Draft Report

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

Sira Taluk, Tumkuru District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region,Bengaluru

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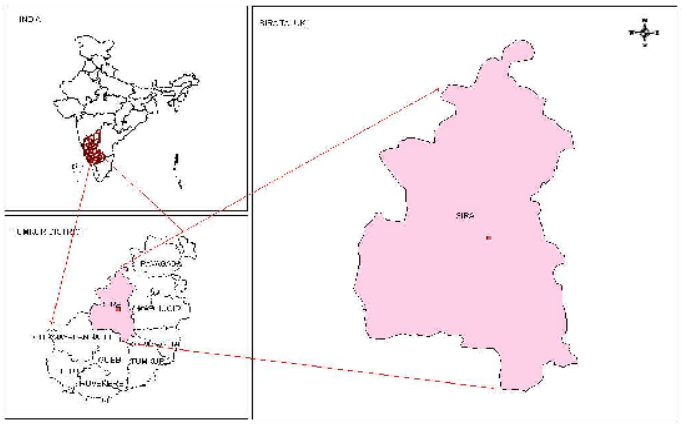
Government of India
Ministry of Water Resources, River Development & Ganga Rejuvenation
Central Ground Water Board

SIRA TALUK AQUIFER MAPS AND MANAGEMENT PLANS, TUMKURU DISTRICT, KARNATAKA STATE

LOCATION MAP OF SIRA TALUK, TUMKUR DISTRICT, KARNATAKA



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SIRA TALUK AQUIFER MAPS AND MANAGEMENT PLANS,
TUMKURU DISTRICT,
KARNATAKA STATE

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SIRA TALUK AQUIFER MAPS AND MANAGEMENT PLANS,
TUMKUR DISTRICT, KARNATAKA STATE

1. SALIENT FEATURES

Name of the taluk : **SIRA**
District : Tumkur
State : Karnataka
Area : 1, 556 sq.km.
Population : 3, 13,758 (2011)
Annual Normal Rainfall : 658 mm

Sira taluk, is located in northern portion of Tumkur district, Karnataka state covering an area of 1,556 sq. kms and is a part of North Pennar river basin located at longitudes 13029'21.0": 14^0 05' 29.8" and east latitude of $76^0$40'50.2": $77^0$03'16.8". It is surrounded by Hiriyur taluk on North, Gubbi taluk in south, Chikkanayakanahalli and Hiriyur taluk in the west and in the east by Madhugirl and Andhra Pradesh. The Location map of the taluk is in Figure 1.

The Sira taluk is a part of Madhugiri revenue sub-division with Sira as taluk head quarter. There are five revenue hoblies – Sira, Kallamballa, Bukkapatna, Hulikunte and Gowdanagere which covers 234 Inhabitated and 15 uninhabitated villages. The taluk is well connected with good network of roads with NH-4, NH-48 and NH-234 along with State highways and other roads forming good net work of transport facility.

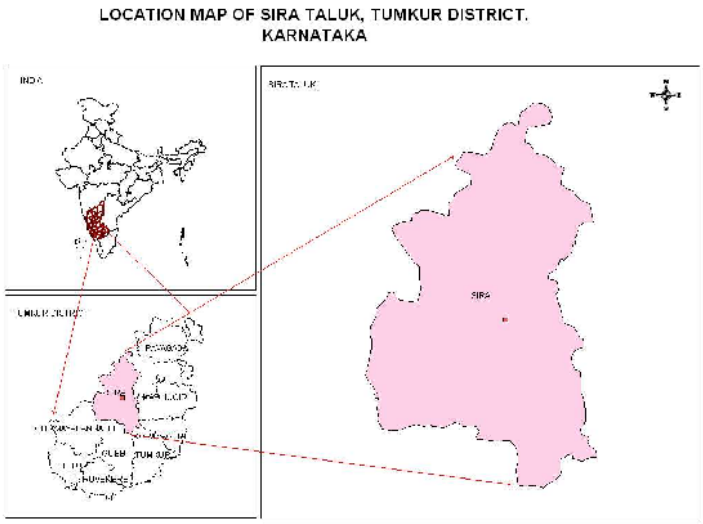

Fig 1: Location map of Sira taluk, Tumkur district

1.2 Population

As per 2011 census, the total population in Sira taluk is 3,13,758 (158978 males and 154780 Females) of which about 256204 (81.656 %) constitutes the rural population. The Taluk has an overall population density of 202 persons per sq.km. The decadal change is 4.07%.

