



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

Bagalkot Taluk, Bagalkot District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region, Bengaluru



**BAGALKOT TALUK AQUIFER MAPS AND MANAGEMENT PLANS,
BAGALKOT DISTRICT, KARNATAKA STATE**

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**BAGALKOT TALUK AQUIFER MAPS AND MANAGEMENT PLANS,
BAGALKOT DISTRICT, KARNATAKA STATE**

1. SALIENT FEATURES

Name of the taluk : **BAGALKOT**
District : Bagalkot
State : Karnataka
Area : 936 sq.km.
Population : 2,85,114 (2011)
Annual Normal Rainfall : 548 mm

Bagalkot taluk is located in northern part of Bagalkot district, Karnataka state covering an area of 936 sq. kms and is a part of Krishna river basin located at longitudes $16^{\circ}04'0.5''$: $16^{\circ}21'02.7''$ and east latitude of $75^{\circ}25'59.9''$: $76^{\circ}03'25.1''$ falling in survey of India toposheet numbers 47 P/8,12,15,16,56D/3 and D/4. It is surrounded by Bilgi (Bagalkot district) and Basavana Bagewadi taluk of Bijapur district towards north, Badami taluk of Bagalkot district towards south, Mudhol and Jamakhandi taluks of Bgalkot towards west and in east it is Hunugund taluk of Bagalkot district. The Location map of the taluk is in Figure-1.

Bagalkot town is the taluk head quarters. There are three revenue hoblies which cover 95 Inhabited villages with 30 VA circles and 22 grama panchats. The taluk is well connected with good network of roads with NH-218 Hubli-Humnabad passes through Bagalokot. State highways passing through Bagalkot connects NH-13 and district roads and broad gauge railway line (Gadag-Hotgi) forming good net work transport system.

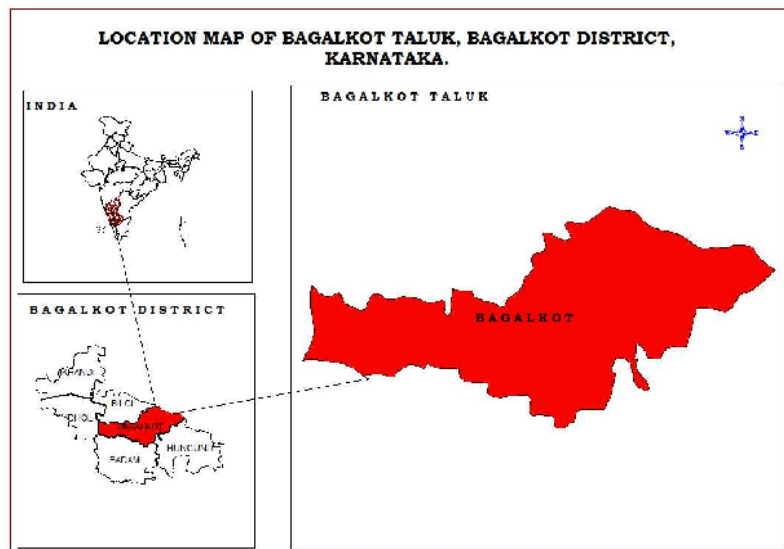


Fig 1: Location map of Bagalkot taluk, Bagalkot district

1.2 Population

As per 2011 census, the total population in Bagalkot taluk is 285114 (143220 males and 141894 Females) of which about 173181 (60.74 %) constitutes the rural population. The Taluk has an overall population density of 304.52 persons per sq.km. The decadal change is 15.3%.

1.3 Rainfall

Bagalkot 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 average minimum temperature varies from 16.5⁰ to 23⁰ and maximum average temperature varies from 28.5⁰ to 38.2⁰ C. The hottest month is April with an average temperature of 29.40 C and lowest average is 22.7⁰C. 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 548 mm and the statistical analysis of rain fall data is presented in the table-1.

