
**केंद्रीय भूमि जल बोर्ड**

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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

## SINDHANUR TALUK,

## RAICHUR DISTRICT, KARNATAKA

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region, Bengaluru

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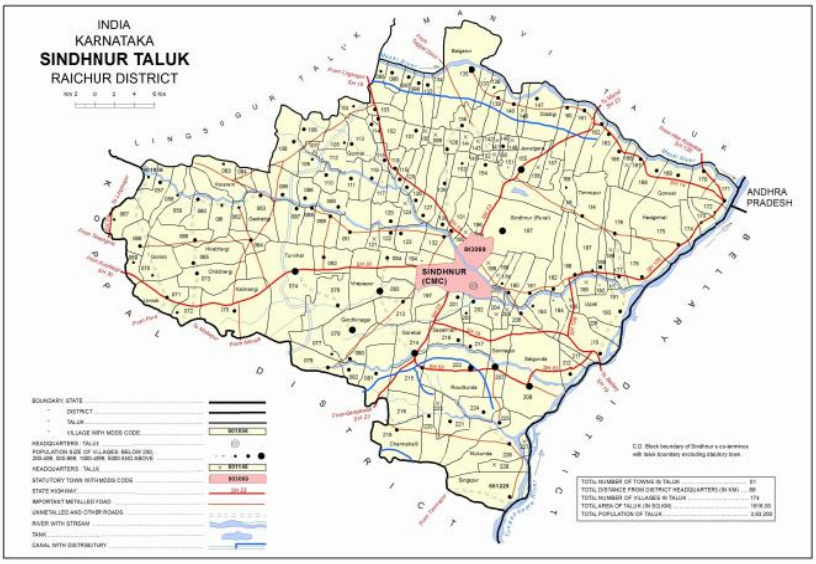
**GOVERNMENT OF INDIA**
**MINISTRY OF JAL SHAKTI**
**DEPT. OF WATER RESOURCES, RD & GR**
**CENTRAL GROUND WATER BOARD**

# AQUIFER MANAGEMENT PLAN OF SINDHANUR TALUK, RAICHUR DISTRICT, KARNATAKA STATE

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# AQUIFER MANAGEMENT PLAN OF SINDHANUR TALUK, RAICHUR DISTRICT, KARNATAKA STATE

## CONTENS

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## 1. SALIENT FEATURES:

Sindhanur taluk, located in southern portion of Raichur district, Karnataka state covering an area of 1601.16 Sq. kms and is a part of Krishna river basin located at longitudes $15^0$32'47": $15^0$ 59'43" and East latitude of $76^0$24'42": $77^0$01'58". It is surrounded by Lingasugur and Manvi taluks of Raichur district towards north, Gadngavathi taluk of Koppal district in south, Gangavathi and Kushtagi taluks of Koppal district in the west and Siruguppa taluk in the east. The Location map of the taluk is in **Figure 1.**

The Sindhanur taluk is a part of Gulbarga revenue division and Lingsugur sub division with Sindhanur as taluk head quarter. There are fourteen revenue hoblies which covers 147 inhabitated villages and 27 uninhabitated falling in 36 Grama Panchayats. The Sindhanur is located at a distance of 91 kms west of Raichur the district head quarter. The taluk is well connected with good network of roads with State highway and district roads and forming good net work of transport facility.

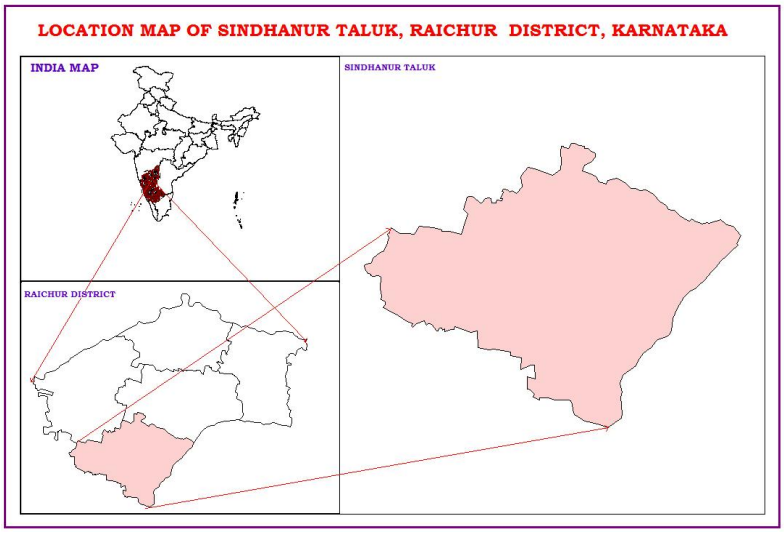


**Figure-1: Location map of Sindhanur Taluk**

### 1.2 Population:

As per 2011 census, the total population in Sindhanur taluk is 393200 (196264 males and 196936 Females) of which about 317363 (80.71 %) constitutes the rural population. The taluk has an overall population density of 245.57 persons per sq.km. The decadal change is 9.17 %.

