



केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga

Rejuvenation

Government of India

Report on

AQUIFER MAPPING AND MANAGEMENT PLAN

Holalkere Taluk, Chitradurga District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region, Bengaluru



**HOLALKERE TALUK AQUIFER MAPS AND MANAGEMENT PLANS,
CHITRADURGA DISTRICT,
KARNATAKA STATE**

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AQUIFER MANAGEMENT PLAN OF HOLALKERE TALUK, CHITRADURGA DISTRICT, KARNATAKA STATE

1. SALIENT FEATURES

Name of the Taluk : HOLALKERE

District : Chitradurga

State : Karnataka

Area : 1108 sq.kms

Population : 2, 07,377 (2011 Census)

Rainfall : 756 mm

Holalkere taluk, Chitradurga district, Karnataka state covering an area of 1108 Sq. Kms and is a part of Krishna river basin located at longitudes $13^{\circ} 51' 35.3''$: $14^{\circ} 15' 20.5''$ and east latitude of $76^{\circ} 01' 30.7''$: $76^{\circ} 28' 36.1''$ and is bounded by Channagiri taluk towards west, Davanagere taluk towards north, Chitradurga taluk towards east, and Hosadurga taluk towards south. The Location map of the taluk is in Figure-1.

Holalkere taluk is a part of Chitradurga revenue sub-division with Holalkere as taluk head quarter. There are four revenue hoblies-Holalkere, Talya, Ramagiri and Bharmanaikanadurga which covers 166 Inhabited and 36 un inhabited villages. The taluk is well connected with good network of roads with NH-1 & 2, broad gauge railway line along with state high ways forming good new work of transport facility.

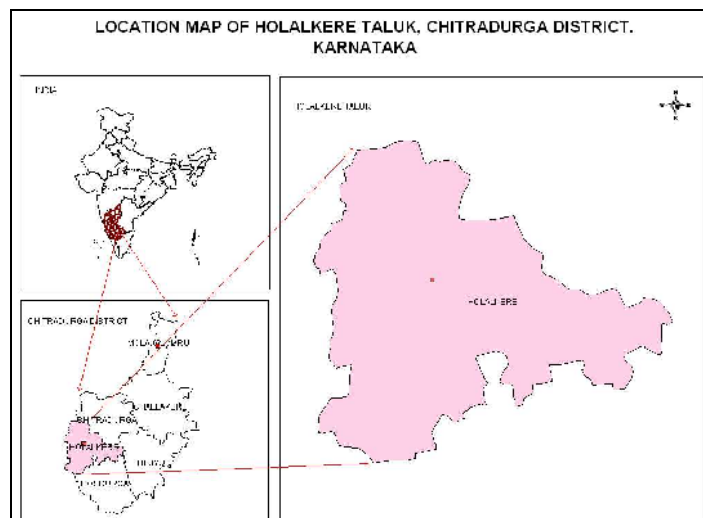


Fig 1: Location map of Holalkere taluk, Chitradurga district

1.2 Population

As per 2011 census, the total population in Holalkere taluk is 207377 (105212 males and 102165 Females) of which about 185808 (89.599 %) constitutes the rural population. The Taluk has an overall population density of 189.41 persons per sq.km. The decennial growth rate is 4.86.

1.3 Rainfall

Holalkere taluk enjoys arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Central 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 temperature in summer is in between 30^{0C} to 39^{0C} and in winter it is 16⁰ to 27⁰ C. The rainy season or South-West monsoon is from June to September followed by North-East monsoon; post-monsoon from October to December. The Annual Normal rainfall (1981 to 2010) in the taluk is 756 mm and the statistical analysis of rain fall data is presented in the table-1

Table 1: Statistical Analysis of Rainfall Data of Holalkere Station, for the Period 1981 to 2010

Item	JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
NRM	1	1	15	37	72	126	74	94	116	128	412	144	65	9	218	756
STDEV	4	4	27	40	56	71	49	41	54	89	143	89	127	20	144	234
CV%	392	277	187	107	78	56	66	44	47	70	35	62	195	226	66	31

Assessment of Drought

Rainfall data has been analysed to assess the drought condition using for 105 years Rain fall data and the results / classification thus obtained are listed in the Table-2. It is observed that the Holalkere taluk has experienced alternating no drought to moderate drought conditions over the years.

