (Ham) | | | | Total Annual Ground Water (Ham) Recharge (5=1+2+3+4) | Total Natural Discharges (Ham) | Annual Extractable Ground Water Recharge (Ham) (7=5-6) |
|---|---|---|---|---|---|---|---|
| | Monsoon Season | | Non-monsoon season | | | | |
| | Recharge from Rainfall | Recharge from Other Sources | Recharge from Rainfall | Recharge from Other Sources | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Chhuikhadan | 3775.85 | 1927.09 | 548.70 | 2210.36 | 8462.00 | 846.20 | 7615.80 |

### 1.7 Water Level Behaviour:

### 1.7.1 Pre- monsoon water level (May 2018):

In the pre-monsoon period, it has been observed that in Chuikadan block, water level in Phreatic aquifer vary between 4.99 to 13.9 m bgl with average water level of 7.55m bgl shown in Table No. 5(A). In deeper semi-confined aquifer, water level varies between 7.63 to 20 m bgl with average water level of 13.9 m bgl shown in Table No. 5(B).

**Table 5(A)** Aquifer wise Depth to Water Level (Pre-monsoon)

| Block Name | Phreatic Aquifer | | |
|---|---|---|---|
| | Min | Max | Avg |
| **Dongargarh** | 4.99 | 13.9 | 7.55 |

**Table 5(B)** Aquifer wise Depth to Water Level (Pre-monsoon)

| Block Name | Semi-confined Aquifer | | |
|---|---|---|---|
| | Min | Max | Avg |
| **Dongargarh** | 7.63 | 20 | 13.9 |