### 1.3 Rainfall:

Sindhanur taluk enjoys semi arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Northern Dry agro-climatic zone of Karnataka state and is categorized as drought prone. The climate of the taluk is quite agreeable and free from extremes. The minimum temperature in summer is in between $19.00^0$C to $21.2^0$C and maximum temperature ranges from $32.3^0$C to $33.4^0$C and in winter the minimum temperature ranges from $15.00^0$ to $18.4^0$ C and maximum ranges from $26.7^0$C to $29.5^0$C. Overall temperature range is in between $15.00^0$c to $33.4^0$. The rainy season is South-West monsoon is from June to September followed by North-East monsoon and post-monsoon from October to December.

The Annual Normal rainfall (1981 to 2010) in the taluk is 856 mm and the statistical analysis of rainfall data for the above period is presented in the **Table-1.**

**Table 1: Statistical Analysis of Rainfall Data of Sindhanur Taluk, Raichur District, for the Period 1981 to 2010**

| STATION | | JAN | FEB | MAR | APR | MAY | PRE | JUN | JUL | AUG | SEP | SW | OCT | NOV | DEC | NE | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sindhanur | NRM | 2 | 0 | 9 | 12 | 41 | 65 | 100 | 77 | 109 | 155 | 442 | 129 | 35 | 4 | 169 | 856 |
| | ST. DEV | 7 | 1 | 28 | 24 | 48 | 108 | 96 | 64 | 75 | 118 | 253 | 98 | 73 | 11 | 183 | 421 |
| | CV% | 270 | 346 | 319 | 192 | 118 | 166 | 96 | 83 | 68 | 76 | 80 | 76 | 210 | 266 | 108 | 49 |

**Assessment of Drought**

Rainfall data has been analysed to assess the drought condition using 53 years Rain Fall data and the results / classification thus obtained are listed in the **Table-2.** It is observed that the Sindhanur taluk has experienced alternating no drought to severe drought conditions over the years.

**Table :2 Classification of drought and its periodicity (IMD, 1971)**

| % Deviation (Di) | | >0 | 0 to -25 | -25 to -50 | 50 to 75 | Probability of drought occurrences |
|---|---|---|---|---|---|---|
| Category | | No drought | Mild (Normal) | Moderate | Severe | |
| | | Years | | | | |
| Taluk | Sindhanur | 29 | 10 | 13 | 1 | Once in 4 years |

Out of 53 years of analysis in Sindhanur taluk, "No Drought" condition is experienced in 29 years, "Mild Drought" condition is 18 years and "Moderate Drought" condition experienced in 10 years. Further it is observed that "Severe Drought" condition is experienced in 1 year ie, during 1972. Based on occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought at each station has been studied. It has been observed that the frequency of occurrence of drought is **once in 4 years.**

**1.4 Agriculture & Irrigation:**

Sindhanur taluk is having 81315ha of total sown/cropped area of which 45353ha are under canal command area (District at a glance 2015-2016) and remaining are wholly dependent on the rain fall for their agricultural activities. The land use pattern of the taluk is presented in the **Table-3**.

**Table-3: Land use pattern of Sindhanur Taluk, Raichur District**

| Geographical area (Ha) | Area under forest (Ha) | Area not available for cultivation (Ha) | Uncultivable land (Ha) | Fallow land (Ha) | Area sown (Ha) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Net sown area | Area sown more than once | Total sown/cropped area |
| 160116 | 1075 | 11354 | 6244 | 73723 | 67770 | 13545 | 81315 |

*District at a glance 2015-2016*

### 1.4.1 Principle crops:

Since the Sindhanur taluk falls under Tungabhadra canal command area the only principle crop of the taluk is Paddy - 41704 ha (51.28% to the total cropped area). The other major crops are Bengal gram of 13597 ha (16.72 % to the total cropped area), Jowar with 9697ha (11.92%) and Sun flower with an area of 8776 (10.97%) which are normally rain fed crops. Overall food crops are of 83.83% of which cereals with 65.76% and Pulses are of 18.07% are the major crops grown during Rabi season. Vegetables and fruits crops are the Kharif crops. The principle crops and area grown are in the below **Table-4**.

**Table 4: Principle crops in Sindhanur taluk**

| Crops | Cereals (Area in Ha) | | | Pulses (Area in Ha) | | | | Fruits (Area in Ha) | Vegetables (Area in Ha) | Oil seeds (Area in Ha) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Paddy | Jowar | Bajra& maize | Bengal gram | Tur | Black gram | Others | | | Sun Flower | Ground nuts | others |
| | 41704 | 9697 | 2077 | 13597 | 715 | 262 | 120 | 291 | 524 | 8776 | 55 | 0 |
| **Total** | 53478 | | | 14694 | | | | 291 | 524 | 8831 | | |
| | **Total Food Grains -68172 ha** | | | | | | | - | - | **Total Oilseeds-16710 ha** | | |

*District at a glance 2015-2016 (ASCR)*

### 1.4.2 Irrigation Practices:

As indicated the Sindhanur taluk falls in canal command area and lift irrigation, the utilization of ground water is less when compared to surface water. The ground water is being developed from ground water structures like 9 dug wells and 787 shallow tube wells (Report on 4$^{th}$ census of Minor Irrigation Schemes 2006-2007) is for irrigation purposes. The ground water thus developed from these structures were managed through water distribution irrigation practices by adopting- Open channel, Underground pipe, surface pipe, drip irrigation, sprinklers and others.