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

% Deviation (Di)		>0	0 to -25	-25 to -50	Probability of drought occurrences
Category		No drought	Mild (Normal)	Moderate	
		Years			
Taluk	Holalkere	46	40	19	Once in 6 years

Out of 105 years of analysis, "No Drought" condition is experienced in 46 years, "Mild Drought" for 40 years and it experienced "Moderate Drought" condition in 19 years. Based on

occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought has been studied. It has been observed that the frequency of occurrence of drought is once in **6 years** in Holalkere taluk.

1.4 Agriculture & Irrigation

Holalkere taluk is having 185808 (89.599 %) of rural population 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 in Holalkere taluk

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
135868	8878	11408	22242	12528	80812	1524	82336

Source: District at a glance 2011-2012

1.4.1 Principal crops

The principal crops of the taluk are Maize - 39750 ha (48.27% to the total cropped area), Sun Ground nuts and sesame are the main oilseeds. Overall food grains are the major crops comprising of cereals and pulses grown in an area of 53328 ha (64%) and oil seeds with an area of 11782 ha (14.38%) grown during Rabi season. Vegetables and paddy crops are the Kharif crops. The principle crops and area grown are in the below table-4.

Table 4. Principal crops in Holalkere taluk

Crops	Cereals (Ha)			Pulses (Ha)				Fruits (Ha)	Vegetables (Ha)	Oil seeds (Ha)		
	Maize	Ragi	Others	Bengal gram	Horse gram	Tur dal	Others			Ground nuts	Sesamum	others
	39750	5460	4759	2558	1327	1235	1239	1617	2603	1180	1015	458
Total	46969			6359				1617	2603	2653		
	Food Grains (53328 ha)							Fruits	Vegetables	Oilseeds		

Source: District at a glance 2011-2012

1.4.2 Irrigation Practices

In Holalkere taluk the ground water is being developed from ground water structures like 74 dug wells and 10727 number of shallow tube wells (Report on 4th census of Minor Irrigation Schemes 2006-2007) for irrigation purposes. The ground water thus developed from these structures were managed through water distribution irrigation practices by adopting- Open channel (953 bore wells & 38 dug wells), Underground pipe (1875 bore wells & 9 dug wells), surface pipe (384 bore wells & 3 dug well), drip irrigation (7498 bore wells & 24 dug wells) sprinklers (14 bore wells & 0 dug wells) and others (38 bore wells).

1.4.3 Ground water and surface water Irrigation

Ground water is the main source of irrigation in Holalkere taluk. The details of surface water and ground water irrigation are in the table-5.

Table 5. Details of irrigation in Holalkere taluk.

Sl. No.	Source		No. / Length	Net area irrigated	Gross area irrigated
1	Surface water	Canals	0	0	0
		Tanks	57	0	0
2	Ground water	Dug Wells	703	0	0
		Bore wells	10080	13504	14578
5		Total	10840	13504	14578

Source: District at a glance 2011-2012

1.5 Geomorphology, Physiography & Drainage

Geomorphologically Holalkere taluk is characterised by huge undulating plains and is part of Eastern Ghats with a range of hills extends from south to north till Arasanaghatta and a branch of this extends westwards till Ramagiridurga, besides this small hill ranges near Kudu, Ramagiri and Gundari. Prominent hill ranges are Doddahatti, Rangappanagudda (3751feet) and Waddera gudda (3138 feet) figure 2. The taluk lies on a elevation between 487m to 1137m with an average elevation of 711m a msl.

Drainage

Holalkere taluk is the part of Krishna river basin. The taluk is drained by Janagahalla or Chikka Hagari originates in the taluk having its source and flows towards chitradurga and joins Vedavathi River. The other major stream is Syagalahalla (Sulekere) also originates in the taluk and ultimately joins Tungabhadra near Harihar. The general drainage pattern is of sub-rectangular due to marked influence of geologic structures in the basin Figure-3.