Table 1: Statistical Analysis of Rainfall Data of Bagalkot Taluk for the Period 1981 to 2010

STATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual
Bagalkot	NRM	2	2	8	14	48	93	50	69	124	104	26	9	548
	ST.DEV	5	10	28	16	38	69	36	41	87	77	35	20	186
	CV%	267	468	352	112	81	74	71	60	70	74	136	232	34

Assessment of Drought

Rainfall data has been analysed to assess the drought condition using 106 years Rain fall data and the results / classification thus obtained are listed in the **Table-2**. It is observed that the Bagalkot 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	Bagalkot	49	32	20	5	Once in 5 years

Out of 106 years of analysis in Bagalkot taluk, "No Drought" condition is experienced in 49 years, "Mild Drought" condition is 32 years and "Moderate Drought" condition experienced in 20 years. Further it is observed that "Severe Drought" condition is experienced in 5 years ie, during 1922, 1945, 1984, 2003 and 2012. 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 5 years.

1.4 Agriculture & Irrigation

Bagalkot taluk is having 173181 (60.74 %) 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

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
93627	11611	6152	264	8706	66894	6265	73159

Source: District at a glance 2014-2015, Govt of Karnataka

1.4.1 Principal crops

The principal crop of the taluk is Jowar - 19924 ha (27.23% to the total cropped area) followed by Maize crops (8.76% to the total cropped area) and Sun flower with an area of 4509 ha, (6.16%) which are normally rain fed crops. Overall food crops (45.11%) and pulses (31.51%) are the major crops grown during Rabi season. Vegetables and paddy crops are the Kharif crops. The principal crops and area grown are in the below table-4.

Table 4: Principal crops in Bagalkot taluk

Crops	Major Cereals (Ha)			Pulses (Ha)				Fruits (Ha)	Vegetables (Ha)	Oil seeds (Ha)		
	Jowar	Maize	Bajra	Bengal gram	Green gram	Tur dal	Others			Sun Flower	Ground nuts	others
	19924	6510	3900	14050	7503	1116	384	2140	944	4509	3980	483
Total	30334+2670(wheet)			23053				2140	944	8972		
	Total Food Grains -56057 ha							-	-	Total Oilseeds-8972ha		

Source: District at a glance 2014-2015, Govt of Karnataka

1.4.2 Irrigation Practices

In Bagalkot taluk, the ground water is being developed from ground water structures like 86 dug wells and 4423 shallow tube wells (Report on 4th 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 etc. and others.

1.4.3 Ground water and surface water Irrigation

In Bagalkot taluk, Ground water is the main source of irrigation with net irrigated area of 16627ha (64.50% to the total net irrigated area). The details of surface water and ground water irrigation are in the table-5.

Table 5: Details of irrigation in Bagalkot taluk

Sl. No.	Source	No. / Length (km)	Net area irrigated (ha)	Gross area irrigated (ha)	
1	Surface water	Canals	28	3918	3918
		Tanks	4	0	0
		Lift Irrigation	1	189	189
2	Ground water	Dug Wells	1328	145	170
		Bore wells	4918	16482	17292
3	Other Sources	-	-	5043	5823
4		Total	6279	25777	27392

Source: District at a glance 2014-2015, Govt of Karnataka

1.5 Geomorphology, Physiography & Drainage

Geomorphologically, Bagalkot taluk falls in Northern maidan region. In general the topography characterised is rugged and undulating with rolling topography and is part of western Ghats with a detached range of hills extends from east to west direction. The ortho quartzite and the banded hematite quartzite have formed well defined linear ridges. The important land forms, which are seen in the region, are residual hills and escarpments on its periphery followed by pediments, river plains, including terraces and river channels. The ground elevation of taluk ranges from 480 to 729m a msl, fig-2.

Drainage

Bagalkot taluk is part of Krishna river basin. The Ghataprabha is the main tributary along with number streams drains the taluk. The Ghattaprabha enters the Bagalkot district in Mudhol taluk, through Mudhol to Bagalkot taluks it runs a course of about 50 miles, south-easterly till the village Budani and then easterly up to Bagalkot town. From here it flows in a region of sand stone and quartzite hills and develops a beautiful gorge near Herakal and joins Krishna near Chimalgi. At the confluence, the river is nearly 100 yards broad, much wider during the rainy seasons, Fig-3.

