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Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

BAGEVADI

TALUK, BIJAPUR DISTRICT, KARNATAKA

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region, Bengaluru

AQUIFER MANAGEMENT PLAN OF BASAVANA BAGEVADI TALUK, BIJAPUR DISTRICT, KARNATAKA STATE

CONTENTS

1.0 SALIENT INFORMATION

Name of the Taluk: **BASAVANA BAGEVADI**

District: Bijapur

State: Karnataka

Area: 1976 sq.km

Population: 3, 48,721

Annual Normal Rainfall: 665 mm

1.1 AquiferManagementstudyarea

Aquifer mapping studies were carried out in Basavana Bagevadi Taluk, Bijapur district of Karnataka covering an area of 1976 sq.kms under National Aquifer Mapping Project. Basavana Bagevadi Taluk of Bijapur district is located between North latitude 16°20'30"and 16°34'30" & East longitude 75°47'30" and 75°58'0"and is covered in parts of Survey of India Toposheet Nos.47 P/10, 47P/11, 47P/14, 47P/15, 56D/2 and 56D/3.Basavana Bagevadi Taluk is bounded by Sindgi Taluk on North and North-East, Bijapur Taluk on North and North-West, Muddebihal Taluk on South-East, Bilgi Taluk on West and Bagalkot Taluk on South side. Location map of Basavana Bagevadi Taluk of Bijapur district is presented in **Figure 1.**

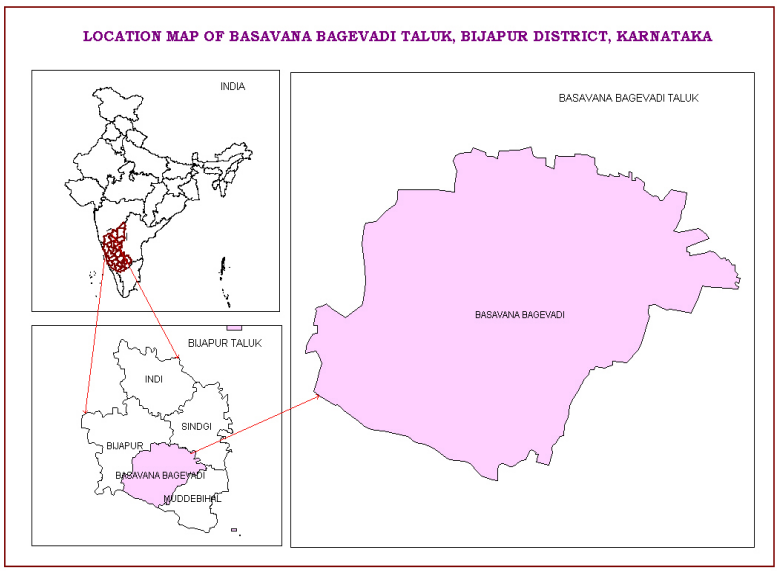

Figure 1: Location Map of Basavana Bagevadi Taluk, Bijapur district, Karnataka

Taluk administration of Basavana Bagevadi is divided into 5 Hoblies and 38 Gram Panchayats. There are 122 inhabited and 3 uninhabited villages in the Taluk.

1.2 Population

According to 2011 census, the population in Basavana Bagevadi Taluk is 3, 48,721 of which rural population is 3,15,523 constituting about 90%, and the urban population is 33,198 constituting only about 10% of the total population. The Taluk has an overall population density of 176 persons per sq.km.

1.3 Rainfall

There is one rain gauge station located in Basavana Bagevadi Taluk (**Table 1**). The data in respect of this station from the year 1981 to 2010 is analyzed and presented in **Table 2**. The data pertaining to these gauges is of long-term nature and are well maintained. It is presumed that they are representative of the Taluk and the same is used for analysis. Normal annual rainfall in Basavana Bagevadi Taluk for the period 1981 to 2010 is 665 mm.

Table 2: Rain gauge and its location in Basavana Bagevadi Taluk

Sl.No	Station	Latitude	Longitude	Altitude
1	Basavana Bagevadi	16.57	75.97	685.3

Computations were carried out for the 30 year blocks of 1981- 2010 on Mean, Standard deviation and coefficient of variation of each month pre-monsoon, monsoon, post monsoon and annual and are shown in **Table 2**. Basavana Bagevadi Taluk experiences 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.

Statistical analysis

The mean monthly rainfall at Basavana Bagevadi Taluk is ranging between 3 mm during February to 181 mm during September. The CV percent for pre monsoon, monsoon and post monsoon season is 73, 38 and 54 percent respectively. Annual CV at this station works out to be 28 percent.