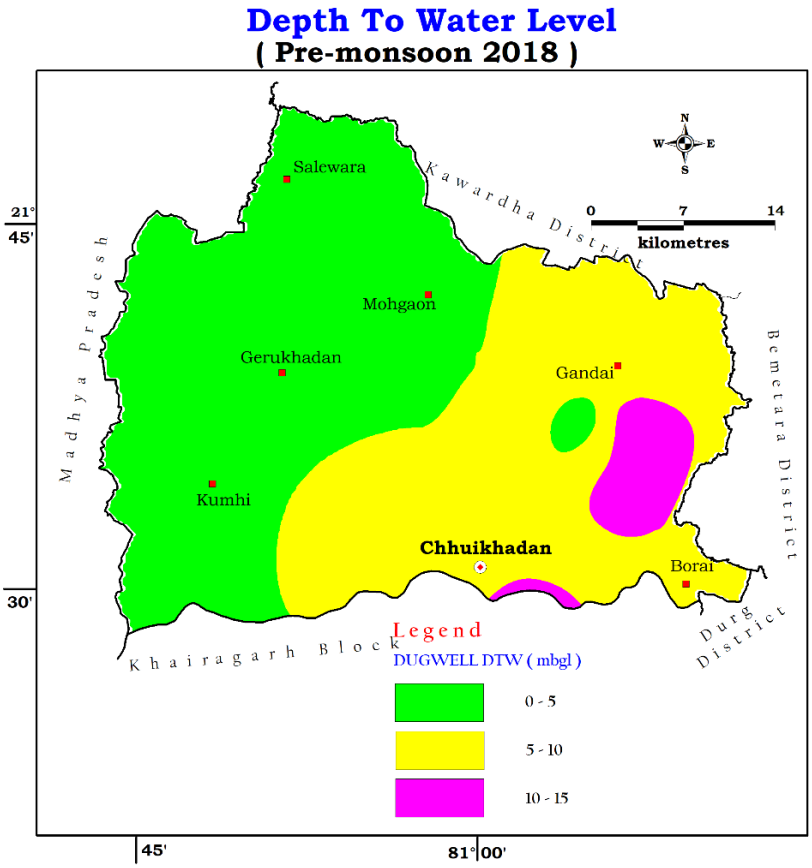



**Figure 4** Pre monsoon Depth to water level of Phreatic Aquifer

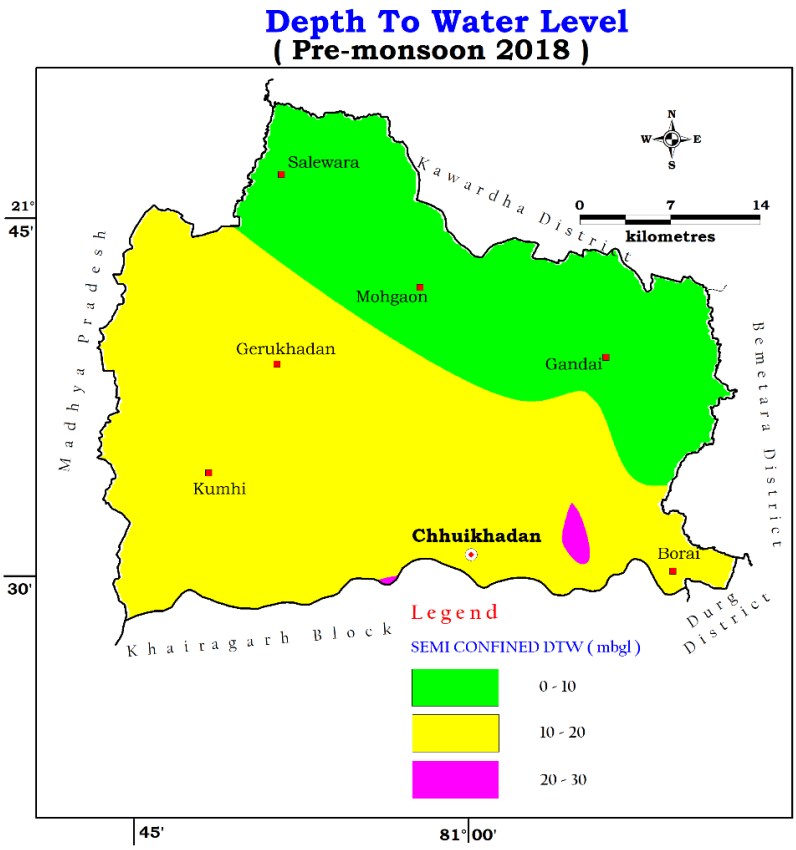



**Figure 5** Pre monsoon Depth to water level of Semiconfined Aquifer

### 1.7.2 Post- monsoon water level (Nov 2018):

In the post-monsoon period, it has been observed that in Chuikadan block, water level in Phreatic aquifer vary between 0.8 to 7.45 m bgl with average water level of 4.17 m bgl shown in Table No. 5(C). In deeper semi-confined aquifer, water level varies between 4.86 to 11.38 m bgl with average water level of 7.65 m bgl shown in Table No. 5(D).

**Table 5(C)** Aquifer wise Depth to Water Level (Post-monsoon)

| Block Name | Phreatic Aquifer | | |
|---|---|---|---|
| | Min | Max | Avg |
| Dongargarh | 0.8 | 7.45 | 4.17 |

**Table 5(D)** Aquifer wise Depth to Water Level (Post-monsoon)

| Block Name | Semi-confined Aquifer | | |
|---|---|---|---|
| | Min | Max | Avg |
| Dongargarh | 4.86 | 11.38 | 7.65 |

