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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

BIJAPUR TALUK, BIJAPUR DISTRICT, KARNATAKA

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region, Bengaluru

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

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

1.0 Salient information:

Taluk name: **BIJAPUR**

District: BIJAPUR State: Karnataka

Area: 2664 sq.km.

Population: 721075

Normal Annual Rainfall: 612 mm

1.1 Aquifer Management study area:

Aquifer mapping studies was carried out in Bijapur Taluk, Bijapur district of Karnataka, covering an area of 2664 sq.kms under National Aquifer Mapping. Bijapur Taluk of Bijapur district is located between north latitude 16^0 24' 32" and 17^0 05' 31" & east longitude 75^0 19''58" and 76^0 01'35", and is covered in parts of Survey of India Toposheet Nos. 47P/5, 47P/9, 47P/10 & 47P/13. The Taluk is bounded by Indi Taluk and parts of Sholapur district of Maharashtra state in north, Bagalkot district in south, Sindgi Taluk in east and Belgaum district on the western side. Location map of Bijapur Taluk, Bijapur district is presented in **Fig. 1.**

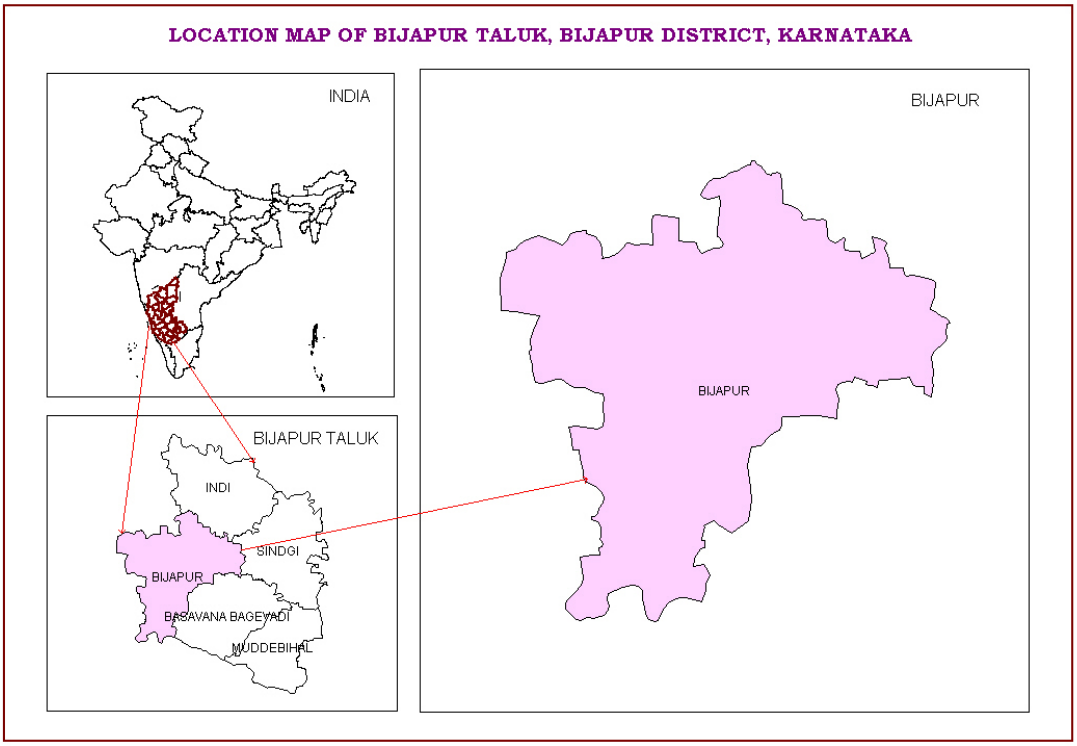

Fig. 1: Location Map of Bijapur Taluk, Bijapur district

The city of Bijapur is the district headquarters of Bijapur district and is located 530 km northwest of Bangalore. There are 129 inhabited and 4 uninhabited villages in Bijapur Taluk. It is well connected by railway and road. The broad gauge line of SW Railway connecting Hubli-Sholapur passes through it. The NH-13 Bangalore to Sholapur and NH-213 of Hubli-Sholapur pass through the district. The nearest airport to Bijapur is the Sambre Airport of Belgaum and Hubli Airport.