1.3 Rainfall

Sira taluk enjoys semi 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 29^{0C} to 37^{0C} and in winter it is 16^{0} to 27^{0} C. The rainy season or 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 658 mm and the statistical analysis of rain fall data is presented in table 1.

Table 1: Statistical Analysis of Rainfall Data of Sira Taluk (Sira Station), for the Period 1981 to 2010

	JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
NRM	2	4	14	24	65	109	67	66	96	149	377	123	42	6	172	658
STDEV	5	9	25	30	48	71	48	63	96	83	161	87	49	13	113	243
CV%	286	205	175	124	74	65	72	96	100	56	43	71	116	193	66	37

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 Pavagada 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	50 to 75	Probability of drought occurrences
Category	No drought	Mild (Normal)	Moderate	Severe	
	Years				
Sira Taluk	49	23	30	3	Once in 3 years

Out of 105 years of analysis in Sira taluk, “No Drought” condition is experienced in 40 years, “Mild Drought” condition is 23 years and “Moderate Drought” condition experienced in 30 years. Further it is observed that “Severe Drought” condition is experienced in 3 years ie, during

1914, 1942 and 1985. 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 3 years.**

1.4 Agriculture & Irrigation

Sira taluk is having 256204 (81.656 %) 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, Sira 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
155377	5452	30009	27150	34916	57850	10342	68192

Source: District at a glance 2014-2015

1.4.1 Principal crops

The principal crop of the taluk is Ragi (15.15%) among food crops and Ground nuts - 23918 ha (35.07% to the total cropped area) among oil seeds, which are rain fed crops. Overall food food grains are the major crops grown during Rabi season. Vegetables and paddy crops are the Kharif crops. The principal crops and area grown are in table-4.

Table 4: Principal crops in Sira taluk

Crops	Cereals (Ha)			Pulses (Ha)				Fruits (Ha)	Vegetables (Ha)	Oil seeds (Area in Ha)		
	Ragi	Maize& Paddy	Others	Tur dal	Horse gram	Cow pea	Others			Ground nuts	Sun flower	others
	10325	1235	517	2650	3499	321	357	2609	768	23918	1296	136
Total	12077			6827				2609	768	25372		
	Total Food Grains -18946 ha							**Fruits**	**Vegetables**	**Total Oilseeds-25372ha**		

Source: District at a glance 2014-2015

1.4.2 Irrigation Practices

In Sira taluk the ground water is being developed from 4061 dug wells and 10873 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, Underground pipe, surface pipe, drip irrigation, sprinklers and others.

1.4.3 Ground water and surface water Irrigation

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

Table 5. Details of irrigation in Sira taluk.

Sl. No.	Source		No. / Length in kms	Net area irrigated	Gross area irrigated
1	Surface water	Canals	6.4	0	0
		Tanks	207	430	466
2	Ground water	Dug Wells	6135	99	99
		Bore wells	23893	15967	18105
		Total	30241.4	16496	18670

Source: District at a glance 2014-2015

1.5 Geomorphology, Physiography & Drainage

Geomorphologically Sira taluk falls in southern maidan region (Figure-2). The landscape consists of mainly undulating plains interspersed with a sprinkling parallel range of hills from north to south made up of granites and the second one mainly composed of schistose rocks passes through western side of Sira. No Prominent hill ranges in the taluk average elevation of taluk is 662m amsl.

Drainage

Sira taluk taluk is the part of North Pennar river basin. There are no perennial rivers in the taluk. The western Suvarnamukhi of western belt tributary of Vedavathy originates at Badamuddanahalli (Koratagere taluk) and enters Sira near Madalur village which flows north westerly direction. Doddahalla Stream originates southern portion of the taluk near Shettikere (Chicknaikanahalli taluk) from south which drains southern portion flows north easterly direction and joins the other branch of Suvarnamukhi near Husahalli of sira taluk (Figure-3).