Table 2: Statistical Analysis of Rainfall Data of Basavana Bagevadi Taluk, Bijapur District, Karnataka for the Period 1981 to 2010

STATION		JAN	FEB	MAR	APR	MAY	PRE MONSOON	JUN	JUL	AUG	SEP	SOUTH WEST MONSOON	OCT	NOV	DEC	NORTH EAST MONSOON	ANNUAL RAINFALL
BASAVANA BAGEWADI TALUK	Normal Rainfall (mm)	4	3	8	15	53	83	100	70	86	181	437	114	23	8	145	665
	ST.DEV	11	8	23	15	55	60	66	45	62	114	168	77	38	16	78	186
	CV%	268	316	300	99	103	73	66	64	72	63	38	68	164	214	54	28

Assessment of Drought

Rainfall data of Basavana Bagevadi Taluk has been analysed for 104 years using IMD method to assess the drought condition in the Taluk. The results of the classification are listed in the **Table 3**. It is observed that the Basavana Bagevadi Taluk has experienced alternating no drought to severe drought conditions over the years.

Table 3 : Classification of drought and its periodicity (IMD, 1971)

% Deviation (Di)		>0	0 to -25	-25 to -50	50 to -75	<-75	Probability of drought occurrences
Category		No drought	Mild (Normal)	Moderate	Severe	Acute	
		Years					
Taluk	Basavana Bagevadi	22	57	23	2	0	Once in 4 years

The details of the drought assessment are discussed as herein under. Out of 104 years of analysis in Basavana Bagevadi Taluk, "No Drought" condition is experienced in 22 years, "Mild Drought" condition is experienced in 57 years and "Moderate Drought" condition experienced in 23 years. Further it is observed that "Severe Drought" condition is experienced in 2 years i.e., during 1920 and 2003 in Basavana Bagevadi Taluk. 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 Basavana Bagevadi Taluk.

1.4 Agriculture and Irrigation

Agriculture is the main occupation in Basavana Bagevadi Taluk. Pulses are the major crop grown in the Taluk accounting for almost 64 percent of the total crop area, followed by Jowar (11%) , Oil seeds (9%), Sugar cane (11%), Bajra and wheat (4%), Maize (4%), Vegetables (4%), Fruits (1%) and Cotton (1%), and of the total crop area respectively **(Table 4)**.

Table 4: Cropping pattern in Basavana Bagevadi Taluk 2015-2016 in Ha

Paddy	Jowar	Bajra	Maize	Ragi	Wheat	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
20	21831	1768	7411	0	6300	122063	1937	7029	16454	6460	110

It is observed that net sown area accounts for about 90% of total geographical area, while area sown more than once is 7% of total geographical area in the Taluk **(Table 5).** As per the data available, the Taluk uses 6814 Dug wells and 7189 Borewells for irrigation purpose. Ground water and canals are the source for irrigation in the Taluk **(Table 6).**Land use pattern of the Taluk is represented as **Figure 2**.

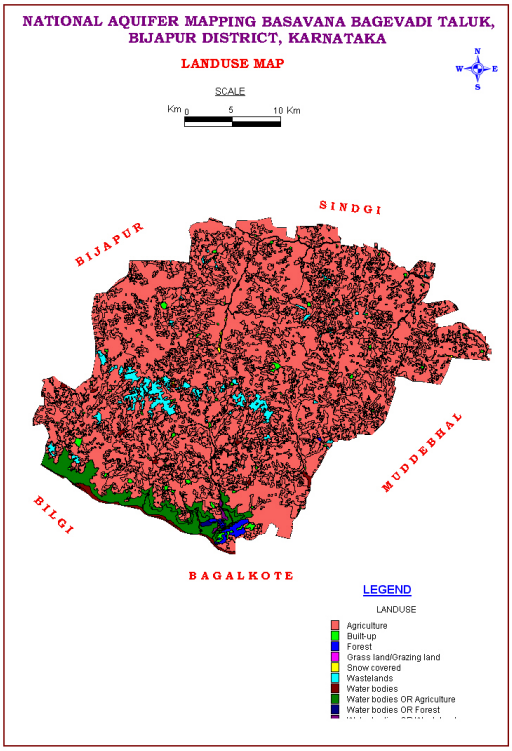

Figure 2: Land use Map

Table 5: Details of land use in Basavana Bagevadi Taluk 2015-2016 in Ha

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Basavana Bagevadi	197600	1143	8946	4559	178273	14165

Source: District at a Glance 2015-16, Govt. of Karnataka

Table 6: Irrigation details in Basavana Bagevadi Taluk in Ha

Source of Irrigation	Net area irrigated (Ha)	% of area
Canals	9558	24.95
Tanks	0	0
Wells	11094	28.9
Bore wells	17015	44.42
Lift Irrigation	0	0
Other Sources	635	1.65
Total	**38302**	

Source: District at a Glance 2015-16, Government of Karnataka

1.5 Geomorphology, Physiography and Drainage

The entire Taluk is categorised as Deccan Pediplain **(Figure 3).** Physiographically, it can be divided into four physiographic units viz., residual hills, pediments, pediplains and valleys. The ground altitude varies from 470 to 650 m above msl. The ground surface is flat, gently sloping forming broad valleys and flat-topped hills. Flat topped hills with step like sides exhibit the terraced landscape. The northern belt is a succession of low rolling uplands devoid of vegetation. The Taluk is drained by Krishna river basin **(Figure 4).**