### 1.4.3 Ground water and surface water Irrigation:

In Sindhanur taluk, Surface water is the main source of irrigation when compared to ground water. The details of surface water and ground water irrigation are in the **Table-5**.

**Table-5: Details of irrigation in Sindhanur taluk**

| Sl. No. | Source | | No. / Length | Net area irrigated (ha) | Gross area irrigated (ha) |
|---|---|---|---|---|---|
| 1 | Surface water | Canals | 59 kms | 42144 | 45353 |
| | | Tanks | 2 | 0 | 0 |
| | | Lift Irrigation | 1742 | 672 | 681 |
| 2 | Ground water | Dug Wells | 101 | 1549 | 2495 |
| | | Bore wells | 829 | 1071 | 1104 |
| 3 | Other sources | | - | 750 | 924 |
| 4 | Total | | 2733 | 46186 | 50557 |

*District at a glance 2015-2016 (ASCR)*

### 1.5 Geomorphology, Physiography & Drainage:

Geomorphologically Sindhanur taluk falls in Northern maidan region. Topographically the region is generally more or less flat plateaus with gneissic hills which are broken and covered with a thin mantle of red loamy soil. The general slope is from south west to north. The elevation is generally vary from 350 to 400m amsl. The average elevation of taluk is 377 m above msl **Figure-2**. .

**Drainage**:
Sindhanur taluk is part of upper Krishna river basin. Tungabhadra – tributary of Krishna is the major perennial river along with small rivulets which drain the entire taluk. The Tungabhadra River runs all along the southern to north eastern border of the taluk. The Maski nala is one of the major stream in the north which flows for a length of 112 kms in the taluk before joining to Tungabhadra River. Similarly Sindhanur nala in the south the other major stream which flow for a distance of 80 kms in the taluk ultimately drains into the Tungabhadra River. These are active during monsoon season and drains excess water of Tungabhadra left bank canal during other season. The general flow direction is north to north eastern border of the taluk. The general drainage pattern is of dendritic due to marked influence of geologic structures in the basin **Figure-3**.

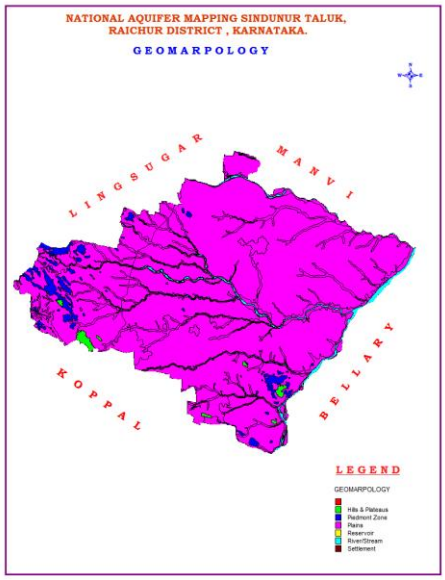


**Figure-2 Geomorphology map**

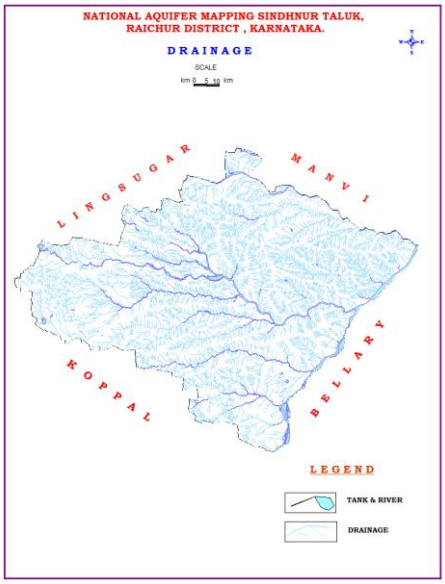


**Figure-3 Drainage map**

**1.6 Geology:**
Major portion of Sindhanur taluk is occupied by Banded Gneisses referred as peninsular Gneiss and small patch of granites in north western portion as major rock formation **Figure-4**.

**1.7 Soil :**
The soils of the taluk are derived from Gneiss / Granites. The soils are hard and poor in general. Clayey, loam, black soil are the soil types **Figure-5**.

