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

Ramdurg Taluk, Belgaum District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region,Bengaluru

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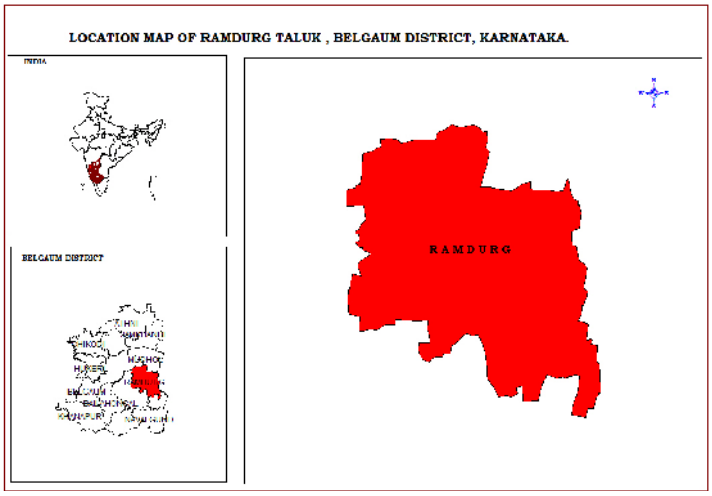
RAMDURG TALUK AQUIFER MAPS AND MANAGEMENT PLANS, BELGAUM DISTRICT, KARNATAKA STATE



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RAMDURG TALUK AQUIFER MAPS AND MANAGEMENT PLANS, BELGAUM DISTRICT, KARNATAKA STATE

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RAMDURG TALUK AQUIFER MAPS AND MANAGEMENT PLANS,
BELGAUM DISTRICT, KARNATAKA STATE

1. SALIENT INFORMATION

Name of the taluk	: **RAMDURG**
District	: Belgaum
State	: Karnataka
Area	: 1,223 sq.km.
Population	: 2,58,527
Annual Normal Rainfall	: 545 mm

1.1 Aquifer management study area

Aquifer mapping studies were carried out in Ramdurg taluk, Belgaum district of Karnataka, covering an area of 1,387 sq.kms under National Aquifer Mapping Project. Ramdurg taluk of Belgaum district is located between north latitude 15°46'46.9" and16°12'36.0" & east longitude 75°04'16.3" and 75°27'36.7", and is covered in parts of Survey of India Toposheet Nos. 48M/1, 48M/5, 47P/4 and 47P/8. Ramdurg taluk is bounded by Mudhol and Gokak taluks on north, Nargund and Soundatti taluks on south, Badami taluk on east and Saundatti taluk on western side. Location map of Ramdurg taluk of Belgaum district is presented in Fig-1.

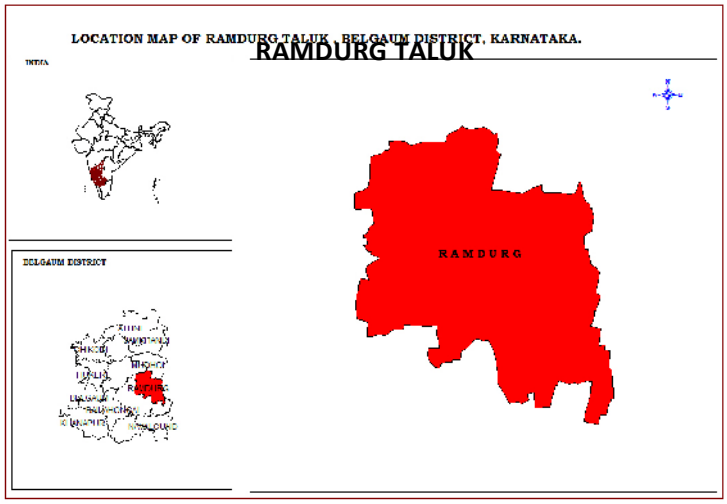

Fig 1: Location Map of Ramdurg taluk, Belgaum district, Karnataka

Ramdurg Taluka, with population of about 2.6 lakh is the second least populous and economically quite backward taluk of Belgaum district. Taluk administration of Ramdurg is divided into 4 Hoblies and 37 Gram Panchayaths. Ramdurg is the largest town in taluk, which is the taluk and district headquarter also. There are 115 villages in the taluk, out of which only one village is uninhabited. Out of these 115 villages in the taluk, Katakol is the most populous

village with population of about 13 thousand and Gudagumnal is the least populous village with population of 153. Area wise, Katakol is the biggest village in the taluk with an area of 58 km^2 and Maradagi is the smallest with 1 km^2 area.