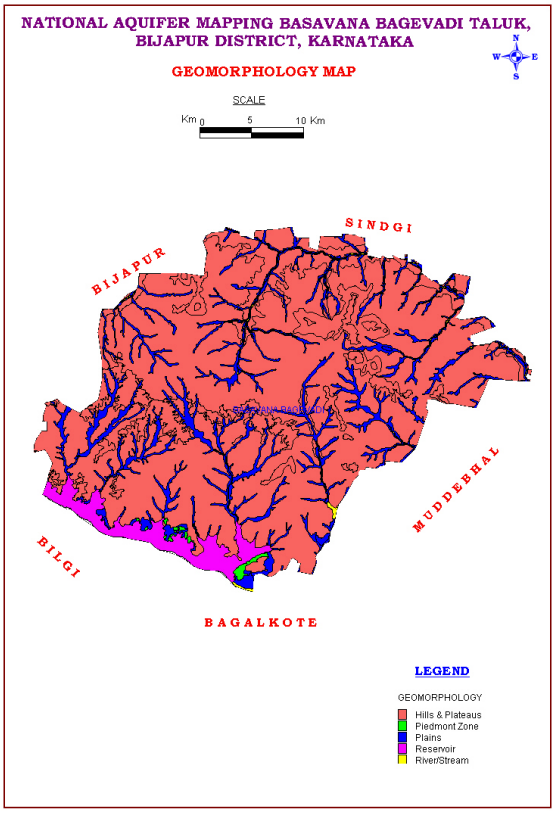

Figure 3:Geomorphology Map

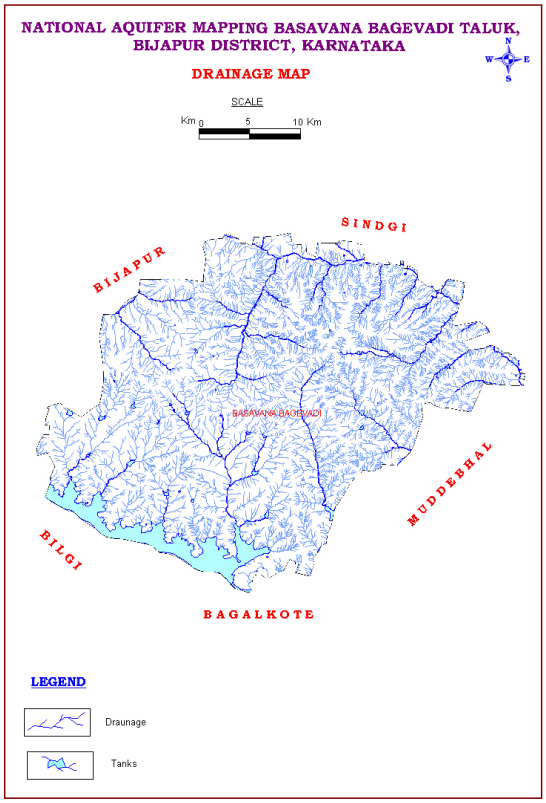

Figure 4: Drainage Map

1.6 Soil

The Taluk is occupied by two types of soils viz. Clayey and loamy soils. These are dark greyish brown and dark brown to dark reddish brown in colour.Formation of various types of soils is a complex function of chemical weathering of bedrocks, vegetative decay and circulation of precipitated water. Soils are mostly in-situ in nature **(Figure 5).**

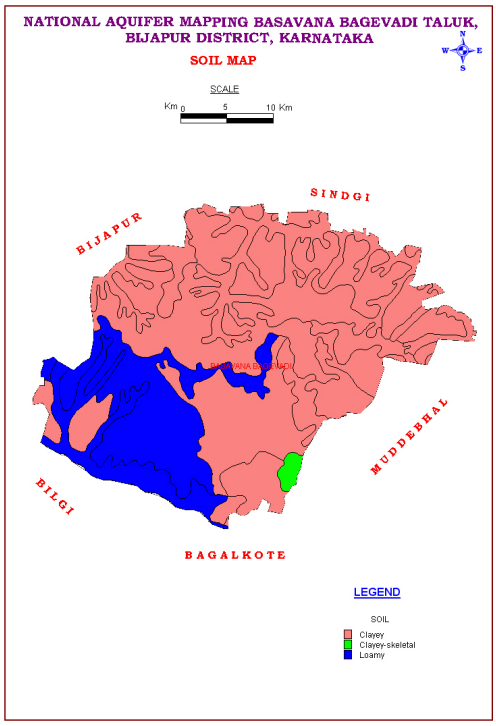

Figure 5: Soil Map

1.7 Ground water resource availability and extraction

Aquifer wise total ground water resources up to 200 m depth are given in **Table 7** below.

