केन्द्रीय भूमिजल बोर्ड

जल शक्ति मंत्रालय, जल संसाधन, नदी विकास और गंगा संरक्षण विभाग

भारत सरकार

Central Ground Water Board

Ministry of Jal Shakti,
Department of Water Resources, River Development
and Ganga Rejuvenation
Government of India

Report on

AQUIFER MAPPING AND MANAGEMENT PLAN

Alur Taluk, Hassan District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु

South Western Region, Bengaluru

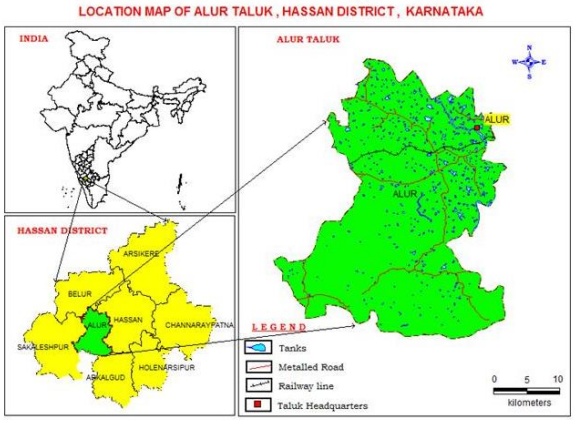
FOR OFFICIAL USE ONLY
No. *SWR/RP/NQM/2022-23/25*

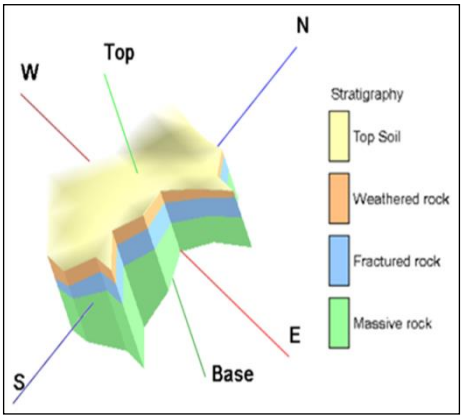
भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
एवं गंगा संरक्षण विभाग
केन्द्रीय भूमिजल बोर्ड
दक्षिण पश्चिमीक्षेत्र, बेंगलुरु

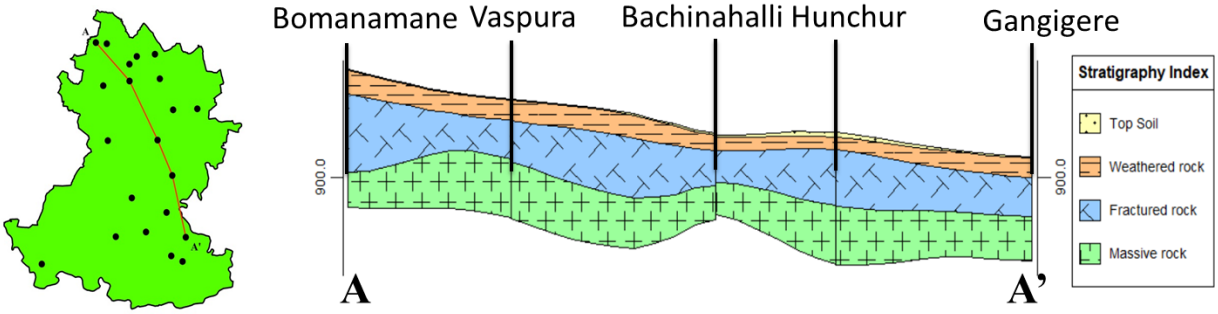
Government of India
Ministry of Jal Shakti
Department of Water Resources,
River Development &
Ganga Rejuvenation
Central Ground Water Board
South Western Region, Bengaluru

AQUIFER MAPS AND MANAGEMENT PLAN, ALUR TALUK, HASSAN DISTRICT, KARNATAKA STATE

(AAP – 2021-2022)







By

Damera Anjaneyulu, Assistant Hydrogeologist, CGWB, SWR, Bangalore

AUGUST2022

AQUIFER MAPS AND MANAGEMENT PLAN, ALUR TALUK, HASSAN DISTRICT, KARNATAKA STATE

(AAP – 2021-2022)

1 Contents

AQUIFER MANAGEMENT PLAN OF ALUR TALUK, HASSAN DISTRICT, KARNATAKA STATE

1. SALIENT INFORMATION

Name of the taluk: **ALUR**

District: **HASSAN**

State: Karnataka

Area: 428 sq.km.

Population: 85,255 (As 2011 census)

Annual Normal Rainfall: 1050 mm

1.1 Study Area

Aquifer mapping studies was carried out in Alur Taluk, Hassan district of Karnataka, covering an area of 428 sq.kms under National Aquifer Mapping Project. Alur Taluk of Hassan district is located between north latitude 12° 48' 03" and 13° 04' 10" & east longitude 75° 49' 25" and 76° 03' 31" and is covered in parts of Survey of India Topo sheet Nos. 57D/1, 57C/4, 48O/16 & 48P/13. Alur Taluk is bounded by Belur Taluk on north, Arkalgud&Somawarpet Taluks on south, Hassan Taluk on east and Sakleshpura Taluk on the western side. Location map of Alur Taluk of Hassan district is presented in Figure-1. Taluk administration of Alur Taluk is divided into 4 Hoblies. Alur town is also the Taluk head quarter. There are 251 inhabited and 8 uninhabited villages in the Taluk.