Fig 2. Geomorphology map

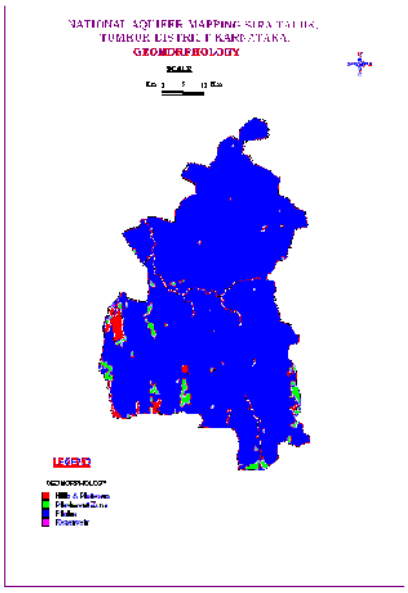

Fig 3. Drainage emap

1.6 Geology

Sira taluk is occupied by Banded Gneisses called as pemninsular Gneiss and Schists constituting are the major rock formation figure-4.

1.7 Soil

The soils of the area are derived from Granitic Gneiss and Schists. The soils are hard and poor in general. Sandy, clay, loam, black soil are the soil types Figure-5.

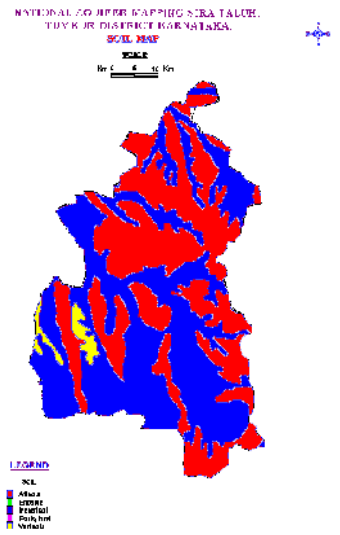

Fig 4. Gology map

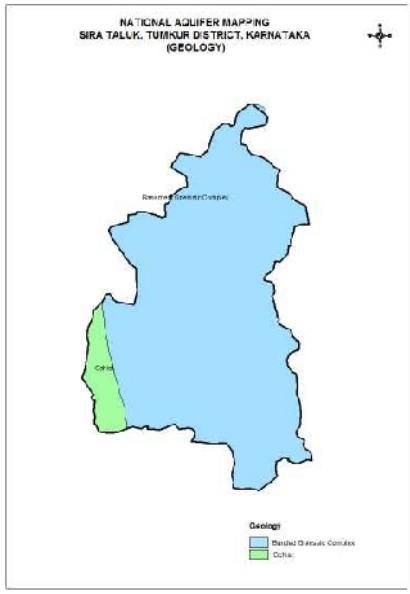

Fig 5. Soil map

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, HAM
		Phreatic	Fractured (Down to 200m)	Dynamic + phreatic in-storage + fractured
2009	11294	25556	3510	40160
2013	11628	0	3510	7035

As per the estimation **(GEC 2013**) the ground water draft (extraction) for irrigation worked out to be **10567 ham** with stage of ground water development of 96%.

1.9 Existing and future water demands

As per GEC (2013) existing ground water draft for irrigation, industrial & domestic (all use) is **11177 ham** and availability for future demands with judicious utilization since the stage of ground water development is already reached up to **96** % having less scope it is 1457 **ham** of which **674 ham** is for domestic and industrial use and **783 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 table 7 and figures 6 to 10.