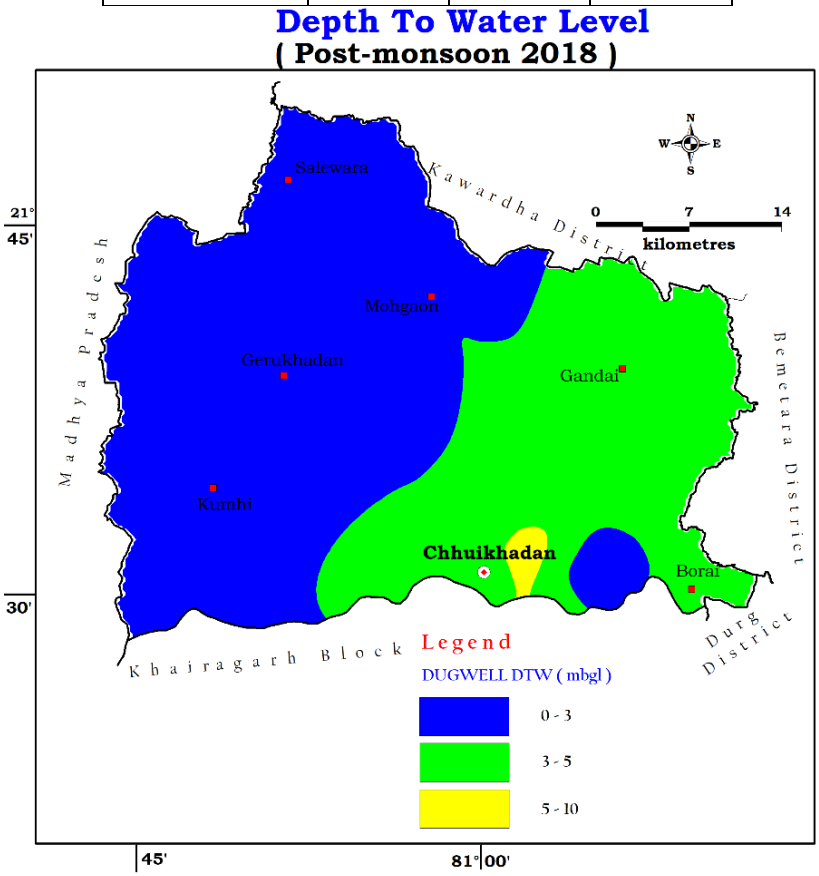



**Figure 6** Post monsoon Depth to water level of Phreatic Aquifer

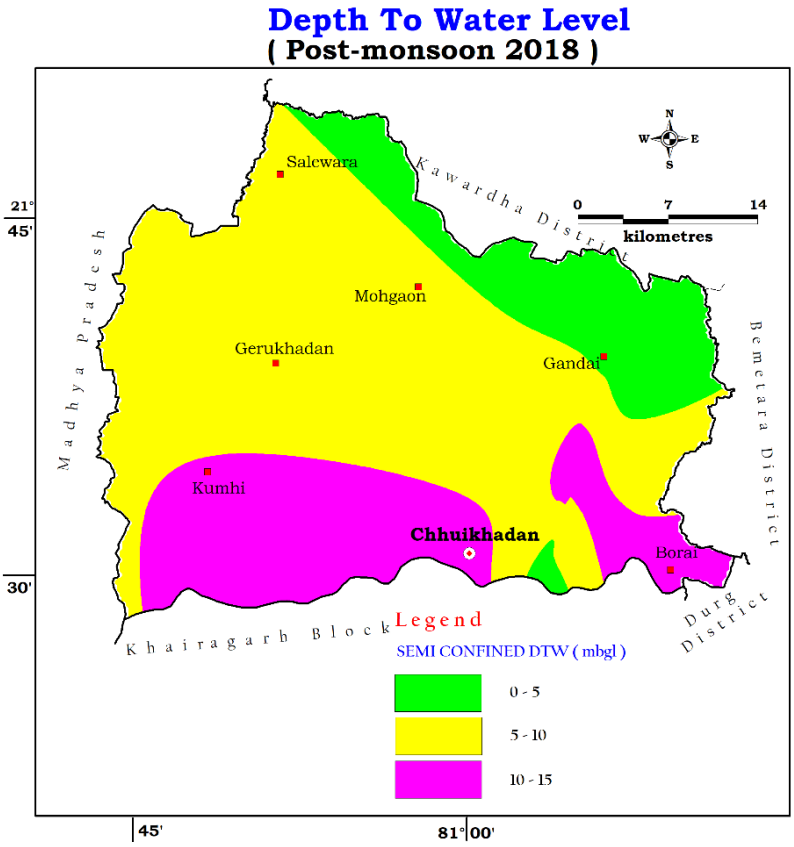



**Figure 7** Post monsoon Depth to water level of Semiconfined Aquifer

### 1.7.3 Seasonal water level fluctuation:

The water level fluctuation data indicates that in Chhuikhadan block, water level fluctuation in phreatic aquifer varies from 0.25 to 8.7m with an average fluctuation of 3.38 m show in Table No. 5(E). Water level fluctuation in semi-confined aquifer varies from 2.04 to 11.23 m with an average fluctuation of 6.25m shown in Table No. 5(F).

**Table 5(E)** Aquifer wise Depth to Water Level Fluctuation (Phreatic aquifer)

| Block Name | Phreatic Aquifer | | |
|---|---|---|---|
| | Min | Max | Avg |
| Dongargarh | 0.25 | 8.7 | 3.38 |

**Table 5(F)** Aquifer wise Depth to Water Level Fluctuation (Semi-confined aquifer)

| Block Name | Semi-confined Aquifer | | |
|---|---|---|---|
| | Min | Max | Avg |
| Dongargarh | 2.04 | 11.23 | 6.25 |