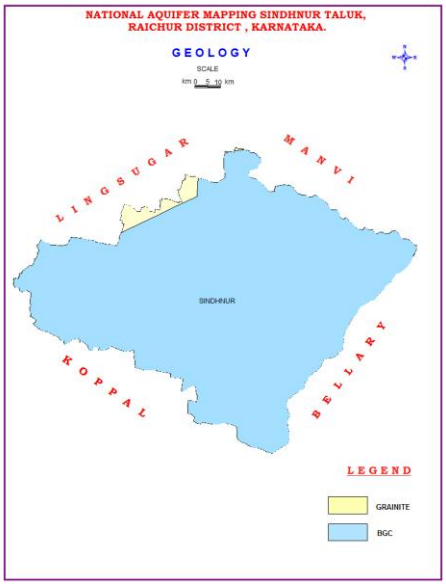


**Figure-4:** Geology map

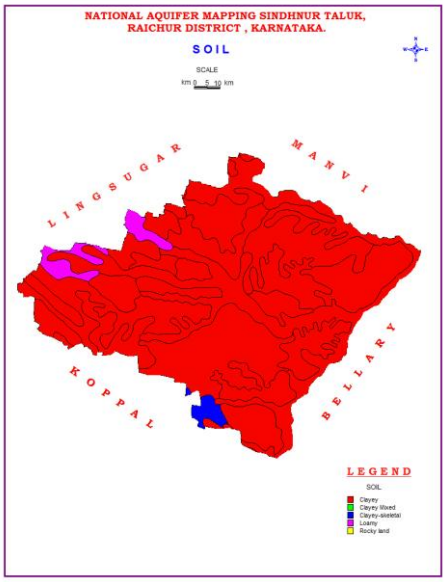


**Figure-5:** Soil map

## 1.8 Ground water resource availability and extraction:

The Ground water availability as per Resource Estimation 2009 & 2013 is as in the **Table-6**.

| **Year** | **Annual replenishable GW resources** (HaM) | **Fresh In-storage GW resources** (HaM) | | **Total availability of fresh GW resources** |
|---|---|---|---|---|
| | | **Phreatic** | **Fractured (Down to 200m)** | **Dynamic +phreatic in-storage + fractured** |
| 2009 | 26054 | 15952 | 4076 | 46082 |
| 2013 | 26648 | 13402 | 4076 | 44126 |

As per the estimation **(GEC 2013)** the ground water draft (extraction) for irrigation worked out to be **5133 ham** with stage of ground water development of 20%.

### 1.9 Existing and future water demands

As per GEC (2013) existing ground water draft for irrigation, industrial & domestic (all use) is **5406 ham** and availability for future demands with judicious utilization since the stage of ground water development is already reached up to **20** % having scope of 20938 **ham** of which **577 ham** is for domestic and industrial use and **20938 ham** is for future irrigation purposes.

### 1.10 Water level behavior:

The depth to water levels during pre and post monsoon and the rate of fluctuation of water level are in the T**able-7 and Figures 6 to 11.**

The analysis of **long term water level trend in Aquifer-1** indicates that in pre monsoon there is rising trend in between 0.1272 to 0.3146 m/y with an average of 0.1860m/y and falling trend in the range of 0.0038 to 0.4273 m/y with an average fall of 0.2139m/y. Similarly during post monsoon showed rising trend in the range of 0.0103 to 0.0.105m/y with an average of 0.0104m/y. Falling trend during post monsoon observed in the range of 0.0570 to 0.4020m/y with an average of 0.2253m/y. Overall trend indicates that no rising trend in the taluk were noticed instead all the wells showed falling trend in the range of 0.0472 to 0.4618m/y with an average of 0.1915m/y.

| Item | Table-7 : Depth to Water levels in Sindhanur taluk | | | | | |
|---|---|---|---|---|---|---|
| | Pre monsoon | | Post monsoon | | Water level fluctuation | |
| | Aquifer I | Aquifer II | Aquifer I | Aquifer II | Aquifer I | Aquifer II |
| Range | 1.15 to 10.95 | 0.92 | 1.66 to 8.90 | 0.63 | 0.50 to 7.45 | 0.29 |
| Average | 6.637 | 0.92 | 4.53 | 0.63 | 2.97 | 0.29 |