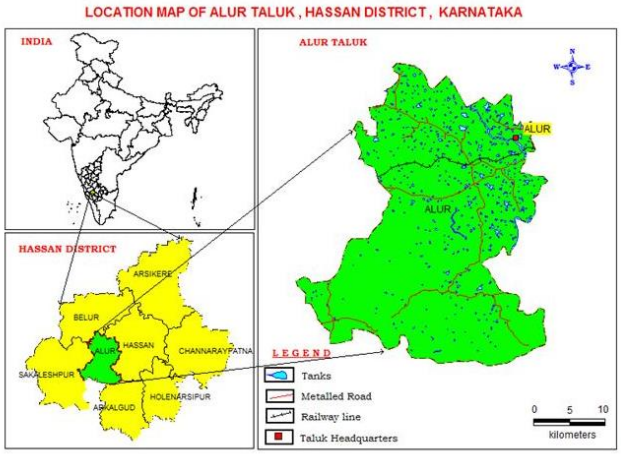


Fig-1: Location map.

1.2 Population

According to 2011 census, the population in the Taluk is 85,255, in which 78,714 constitute the rural population and 6,541 urban population, which works out to 92 % (rural) and 8 % (urban) of the total population of Taluk. The study area has an overall population density of 199 persons per sq.km. The decadal variation in population from 2001 to 2011 is -0.95 % in Alur Taluk.

Table-1: Population details of Alur taluk

Total	Male	Female	Share of the district population	Rural population	Urban population	Decadal change in population	Decadal change in rural population	Decadal change in urban population
85,255	**42253**	**43002**	**4.79**	**78714**	**6541**	**-0.95**	**-1.55%**	**6.23%**

Source: District at a glance 2018-19, Govt. of Karnataka

1.3 Rainfall

Alur Taluk enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Southern Dry agro-climatic zone of Karnataka state and is categorized as drought prone. The normal annual rainfall in Alur Taluk for the period 1951 to 2018 is 1011 mm. Seasonal rainfall pattern indicates that, major amount of (751 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 74% of the annual normal rainfall, followed by North-East Monsoon season (260 mm) constituting 25% (Table-1).

Table-2:Average Rainfall Data of Alur Taluk, Hassan district, Karnataka (2001-2018)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN.RAINFALL
Alur	1.3	5.8	29.5	89.6	116.3	141.4	183.5	160.8	135.7	129.7	49.3	7.4	1011.2

Table-3: The annual rainfall data of Alur Taluk, Hassan district, Karnataka (2001-2018)

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
ANNRain	781	665	622	987	1416	1295	1211	1698	1160	1473	1319	714	498	1007	977	875	831	1375

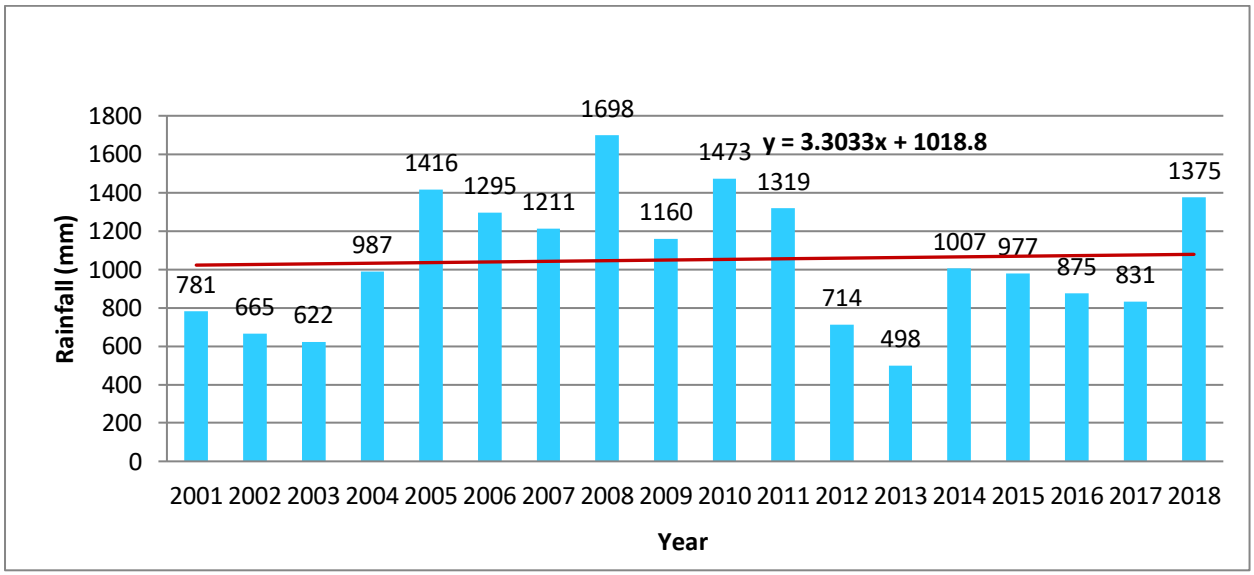


Fig. 2 - Rainfall Trend Analysis

The rainfall pattern in the Alur Talukreveals the irregularity of rainfall behaviour (**Fig-2**) and the rainfall varies from 498 mm to 1698 mm (**Table-3**). As mentioned above, the normal annual rainfall of

ALUR TALUK is 1050 mm.ALUR TALUK received rainfall above normal during the years 2005-2011 and 2018.