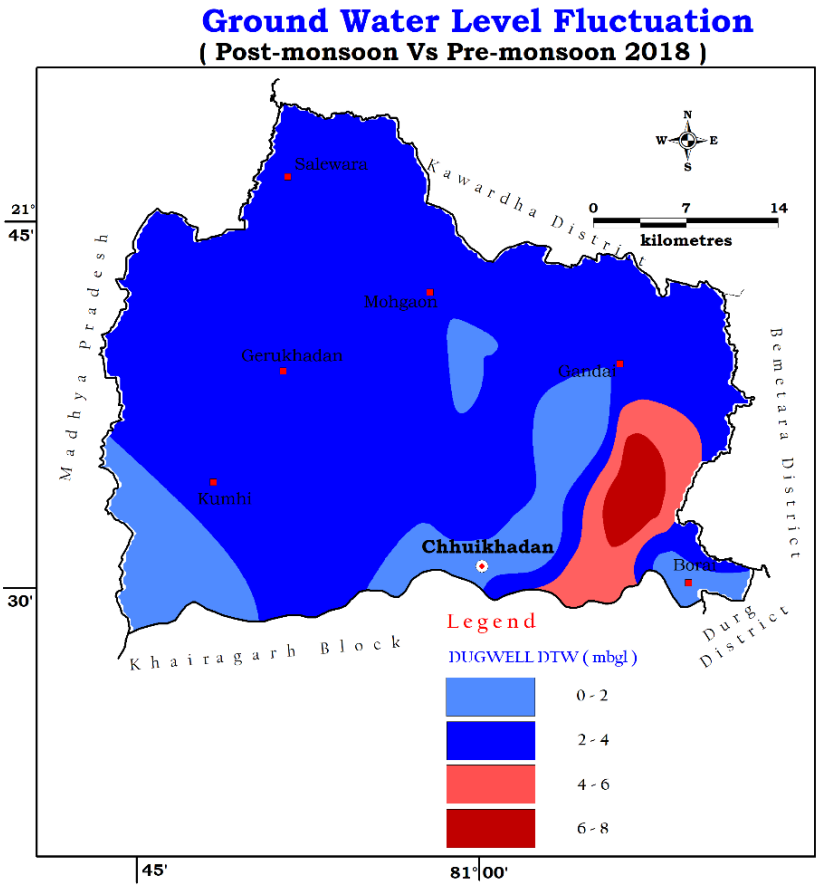



**Figure 8** Ground water level fluctuation of Phreatic Aquifer

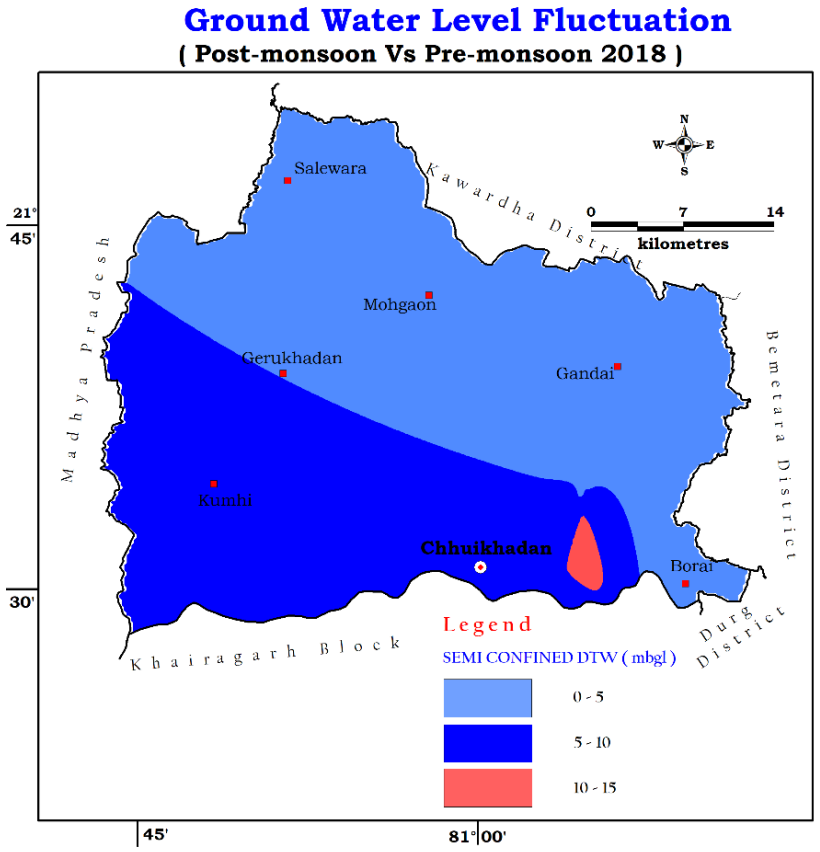
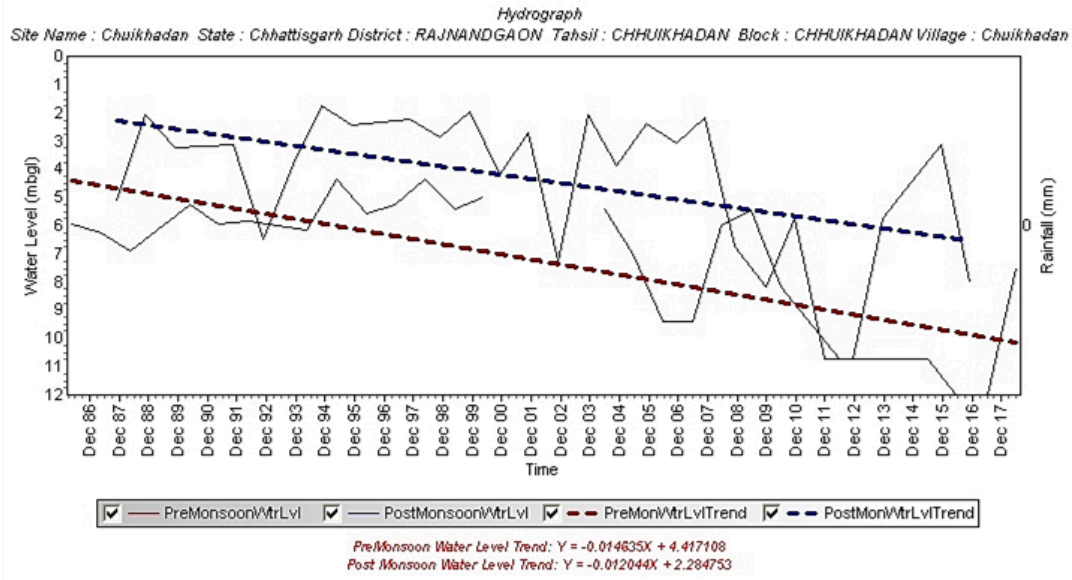