1.6 Geology

Bagalkot taluk is occupied by Lime stones Argillite quartzite, Domites and granites. The sedimentary and slightly metamorphosed rocks are collectively known as the Kaladgi series. Its occurrence in the eastern end is the more complex, due to the presence of gneissic rocks. The Kaladgi quartzites' occur in two broad bands, which in their residual form are known as the north Ghataprabha range and the north Malaprabha range (Fig-4).

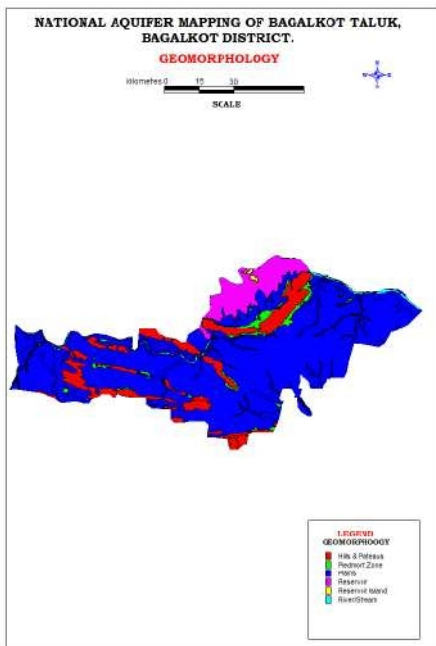


Fig 2. Geomorphology map

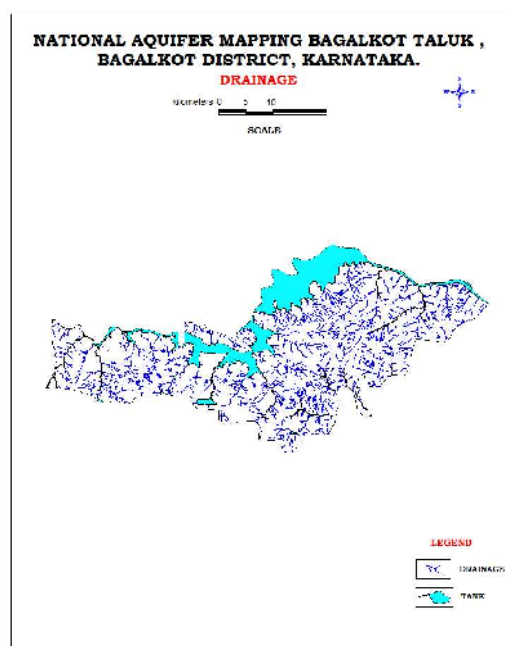


Fig 3. Drainage map

1.7 Soil

The soils of the taluk are derived from Lime stones, Basalts and Granites. The soils are hard and poor in general Sandy, clay, loam, black soil which are moderate and deep black cotton soils derived from basalt, dark grey clayey and calcareous soil from limestone, clayey soil from schist and sandy loam soil from gneiss (Fig-5.)