Table-7: Depth to Water levels in Sira taluk

	Pre- monsoon, mbgl		Post- monsoon, mbgl		Water level fluctuation, m	
	Aquifer I	**Aquifer II**	**Aquifer I**	**Aquifer II**	**Aquifer I**	**Aquifer II**
Range	2.80 to 6.82	13.08	2.80 to 4.52	12.04	0.00 2.27	1.04
Average	4.81	13.08	3.66	12.04	2.27	1.04

A.Depth to water level: Aquifer I

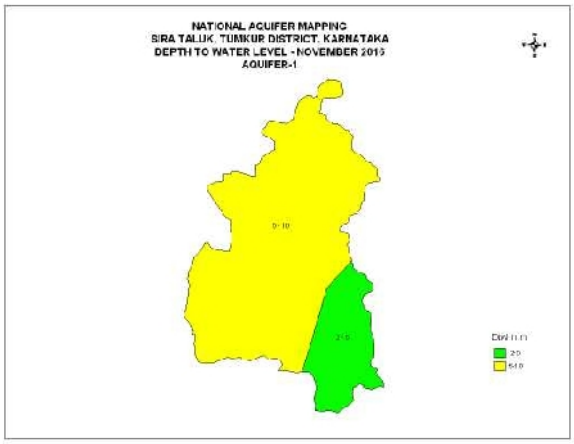

Fig 6. Pre-monsoon DTW Aquifer I

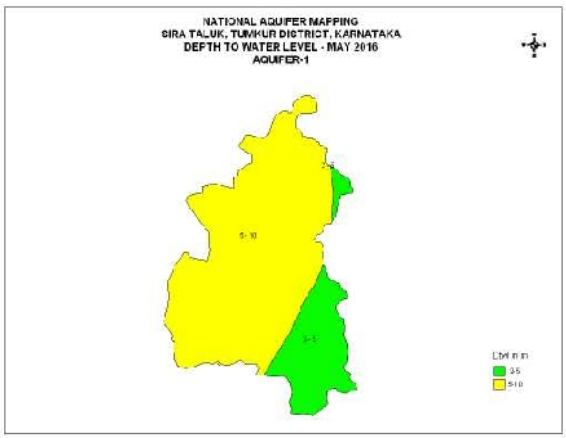

Fig 7. Post-monsoon DTW Aquifer-I

B.Depth to water level: Aquifer II

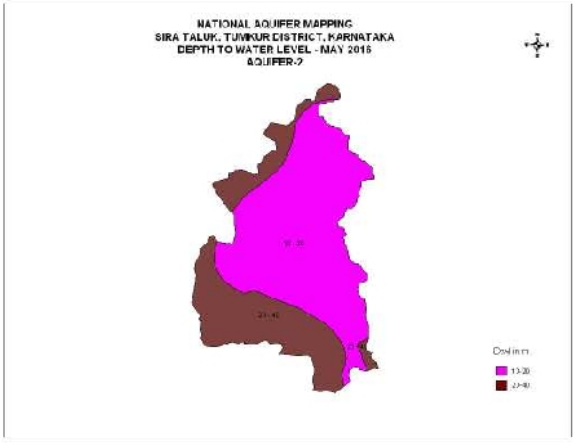

Fig 8. Post- monsoon DTW Aquifer II

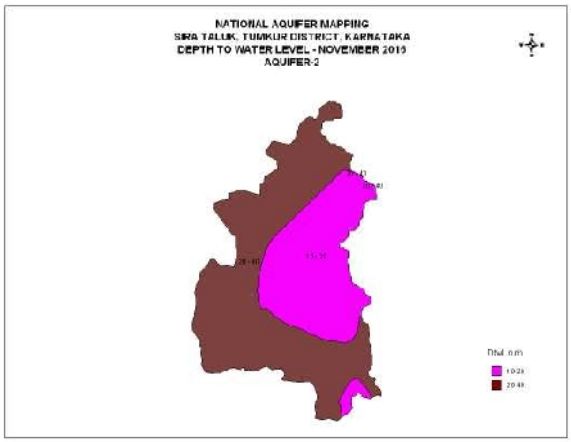

Fig 9. Post monsoon DTW Aquifer II

C.Water level fluctuation

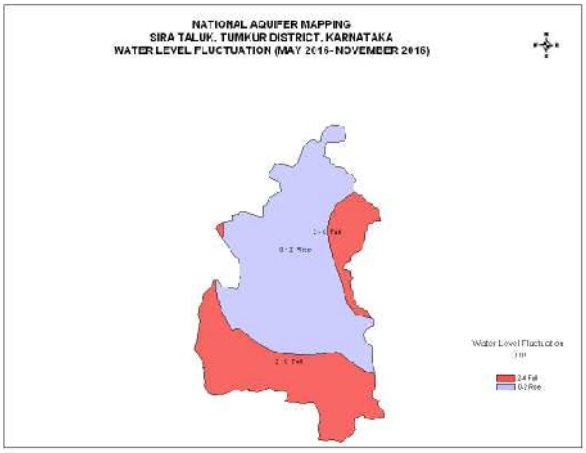

Fig 10. Water level Fluctuation Aquifer I

The analysis of long term water level trend in Aquifer-1 indicates that in pre monsoon there is rising trend of 0.116 m/y and falling trend of 0.010 m/y. Similarly during post monsoon showed rising trend of 0.029 m/y and falling trend of 0.319m/y. Overall trend indicates that rising trend to the tune of 0.0.34 to 0.065 m/y with an average of 0.202m/y and falling trend it ranged 0.215 to 0.135 m/y with an average of 0.175 m/y.

2. 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. The details of ground water exploration are in table-8.

Table 8: Details of Ground water Exploration in Sira taluk

Sl. No.	Details	No. / Range
1	No of wells drilled	10
2	Depth range in 'm'	65.00 to 193.21
3	Depth of Casing in 'm'	6.10 to 27.00
4	Discharge in LPS	1.26 to 12.67
5	S.W.L. in m	0.007 to 15.01
6	Transmissivity, m^2/day	7.85 to 12.182

The yield analysis indicated that 40% and 40% in between 1 to 5 LPS and above five LPS discharge followed by 20% are with less than 1 LPS discharge.