Table 7: Total GW Resources (2017) in 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
Basavana Bagevadi	6149	7155	4869	18173

1.8 Existing and future water demands (as per GEC-2017)

Net ground water availability for future irrigation development: 1165 Ham

Domestic and Industrial sector demand for next 25 years: 729 Ham

1.9 Water level behaviour

(a) Depth to water level

Aquifer-I

Pre-monsoon: 5.01 to 16.25 mbgl **(Figure 6)**

Post-monsoon: 0.80 to 16.50 mbgl **(Figure 7)**

Aquifer-II

Pre-monsoon: 5.70 to 15.22mbgl **(Figure 8)**

Post-monsoon: 14.74 to 17.21mbgl (**Figure 9)**

(b) Water level fluctuation

Aquifer-I

Seasonal Fluctuation: Fall in the range of 0.25 m to 6.28 m and rise in the range of 0.35m to 8.37m. **(Figure 10)**

Aquifer-II

Seasonal Fluctuation: Fall of 1.99 m for one well. **(Figure 11)**

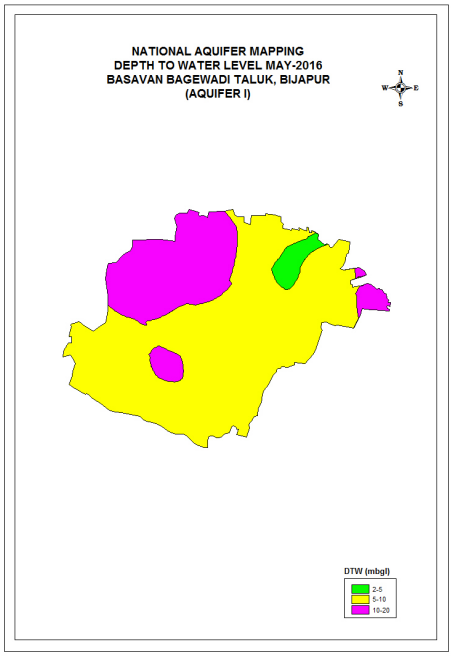

Figure 6: Depth to Water Level, May, 2016, Aq-I

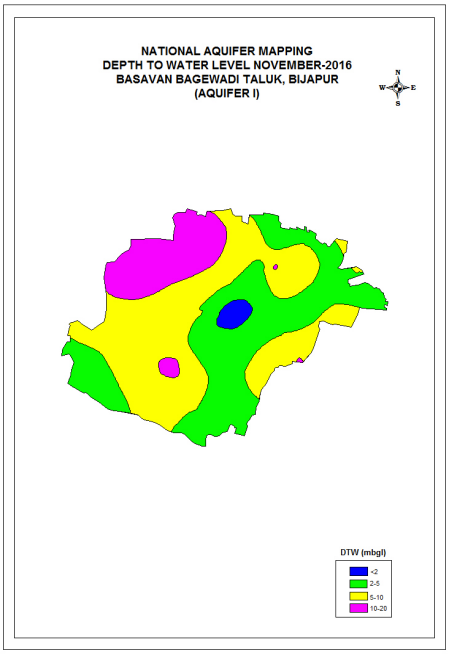

Figure 7: Depth to Water Level, Nov, 2016, Aq-I

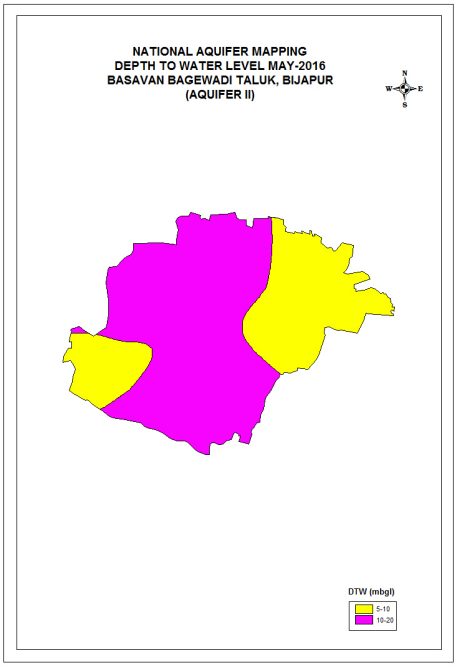

Figure 8: Depth to Water Level, May, 2016, Aq-II

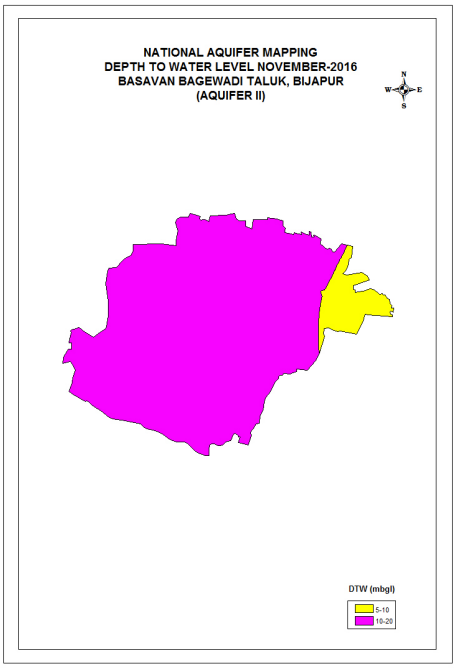