1.2 Population

According to 2011 census, the population in Ramdurg taluk is 2,58,527 of which rural population is 2,23,727 constituting about 87%, and the urban population is 34,800, constituting about 13% of the total population. In the era of urbanisation, Ramdurg taluk presents an entirely different scenario, a negative decadal growth of 5% in Urban population. The taluk has an overall population density of 211 persons per sq.km and showed a decadal increase of about 13.68% during 2001-2011.

1.3 Rainfall

Ramdurg 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 study area is quite agreeable and free from extremes. The year is usually divided into four seasons: summer from March to May; rainy season or south-west monsoon season from June to September; post-monsoon season covering the months of October and November and dry or winter Season from December to February.

The normal annual rainfall in Ramdurg taluk for the period 1981 to 2010 is 545 mm. Seasonal rainfall pattern indicates that, major amount of (326 mm) rainfall is received during South-West Monsoon seasons, which contributes to about 60% of the annual normal rainfall, followed by North-East Monsoon season (148 mm) constituting about 27% and remaining (70 mm) 13% during pre-monsoon season (Table-1).

Computations were carried out for the 30 year blocks of 1981- 2010, the mean monthly rainfall in Ramdurg taluk is ranging between 0 mm during January to 117 mm during October. The coefficient of variation percent for pre-monsoon, monsoon and post-monsoon season is 51, 39 and 43 percent respectively. Annual CV at this station works out to be 26 percent (Table-1).

Table-1: Statistical Analysis of Rainfall Data of Ramdurg Taluk, Belgaum District, Karnataka (1981 to 2010)

Station		JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
Ramdurg	NORM	0	2	6	12	50	70	88	58	64	117	326	114	31	4	148	545
	STDEV	0	9	21	14	35	36	70	35	41	79	127	60	48	10	64	140
	CV%	387	479	348	111	69	51	80	60	64	68	39	53	156	247	43	26

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 at Ramdurg taluk.

1.4 Agriculture and Irrigation

Agriculture is the main occupation in Ramdurg taluk. Jowar is major crop, grown in almost half of the total crop area followed by pulses, vegetables, oilseeds and Cotton covering about 18%, 12%, 8% and 7% of the total crop area respectively. Amongst the water-intensive crops, while paddy cultivation is almost negligible, sugarcane is grown in almost 14% of the crop area, complementing the net area irrigated by canals.

Table 2: Cropping pattern in Ramdurg taluk 2014-2015 (Ha)

Year	Paddy	Maize	Bajra	Jowar	Wheat	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
	Area under cultivation (in ha)										
2014 -15	09	17069	2366	27335	6143	18677	241	4385	13477	15927	5181

It is observed that net sown area accounts for about 46.8% of total geographical area, while area sown more than once is 44.8% of total geographical area in the taluk (Table-3). It is partially due to surface water availability through canals in the taluk. Ground water caters to almost 83% of the irrigated area, primarily due to the presence of large number of irrigation Dug wells, which cater to almost half of the irrigated area of the taluk. Borewells cater to almost one third of the irrigated area of the taluk (Table-4).

Table 3: Details of land use in Ramdurg taluk 2014-2015 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Ramdurg	1,21,542	15,081	9,161	39,139	56,962	54,468

Source: District at a glance 2014-15, Govt. of Karnataka

Table 4: Irrigation details in Ramdurg taluk (Ha)

Source of Irrigation	Net area irrigated (Ha)	% of area
Canals	6,120	13/%
Tanks	0	0
Wells	22,725	49%
Bore wells	15,435	34%
Lift Irrigation	0	0
Other Sources	1,727	4%
Total	**45,917**	

Source: District at a Glance 2014-15, Government of Karnataka

1.5 Geomorphology, Physiography and Drainage

Geomorphologically, the taluk is a rugged and undulating terrain, traversed by chains of detached hills trending in east - west direction. Elevation in the taluk ranges from 526 m to 560 m amsl. An area of 638.33 sq. km in the taluk is covered by plain topography, 2.62 Sq. km by piedmont zone and 658.4 sq km by hills and plateaus (Fig-2). The taluk is a part of Krishna River Basin, Malapraphaha river flows through the district. The drainage pattern in the taluk is dendritic (Fig-3).