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Alur Taluk. Major Kharif crops are paddy, maize, ragi, tur and vegetables. Main crops of Rabi season are maize, ragi, horse gram, vegetables, groundnut, and sunflower (Table-2). Water intensive crops paddy is grown in 16% of total crop area. Maize is grown in 59%, ragi in 19%, vegetables in 1.5% and pulses in 0.4% of total crop area of Taluk shown in Table.4.

Table-4: Cropping pattern in Alur Taluk 2017-18 (Ha)

Year	Paddy	Maize	Ragi	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
2017-18	1849	6989	2290	0	52	401	178	10	0	0

It is observed that the net sown area accounts 52% and area sown more than once is 17% of total geographical area in Alur Taluk. Area not available for cultivation and Forest covers 32% & 4% of total geographical area respectively (Table-5). 63% of net area irrigated is only from bore wells and 18% from tank irrigation (Table-6).

Table-5: Details of land use in Alur Taluk 2017-18 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Alur	40265	487	14402	11422	13954	3004

Source: District at a glance 2018-19, Govt. of Karnataka

Table-6: Irrigation details in Alur taluk (in ha)

Source of Irrigation	Net area irrigated (Ha.)	% of area
Canals	0	0
Tanks	1032	42
Wells	23	1
Bore wells	350	14.5
Lift Irrigation	0	0

Other Sources	1037	42.5
Total	2442	

Source: District at a glance 2018-19, Govt. of Karnataka

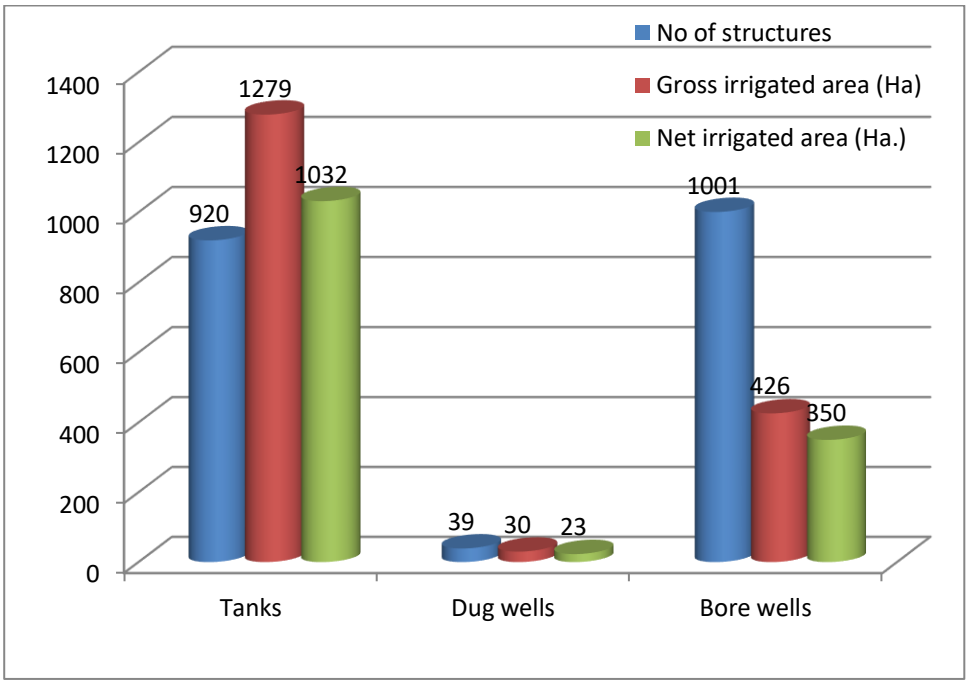


Fig.3. Irrigation source in Alur Taluk, Hassan district

1.5 Geomorphology, Physiography & Drainage

The general land elevation on the eastern side of the Taluk is about 920 m amsl and increases to 1050 m amsl in the west. The general slope is mostly towards NW to SE(Fig.-4).

The Taluk is drained by 1st to 4th order streams which flow towards south and east wards. The southern boundary of the Taluk is coinciding with the Hemavathi River. The tank system is well developed in the Taluk. The general drainage pattern is dendritic to sub-dendritic in nature and mostly joins Hemavathi River (Fig.-5).