Figure 9: Depth to Water Level, Nov, 2016, Aq -II

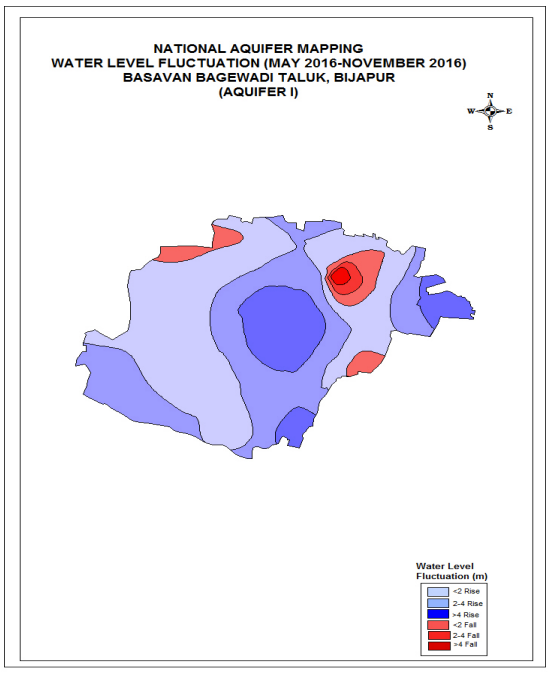

Figure 10: Water Level Fluctuation, Pre-Post 2016 Aq-I

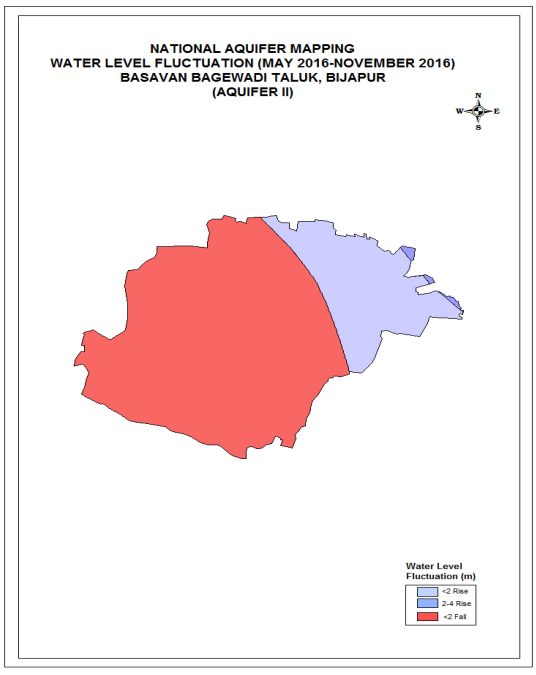

Figure 11: Water Level Fluctuation, Pre-Post 2016 Aq-II

2.0 AQUIFER DISPOSITION

2.1 Number of aquifers: In Basavana Bagevadi Taluk, there are mainly two types of aquifer systems;

i. Aquifer-I (Phreatic aquifer) comprising of Weathered Basalt

ii. Aquifer-II (Fractured aquifer)comprising Fractured Basalt

In Basavana Bagevadi Taluk, fractured basalt is the major water bearing formation. A small portion is covered with granite, limestone and laterite **(Figure 12)**. Groundwater occurs within the jointed and fractured basalt under semi-confined to confined conditions. In Basavana Bagevadi Taluk, bore wells were drilled from a minimum depth of 64.60 mbgl to a maximum of 120.0 m bgl **(Table 8)**. Depth of weathered zone (Aquifer-I) ranges from 4.9 mbgl to 29.0 mbgl. However, isolated patches in topographical lows are seen yielding seasonally, that too for very short durations. Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth range of 70 to 100 m bgl. Yield ranges from 0.13to 4.75 lps.