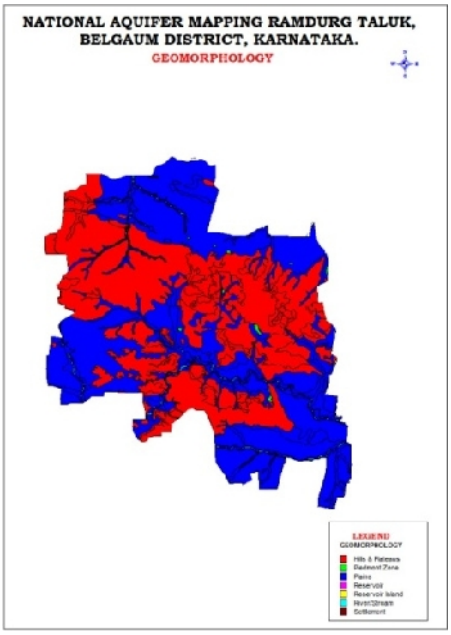

Fig 2: Geomorphology Map

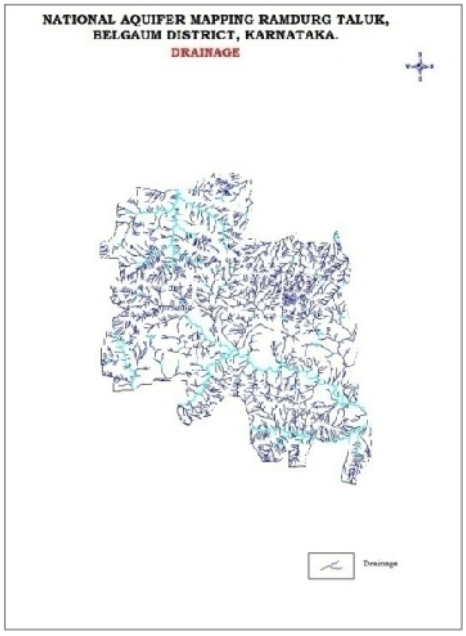

Fig 3: Drainage Map

1.6 Soil

The taluk is having predominantly fertile black soil with varying clayey and sandy mixtures. Red loamy soil cover is also seen in some parts of the taluk.

1.7 Ground water resource availability and extraction

Aquifer wise total ground water resources up to 200 m depth is given in Table-5 below.

Table 5: Total GW Resources (2013) (Ham)

Taluk	Annual Replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (down to 200 m)	Dynamic + Phreatic in-storage + fractured
Ramdurg	5,441	3,875	1,424	10,740

1.8 Existing and future water demands (as per GEC-2013)

Net ground water availability for future irrigation development : 0.28 MCM

Domestic and Industrial sector demand for next 25 years : 5.37 MCM

1.9 Water level behaviour

(a) Depth to water level

Aquifer - I **

Pre-monsoon: 5.40 - 15.00 mbgl (Fig-4)

Post-monsoon: 3.40 - 15.00 mbgl (Fig-5)

Aquifer - II

Pre-monsoon: 16.71 mbgl

Post-monsoon: 13.42 mbgl

(b) Water level fluctuation

Aquifer-I

Seasonal Fluctuation: (Fig-6)

Rise, ranges between 0.00 - 2.78 m

Aquifer-II

Seasonal Fluctuation: Rise, 3.29 m

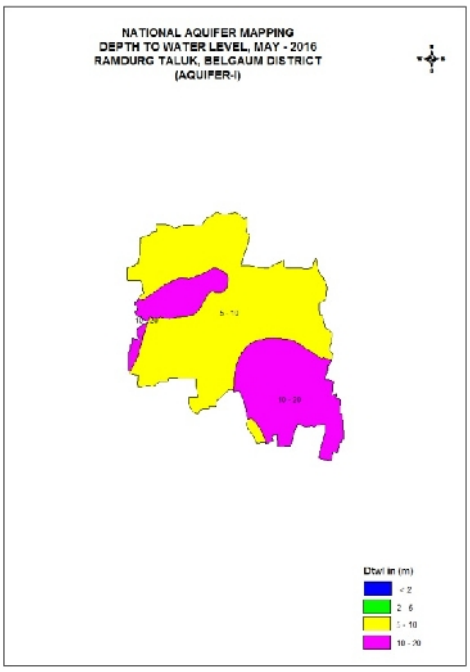

Fig.4: Pre-monsoon Depth to Water Level (Aq-I)