**Figure 9** Ground water level fluctuation of Semiconfined Aquifer

### 1.7.4 The long-term water level trend:




Considering the last 32 years from 1986 to 2017 there was fall in both pre-monsoon and post-monsoon water level trend which implies the extraction of ground water was increased.

## 2 AQUIFER DISPOSITION:

### 2.1 Number of Aquifers:

There are two major aquifers present in this block. As the aquifers are Consolidated in nature, so further those aquifers are divided in to two sub aquifers in Z-direction. One is Aquifer-I, which represents the Phreatic Aquifer or Weathered zone and another one is Aquifer-II, which represents Fractured Aquifer or Semi-confined aquifer as the fractures are connected to the weathered zone.

**Table 6** Details of Aquifer in Chhuikhadan Block

| Geological Formation | Aquifer | Area Covered (Sq. k. m.) |
|---|---|---|
| Chandi Limestone | Chandi Limestone<br>*Aquifer-I (Phreatic Aquifer)*<br>*Aquifer-II (Fractured aquifer*) | 153 |
| Gunderdehi Formation | Shale<br>*Aquifer-I (Phreatic Aquifer)*<br>*Aquifer-II (Fractured aquifer*) | 115 |
| Bijli Rhyolite | Acidic Rock<br>*Aquifer-I (Phreatic Aquifer)*<br>*Aquifer-II (Fractured aquifer*) | 167 |