1.2 Population:

According to 2011 census, the population in Bijapur Taluk is 721075. Out of the total population, 393648 constitute the rural population and 327427 is the urban population, which works out to 55 % (rural) and 45% (urban) of the total population of the Taluk. The total male population is 367176 and female population is 353896. Decadal change in population from 2001-2011 is 21% in Bijapur Taluk.

1.3 Rainfall:

Bijapur Taluk has semi-arid climate. 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 dust storms and severe heat waves are common during April and May months. The Taluk falls under Northern dry zone of the agro climatic zone of Karnataka state and is categorized as drought prone.

There is one rain gauge station in Bijapur Taluk. (**Table 1**).

Table 1: Rain gauge and its location in Bijapur Taluk

Station	Latitude	Longitude	Altitude
Bijapur	16.83	75.72	674.2

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 Taluks and the same is used for analysis. Normal annual rainfall in Bijapur Taluk for the period 1981 to 2010 is 612 mm.

Table 2: Statistical Analysis of Rainfall Data of Bijapur Taluk, Bijapur District 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
BIJAPUR	Normal Rainfall (mm)	3	0	5	17	45	71	107	62	83	155	406	107	21	7	135	612
	ST.DEV	8	1	10	21	57	58	69	40	61	96	132	94	30	15	95	178
	CV%	249	548	189	119	127	82	64	65	74	62	32	88	144	230	71	29

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 are shown in Table 2. The mean monthly rainfall at Bijapur Taluk is ranging between 0 mm during February to 155 mm during September. The CV % for pre-monsoon, monsoon and post monsoon season is 82, 32 & 71 % respectively. Annual CV at this station works out to be 29 %.

Seasonal rainfall pattern indicates that, major amount of rainfall (406 mm) was recorded during South-West Monsoon seasons, which contributes to 66% of the annual normal rainfall, followed by North - East Monsoon season (135 mm) constituting 22% and remaining (71 mm) 12% in Pre - Monsoon season.

Rainfall data of Bijapur Taluk has been analyzed for 106 years using IMD method to assess the drought condition. The results of the classification are listed in Table 3. It is observed that the Bijapur 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 occurrence
Category		No drought	Mild (Normal)	Moderate	Severe	Acute	
		Years					
Taluk	Bijapur	55	25	23	3	0	Once in 4 years

The details of the drought assessment are discussed as herein under. Out of 106 years of analysis in Bijapur Taluk, "No Drought" condition is experienced in 55 years, "Mild Drought" condition in 25 years and "Moderate Drought" condition experienced in 23 years. Further it is observed that "Severe Drought" condition is experienced in 3 years i.e., during 1918, 1936 and 2003 in Bijapur Taluk. Based on occurrence and frequency of past drought events, it has been observed that the frequency of occurrence of drought is once in 4 years at Bijapur Taluk.

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Bijapur Taluk as 55% of the total population constitutes the rural population. The amount of rainfall and its distribution throughout the season contributes to the cropping pattern (**Table 4**) in the area. There are two agricultural seasons namely Kharif (June – October) and Rabi season (Mid October – Mid February). Major Kharif crops are jowar, bazra, maize, wheat and vegetables. Main crops of Rabi season are pulses and oilseeds. Sugarcane, fruits and cotton are other crops grown in the area. Hence, cereals are the major crops grown in the Taluk followed by pulses and oilseeds (**Table 4**).

Table 4: Area wise crops grown in Bijapur Taluk (Ha)

Taluk	Cereals	Pulses	Oil seeds	Fruits	Vegetable	Sugarcane	Cotton
Bijapur	111271	59874	27004	10466	6251	9946	162

In Bijapur Taluk, majority of the area is under agriculture (**Fig 2**) with very less forest cover (3%). Water bodies are present in the southern margin of the Taluk and about 85% of the area is the total net area sown (**Table 5**).