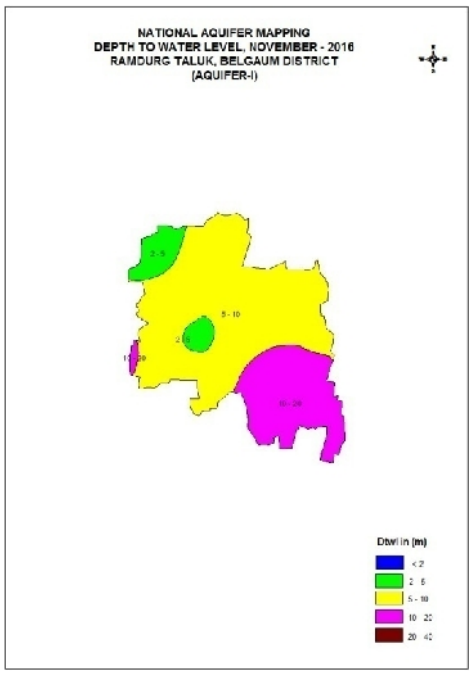

Fig.5: Post-monsoon Depth to Water Level (Aq-I)

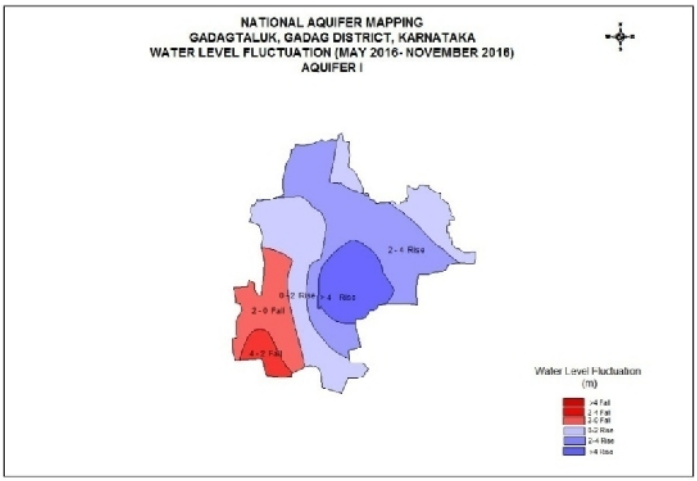

Fig.6: Water Level Fluctuation (Aq-I)