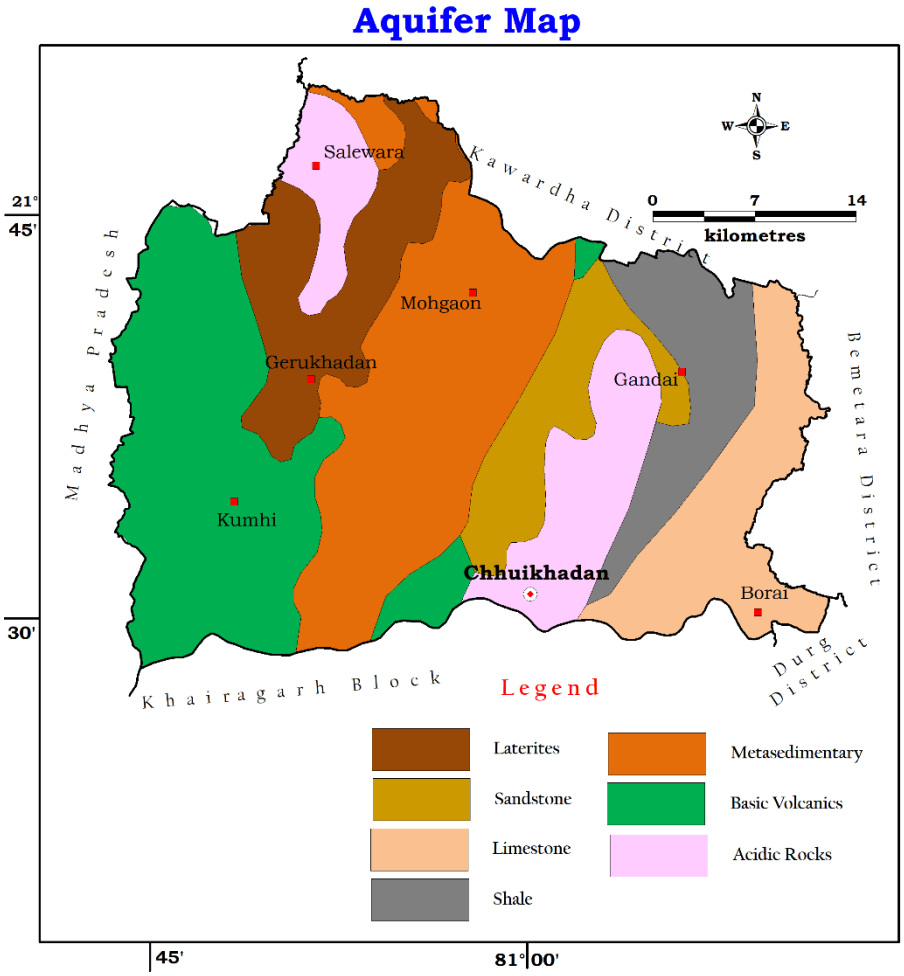



**Figure 10** Aquifer Map of Chhuikhadan Block

## 2.2 3-d aquifer disposition and basic characteristics of each aquifer:

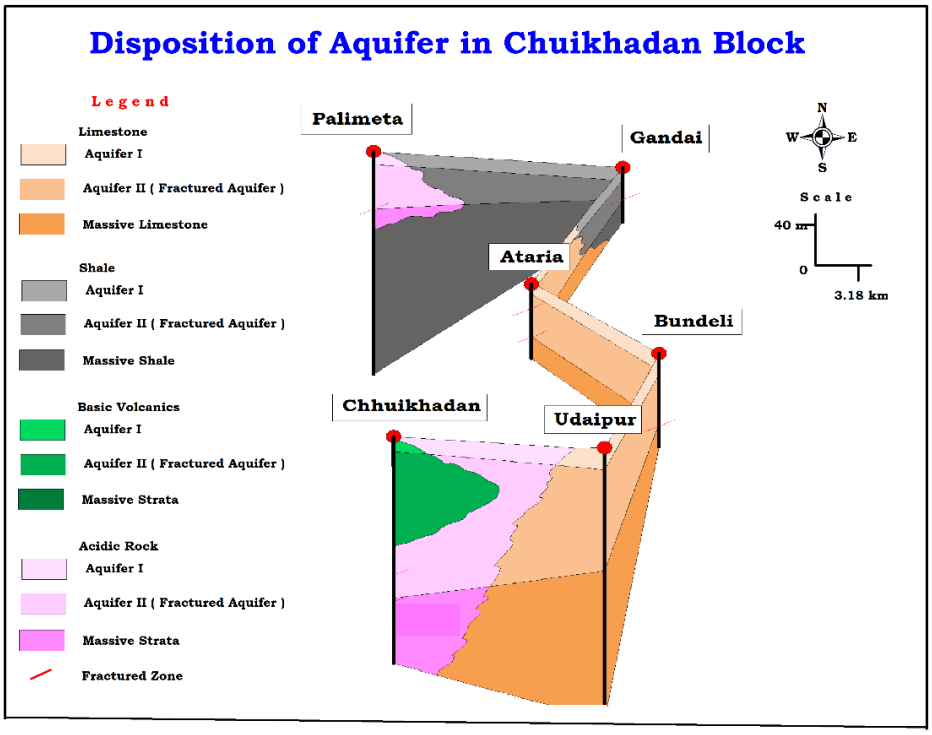



**Figure 11** Fence diagram of Chhuikhadan Block

**Table 7** Aquifer Characteristics of Chhuikhadan Block

| Places | | Udaypur | Atariya | Chhuikhadan |
|---|---|---|---|---|
| **Major Formation** | | Limestone | Limestone | Basic volcanics & Acidic Rocks |
| **Thickness (in m)** | Aquifer-I | 14.5 | 21.7 | 15 |
| **No of potential zone** | Aquifer-II | 1 (88.20-91.3) | 2 (33.3-39.4, 137-140) | 1(105-108) |
| **Yield (lps)** | | 0.078 | 0.731 | 2 |
| **Transmissivity (m2/day)** | | 0.85 | 0.473 | 13 |
| **Drawdown (m)** | | 20 | 15 | 35 |

## 3. GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES:

Aquifer wise resource availability is given in the following table where the total resource available in Khairagarh block is 3467.61 ham. The extraction details and the future scenario (2025) along with the categorization is depicted in following table.