2.1 Number of aquifers

Based on the Ground water exploration data In Sira taluk, there are mainly two types of aquifer systems;

i. **Aquifer-I- (Phreatic aquifer)** comprising Weathered Gneiss, Schist.
ii. **Aquifer-II- (Fractured multi-aquifer system)** comprising Fractured Gneiss / Schist.

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 Sira taluk as on 2011 & 2013 indicating present and future scenario (2025), Stage of ground water development and categorization is presented in 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	11334.12	11628
2	Existing Gross Ground Water Draft for Irrigation in HAM	10360.21	10567
3	Existing Gross Ground Water Draft for Domestic and Industrial Water Supply in HAM	453.27	610
4	Existing Gross Ground Water Draft for all use in HAM	10813.48	11177
5	Allocation for Domestic And Industrial Use for next 25 years in HAM	614.64	674
6	Net Ground Water Availability for future Irrigation Development in HAM	438.44	783
7	Existing Stage Of Ground Water Development in percentage	95	96
8	Categorization	Critical	Critical

3.2 Chemical quality of ground water and contamination

The chemical quality of ground water in Sira taluk is assessed from the analytical results 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-10 to 14.

Table 10. Range and average of chemical constituents in Ground water.

Chemical consitituennts in PPM →	pH	EC, m/ mhos/cm at 25 ^{0} c	TH as $CaCO_3$	Ca	Mg	Na	K	HCO_3	Cl	SO_3	NO_3	F
Range	8.09 to 8.47	1165 to 4300	240 to 1050	16 to 36	41.37 to 235.88	114 to 495	7.0 to 7.8	293 to 427	128 to 745	47 to 211	0.3 to 62.0	0.81 to 1.6
Average	8.32	2108	500	28	104.5	243.5	7.00	381.2	314	91.75	24.05	1.09