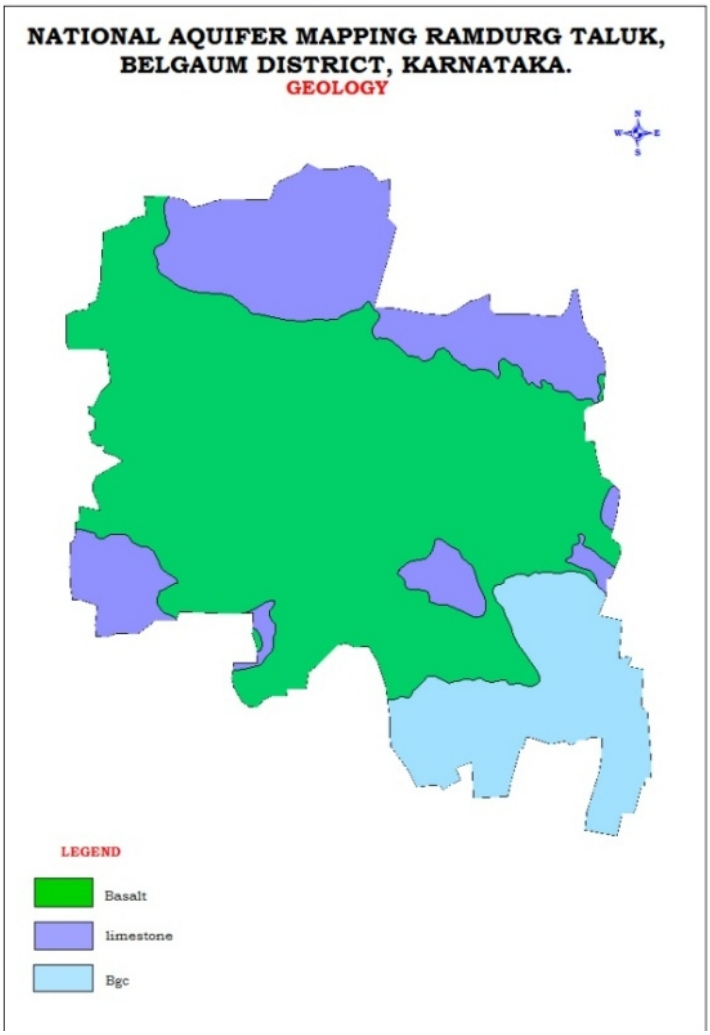

Fig 7: Geology Map

2. AQUIFER DISPOSITION

2.1 Number of aquifers: In Ramdurg taluk, there are mainly two types of aquifer systems;

i. **Aquifer-I (Phreatic aquifer)** comprising Weathered Granite Gneiss, Basalt and Limestone

ii. **Aquifer-II (Fractured aquifer)** comprising Fractured Granite gneiss, Basalt and cavernous Limestone

In Ramdurg taluk, weathered and fractured Granite gneiss, Basalt and cavernous Dolomitic limestone are the main water bearing formations (Fig-7). Lineaments are trending mainly in NE – SW and NW – SE directions. Weathered thickness of formations varies according to varying rock types from 5 m to 22 m with an average of 10 m. In Aquifer-I comprising of weathered formations, ground water occurs under phreatic conditions (in small isolated and localized patches) at shallow levels and is being utilised through large number of dug wells in the taluk, which are seasonal in nature and have limited sustainability. Ground water occurs under semi-confined to confined conditions at deeper levels in Aquifer-II comprising of jointed and fractured Granite gneiss, Basalt and Dolomitic limestone. In limestone, solution cavities are found to be more potential than weathered and fractured formation. Yield ranges from negligible to 6.05 lps. Transmissivity ranges from 1 to 200 m^2/day. The basic characteristics of each aquifer are summarized in Table-7.

Table 6: Details of Ground water Exploration

Sl. No.	Location	Latitude	Longitude	Depth Drilled (m bgl)	Casing Depth (m bgl)	Fracture Zones (mbgl)	SWL (mbgl)	Q (lps)	DD (m)
1.	Batkurki	16°04'45"	75°17'05"	200.00	6.00	30 - 31, 68 - 69, 102 - 103	6.44	neg	
2.	Chippalkatti	16°08'20"	75°11'36"	26.60	17.00	21 - 36	2.54	neg	
3.	Chunchanur	15°55'20"	75°07'10"	82.50	7.90	26 - 28, 34 - 36, 54 - 56 80 - 82	8.30	6.05	0.12
4.	Godchi	16°00'45"	75°11'36"	94.95	4.70	43 - 44, 50 - 51, 61 - 62	2.48	0.95	12.57
5.	Kittur	15°50'40"	75°12'17"	57.60	22.00	30 - 31	7.70	4.80	8.04
6.	Murkatnal	16°04'00"	75°07'00"	200.00	6.00	15 - 16	6.81	0.64	12.08
7.	Suriban	15°53'34"	75°23'48"	82.00	8.70	11 - 18, 21 - 28, 31 - 34, 49 - 51	5.93	4.88	6.39

Table 7: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Granite Gneiss / Basalt / Limestone	Jointed /Fractured Granite Gneiss, Basalt, Limestone, Cavernous Limestone
Thickness range (m bgl)	22.0 0	Fractures down to 200 mbgl depth
Depth range of occurrence of fractures (mbgl)	11.00 - 22.00	22 - 103 80% between 30.00 - 70.00
Range of yield potential (lps)	Poor yield, being utilised through Seasonal Dug wells	neg - 6.05
Specific Yield	2%	0.2%
T (m^2/day)	-	2 - 100
Quality, Suitability for Irrigation	Suitable	Suitable
Suitability for Domestic purposes	Suitable	Suitable
Remarks	Over-Exploited	Ground water potential fractures, 1 to 4 sets likely down to the depth of 200 m bgl.