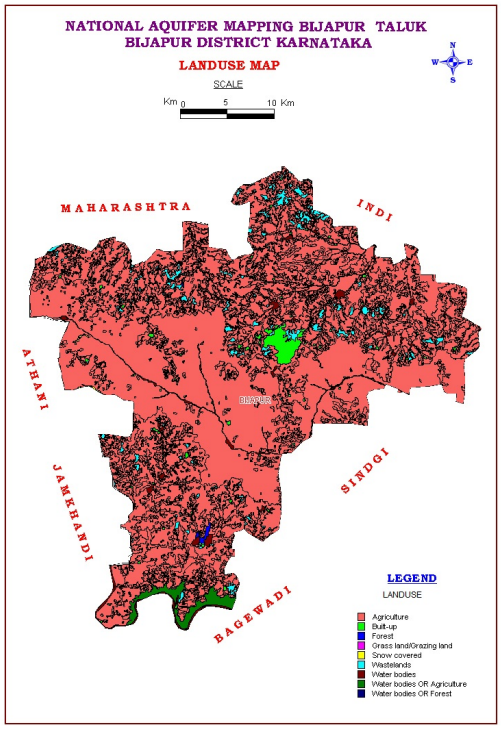

Fig. 2: Land use map

Table 5: Land use pattern of Bijapur Taluk (Area in sq km)

Taluk	Total Area	Forest	Land not available for cultivation	Un cultivable land	Fallow land	Net area sown		
						Net once Sown	Sown more than Total	
Bijapur	2664	8.34	199.73	80.88	272.58	2096.16	157.65	2253.81

Canals, tanks, dug wells and bore wells are the important sources for irrigation and the irrigated area from the different sources is given in Table 6. There are 9793 dug wells and 15061 numbers of bore wells in the Taluk and ground water plays an important role as a source of irrigation. The gross area irrigated is 69111 hectare and net area irrigated is 55580 hectares.

Table 6: Irrigation practice in Bijapur Taluk

Source of irrigation	No. of irrigation source	Net area irrigated (ha)	Gross area irrigated (ha)
Canals	78 (length)	8574	10074
Tanks	32	-	1323
Dug Wells	9793	18868	21321
Bore wells	15061	27233	35391
Lift Irrigation	-	-	-
Other Sources		905	1002
Total		**55580**	**69111**

1.5 Geomorphology, Physiography & Drainage:

Geomorphology of Bijapur Taluk is characterized by Deccan plateau comprising of rolling and undulatory flat-topped hills **(Fig. 3**) The Deccan plateau is an upland plain which are built of nearly horizontal sheets of basaltic lava flows called 'Deccan Traps' with its typical terraced and scarped characters. The plateau has been dissected by streams to form mesa type of landforms. Wherever these streams are smaller with gentle gradient, the valleys tend to have wide open areas as in the Don basin. But where the action of the stream is more powerful, the valleys are narrow and deeper. The trap topography of flat tablelands and steep sides is well presented here by the main upland of Bijapur town and from here it bifurcates into northern and south-eastern branches. The stream promotes small well-formed valleys where water is available for the major part of the year. These valleys are vital as they form the belt of agricultural development and human concentration. This upland topography goes further east of the Bijapur town. But under drier climatic condition the erosion is less active and the topography tends to be semi-arid.

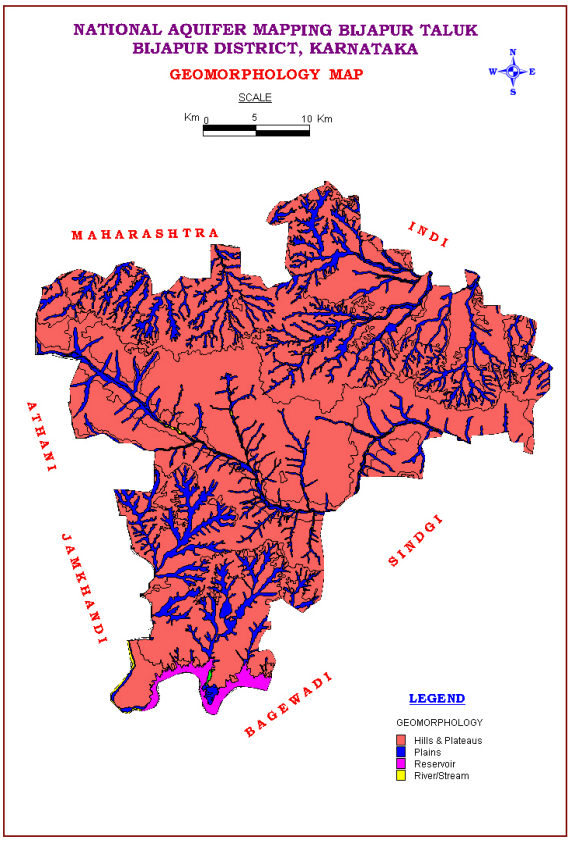

Fig. 3: Geomorphology map

The Krishna river flows along the southern margin of the Taluk. Its tributaries - Bhima river flows in the northern part and Don river in the centre of the Taluk. The drainage pattern is sub -dendritic to sub –parallel in nature. **(Fig 4)**