1.6 Geology

Holalkere taluk is occupied by crystalline Schist and greywackes constituting Chitradurga schist belt and banded gneissic complex as major rock formation figure 4.

1.7 Soil

The soils of the area are derived from Schist / Gneiss. The soils are clayey, clayey missed, clayey skeletal, Loamy and rocky land (Figure 5).

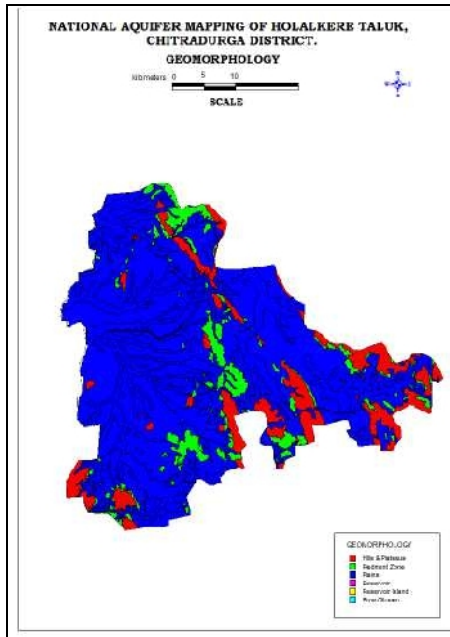


Fig 2. Geomorphology map

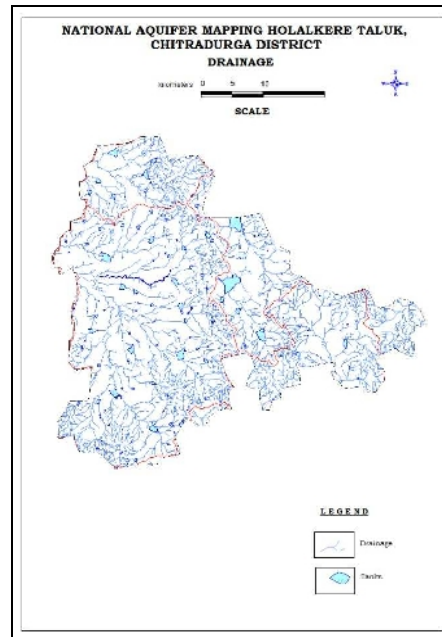


Fig 3. Drainage map

1.8 Ground water resource availability and extraction

The Ground water availability as per Resource Estimation 2009 is as in the table-6.

Table 6. Ground water resource availability and extraction

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (Down to 200m)	Dynamic + phreatic in-storage + fractured
HAM	9320	11054	2409	22783

As per the estimation (GEC 2013) the ground water draft (extraction) for irrigation worked out to be 11356 ham with stage of ground water development of 137%.