Presently, only limited data is available about aquifer-II, as exploratory drilling to the targeted depth of 200 m has to be completed in the taluk.

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

a. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2013)

Taluk	Net Annual Ground Water Availability (Ham)	Existing Gross Ground Water Draft for Irrigation (Ham)	Existing Gross Ground Water Draft For Domestic and Industrial Water Supply (Ham)	Existing Gross Ground Water Draft for all Uses (Ham)	Allocation For Domestic and Industrial Use for Next 25 Years (Ham)	Net Ground Water Availability for Future Irrigation Development (Ham)	Existing Stage Of Ground Water Development (%)	Category
Ramdurg	5441	7177	380	7557	537	28	139	OE

(b) Present total Ground Water Resource (in ham)

Taluk	Annual Replenishable GW Resources	Fresh In-storage GW Resources		Total availability of GW Resource
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
Ramdurg	5441	3875	1424	10740

(c) Comparison of Ground Water Availability and Draft Scenario in Ramdurg taluk

Taluk	GW Availability (Ham)	GW Draft (Ham)	Stage of GW Development	GW Availability (Ham)	GW Draft (Ham)	Stage of GW Development	GW Availability (Ham)	GW Draft (Ham)	Stage of GW Development
	2009			2011			2013		
Ramdurg	7408	12253	165	5444	7487	138	5441	7557	139

b. Chemical Quality of Ground Water and Contamination

In general, ground water quality in Ramdurg taluk is good for drinking purpose as per "Indian Standard Drinking Water Specification 2009".

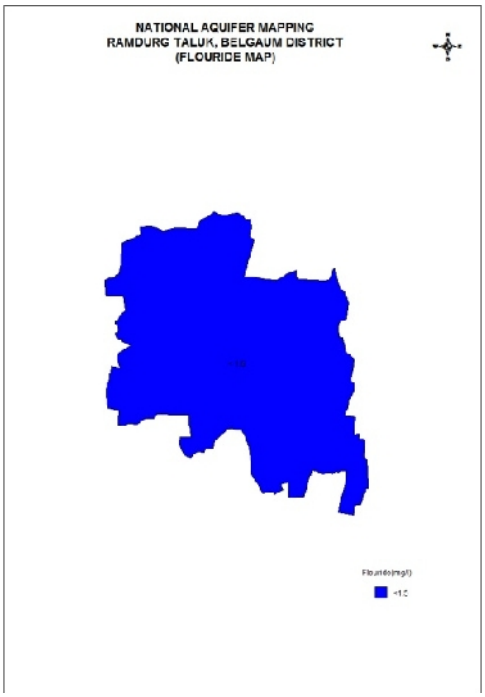

Fig 8: Fluoride Map

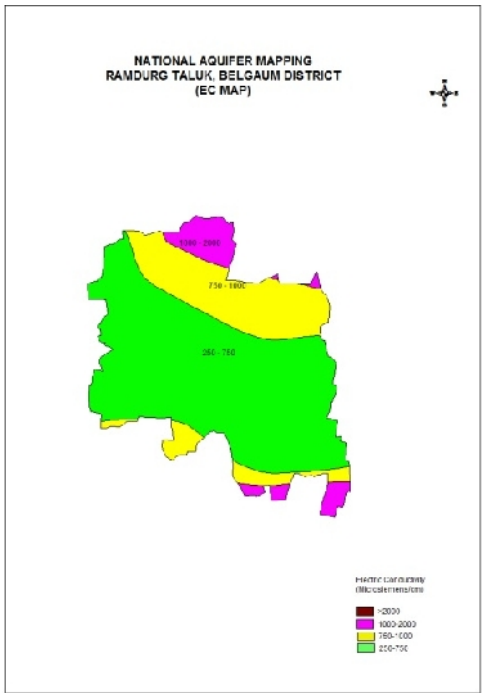

Fig 9: Electrical Conductivity Map

4. GROUND WATER RESOURCE ENHANCEMENT

4.1 Aquifer wise space available for recharge and proposed interventions

Recharge over-exploited phreatic aquifer (Aq-I) in the taluk, through construction of artificial recharge structures, viz., check dams, percolation tanks & point recharge structures (Table-8). The choice of recharge structures should be site specific and such structures need to be constructed in areas already identified as feasible for artificial recharge.