**A.Depth to water level Aquifer I**

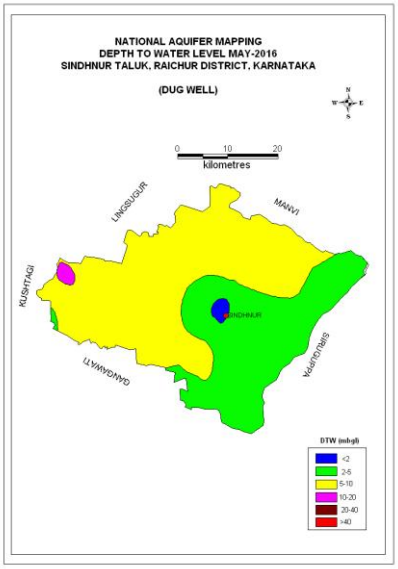


**Fig-6** Pre monsoon DTW Map Aquifer I

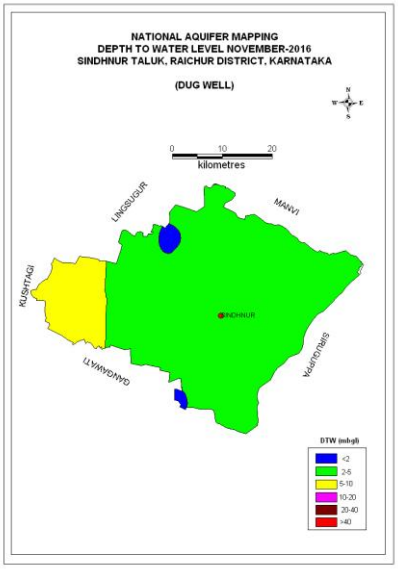


**Fig-7** Post monsoon DTW map Aquifer-I

**B.Depth to water level Aquifer II**

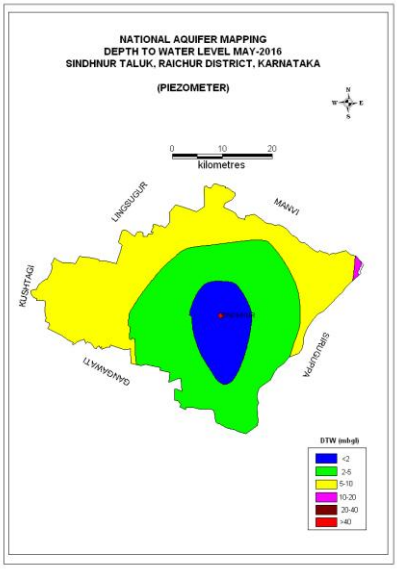


**Figure-8** Pre monsoon DTW Map Aquifer II

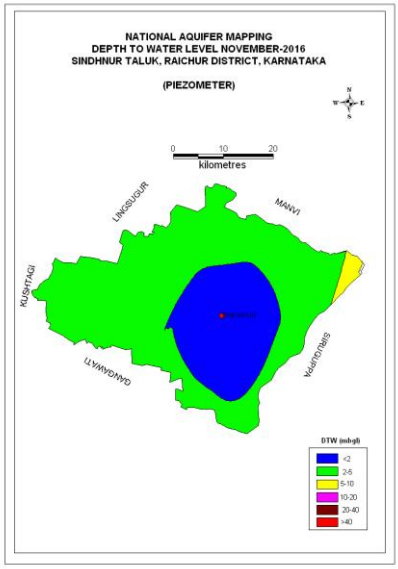


**Figure-9.** Post monsoon DTW map Aquifer II

**C.Water level fluctuation :**

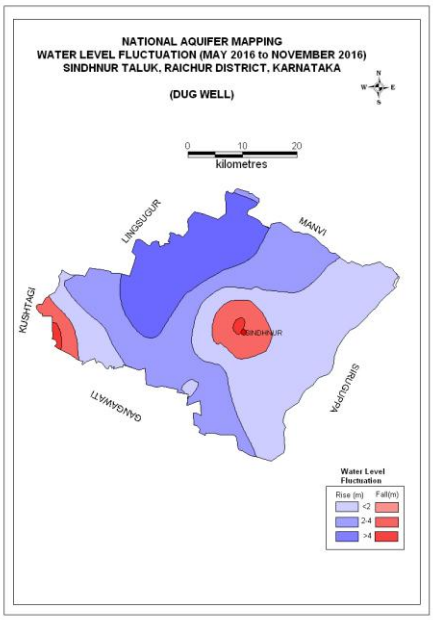


**Figure-10 W/L Fluctuation map Aquifer I**

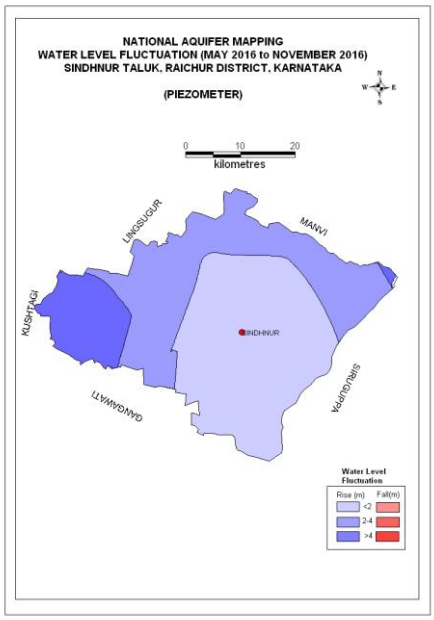


**Figure-11 W/L Fluctuation map Aquifer II**

## 2.0 AQUIFER DISPOSITION

The data collected during Geophysical investigation, Ground water exploration were made use to delineate the aquifer system, Geometry and the extension of aquifer in terms of both lateral and vertical extent. No deep drilling beyond 100m in the taluk. However exploratory drilling up to the depth of 80.00 was carried out during 1988 to 1990 and the details of ground water exploration are in **Table-8**.

**Table - 8: Details of Ground water Exploration in Sindhanur taluk**

| Sl. No. | Details | No/Range | Average |
|---|---|---|---|
| 1 | No of wells drilled | 4 | - |
| 2 | Depth range in 'm' | 50.00 to 80.00 | 57.125 |
| 3 | Depth of Casing in 'm' | - | - |
| 4 | Discharge in LPS | 0.98 to 4.92 | 2.87 |
| 5 | S.W.L. in m | 1.09 to 9.481 | 6.05 |
| 6 | Transmissivity $m^2$/day | 0.95 to 86.00 | 37.18 |

**2.1 Number of aquifers:** Based on the Ground water exploration data In Sindhanur taluk, there are mainly two types of aquifer systems;

**i. Aquifer-I- (Phreatic aquifer)** comprising Weathered Gneiss / Granite / Lime stone / Sand stone.

**ii. Aquifer-II- (Fractured multi-aquifer system)** comprising Fractured **Gneiss / Granite / Lime stone/San dstone.**

## 3. GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION

### 3.1 Aquifer wise resource availability and extraction:

Aquifer wise ground water resource (2009) has already been discussed in above chapter (1.8 & 1.9). However overall Groundwater resource estimation in Sindhanur taluk as on 2011 & 2013 indicating present and future scenario (2025), Stage of ground water development and categorization is presented in the below **Table-9**.