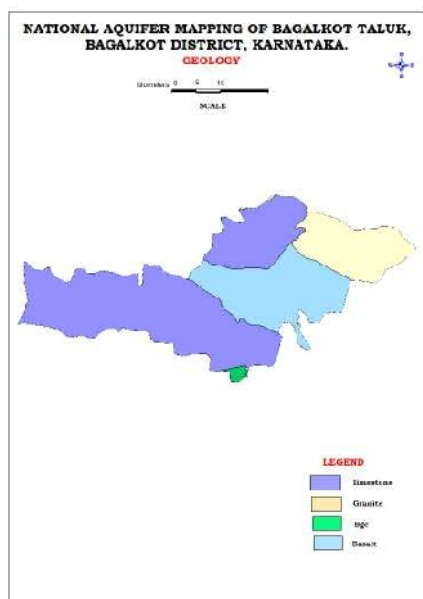


Fig 4. Geology map

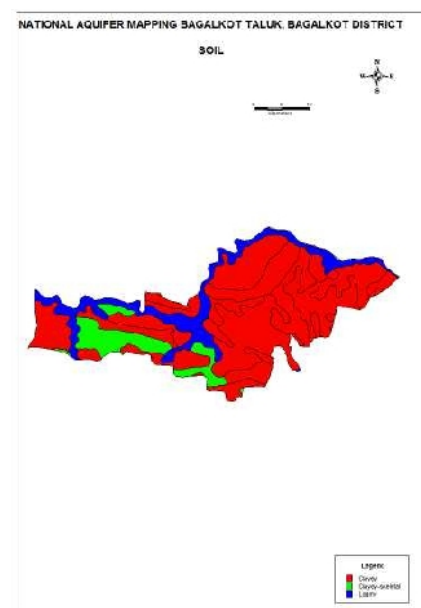


Fig 5. Soil map

1.8 Ground water resource availability and extraction

Aquifer wise the Ground water resource availability up to 200m depth as per Resource Estimation 2013 is as in the table-6.

Table 7: Ground water resource availability

Year	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
2013	4229 HAM	6448 HAM	1665HAM	12342HAM

As per the estimation (**GEC 2013**) the ground water draft (extraction) for irrigation worked out to be **6118 ham** with stage of ground water development of 158%.

1.9 Existing and future water demands

As per GEC (2013) existing ground water draft for irrigation, industrial & domestic (all use) is **6680 ham** and availability/allocation for future demands with judicious utilization since the stage of ground water development is already reached up to **158 %** having No/less scope it is **668 ham** of which **636 ham** is for domestic and industrial use and **32 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 11.

Table 7: Depths to water levels

Item	Depth to Water levels in Bagalkot taluk					
	Pre monsoon		Post monsoon		Water level fluctuation	
	Aquifer I	Aquifer II	Aquifer I	Aquifer II	Aquifer I	Aquifer II
Range	5.00 to 20.00	10.00 to 41.00	2.00 to 10.00	10.00 to 40.00	0.00 to 9.00	0.00 to 4.00
Average	15.56	25.00	7.75	35.00	7.81	7.51