Table 8: Quantity of non-committed surface runoff and expected recharge through AR structures

Artificial Recharge Structures Proposed	Ramdurg Taluk
Non committed monsoon runoff available (Ham)	830
Number of Check Dams	51
Number of Percolation Tanks	03
Number of Point Recharge structures	06
Tentative total cost of the project (Rs. in lakhs)	200.32
Excepted recharge (MCM)	4.708
Expected rise in water level (m)	0.224
Cost Benefit Ratio (Rupees / cu.m. of water harvested)	4.26

4.2 Improvement in GW availability due to Recharge, Ramdurg taluk

Taluk	Net annual ground water availability	Existing gross ground water draft for all uses	Existing stage of ground water development	Expected recharge from proposed Artificial Recharge Structures	Additional potential from proposed irrigation development schemes through inter-basin transfer	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water development
	HAM	HAM	%	HAM	HAM	HAM		%
Ramdurg	5441	7557	139	471	-	5911	11	128

After implementation of Artificial Recharge structures for GW recharge, the annual ground water availability will increase from 5441 to 5911 ham and the expected improvement in stage of development is 11% i.e., from 139% to 128%

5. DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

It is observed that presently, ground water is the source for irrigation about 83% of the total irrigated area in the taluk. As per data available, there are about 2212 dug wells and 2897 bore wells, irrigating 22,725 and 15,345 hectares area respectively. Water use efficiency measures are need of the hour. Adopting these measures will contribute in bringing sustainability to ground water resource management in the long run.

Efficient irrigation practices like Drip irrigation and sprinkler need to be adopted by the farmers in the existing 42,200 ha of gross irrigated area catered through ground water source. Presently, draft through irrigation is 5,441 ham. Efficient irrigation techniques will contribute in saving ground water by 1,632 ham and thus, will improve stage of development by 28%, bringing stage of GW development from 128% to 100% (Table-9).

Table-9: Improvement in GW availability due to saving by adopting water use efficiency

Taluk	Cumulative annual ground water availability after implementing ar structures & irrigation development schemes	Existing gross ground water draft for all uses	Stage of ground water development after implementing AR Structures	Saving due to adopting WUE measures	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water development
	Ham	Ham	%	Ham	Ham	%	**%**
Ramdurg	5911	7557	128	1632	7543	28	100

5.2 Change in cropping pattern

In Ramdurg taluk, water intensive crop, Sugarcane is being grown, that too, through surface water source, hence, it may not be of any consequence to apply modifications in cropping pattern. Hence, change in cropping pattern is not suggested.

5.3 Additional area of irrigation

After adopting various water use efficiency techniques and recharge measures and its resultant savings, the stage of development is expected to be 100% in the taluk, which will improve the situation in the taluk, but the taluk will remain in the **over-exploited** category. Hence, bringing additional area under irrigation may not be feasible with a long-term resource management point of view.

5.4 Regulation and Control

Ramdurg taluk has been categorized as **Over-Exploited**, since the Stage of ground water development has reached **139%** (GE March 2013). Hence, stringent action has to be taken up through Karnataka Ground Water Authority to control ground water exploitation in the taluk**.**

Ground water recharge component needs to be made mandatory in the taluk to save the situation from deteriorating further.

5.5 Other interventions proposed:

Periodical maintenance of artificial recharge structures should also be incorporated in the Recharge Plan.

5.6 Summary

The summary of Management plan of Ramdurg taluk is given in Table-10.

Table-10: Summary of Management plan of Ramdurg taluk

Ramdurg taluk is 'Over-Exploited' and present stage of GW Development (2013)	139%
Net Annual Ground Water Availability (MCM)	54.41
Existing Gross Ground Water Draft for all uses (MCM)	75.57
Groundwater development feasibility	0.28
Total GW Resources (Dynamic & Static up to the depth of 200 m bgl) (MCM)	107.40
Expected additional recharge from monsoon surplus runoff (MCM)	4.71
Change in Stage of GW development (%)	139 to 128
Expected Saving due to adopting WUE measures (MCM)	16.32
Change in Stage of GW development, %	128 to 100