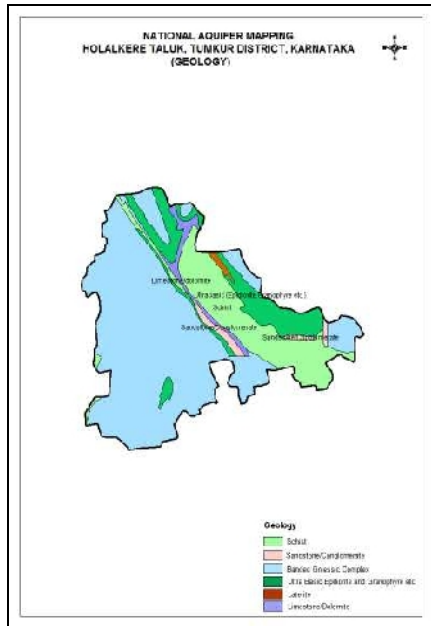


Fig 4. Gology map

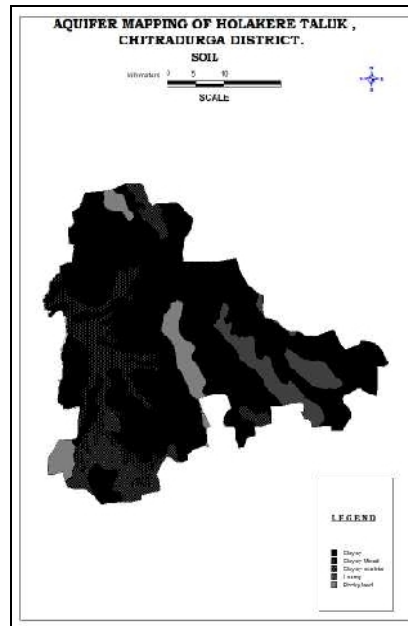


Fig 5. Soil map

1.9 Existing and future water demands

As per GEC (2013) existing ground water draft for irrigation, industrial & domestic (all use) is **12086 ham** and availability for future demands with judicious utilization since the stage of ground water development is already reached up to **137 %** having less scope it is **788 ham** of which **758 ham** is for domestic and industrial use and **30ham** 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 table 7 and figures 6 to 11.

Table 7. Depth to Water levels (mbgl) in Holalkere taluk

	Pre monsoon		Post monsoon		Water level fluctuation	
	Aquifer I	Aquifer II	Aquifer I	Aquifer II	Aquifer I	Aquifer II
Range	11.23 to 11.96	6.97 to 15.12	0.97 to 6.10	5.70 to 16.84	0.13 to 12.43	-1.27 to 1.72
Average	5.28	11.04	3.31	11.27	2.33	0.225