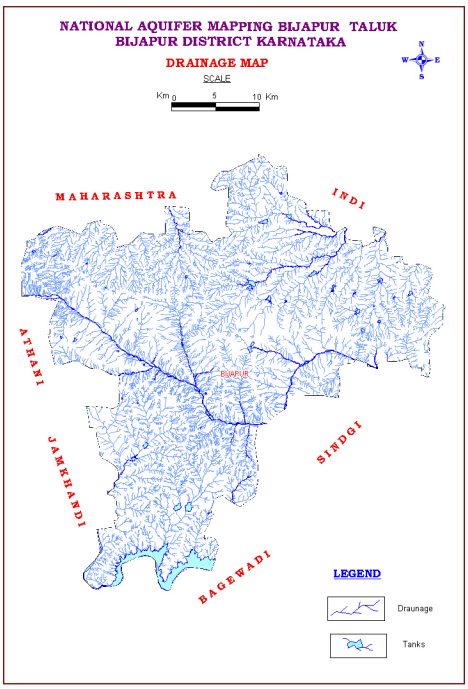

Fig. 4: Drainage map

1.6 Soil

The Taluk is covered by clayey and loamy soil. In the northern part, loamy soil and clayey soil is prevalent, whereas in the central part only clayey soil is exposed. Toward the south, loamy soil with minor clay soil is found to occur. **(Fig. 5)** Loamy soil contains equal parts of clay, silt, and sand which can retain water easily. Clay soils have greater strength especially when dry but have limited water movement, poor root development and inadequate aeration.

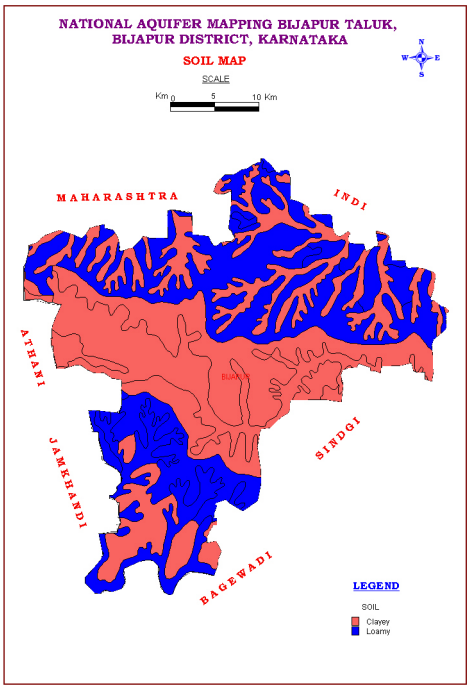

Fig. 5: Soil map

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) (Ham)

Taluk	Annual replenishable GE resources (in ham)	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic (in ham)	Fractured (Down to 200m) (in ham)	Dynamic + phreatic in-storage + fractured (in ham)
Bijapur	14359	9005	7071	30435

1.8 Existing and future water demands based on ground water resource estimation of March 2013

Annual Ground water Availability: 14359 Ham

Net ground water availability for future irrigation development: 7863 Ham

Domestic and Industrial sector demand for next 25 years: 824 Ham

Existing Gross Ground water draft for all uses: 9206 Ham

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

- Pre-monsoon: 2.67 to 18.50 mbgl (Fig 6)
- Post-monsoon: 1.25 to 25.10 mbgl (Fig 7)