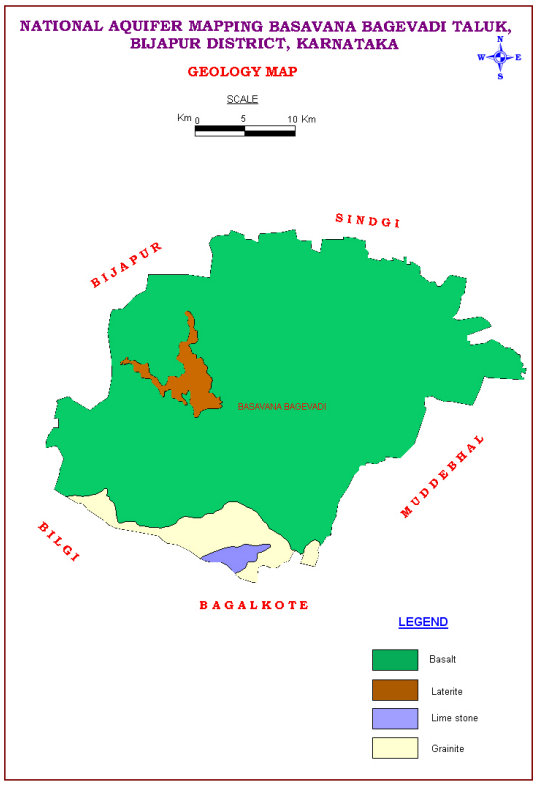

Figure 12: Geology Map

Table 8: 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.	Deginal EW	16^0 40' 45"	75^0 56' 00"	76.70	21.85	12.50, 24.90,34.05,53,61.5	6.5	4.75	4.3
2.	Deginal OW	16^0 40' 45"	75^0 56' 00"	73.70	21.85	12.7, 25.9, 39.1, 57.4, 63.5	5.54	4.75	5.186
3.	Golsangi EW	16^0 29' 10"	75^0 52' 45"	64.60	4.9	8.3, 19.85, 57.45	5.53	1.00	22.740
4.	Hebbal EW	16^0 26' 15"	75^0 57'00"	120.0	29.0	6.25, 29.0, 37.15, 78.80	13.051	0.33	6.578
5.	Ivangi EW	16^0 32' 30"	75^0 59'55"	120.0	19.4	14.8, 19.9, 42.3, 119.6	>80.00	2.50	-
6.	Kudagitanda EW	16^0 32' 30"	75^0 50' 40"	120.0	24.7	11.40, 113, 120	>50.00	0.43	-
7.	Mangoli EW	16^0 38' 40"	75^0 48' 35"	117.0	15.90	6, 24.95, 52.40, 177	2.746	1.50	26.173
8.	Muttihal EW	16^0 28' 00"	75^0 45' 00"	95.15	N.A*	21.90, 51.35, 76.80, 90	13.816	1.33	14.176
9.	Somanal EW	16^0 37' 00"	76^0 11' 00"	75.00	N.A	14, 19,52, 75	5.370	0.13	-
10.	Yambatnal EW	16^0 44' 45"	75^0 56' 30"	80.00	N.A	21-22, 51, 63	6.450	0.30	22.310

* NA: Not Available

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

3.1. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2013)

Taluk	Command/Non Command	Net Annual Ground Water Availability	Existing Gross Ground Water Draft For Irrigation	Existing Gross Ground Water Draft For Domestic and Industrial Water Supply	Existing Gross Ground Water Draft for all Uses	Allocation for Domestic and Industrial Use for Next 25 Years	Net Ground Water Availability for Future Irrigation Development	Existing Stage of Ground Water Development	Category
		Ham	Ham	Ham	Ham	Ham	Ham	%	
Basavana Bagevadi	Command	814.45	444.09	143.52	587.62	159.57	210.79	72	Semi-critical
Basavana Bagevadi	Non Command	5334.98	4322.34	544.93	4867.27	568.97	954.36	91	Semi-critical
Basavana Bagevadi		6149.43	4766.43	688.45	5454.89	728.55	1165.14	89	Semi-critical

(b)Present total Ground Water Resource (Ham)

Taluk	Annual Replenishable GW Resources	Fresh In-storage GW Resources		Total availability of GW Resource
		Phreatic	Fractured	Dynamic+phreaticin-storage+ fracturedin-storage
Basavana Bagevadi	6149	7155	4869	18173

(c) Comparison of Ground Water Availability and Draft Scenario in Basavana Bagevadi 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 (%)	GW Availability (Ham)	GW Draft (Ham)	Stage of GW Development (%)
	2009			2011			2013			2017		
Basavana Bagevadi	7589	6819	90	5462	4651	85	5867	5102	87	6149	5455	89

3.2. Chemical Quality of Ground Water and Contamination

Ground Water Quality (May 2014)

The water samples collected from shallow aquifers of GWMS were collected during pre-monsoon and analysed in the Regional Chemical Laboratory for pH, Electrical Conductivity (EC), Chloride, Nitrate and Fluoride by employing Standard methods. Based on the hydro chemical data, the portability of these samples has been assessed as per the Standards prescribed by the Bureau of Indian Standards (IS 10500: 2012) and categorized into 'Desirable', 'Permissible' and 'Unsuitable' classes.

The electrical conductivity in water samples is an indication of total dissolved ions. Thus the higher the EC, the higher the levels of dissolved ions in the sample. The perusal of the data indicates that the distribution of electrical conductivity in the Taluk shows wide variations from 660 to 3280µS/cm at 25˚ C **(Figure 13)**. The BIS has recommended a drinking water standard for total dissolved solids a limit of 500 mg/l (corresponding to about EC of 750 µS/cm at 25^0C) can be extended to a TDS of 2000mg/l (corresponding to about 3000 µS/cm at 25^0C) in case of an alternate source. Water samples having TDS more than 2000mg/l are not suitable for drinking.