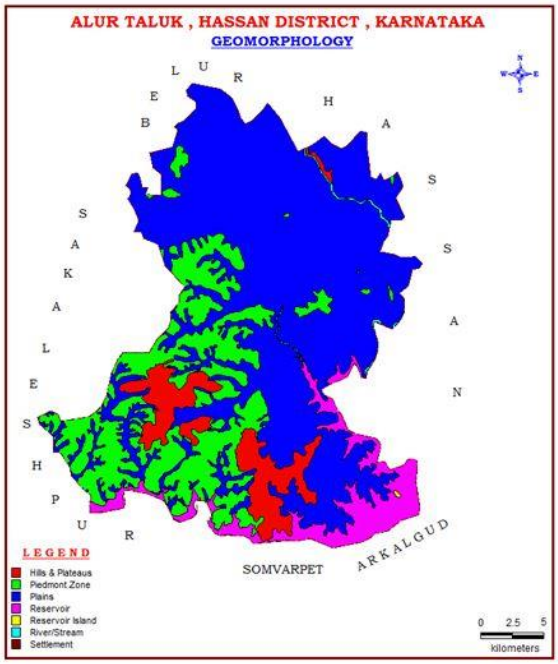


Fig.4. Geomorphology map

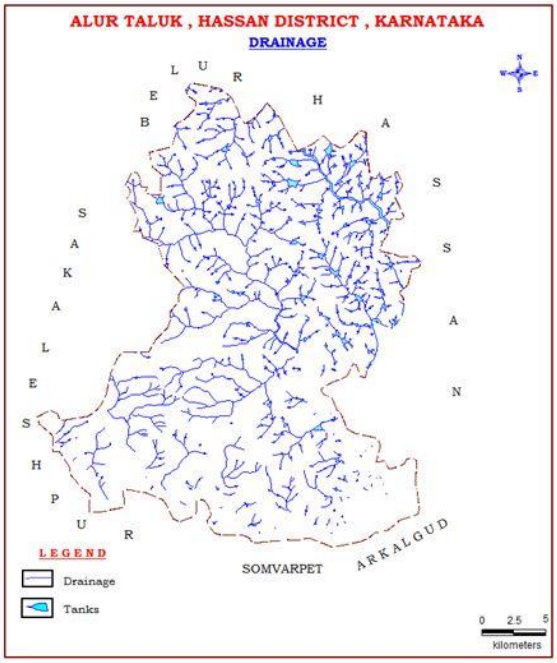


Fig.5. Drainage map

1.6 Soil

In general, the Taluk is covered by red soil. Patches of black cotton soil are also found at places. The red soil in general derive from granite gneisses. Black cotton soils are derived from schist and alluvial soil found in limited extent and confined to river/nala courses in Fig.6.

The land use map of the taluk is shown in **Fig.7.** Major part of the taluk is covered by agriculture activity.

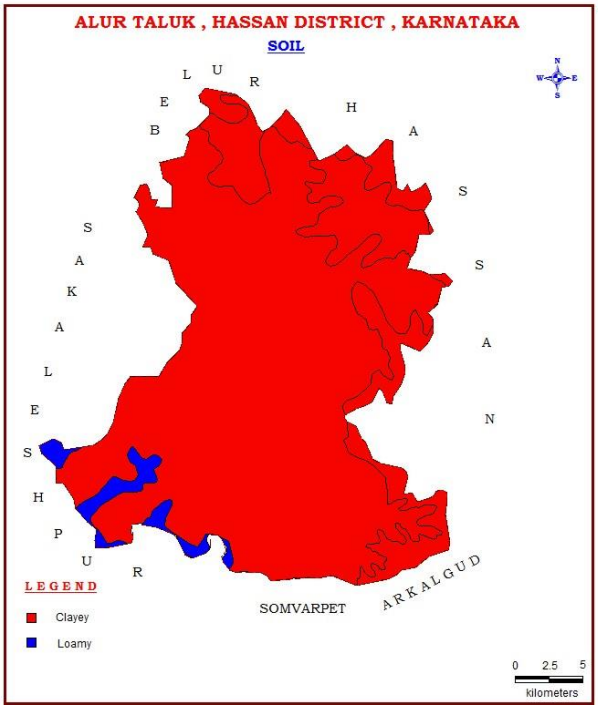


Fig-6: Soil Map

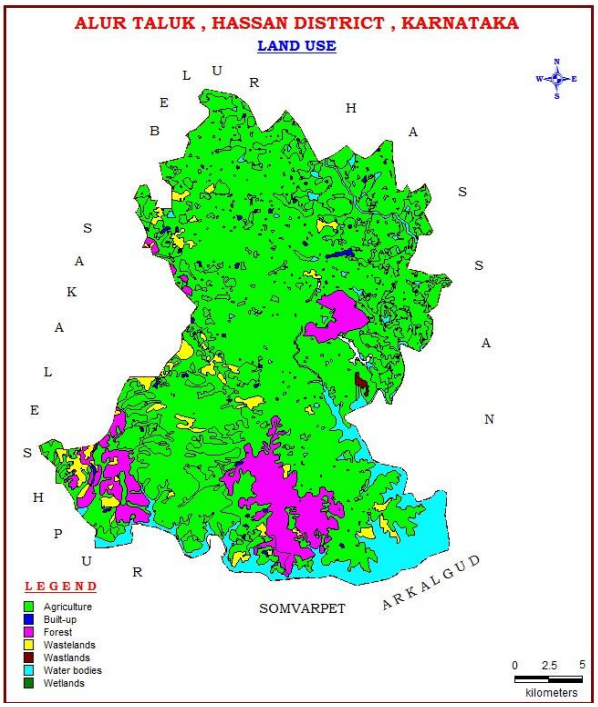


Fig-7: Land use Map

1.7 Ground water resource availability and extraction

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

Table-7:Total Ground Water Resources (2017) (Ham)