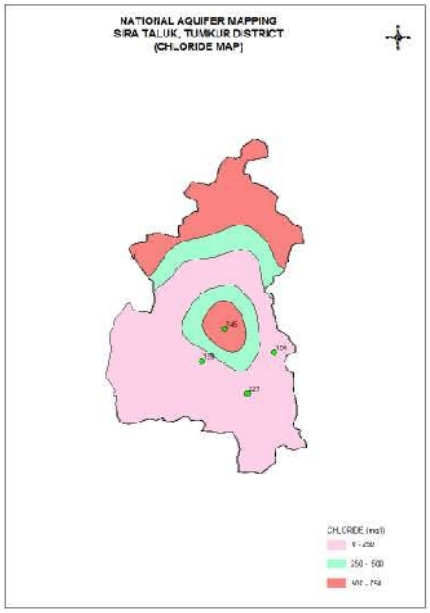

Fig11. Distribution of Chloride

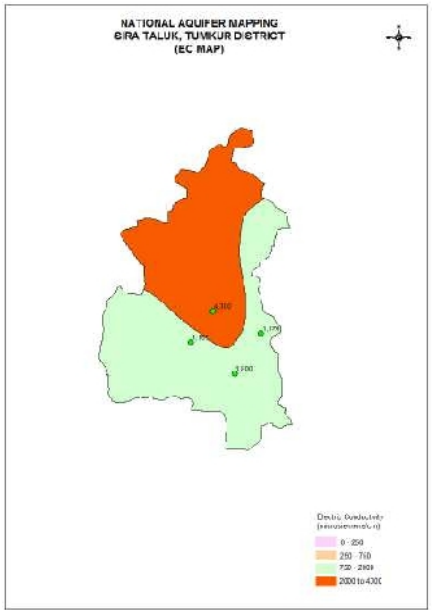

Fig12. Distribution of EC

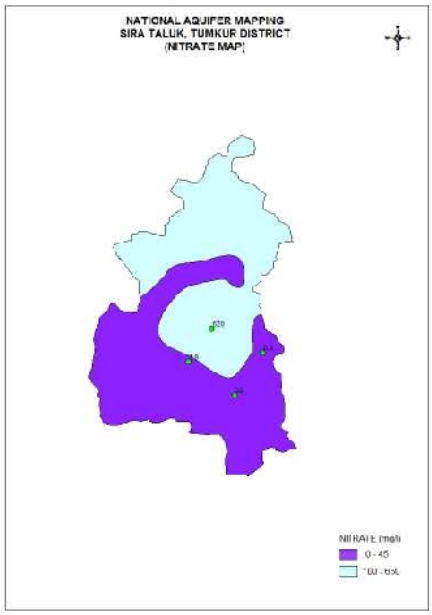

Fig 13. Distribution of Nitrate

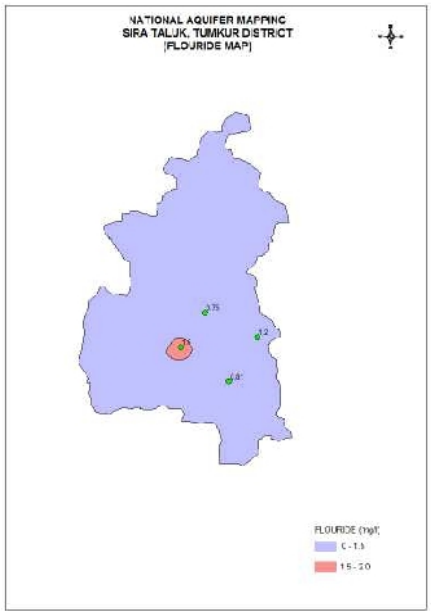

Fig 14. Distribution of Fluoride

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 excerpt Fluoride which is in higher range. The range of chemical constituents (under NAQUIM) in ground water of the taluk is plotted in Piper diagram Figure-15.