One of the essential elements for maintaining normal development of healthy teeth and bones is Fluoride. Lower concentrations of fluoride usually below 0.6mg/l may contribute to dental caries. However, continuing consumption of higher concentrations, above 1.2 mg/l however cause dental fluorosis and in extreme cases even skeletal fluorosis. Most of the fluoride found in groundwater is of geogenic origin. Distribution of fluoride in the Taluk ranges from 1.5 mg/l to 3.1 mg/l. Thus majority of samples in the Taluk shows fluoride concentration beyond 1.5 mg/l rendering them unsuitable for drinking purpose **(Figure 14).**

Nitrate is a problem as a contaminant in drinking water primarily from groundwater and wells due to its harmful biological effects. High concentrations can cause methemoglobinemia, and have been cited as a risk factor in developing gastric; an intestinal cancer.The distribution of nitrate in the Taluk indicated that the values are in the range of 29 mg/l to 198 mg/l. **(Figure 15)**. Nitrate in drinking water should not exceed 45 mg/l as per BIS standard (IS: 10500: 2012)**.**Thus majority of the samples collected from the Taluk indicates that the ground water is not suitable for drinking purposes.

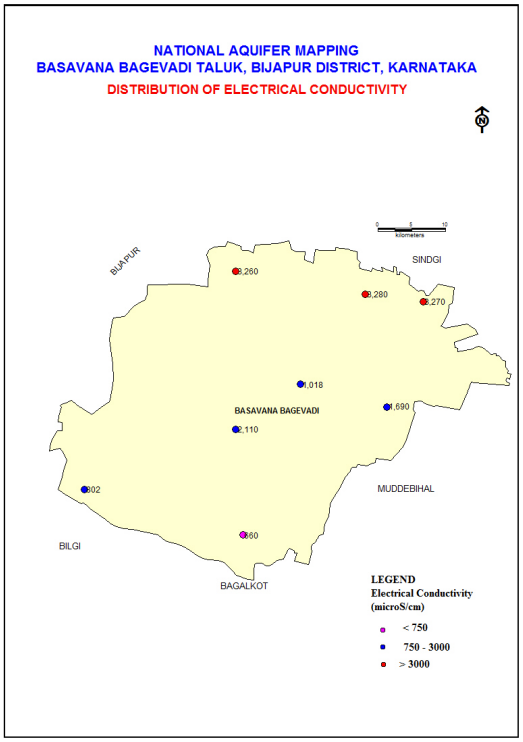

Figure 13: Distribution of EC

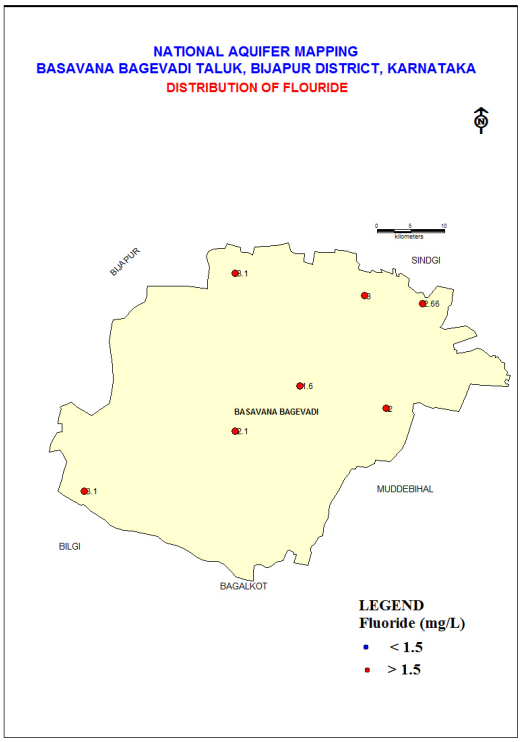

Figure 14: Distribution of Fluoride

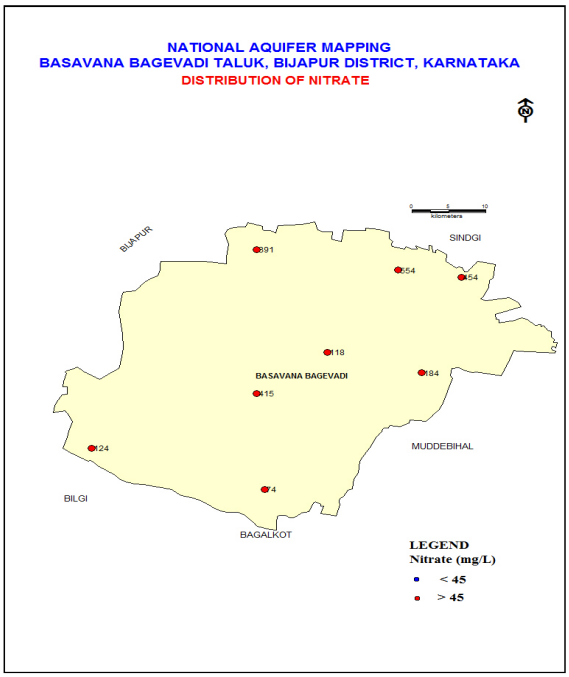

Figure 15: Distribution of Nitrate

4. 0 GROUND WATER RESOURCE ENHANCEMENT

4.1 Aquifer wise space available for recharge and proposed interventions

Recharge phreatic aquifer (Aq-I) in the Taluk, through construction of artificial recharge structures, viz. Check-dams ,percolation tanks &subsurface dykes **(Table 9).**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 9: Quantity of non-committed surface runoff and expected recharge through AR structures(As per Master Plan on Artificial recharge in Karnataka & Goa,2020)