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
ALUR	13032	Phreatic	Fractured (Down to 200m)	Dynamic + phreatic in-storage + fractured
		15762	1863	30657

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

- Net ground water availability for future irrigation development: 66.49 MCM
- Domestic (Industrial sector) demand for next 25 years: 6.98 MCM

1.9 Water level behavior

(a) Depth to water level: The depth to water level data is shown in **Table.8**

Aquifer-I

- Pre-monsoon: 3.15 – 19.32 mbgl (**Fig.-8**).
- Post-monsoon: 1.13 – 19.32 (**Fig.-9**).

.

Aquifer-II

- Pre-monsoon: 8.95-11.65 mbgl
- Post-monsoon: 6.40-8.10 mbgl

(b) Water level fluctuation

Aquifer-I

- Seasonal Fluctuation: Rise ranges -0.54 – 11.81 m.

Aquifer-II

- Seasonal Fluctuation: Rise ranges 2.55-3.55 m.

(c) Long-Term Water level trend: The data is shown in **Table.9**.

- Pre-monsoon: Falling ranges 0.00743-0.3270 m
  Rising ranges 0.0910-0.1810 m
- Post-monsoon: Falling ranges 0.1859-0.5550 m
  Rising ranges 0.0910-0.1608 m

Table-8: Depth to water level for pre-monsoon and post-monsoon

Sr. No	Village	Source	Pre-monsoon Depth to water May-2019 (mbgl)	Post-monsoon Depth to water Nov-2019 (mbgl)	Water level Fluctuation
	Aquifer-I				
1	Alur1	DW	9.89	1.94	7.95
2	Harihalli	DW	13.14	1.33	11.81

Sr. No	Village	Source	Pre-monsoon Depth to water May-2019 (mbgl)	Post-monsoon Depth to water Nov-2019 (mbgl)	Water level Fluctuation
3	Hosapalya	DW	13.09	13.63	-0.54
4	Kanathur	DW	3.15	1.13	2.02
5	KenchammanaHoskote	DW	13.10	10.04	3.06
6	Lakkamanahalli	DW	19.32	19.32	0.00
7	Byaba	DW	7.20	3.50	3.70
8	K Hosakote	DW	12.00	7.90	4.10
9	Kundur	DW	8.90	3.10	5.80
Aquifer-II					
10	Imatipura	BW	8.95	6.40	2.55
11	K Hosakote Hp	BW	11.65	8.10	3.55

Table–9 Long Term Water Level Trends (Based on CGWB's National Hydrograph Stations).

Sl. No.	Location	Period of observation	Water level trend m/year			
			Pre monsoon		Post monsoon	
			Fall	Rise	Fall	Rise
1	Alur	2011-2020	0.19	-		0.15
2	Harihalli	2011-2020	0.09	-		1.07
3	Hosapalya	2011-2020	0.29	-	0.30	
4	Kanathur	2011-2020	0.15	-	0.00	
5	KenchammanaHoskote	2011-2020	0.23	-	0.12	
6	Lakkamanahalli	2011-2020	1.54	-	0.55	0.15