## 4. GROUND WATER RESOURCE ENHANCEMENT:

**Table 8** Ground Water Resources of Chhuikhadan block in Ham

| | |
|---|---|
| **Net Annual Ground Water Availability (Ham)** | 21587.95 |
| **Existing Gross Ground Water Draft for All uses (Ham)** | 5165.53 |
| **Provision for domestic requirement supply to 2025(Ham)** | 615.31 |
| **Stage of Ground Water Development %** | 67.83 |
| **Category** | Safe |

| Name of Block | Annual Extractable Ground Water Recharge (Ham) (7=5-6) | Current Annual Ground Water Extraction (Ham) | | | | Annual GW Allocation for for Domestic Use as on 2025 | Net Ground Water Availability for future use (13=7-8-9-12) |
|---|---|---|---|---|---|---|---|
| | | Irrigation Use | Industrial Use | Domestic Use | Total Extraction (11=8+9+10) | | |
| | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Chhuikhadan | 7615.80 | 4709.86 | 0.00 | 455.67 | 5165.53 | 615.31 | 2290.63 |

### 4.1 Aquifer wise space available for recharge and proposed interventions:

**Table 9** Aquifer wise space availability

| Block | Area Identified for Artificial Recharge * Sq.Km | Average Depth to Postmonsoon water level (mbgl)-3 | | | Sy | Sub surface storage potential (mcm) | Surface Water Requirement (mcm) |
|---|---|---|---|---|---|---|---|
| | | 3 to 5 | 5 to 10 | 10 to 15 | | | |
| **Chhuikhadan** | 506 | 1 | 4.5 | | 0.015 | 8.2 | 10.9 |

### 5. ISSUES:

i. The aquifer itself is a low yielding one due to which during summer, dugwells in almost all villages are dry except a few locations. Several handpumps also stop yielding water.

ii. It has been observed during fieldwork in pre-monsoon period, there is colossal wastage of groundwater through public water supply system.

iii. Uneven distribution of yield potential in consolidated Khairagarh Group.

iv. Good potential zone confined in structurally low laying areas whereas in higher elevation, it is poorly yielding

v. There is further scope of groundwater development.

### 6. MANAGEMENT PLAN:

### 6.1 Supply side interventions:

i. Sanctuary wells may be constructed for drinking needs as a step towards crisis management.

ii. It has been observed during fieldwork in pre-monsoon period, there is colossal wastage of groundwater through public water supply system. In this state, the Government has undertaken “Nal Jal Yojana” to provide water to villages. Under this scheme, the government has dug borewells of about 150-200feet depth, lowered a pump in the well to draw out water and constructed a small tank to hold water. Unfortunately, people do not switch off the pump once the tank is full. Also, the pipes are not fitted with taps to control the flow of water. So, Information, education and Communication (IEC) activities to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance community participation in saving water.

iii. Desiltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also Rain water harvesting structures may be constructed in villages to reduce stress on groundwater.