A. Depth to water level Aquifer I:

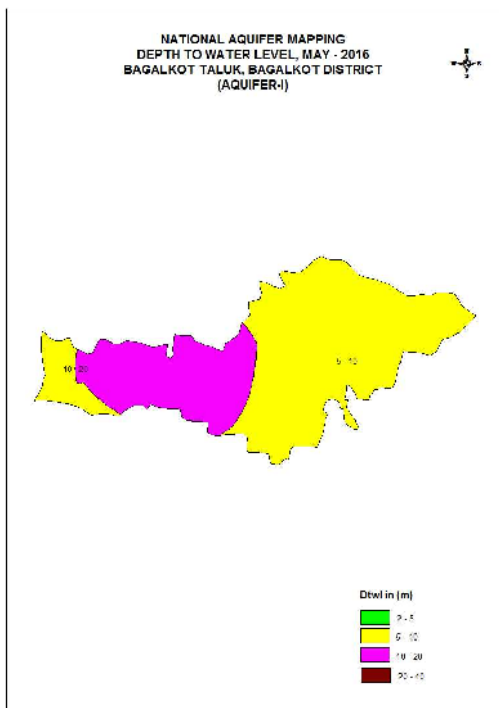


Fig 6. Pre-monsoon DTW Map Aquifer- I

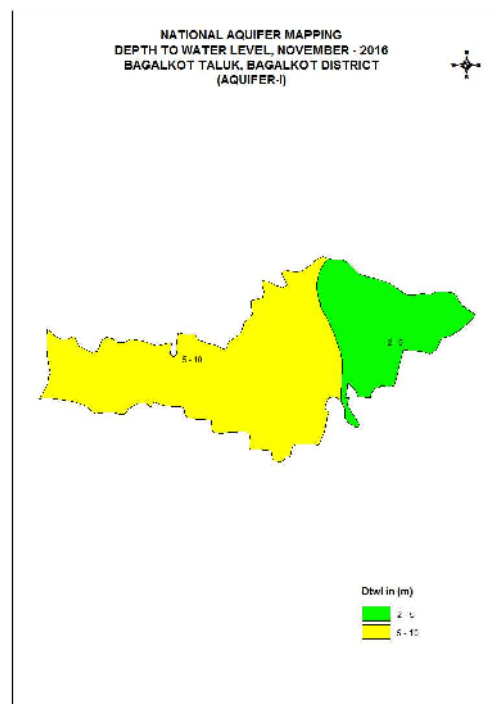


Fig 7. Post-monsoon DTW map Aquifer-I

B. Depth to water level Aquifer II:

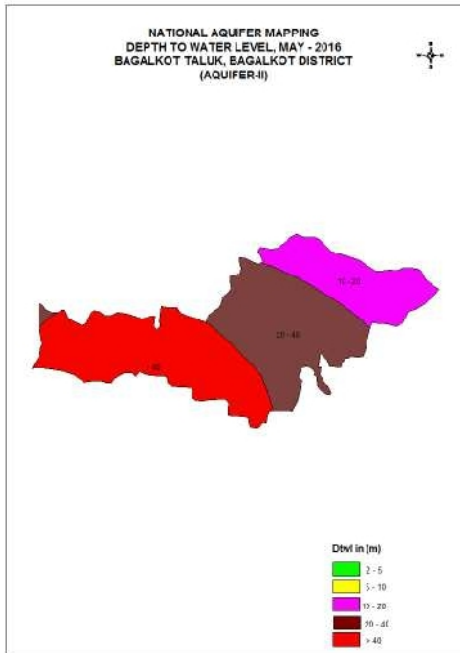


Fig 8. Pre-monsoon DTW Map Aquifer II

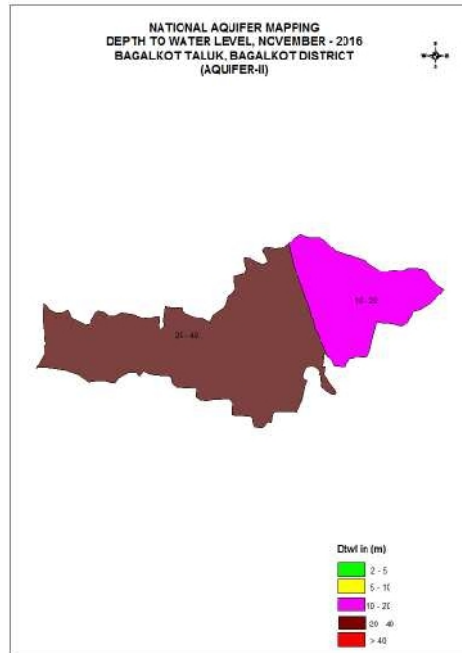


Fig 9. Post-monsoon DTW map Aquifer II

C. Water level fluctuation

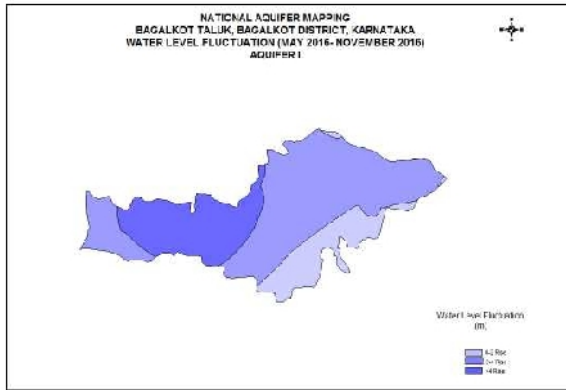


Fig 10. W/L Fluctuation map Aquifer I

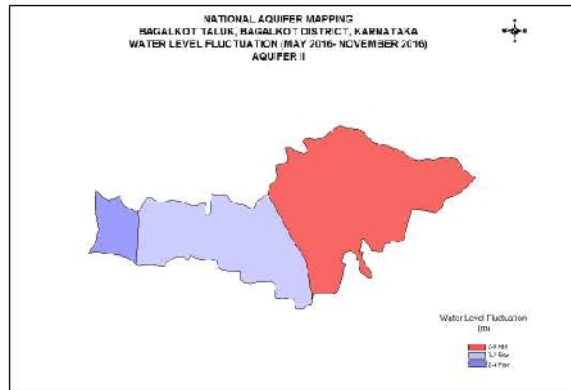


Fig 11. W/L Fluctuation map Aquifer II

The analysis of long term water level trend in Aquifer-1 indicates that is rising trend of 0.297 m/y and falling trend in the range of 0.463 to 0.872 m/y with an average fall of 0.716 m/y. Whereas in Aquifer II the long term trend analysis indicates that there is rising trend in the range of 1.055 m/y to 2.680 m/y with an average rise of 1.604 m/y. Falling trend observed in one well that is of 0.882 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 Bagalkot taluk