Artificial Recharge Structures	Basavana Bagevadi Taluk
Non committed monsoon runoff available(MCM)	107.190
Number of Check Dams	316
Number of Percolation Tanks	96
Number of Subsurface dykess	3
Tentative total cost of the project (Rs.in lakhs)	5143.370
Expected recharge (MCM)	80.392
Cost Benefit Ratio (Rupees /cu. m of water harvested)	6.4

Table 10: Improvement in GW availability due to Recharge, Basavana Bagevadi Taluk

Taluk	Net annual ground water availability	Existing gross ground water draft for all uses	Existing stage of ground water development	Expected recharge from implementing proposed artificial recharge structures and ground water recharge schemes	Additional potential from proposed irrigation development schemes through inter-basin transfer project	Cumulative annual ground water availability	Expected NewStage of ground water development after the implementation of artificial recharge structures&inter-basin transfer project	Expected improvement in overall stage of ground water development
	Ham	Ham	%	Ham	Ham	Ham	%	%
Basavana Bagevadi	6149	5455	89	8039.2	7362	21550.2	25.3	63.7

After implementation of artificial recharge structures and irrigation development schemes through inter-basin transfer project for ground water recharge, the net annual ground water availability will increase from 6149 ham to 21550.2 ham and the expected improvement in stage of development is 63.7% i.e. from 89% to 25.3%. (**Table 10**)

5.0 DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

It is observed that presently in the command areas, canals are the source of irrigation and in non-command areas ground water through dug wells and borewells is used for irrigation purpose in the Taluk. Water use efficiency measures have to be adopted for saving the ground water resources.

Efficient irrigation practices like drip irrigation and sprinkler has to be adopted by the farmers in the existing 38302 Ha of gross irrigated area. Presently, draft through irrigation is 4766 Ham. Implementation of efficient irrigation techniques will contribute in saving groundwater by 1429.8 Ham and thus, will improve stage of development by 65.27% from 89% to 23.73% **(Table 11).**

Table 11: Improvement in GW availability due to saving by adopting water use efficiency

Taluk	Cumulative annual ground water availability	Existing gross ground water draft for all uses	Cumulative annual ground water availability after implementing artificial recharge structures and inter-basin transfer project	Stage of ground water development after implementing proposed AR structures &Surface water schemes	Saving due to adopting WUE measures	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of all the projects	Expected improvement in overall stage of ground water development
	Ham	Ham	Ham	%	Ham	Ham	%	%
Basavana Bagevadi	6149	5455	21550.2	25.3	1429.8	22980	23.73	65.27

5.2 Change in cropping pattern

In Basavana Bagevadi Taluk, the water intensive crops grown are paddy and sugarcane. Paddy is grown in small area of 20 hectares which is basically for self-consumption, and hence, it may not be possible to change it. Sugarcane is grown in 6460 hectares which can be reduced by using less water intensive crops.

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 23.73% in the Taluk, the non-command area and command areas which are in semi-critical category can be brought to safe category. In command area, irrigation has to depend on canals only and can retain it on safe category. Hence bringing additional area under irrigation may not be practical with a long-term resource management point of view.

5.4 Regulation and Control

In the Basavana Bagevadi Taluk, the command area and non-command area both are falling under semi-critical category. The overall stage of development in the Taluk is 89%.Karnataka Ground Water Authority has to take necessary action for controlling the over exploitation of ground water 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 Artificial Recharge Plan.

5.6 Summary

The summary of Management plan of Basavana Bagevadi is given in **Table 12.**

Table 12: Summary of Management plan of Basavana Bagevadi Taluk

Basavana Bagevadi Taluk is 'Semi-critical' and present stage of GW Development (2017)	89%
Net Annual Ground Water Availability (MCM)	61.49
Existing Gross Ground Water Draft for all uses (MCM)	54.55
Total GW Resources (Dynamic & Static up to the depth of 200 m bgl) (MCM)	181.73
Expected additional recharge from monsoon surplus runoff (MCM)	80.392
Additional potential from proposed irrigation development schemethrough inter-basin transfer project (MCM)	73.62
Change in Stage of GW development, %	89 to 25.3
Expected Saving due to adopting WUE measures (MCM)	14.298
Change in Stage of GW development, %	89 to 23.73