**Table-9 Ground water resource**

| Sl.No | Resource details | As per 2011 Estimation | As per 2013 Estimation |
|---|---|---|---|
| 1 | Net Ground Water Availability in HAM | 27420.58 | 26648 |
| 2 | Existing Gross Ground Water Draft for Irrigation in HAM | 5032.65 | 5133 |
| 3 | Existing Gross Ground Water Draft for Domestic and Industrial Water Supply in HAM | 426.92 | 273 |
| 4 | Existing Gross Ground Water Draft for all use in HAM | 5459.57 | 5406 |
| 5 | Allocation for Domestic And Industrial Use for next 25 years in HAM | 959.58 | 577 |
| 6 | Net Ground Water Availability for future Irrigation Development in HAM | 21428.34 | 20938 |
| 7 | Existing Stage Of Ground Water Development in percentage | 20 | 20 |
| 8 | Categorization | Safe | Safe |

### 3.2 Chemical quality of ground water and contamination

The chemical quality of ground water in Sindhanur taluk is assessed from the analysis results of 6 ground water samples from dug wells (Aquifer-I). The variation range and average of the different chemical constituents are presented in the Table-10 and the distribution of Chloride, EC, Nitrate and Fluoride is presented in the **Figure-17** to **20.**

**Table-10 Variation range and average of chemical constituents in Ground water**

| Chemical consitituennts in PPM → | $P^H$ | EC in m/mhos/cm at $25^0$ c | Total hardness as$CaCo_3$ | $Ca^{++}$ | $Mg^{++}$ | $Na^{++}$ | $K^+$ | $Hco_3$ | Cl | $So_3$ | $No_3$ | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Range | 8.42 to 9.02 | 385 to 3920 | 130 to 510 | 31 to 130 | 11 to 44.8 | 44 to 394 | 1.2 to 6.0 | 97 to 361 | 41 to 488 | 6 to 246 | 1 to 36 | 0.18 to 2.10 |
| Average | 8.69 | 1277.22 | 223.33 | 50.44 | 23.28 | 148.00 | 2.9 | 232.67 | 145.56 | 54.11 | 17.18 | 0.62 |

**3.2.1**. Suitability of ground water for **drinking purposes** is assessed as per Indian Standard Drinking water specification (IS 10500:1991) which indicates that water is potable and all the required chemical constituents is within the desirable/permissible limits. The range of chemical constituents (under NAQUIM) in ground water of the taluk is plotted in Piper diagram **Figure-21.**

**3.2.2.** Suitbility of ground water for **irrigation purposes** was assessed and the chemical analysis of the taluk is plotted in United States Regional Salinity Labaratory (1954) classification and presented in the diagram **Figure-22.**