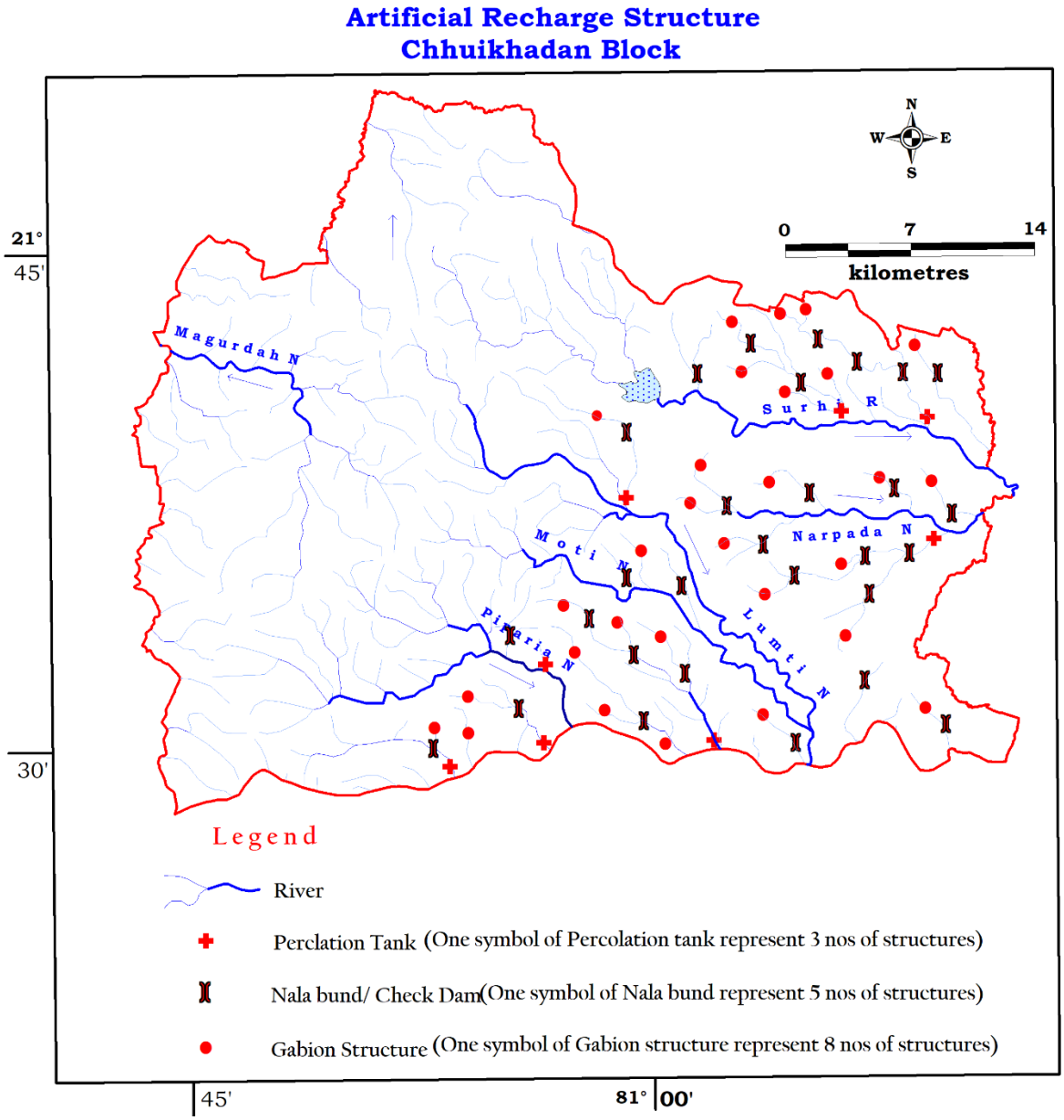



**Figure 12** Management Plan of Chhuikhadan Block

iv. it has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At location near urban areas water level is declining, so we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water storage in the area. The different types of artificial structures feasible in the block are described in table

v. Recharge should be practice in dried up bore well and Dug well.

vi. Govt. may set up network of grids to purchase electricity generated from solar panels. This will encourage the farmers not to waste electricity by extracting groundwater unnecessarily and also provide alternative income.

**Table 10** Types of Artificial Recharge structures feasible

| Name of Block | Area Feasible for recharge (sq.km) | Sub surface storage potential (mcm) | Types of Structures Feasible and their Numbers | | |
|---|---|---|---|---|---|
| | | | P | NB & CD | G |
| Chhuikhadan | 506 | 10.9 | 27 | 145 | 218 |
| | Recharge Capacity | | 5.4 | 4.35 | 1.09 |
| | Estimated cost (Appx. 70.68 million rupees) | | 54 | 14.5 | 2.18 |

**6.2 Demand side interventions:**

i. Change in Irrigation practices- Water can be Saved using micro irrigation methods such as sprinklers, drip irrigation etc.

ii. Change in cropping pattern- Water can be Saved by change crops from paddy to Maize.

iii. Control on wasting water through Public water Supply- Unfortunately, people do not switch off the pump once the tank is full. Also, the pipes are not fitted with taps to control the flow of water.

iv. Sapling should be planted in Barren land

**7. CONCLUSION:**

An area of 1012 sq.km of Khairagarh block of Rajnandgaon district has been considered for Aquifer Mapping and Management Plans. The total groundwater resource is 23646.5 Ham with stage of groundwater development 65.56% and categorized as “Safe”. 66.36 % of the irrigated area is uses groundwater for irrigation. The major aquifer groups are Khairagarh group (Basic volcanics) and Chandi Formation (Limestone). In terms of Demand side management, by change in cropping and irrigation pattern (micro irrigation methods) water can be saved respectively. In terms of Supply side management, Percolation Tank (135), Nala bund or Check dam (329) and Gabion

structures (395) can be constructed to recharge 39.5 MCM water to underground. and constructing of tubewell at suitable locations, drinking water needs may be fulfilled.