A.Depth to water level: Aquifer I

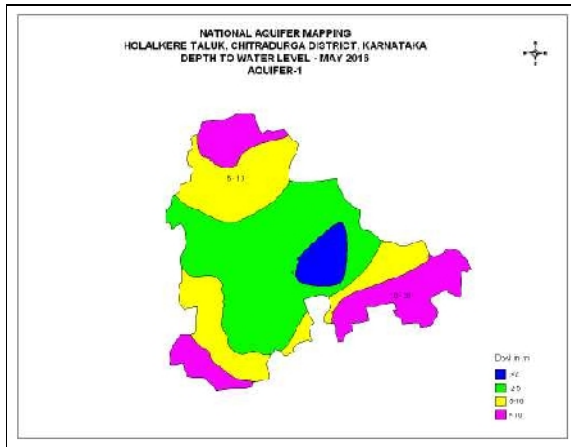


Fig 6. Pre- monsoon DTW Aquifer- I

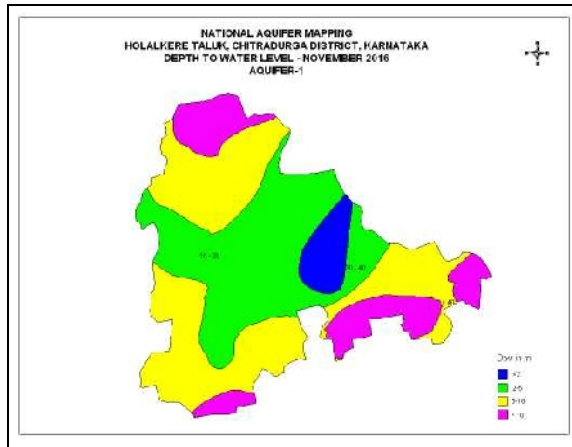


Fig 7. Post-monsoon DTW Aquifer-I

B.Depth to water level: Aquifer II

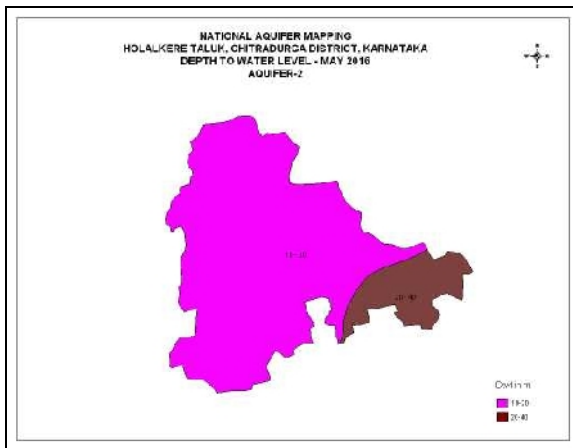


Fig 8. Pre-monsoon DTW Aquifer- II

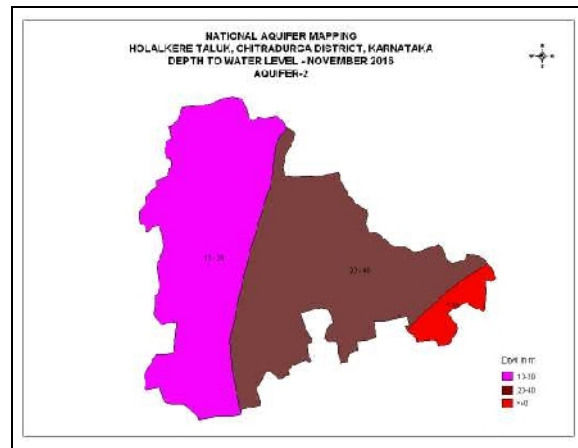


Fig 9. Post- monsoon DTW Aquifer- II

C. Water level fluctuation

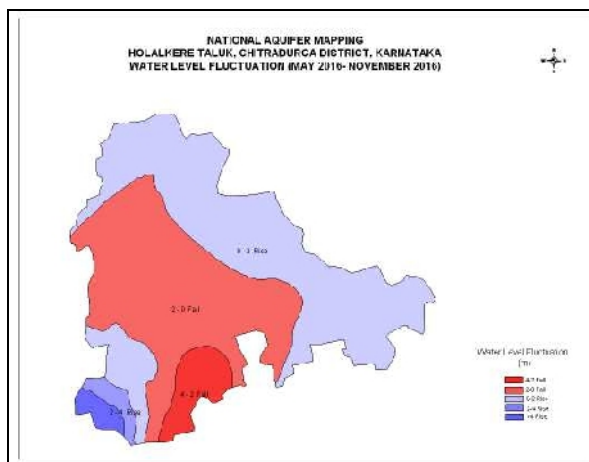


Fig 10. Water level Fluctuation map Aq-I

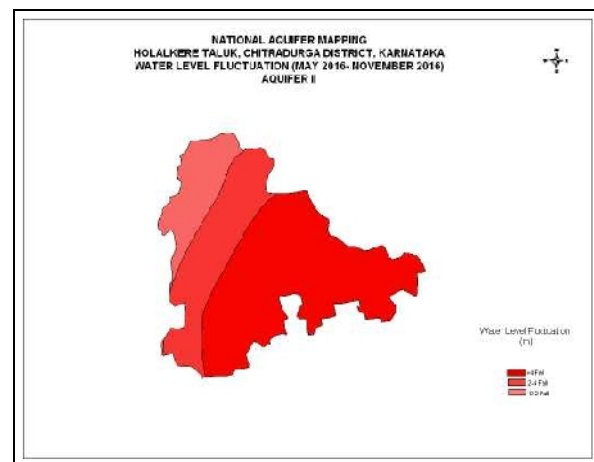


Fig 11. Water level Fluctuation map Aq-II

Analysis of long term water level trend in Aquifer-1 indicates that in pre monsoon there is rising trend of 0.057 to 0.653 m/y with an average of 0.221 m/y and during post monsoon also showed rising trend in the range of 0.074 to 0.488 m/y with an average of 0.231 m/y. Overall trend also showed rising trend with an average of 0.20 m/y.

2. AQUIFER DISPOSITION

The data collected during Geophysical investigation, Ground water exploration (**Table- 5**) were made use to delineate the aquifer system, Geometry and the extension of aquifer in terms of both lateral and vertical extent.

Table 8: Details of Ground water Exploration in Holalkere taluk

Sl. No.	Details	No/Range
1	No of wells drilled	20
2	Depth range in 'm'	38.65 to 200.00
3	Depth of Casing in 'm'	5.5 to 30.73
4	Discharge in LPS	0.13 to 3.52
5	S.W.L. in mbgl	4.94 to 26.55
6	Transmissivity, m ² /day	12.57 to 32.7

The fracture analysis from the above wells indicates about 32% of the fractures are encountered at the depth of 0 to 30.00 m, 45% of the fractures are in between the depth of 30 to 100m and 22% are in between 100 to 200m depth. The yield analysis indicated that 81% of the wells showed 1 to 5 lps discharge followed by 19% are above 5 lps discharge.