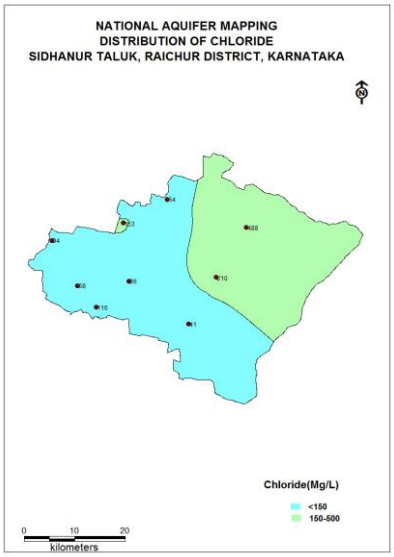


**Figure-17** Distribution of Chloride

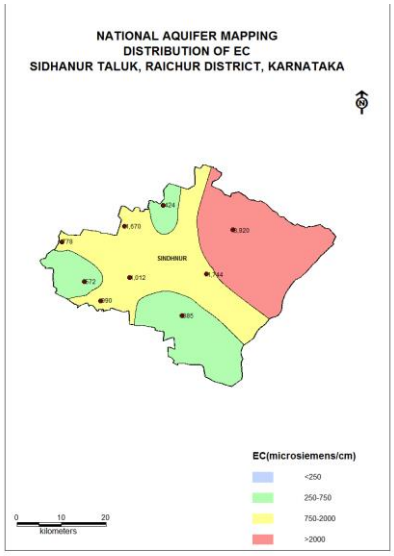


**Figure-18** Distribution of EC


**Figure-19** Distribution of Nitrate

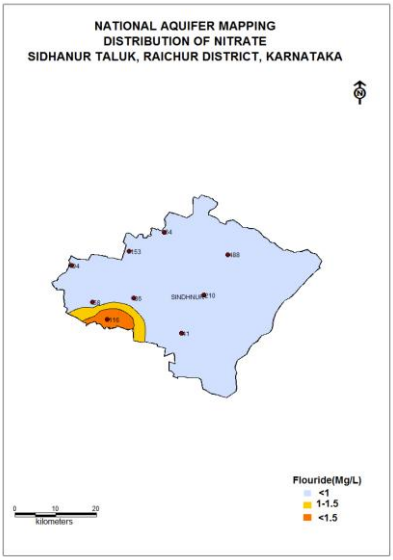


**Figure-20** Distribution of Fluoride

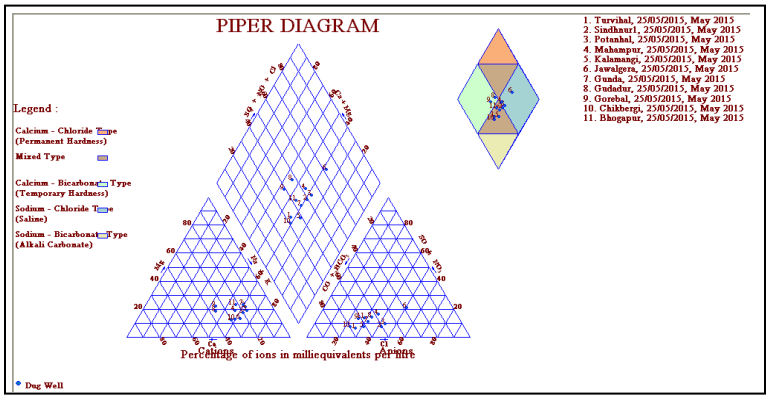


**Figure-21 C**hmeical anlysis Plot on Piper Diagram

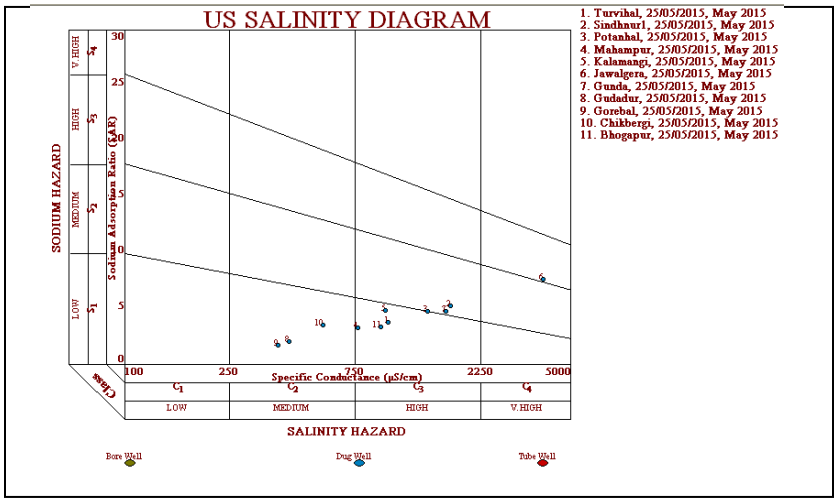


**Figure-22 U.S.** Salinity diagram

### 3.3.Ground water contamination :

Perusal of the above analysis/interpretations of chemical data it indicates that there is no major ground water contamination except point contmination of different chemical constituents were noticed here and there in the taluk.

## 4.0 GROUND WATER RESOURCE ENHANCEMENT:

In non command area of the Sindhanur taluk, increase in agricultural activity, subjected to excessive ground water withdrawal leading to depletion of ground water table, reduction in yield and deterioration of ground water quality etc., suggests a need for proper ground water management and enhancement of storage capacity of aquifers, protection of ground water quality and proper utilization of ground water.

To enhance the storage capacity of aquifers, the dewatered aquifers are to be recharged, for which the artificial recharge structures like Check dams, percolation tanks, point recharge structures etc have to be constructed (**Table-11**).

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

**Quantity of water available through non-committed surface run off**:

The surplus non-committed monsoon run off is calculated to be 31.8548 MCM this can be used to recharge the aquifer through suitable recharge structures which augments the net ground water availability in the taluk. The details of types of structure/number for recharge are presented in the **Table-11**.

**Table-11 Details of Artificial structures**

| Artificial Recharge Structures available/Proposed | Sindhanur taluk | Resource available in MCM |
|---|---|---|
| Non committed monsoon run off available (MCM) | | 31.8548 |
| Number of Check Dams | 196 | 23.573 |
| Number of Percolation Tanks | 13 | 7.964 |
| Number of Point Recharge structures | 21 | 0.319 |
| Tentative total cost of the project (Rs. in lakhs) | 731 | - |
| Excepted recharge (MCM) | 18 | - |
| Expected rise in water level (m) | 1.807 | - |
| Cost Benefit Ratio (Rupees/ cu.m. of water harvested) | 4.26 | - |

Thus considering above source water for ground water recharge the volume of water expected to be conserved or in the ground water resource enhancement is as detailed in the below **Table-12**.