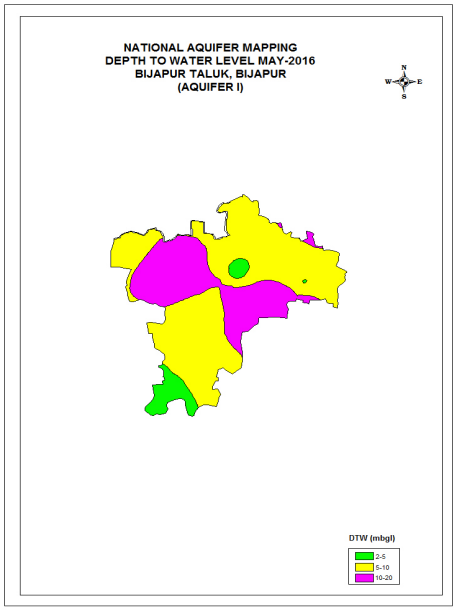

Fig 6: Pre-monsoon DTW (May, 2016), Aq-I

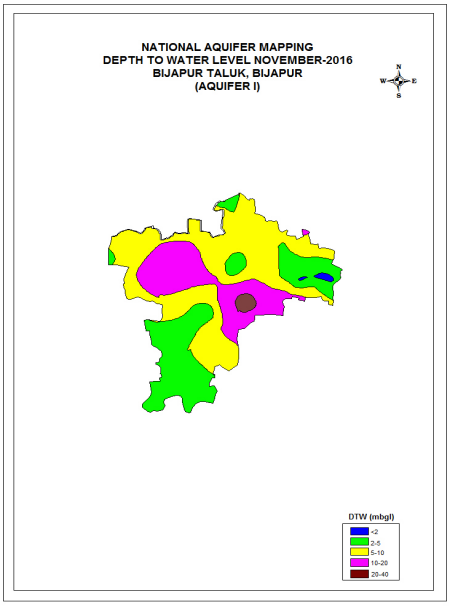

Fig 7: Post-monsoon DTW (Nov, 2016), Aq-I

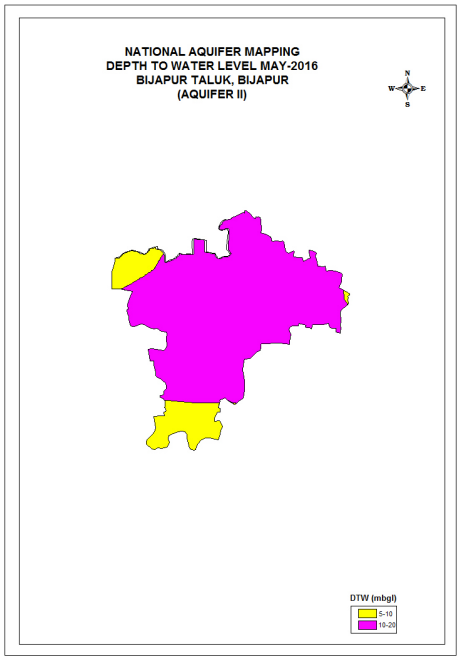

Fig 8: Pre-monsoon DTW (May, 2016) Aq-II

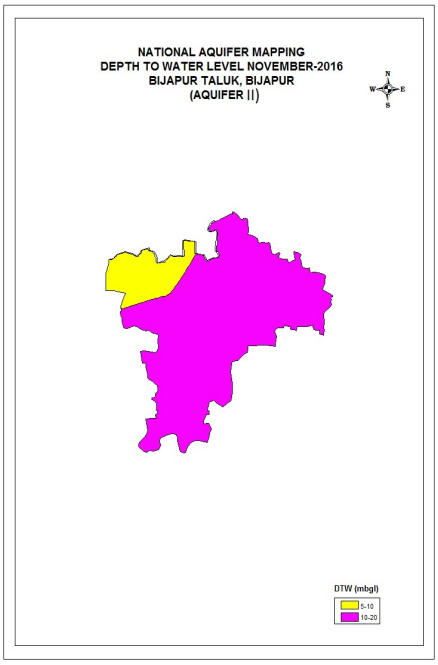

Fig 9: Post-monsoon DTW (Nov, 2016), Aq-II

(b) Seasonal water level fluctuation

Seasonal Fluctuation: (May, 2016 to Nov, 2016)

Aquifer – I (Fig 10)

- Fall 0.29 to 6.60 m bgl
- Rise ranges between 0.31 to 5.20 m bgl

Aquifer – II (Fig 11)

- No fall in depth to water level observed.
- Rise ranges between 1.13 to 2.32 mbgl

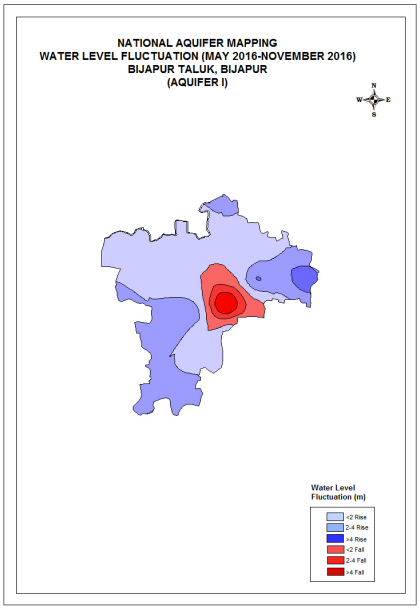

Fig 10: Seasonal water level fluctuation (Aq–I)