Sl. No.	Details	No/Range
1	No of wells drilled	9
2	Depth range in 'm'	13.00 to 100
3	Depth of Casing in 'm'	-
4	Discharge in LPS	0.14 to 6.90
5	S.W.L. in m	2.42 to 21.05
6	Transmissivity m ² /day	65 to 1265

The yield analysis indicated that all the wells are showing average discharge is 2.216 LPS.

2.1 Number of aquifers

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

- i. **Aquifer-I- (Phreatic aquifer)** comprising Weathered Lime stone / Basalt / quartzite.
- ii. **Aquifer-II- (Fractured multi-aquifer system)** comprising Fractured Lime stone / Basalt / quartzite.

3. GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION

3.1 Aquifer wise resource availability and extraction

Aquifer wise ground water resource estimation in Bagalkot 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	4116.01	4229
2	Existing Gross Ground Water Draft for Irrigation in HAM	5998.42	6118
3	Existing Gross Ground Water Draft for Domestic and Industrial Water Supply in HAM	603.04	562
4	Existing Gross Ground Water Draft for all use in HAM	6601.46	6680
5	Allocation for Domestic And Industrial Use for next 25 years in HAM	613.53	636
6	Net Ground Water Availability for future Irrigation Development in HAM	53.62	32
7	Existing Stage Of Ground Water Development in percentage	160	158
8	Categorization	OE	OE

3.2 Chemical quality of ground water and contamination

The chemical quality of ground water in Bagalkot taluk is assessed from the analysis results of 10 samples from dug wells (Aquifer-I). The variation range and average of the different chemical constituents are presented in the table-10.

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

Chemical constituents in PPM	pH	EC, m/mhos/cm at 25 ^o C	TH as CaCO ₃	Ca	Mg	Na	K	Hco ₃	Cl	So ₃	No ₃	F
Range	8.1 to 8.9	366 to 3967	120 to 1140	12 to 260	7 to 153	28 to 778	1 to 75	98 to 281	9.8 to 841	5 to 339	2 to 364	0.08 to 2.26
Average	8.5	1961.5	387	50	63.7	279.1	9.8	256.4	301.2	121.6	83.3	1.04

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/permmissible except Fluoride at places is beyond permmissible limits.

3.2.2. Suitbility of ground water for **irrigation purposes** was assessed and generally it is good but at places the nitrate rich water is observed.

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 contamination (Fluoride & Nitrate) 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 10.4259 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	Bagalkot taluk	Resource available in MCM
Non committed monsoon run off available (MCM)		6.77
Number of Check Dams	42	5.015
Number of Percolation Tanks	3	1.694
Number of Point Recharge structures	5	0.068
Tentative total cost of the project (Rs. in lakhs)	163.36	-
Expected recharge (MCM)	3.839	-
Expected rise in water level (m)	0.23	-
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 in the ground water resource enhancement is as detailed in the below table-12.

The area suitable for the construction artificial recharge structures over Bagalkot taluk is presented in the fig-12.

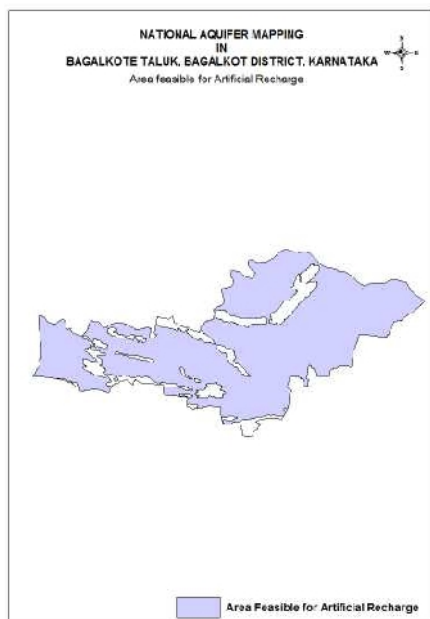


Fig 12. Area suitable for Artificial recharge

4.1.2 Proposed GW Recharge and Assured Supply of Drinking water Schemes (Integrated Irrigation Development-Inter Basin Transfer) project