**Table – 12: Details of resource enhancement after proposed artificial recharge**

| Sl.No | Resource details | As per 2013 Estimation |
|---|---|---|
| 1 | Net Ground Water Availability in HAM | 26648 |
| 2 | Existing Gross Ground Water Draft for All use HAM | 5406 |
| 3 | Existing Stage Of Ground Water Development in percentage | 20 |
| 4 | Expected recharge from Artificial Recharge Projects HAM | 1800 |
| 5 | Cumulative ground water Availability HAM | 28448 |
| 6 | Expected improvement in stage of ground water Development after implementation of the project in percentage | 19.00 |
| 7 | Expected improvement in overall Stage of Ground water development in percentage | 1.00 |
| 8 | Expected additional irrigational potential in hectares | 2201 |

## 5. DEMAND SIDE INTERVENTIONS:

### 5.1 Advanced irrigation practices:

As part of sindhanur taluk falling in command area, the utilization of surface water through surface water flow scheme (3 No.) & surface lift irrigation (1560 no.) are being practiced and potential utilized is 3971ha (4$^{th}$ Minor irrigation census). In the remaining part of non-command, the major crops like is Jowar, Bajra and Bengal gram which is rain fed crop. Remaining crops like some of the other pulses, Vegetables and fruits are depending upon the ground water source.

The ground water for irrigation is being developed through **9** irrigation dug wells and **787** irrigation bore wells. The existing **advanced irrigation practices** and the irrigation potential created over the taluk is as detailed in the below **Table-13**.

**Table-13 Details of Irrigation practices**

| Sl.No | Advanced Irrigation practices | No. of Irrigation Dug wells and potential utilized area in hectares | | No. of Irrigation Bore wells and potential utilized area in hectares | | Total | |
|---|---|---|---|---|---|---|---|
| | | No. Dug wells | potential utilized (area in hectares) | No. of Bore wells | potential utilized (area in hectares) | Total no of structures | Total potential Utilized(area in hectares) |
| 1 | Open water channel | 4 | 6 | 135 | 152 | 139 | 158 |
| 2 | Underground pipe | 5 | 11 | 538 | 1215 | 543 | 1226 |
| 3 | Surface pipe | - | - | 41 | 59 | 41 | 59 |
| 4 | Drip irrigation | - | - | 73 | 194 | 73 | 194 |
| 5 | Sprinklers | - | - | - | - | - | - |
| 6 | Others | - | - | - | - | - | - |
| | **Total** | **9** | **17** | **787** | **1620** | **796** | **1639** |

***Source:*** *4$^{th}$ Census of Minor Irrigation schemes, Department of Minor irrigation, Bangalore, March 2011*

Perusal of the above Table-13, the irrigation practices like Drip irrigation & sprinklers as water distribution system is comparatively negligible with negligible irrigation potential utilized when

compared to other distribution systems resulting in difficulty in economy of water conservation. If these methods of drip and sprinkler irrigation systems increased, maximum available ground water can be conserved judiciously. This ultimately enhances the area under irrigation potential.

**5.2 Change in cropping pattern**

Farmers are facing inadequacy of groundwater for agriculture so farmers have to change in their cropping pattern and water economy irrigation practices like drip irrigation and sprinkler irrigation which are negligible number. If they also adopt the water use efficient irrigation practices like **mulching**-plastic sheeting, spread on the ground around plants to prevent excessive evaporation or erosion, enrich the soil, etc., and there will be additional saving in water. Therefore, encouragement from government is essential for achieving full target of water use efficiency in the taluk.

**5.3. Alternate water sources:**

As per the resource estimation – 2013, Sindhanur taluk falls under Safe category with the stage of ground water development of 20 % having sufficient scope to enhance the agricultural activities with strategic action plan. So there is need to formulate management strategy of Accelerated irrigation program (AIBP), Her Khet Ko Pani (HKKP) etc.

If the artificial recharge projects as proposed is implemented the Surplus non committed monsoon runoff water available-through artificial recharge structures about 31.8548 MCM of water as non committed monsoon run off can be conserved. This alternate water sources will cope up additional irrigational potential of 2201 ha of agricultural land and there will be rise in water level of 1.807m (**Table 11&12**).

**5.4. Regulation and control:**

Considering the current existing ground water draft for all use – 5406 HAM with the stage of ground water development up to 20%, it is still scope to plan to augment the ground water through artificial recharge. Apart from this it is mandatory to adopt advanced irrigation practices like drip irrigation, sprinklers and other practices which are reported to be in no/negligible number and management of ground water for irrigation with water use efficiency methods.

**5.5 Other Interventions proposed:**

It is also to propose strategic action plan for irrigation that the PER DROP MORE CROP where the Micro Irrigation practices with the objective of enhancing the crop productivity by improving water use efficiency through micro irrigation systems as proposed in water management practices. Pradhaan Mantri Krishi Sinchayee Yojana (PMKSY) Water shed development - the other one with the focus on effective management of runoff water and improved soil and moisture conservation such as ridge area treatment, drainage line treatment, rain water harvesting, newly created water harvesting structures such as farm ponds, Check dams, nala bunds, percolation tanks and other ground water recharge structures