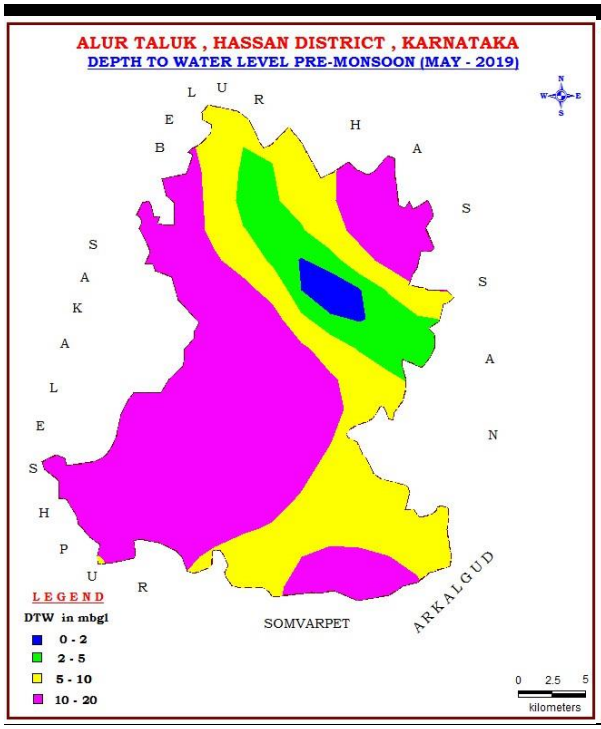


Fig-8: Pre-monsoon Depth to Water Level

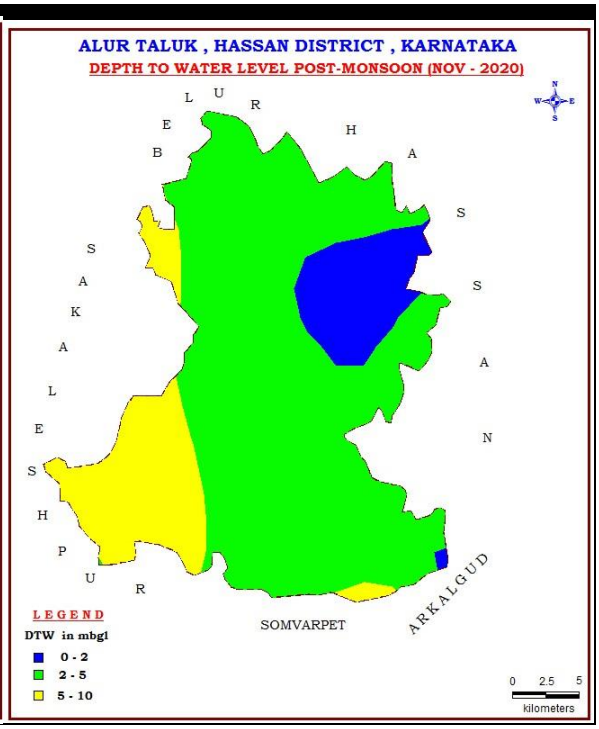


Fig-9: Post-monsoon Depth to Water Level

2 AQUIFER DISPOSITION

2.1 Number of aquifers:

In Alur taluk, there are mainly two types of aquifer systems;

I. **Aquifer-I (Phreatic aquifer) Weathered Granite Gneiss**
II. **Aquifer-II (Fractured aquifer) Fractured Granite Gneiss**

In Alur Taluk, granitic-gneisses is the main water bearing formations (Figure-10). Ground water occurs within the weathered and fractured granitic-gneisses under water table condition and semi-confined condition. In the Taluk, bore wells were drilled from a minimum depth of 70 mbgl to a maximum of 235 mbgl (Table-6). Depth of weathered zone (Aquifer-I) ranges from 5.52 mbgl to 42 mbgl (Figure-11). Ground water exploration reveals that aquifer-II fractured formation was encountered between the depths of 13.20 to 182 mbgl. Yield ranges from 0.1 to 14.29 lps. Transmissivity ranges from 1 to 37.06 m2/day.

Fig.10. Geology map

Table-10: Details of Ground Water Exploration

Sl No.	Location	Latitude	Longitude	Depth drilled (mbgl) / Casing (m)	Lithology	Fracture Zones encountered (mbgl)	SWL (mbgl)	Discharge (lps)	Drow down (m)	T (m2/day)
1	KANDALLI EW			86.0/12.5	GRGN, SCST	41-43, 55-72, 72-86	1.45	5	16.14	20
2	KANDALLI OW			70.70 / 9.7	do	26-57, 57-70	1.36	0.5	33.48	1
3	NAGENAHALLI EW	12.97917	75.99111	235 / 42	GRGN	50.87-52.87, 129.07-131.07, 108-182		1	11.29	19
4	BALLUPET EW	12.95000	75.88333	195.65 / 14.97	PGMT, PICG	95-97, 105-106, 118-121		6.74	23.87	9.6
5	BALLUPET OW1	12.95000	75.88333	134.69 / 14.74	PGMT	73-75,102-104		6.66		22.39
6	BALLUPET OW2	12.95000	75.88333	100 / 18	do	72-73.5		14.29		17.87
7	NALLUR EW	12.90000	75.95000	200 / 9.6		39-42		0.1		
8	Hunchur EW	12.92106	75.99044	178.75 /5.5	Hornblend gneiss	13.20 - 14.20	4.03			7.8
9	Bharatavally EW	12.97558	76.01514	153.5 /24	Granite gneiss	68.10 - 69.10, 70.10 - 71.15	27.83		14.07	37.06
10	Bharatavally OW	12.97567	76.01506	165.7 /24	Granite gneiss	31.50 - 32.50, 96.55 - 98.55	18.19		1.82	13

Table-11: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Granite gneiss	Fractured Granite gneiss
Thickness range (mbgl)	20	Fractures upto182mbgl
Depth range of occurrence of fractures (mbgl)	7-15	47-182
Range of yield potential (lps)	Poor yield	<1 –14.29
Specific Yield	2%	0.2%
T (m^2/day)	-	1-37.06
Quality Suitability for Domestic &Irrigation	Suitable	Suitable

2.2 3-D aquifer disposition and Cross-Sections

2.2.1 Aquifer disposition – Rockworks output

Sub-surface aquifer disposition are prepared based upon the outcome of ground exploration programme. Mainly. Four zones are categorized namely Top soil, Weathered, Fractured and Massive zones. These zones are represented using rockworks to depict the subsurface sections and models and presented in **Fig.-11, Fig.-12 and Fig.13.**