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

- i. **Aquifer-I- (Phreatic aquifer)** comprising Weathered Gneiss / Granite which is dry.
- ii. **Aquifer-II- (Fractured multi-aquifer system)** comprising Fractured Gneiss / Granite.

2.2 3 D aquifer disposition and basic characteristics of each aquifer:

The Exploration drilling data utilised for generating aquifer disposition maps through Rock works soft ware.

3. GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION

3.1 Aquifer wise resource availability and extraction

Aquifer wise ground water resource (2011) has already been discussed in above chapter (1.8 & 1.9). However, overall Groundwater resource estimation in Holalkere 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	8676.01	8824
2	Existing Gross Ground Water Draft for Irrigation in HAM	11133.63	11356
3	Existing Gross Ground Water Draft for Domestic and Industrial Water Supply in HAM	198.97	730
4	Existing Gross Ground Water Draft for all use in HAM	11332.60	12086
5	Allocation for Domestic And Industrial Use for next 25 years in HAM	207.44	758
6	Net Ground Water Availability for future Irrigation Development in HAM	0.01	30
7	Existing Stage Of Ground Water Development in %	31	137
8	Categorization	OE	OE

3.2 Chemical quality of ground water and contamination

The chemical quality of ground water in Holalkere taluk is assessed from the analysis results of 15 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. Range and average of chemical constituents in Ground water.

→ Chemical constituents in PPM	pH	EC in m/mhos/cm at 25 ° c	TH as CaCO ₃	Ca	Mg	Na	K	Hco ₃	Cl	So ₃	No ₃	F
Range	7.95 to 8.15	926 to 2883	90 to 500	16 to 92	15 to 95	88 to 455	0.37 to 73	244 to 793	121 to 461	40 to 215	3.2 to 265	0.3 to 1.3
Average	8.07	211.44	311.11	32.89	57.11	304.78	12.83	451.33	253	120.56	83.09	0.65