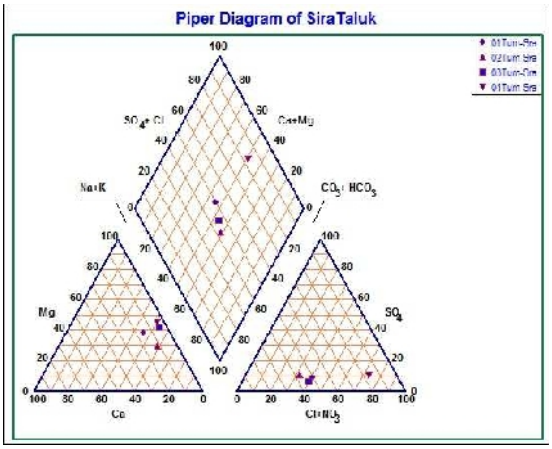

Fig 15. Chmeical anlysis Plot on Piper Diagram

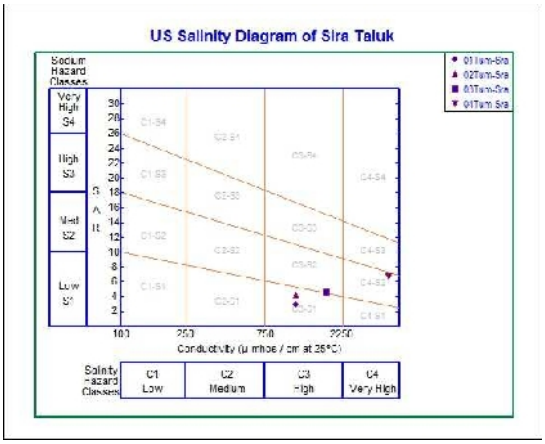

Fig 16. U.S. Salinity diagram

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 Figure-16.

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. 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 9.805 MCM 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	Sira taluk	Resource available in MCM
Non committed monsoon run off available (MCM)	15.6	
Number of Check Dams	96	11.556
Number of Percolation Tanks	47	2.4513.904
Number of Point Recharge structures	10	0.0980.156
Tentative total cost of the project (Rs. in lakhs)	376.44	-
Excepted recharge (MCM)	8.845	-
Expected rise in water level (m)	0.337	-
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	4.2552	-

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	11628
2	Existing Gross Ground Water Draft for All use HAM	11177
3	Existing Stage Of Ground Water Development in percentage	96
4	Expected recharge from Artificial Recharge Projects HAM	885
5	Cumulative ground water Availability HAM	12513
6	Expected improvement in stage of ground water Development after implementation of the project in percentage	89
7	Expected improvement in overall Stage of Ground water development in percentage	7
8	Expected additional irrigational potential in hectares	1065.84

5. DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

Major crop of Sira taluk is Ragi and ground nut which is rain fed crops. Remaining crops like Vegetables and Paddy and fruits are depends 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 below table-13.

Table 13. Details of Irrigation practices

Sl. No.	Advanced Irrigation practices	No. of Irrigation Dug wells and potential utilized area (Ha)		No. of Irrigation Bore wells and potential utilized (Ha)		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	3090	1217	7230	9702	10320	10917
2	Underground pipe	156	208	2740	3601	2896	3601
3	Surface pipe	18	26	250	397	268	423
4	Drip irrigation	4	5	260	577	264	582
5	Sprinklers	792	20	11	18	803	38
6	Others	13	2	372	28	385	30
	Total	**4061**	**1476**	**10873**	**14323**	**14934**	**14499**

Source: 4th Census of Minor Irrigation schemes, Department of Minor irrigation, Bangalore,

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 irrigational potential with economical available ground water can be achieved 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 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, Sira taluk falls under critical category with the stage of ground water development of 96 % 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 15.6 MCM of water can be conserved. This alternate water sources will cope up additional irrigational potential of 1065.84 ha of agricultural land and there will be rise in water level of 0.337m (Table-11&12).

5.4. Regulation and control

Considering the current existing ground water draft for all use 11177 HAM with the stage of ground water development up to 96%, it is mandatory to plan to augment the ground water through artificial recharge besides use of ground water judiciously. 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

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

Excess Fluoride contamination in ground water requires dilution of Fluoride rich ground water through roof top rain water harvesting. The roof top rain water harvesting, direct aquifer recharge, excavation of farm ponds bore well recharge and timely water quality analysis etc will reduce the Fluoride level in water. It is also be achieved through adoption of standard filtration/ removal techniques like Reverse Osmosis filtration, Activated alumina de-fluoridation filter and distillation filtration is strongly recommended. Other methods like Nalgonda techniques, Ion exchange process, and adsorption methods like activated carbon, Tri calcium phosphate and activated alumina may be used.