Proposed Integrated Irrigation Development schemes project that intends to diversion of west flowing streams (Nallas) and surplus waters of East flowing Nallas to east for ground water recharge and assured supply of drinking water to the drought affected 20 district of Karnataka. The project proposal comprises two components namely, Drinking water and tank filling. On implementation of this project helps to recharge 441.73 MCM of water is available by which there will be increase in the ground water availability and stage of ground water development through artificial recharge.

Table 12: Details of resource enhancement after proposed Integrated Irrigation Development schemes-project

Sl. No.	Resource details	As per 2013 Estimation
1	Net Ground Water Availability in HAM	4229
2	Existing Gross Ground Water Draft for All use HAM	6680
3	Existing Stage Of Ground Water Development in percentage	158
4	Expected recharge from Artificial Recharge Projects HAM	384
5	Additional potential from proposed Integrated Irrigation Development project	7362
6	Cumulative ground water Availability HAM	11975
7	Expected improvement in stage of ground water Development after implementation of the project in percentage	56
8	Expected improvement in overall Stage of Ground water development in percentage	102
9	Expected additional irrigational potential in hectares	322.609

5. DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

Major crops of Bagalkot taluk are Jowar and Maize which are rain fed. 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 **86** irrigation dug wells and **4423** 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

Advanced Irrigation practices	No. of Irrigation Dug wells and potential utilized (Ha)		No. of Irrigation Bore wells and potential utilized area in hectares		Total	
	No. Dug wells	potential utilized (Ha)	No. of Bore wells	potential utilized (Ha)	Total no of structures	Total potential Utilized(Ha)
Open water channel	40	111	777	3156	817	3267
Underground pipe	30	42	1933	7627	1963	7669
Surface pipe	12	55	452	1848	464	1903
Drip irrigation	0	0	265	998	265	998
Sprinklers	2	5	993	3768	995	3773
Others	2	0	3	12	5	12
Total	86	213	4423	17409	4509	17622

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 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 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, Bagalkot taluk falls under OE category with the stage of ground water development of 158 % 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 384HAM of water can be conserved. This alternate water sources will cope up additional irrigational potential of 7362 ha of agricultural land and there will be rise in water level of 0.23m (Table-11&12). Addition to this additional ground water potential of 7362HAM from proposed **GW Recharge and Assured Supply of Drinking Water Schemes (Inter basin Transfer)**. Inter-basin transfer from Aphinashini & Bedti Rivers under Project-4 service canal is proposed in the “Integrated Irrigation Development Schemes” by Shri.G.S.Paramashivaiah, Retd. CE, Irrigation Department and submitted to the Govt. of Karnataka.

5.4. Regulation and control

Considering the current existing ground water draft for all use – 6680 HAM with the stage of ground water development up to 158%, 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 and implementation of artificial structures as proposed to recharge the ground water.

6. SUMMARY

The summary of Management plan of Bagalkot taluk is given in Table-14.

Table 14: Summary of Management plan of Bagalkot taluk

Bagalkot taluk is over-exploited & present stage of GW Development (2013)	158%
Net Annual Ground Water Availability (HAM)	4229
Existing Gross Ground Water Draft for all uses	6680
Groundwater development feasibility	32
Total GW Resources (Dynamic & Static up to the depth of 200 mbgl) (MCM)	12342
Expected additional recharge from monsoon surplus runoff (MCM)	384
Change in Stage of GW development, %	158 to 145
Expected additional recharge from proposed GW recharge scheme through inter basin transfer (MCM)	7362
Change in Stage of GW development, %	145 to 56
Expected Saving due to adopting WUE measures (MCM)	1454
Change in Stage of GW development, %	56 to 50