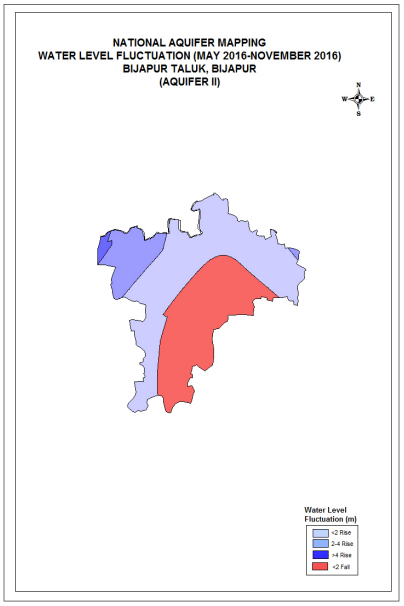

Fig 11: Seasonal water level fluctuation (Aq- II)

2.0 Aquifer disposition:

2.1 Number of aquifers: In Bijapur Taluk, there are two aquifer systems:

i. Aquifer-I (Phreatic aquifer) comprising of weathered zone of basalt**.**

ii. Aquifer-II (Fractured aquifer) comprising of fractured basalt.

But the main aquifer system is the Aquifer I which is the phreatic one.

The Taluk is occupied mainly by the basaltic flows of Deccan traps **(Fig 12)**, which belong to Middle Deccan Traps of Upper Cretaceous to Lower Eocene Age. The basalts of Deccan Traps are either horizontal or gently sloping towards southeast. The basalts are generally black to dark grey in colour, fine grained, highly vesicular and zeolitic in nature. At some places closely spaced joints, the columnar jointing and spheroidal weathering are commonly observed.

Ground water occurrence is controlled by the contrasting water bearing properties of different lava flows. The topography, nature and extent of weathering, jointing and fracture pattern, thickness and depth of occurrence of vesicular basalts and occurrence of red bole bed are the important factors which play a major role in the occurrence and movement of ground water in these rocks. Basalts or Deccan Traps usually have medium to low permeabilities depending on the presence of primary and secondary porosity. The groundwater occurs under water table and semi-confined to confined conditions in weathered and fractured zones in basalts.

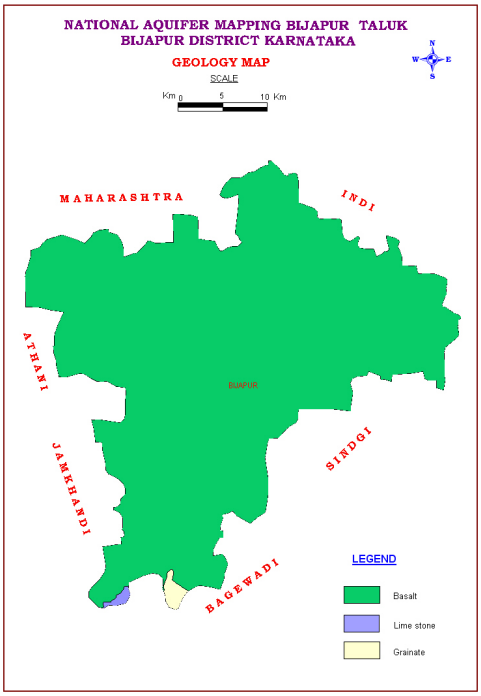

Fig 12: Geology map

Ground water exploration (**Table- 8**) reveals that aquifer– I is the weathered basalt which extends maximum upto 18 m bgl and aquifer-II is the fractured basaltic formation which are encountered between the depth range of 18 to 90 mbgl. Yield ranges from 0.33 lps to 7.6 lps and transmissivity ranges from 3.3 to 150 m^2/day. The basic characteristics of each aquifer are summarized in **Table-9**.