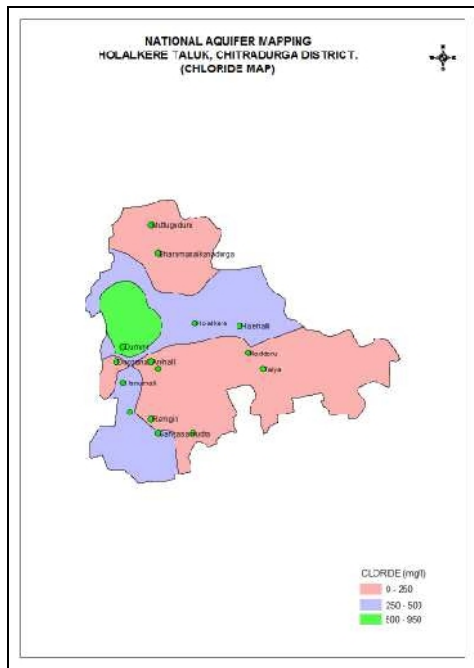


Fig 17. Distribution of Chloride

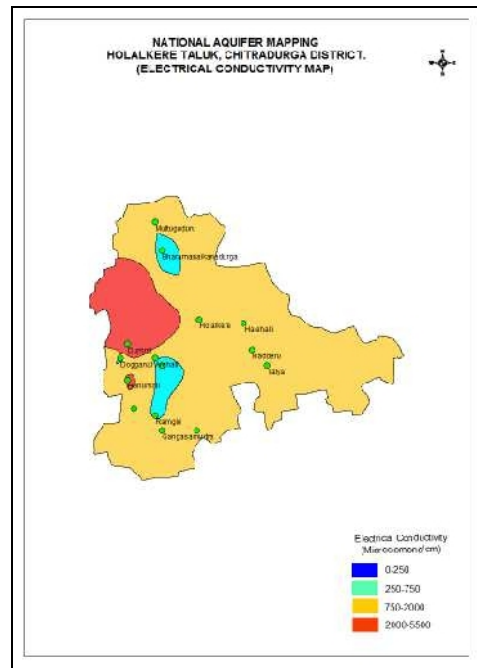


Fig 18. Distribution of EC

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

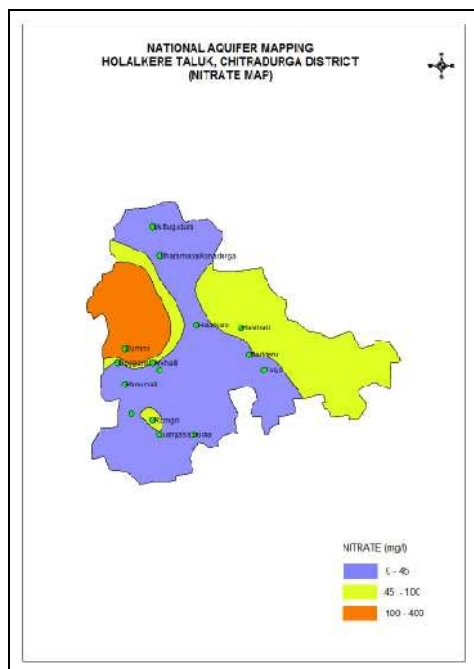


Fig 19. Distribution of Nitrate

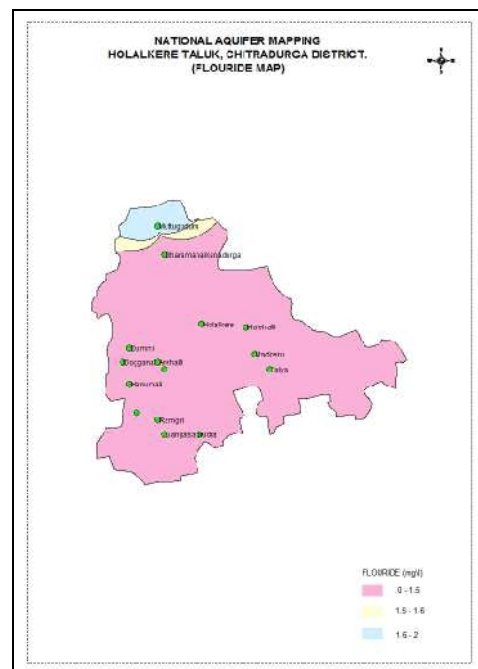


Fig 20. Distribution of Fluoride

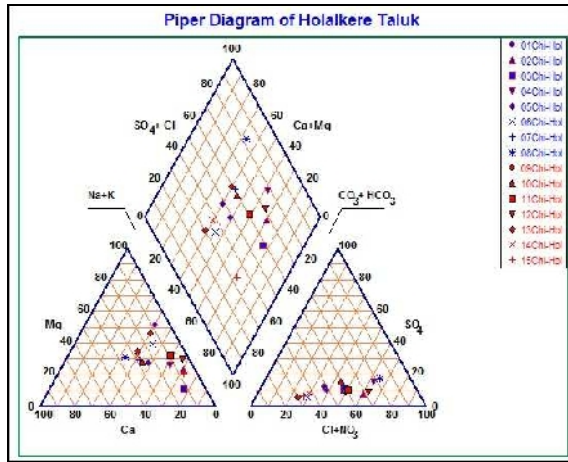


Fig 21. Chemical analysis Plot (Piper Diagram)

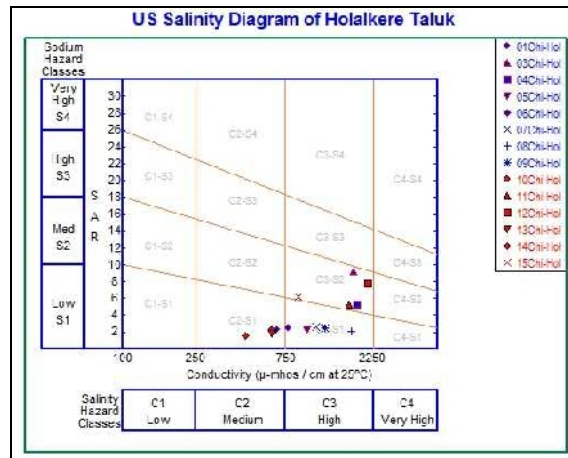


Fig 22. U.S. Salinity diagram

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

3.3. Ground water contamination

Perusal of the above analysis/interpretations of chemical data results it indicates that there is no major ground water contamination except Nitrate contamination (Table-10) for drinking / irrigational purposes over entire Holalkere taluk.