Table 8: Details of Ground Water Exploration

Sl. No	Location	Latitude	Longitude	Depth drilled (mbgl)	Casing depth (mbgl)	Fracture Zones (mbgl)	SWL (mbgl)	Q (lps)	DD (m)	T (m^2/day)
1.	Aheri	16°52'55"	75°35'26"	90	6.1	12, 16, 50, 90	7.26	7.6	1.74	150
2	Aheri	16°52'55"	75°35'26"	30		9, 24, 30	6.56	1.3	1.43	
3	Aliyabad	16°53'15"	75°47'16"	73.75	3.6	12.75, 23.90, 34.10,73.75	3.345	4.3	14.33	9
4	Arjungi	16°37'5"	75°29'5"	90	6.34	14, 32.45, 49.5, 82.8	19.69	1	7.88	3.3
5	Honawad	16°48'3"	75°25'03"	83.5		37, 45, 61, 83.5	28.83	0.33		
6	Jalgeri	16°55'45"	75°37'30"	80		35.5, 55, 74.8	3.01	1.5	18.95	3.7
7	Jalgeri	16°55'45"	75°37'30"	65			2.084	1.4	0.166	
8	Khatijapur	16°45'45"	75°40'20"	90	17.4	25.2, 39, 69	14.98	0.66	4.46	
9	M.D.Hatty	16°53'20"	75°33'20"	58		23.5, 35.5, 51.0, 58.0	7.56	1.96	0.822	150
10	M.D.Hatty	16°53'20"	75°33'20"	44			7.12	1.4	0.552	
11	Tidgundi	16°59'40"	75°45'30"	80		45.9, 47.5, 51.0, 80.0		3.4		
12	Tidgundi	16°59'40"	75°45'30"	48			4.7	1.97	8.99	123

Table 9: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Basalt	Basalt
Thickness range (m bgl)	18	Fractures down to 90
Depth range of occurrence of fractures (mbgl)	Within 18	18 -90
Range of yield potential (lps)	0.33	upto 7.6
Specific Yield	---	---
T (m^2 /day)	---	3.3 to 150
Quality, Suitability for Irrigation	Suitable	Suitable
Suitability for Domestic purposes	Suitable with sporadic occurrence of F, Nitrate and E.C.	Suitable with sporadic occurrence of F, Nitrate and E.C.
Remarks	Productive	Three to four sets of fractures are common.

3.0 Ground water resource, extraction, contamination and other issues

3.1 Aquifer wise resource availability and extraction

Table 10*:* Present Dynamic Ground Water Resource (As on March 2017)

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
Bijapur	14359	8399	807	9206	824	7863	64	SAFE

Table 11: Present total Ground Water Resource

Taluk	Annual replenishable GW resources (in ham)	Fresh In-storage GW resources (in ham)		Total availability of GW resource (in ham)
		Phreatic Aq-I	Fractured Aq-II	Dynamic +Phreatic in-storage+ fractured in-storage
Bijapur	14359	9005	7071	30435

Table 12: Comparison of ground water availability and draft scenario in Bijapur Taluk (2009 to 2017)

Taluk	2009			2011			2013			2017		
	GW Availability	GW Draft	Stage of GW withdrawal	GW Availability	GW Draft	Stage of GW withdrawal	GW Availability	GW Draft	Stage of GW withdrawal	GW Availability	GW Draft	Stage of GW withdrawal
Bijapur	10854	8707	80	11622	9381	81	10737	8974	84	14359	9206	64

3.2. Chemical Quality of Ground Water and Contamination

On perusal of available ground water analysis, it has been found that the ground water quality in the Taluk is overall good and potable. However, there are some sporadic occurrences of Fluoride, Nitrate, and Salinity in the ground water which warrants remedial measures before usage.

4. GROUND WATER RESOURCE ENHANCEMENT

4.1 Aquifer wise space available for recharge and proposed interventions

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. Structures like Sub surface dykes, Check dam, point recharge structures and percolation tank are recommended. This will pave for enhancement of groundwater resources in the Taluk. As per Master Plan of Artificial Recharge, 1197 sq km is the total area calculated out which is found suitable for Artificial Recharge.

Table 13: Quantity of non-committed surface runoff and expected recharge through AR structures(As per Master Plan on artificial recharge in Karnataka and Goa, 2020)

Artificial Recharge Structures Proposed	Bijapur Taluk
Non committed monsoon runoff available (MCM)	306.517
Number of Check Dams	935
Number of Percolation Tanks	275
Number of Subsurface dykes	08
Tentative total cost of the project (Rs. in lakhs)	15008.340
Expected recharge (MCM)	229.888

4.2 Improvement in GW availability due to Recharge, Bijapur 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	%	%
Bijapur	14359	9206	64	22988.8	7362	44709.8	20.59	43.41

After implementation of Artificial Recharge structures for GW recharge and inter-bain transfer, the annual ground water availability will increase from 14359 Ham to 44709.8ham and the expected improvement in stage of development is from 43.41%

i.e., from 64% it will come down to 20.59 %. Hence Bijapur taluk will remain in Safe category.

5. DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

The Taluk is dependent on both groundwater and surface water for irrigation. But dependence of groundwater is more. So efficient irrigation practices like Drip and sprinkle irrigation, mulching and spreading of plastic sheets needs to be adopted by the farmers. These efficient irrigation techniques will contribute in saving ground water and thus will reduce the irrigation draft. By adopting the above said techniques, will definitely contribute in ground water resource enhancement in the long run.

5.2 Change in cropping pattern

In Bijapur Taluk, water intensive crops like Sugarcane is grown but not extensively. Hence, cultivation of such crops should be discouraged. Change in cropping pattern is not suggested as of now. Farmers may be educated about water efficient plants and crops and they may be imparted training in this regard. Micro irrigation practices should be propagated among the farmers in coming years which will ensure availability and sustainability in coming years.

Table-14: 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	Groundwater saved by adopting WUE methods	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	%	%
Bijapur	44709.8	9206	20.59	2519.7	47229.5	19.49	1.1

5.3 Additional area of irrigation

Although the taluka is safe with 64% of groundwater development, bringing additional area under irrigation may not be practical with a long-term resource management point of view as the Taluk was previously in semi-critical category w.r.t. GEC 2013. So, farmers and other stake holders may be discouraged for going for additional area for irrigation and rather they should be encouraged to go for artificial recharge and inter basin transfer as per Integrated Irrigation development Schemes proposed by Sri G.S. Paramashivaiah, Retired. CE, Irrigation department, Government of Karnataka for better management and sustainability of ground water resources in the Taluk. Project 4 and 5 will cover the Taluk and about 2.6 TMC quantum of water is proposed by inter basin transfer in Bijapur Taluk.

5.4 Regulation and Control

Bijapur Taluk has been categorized as **Safe**, since the Stage of ground water development is 64% (GEC March 2017). Ground water recharge component needs to be made mandatory in project related to further development of ground water and to save the future situation from deteriorating further.

5.5 Other interventions proposed:

Remedial measures need to be adopted in the areas affected by Fluoride, Nitrate and EC like dilution of nitrate rich ground water through artificial recharge & water conservation, roof top rain water harvesting. Treated and safe water source is strongly recommended for drinking purpose.

For removal of fluoride, which is of geogenic origin, adoption of site-specific standard filtration/ removal technique like activated alumina de-fluoridation filter and distillation filtration is strongly recommended. Other methods like Nalgonda techniques, Ion exchange process, adsorption methods like activated carbon, Tri calcium phosphate and activated alumina may be used. The blue print for cost effectiveness and economically feasible techniques with zero environmental impact and inbuilt arrangement for proper sanitary disposal of sludge needs to be prepared.

In localities affected by nitrate arising because of anthropogenic activities, awareness programme, health campaign and training may be imparted on solid waste disposal, contaminants and health hazards issues and ground water management by involving the local people, NGOs, Shree-Shakti, Self Help Groups etc. Comprehensive quality mitigative plan for the Taluk may be formulated by incorporating by dissemination of data among the allied State and Central government departments which will pave the way for better management of ground water resource. Regular water quality monitoring mechanism is to be implemented. Periodical maintenance of artificial recharge structures should also be incorporated in the Recharge Plan and all the allied State and Central Departments may work on a common platform for better management and sustainability of the precious ground water resources in the Taluk in coming years.

5.62 Summary

The summary of Management plan of Bijapur Taluk is given in **Table-15**.

Table-15: Summary of Management plan of Bijapur Taluk

Bijapur Taluk is "Safe" and present stage of GW Development (2017)	64%
Net Annual Ground Water Availability (MCM)	143.59
Existing Gross Ground Water Draft for all uses (MCM)	92.06
Total GW Resources (Dynamic & Static up to the depth of 200 m bgl) (MCM)	304.35
Expected additional recharge from monsoon surplus runoff (MCM)	229.888
Change in Stage of GW development after implementation of artificial recharge structures and inter-basin transfer project, %	64 to 20.59
Change in Stage of GW development after implementation of artificial recharge structures , inter-basin transfer project and WUE methods, %	20.59 to 19.49