4. GROUND WATER RESOURCE ENHANCEMENT

Continuous drought, 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

4.1.1 Quantity of water available through non-committed surface run off

The surplus non-committed monsoon run off is calculated to be 14.5046MCM this can be used to recharge the aquifer through suitable recharge structure 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	Holalkere taluk	Resource available in MCM
Non committed monsoon runoff available (MCM)	14.504	14.504
Number of Check Dams	89	10.733
Number of Percolation Tanks	6	3.626
Number of Point Recharge structures	10	0.145
Tentative total cost of the project (Rs. in lakhs)	349.65	-
Excepted recharge (MCM)	8.217	-
Expected rise in water level (m)	0.410	-
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	4.255	-

Thus, considering above source water for ground water recharge the volume of water expected to be conserved or 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	8824
2	Existing Gross Ground Water Draft for All use HAM	12086
3	Existing Stage Of Ground Water Development in percentage	137
4	Expected recharge from Artificial Recharge Projects HAM	822
5	Cumulative ground water Availability HAM	9646
6	Expected improvement in stage of ground water Development after implementation of the project in percentage	125
7	Expected improvement in overall Stage of Ground water development in percentage	12
8	Expected additional irrigational potential in hactares	1002.05

5. DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

Major crops of Holalkere taluk is Maize and Ragi are rain fed crops. Remaining crops like some of the pulses, Vegetables and fruits are depending upon the ground water source.

The ground water for irrigation is being developed through **74** irrigation dug wells and **10727** irrigation bore wells. The existing advanced irrigation practices and the irrigation potential created over the taluk is as detailed in the table 13 below.

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 (hectares)	No. of Bore wells	potential utilized (hectares)	Total no of structures	Total potential utilised
1	Open water channel	38	37	953	1350	991	1387
2	Underground pipe	9	5	1875	2314	1884	2319
3	Surface pipe	3	5	384	407	287	412
4	Drip irrigation	24	24	7498	8082	7522	8106
5	Sprinklers	-	-	14	16	14	16
6	Others	-	-	3	3	3	3
	Total	74	71	10727	12172	8817	12243

Source: 4th 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 very less with less 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 the 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 district.

5.3. Alternate water sources

As per the resource estimation – 2013, Holalkere taluk falls under OE category with the stage of ground water development of 137 % leading towards water scarcity problem. So there is need to formulate management strategy to tackle the water source scarcity in the taluk.

If the artificial recharge projects as proposed is implemented the Surplus non committed monsoon runoff water available-through artificial recharge structures about 14.504 MCM of water will be conserved. This alternate water sources will cope up additional irrigational potential of 1002.05ha of agricultural land and there will be rise in water level of 0.410m (Table-11&12).

5.4. Regulation and control

Considering the current existing ground water draft for all use - 12086HAM with the stage of ground water development up to 1137%, it is mandatory to plan to augment the ground water through artificial recharge besides use of ground water judiciously.

Due to this grim situation of ground water resources in the taluk /district, state government has planned to conduct an intensive survey of ground water level and its quality and planning to impose a ban on sinking of new irrigation bore wells as per the provisions of the Karnataka Ground Water (Regulation and control of Development and Management) bill 2011.

5.5 Other Interventions proposed

The major issue in the taluk is water scarcity for drinking and irrigation. To mitigate this critical issue of scarcity for safe drinking water and for irrigation, construction of rain water harvesting units at the family level are must implementation of artificial structures as proposed to recharge the ground water. Excess nitrate contamination this requires dilution of Nitrate rich ground water through artificial recharge and water conservation.