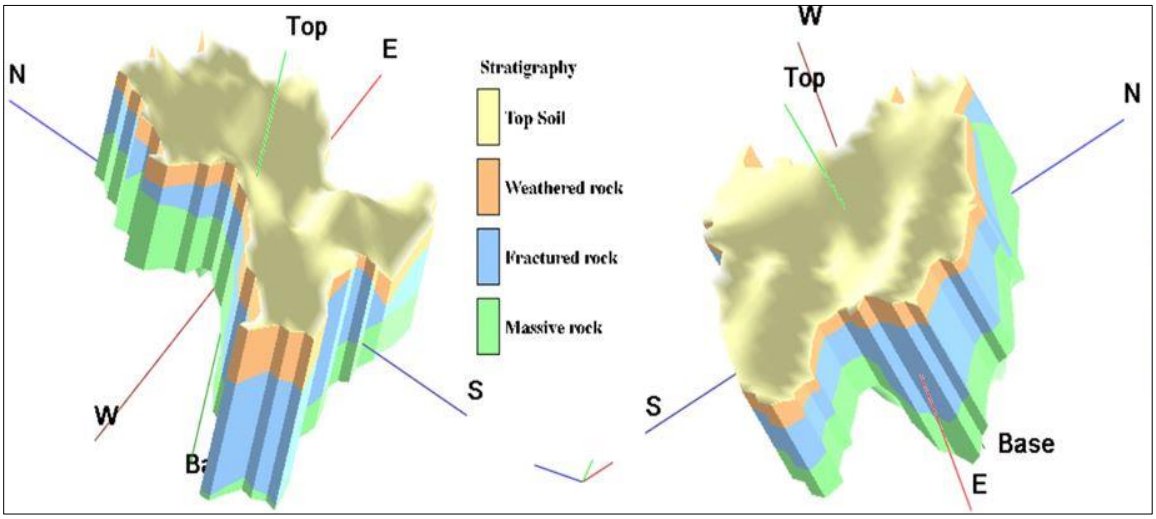


Fig-11: 3D Aquifer Disposition

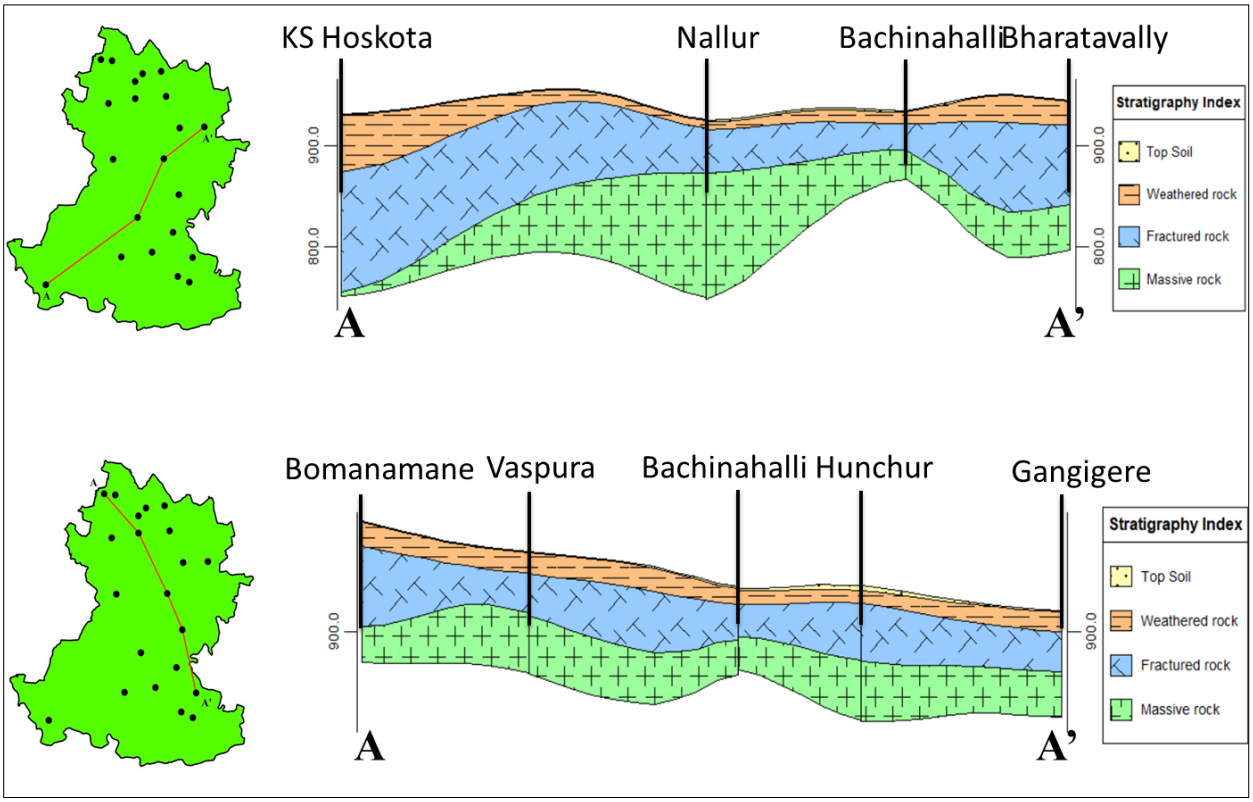


Fig-12: Cross sections in different directions

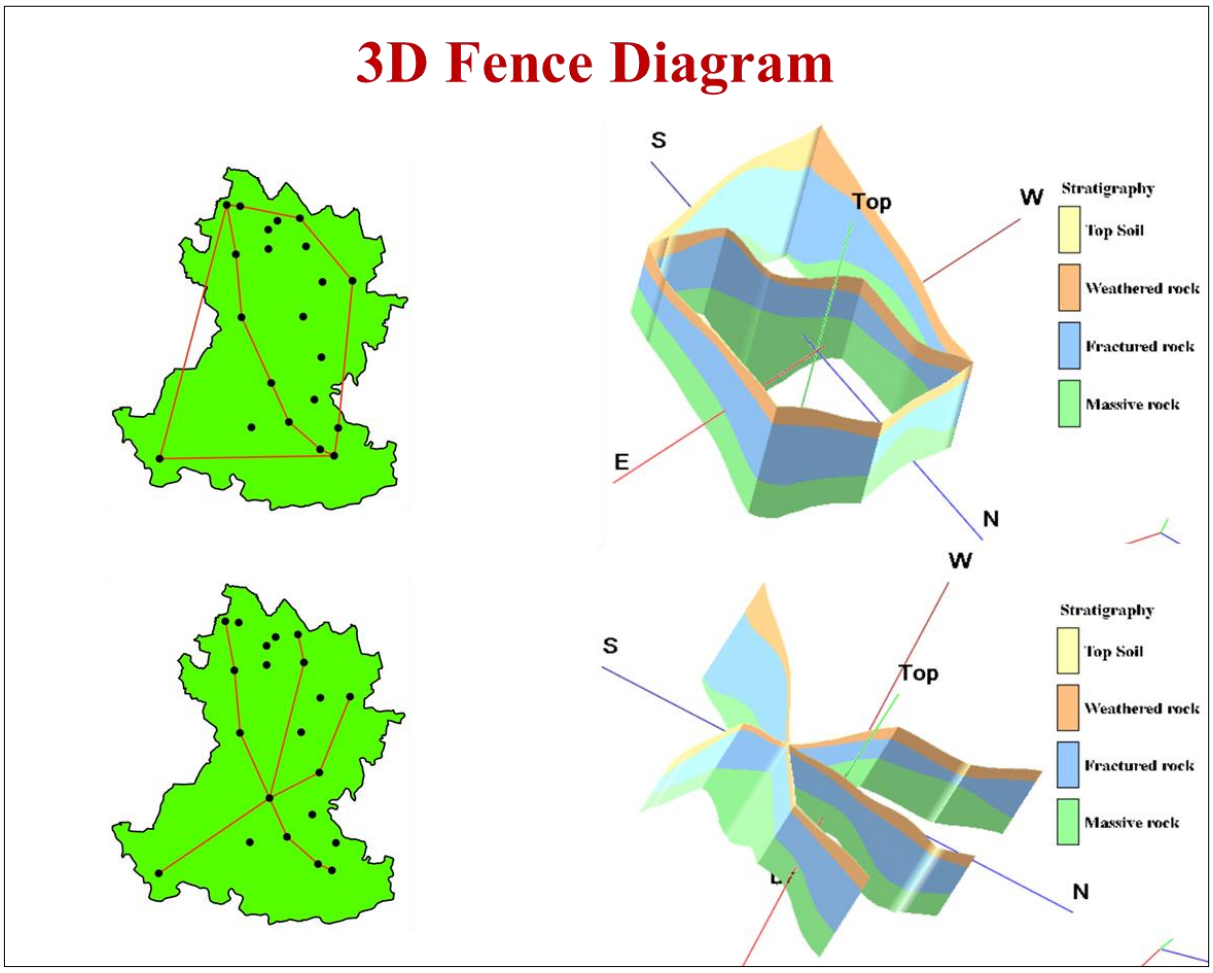


Fig-13: 3D Aquifer Fence Diagram

3 GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

3.1 Aquifer wise resource availability and extraction

Table.12: Present Dynamic Ground Water Resource of ALUR TALUK (2020)

Annual extractable ground water resources (ham)	Existing gross ground water draft for irrigation (ham)	Existing gross ground water draft for industrial water supply (ham)	Existing gross ground water draft for domestic water supply (ham)	Existing gross ground water extraction 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 extraction (%)	Category
4181.34	1135.46	0.00	151.92	1287.39	153.83	2892.05	30.79	safe

Table.13: Comparison of ground water availability and draft scenario in ALUR TALUK

Taluk	GW availability (in ham)	GW draft (in ham)	Stage of GW development (%)	GW availability (in ham)	GW draft (in ham)	Stage of GW development (%)
	2017			**2020**		
ALUR	3877	1575	41	4181	1287	31

It is seen that the stage of ground water extraction is improved in the taluk in comparison with 2017. However, with respect to 2017 estimations, there is an decrease of 10% in the stage of ground water development i.e.,41 to 31% though the taluk is categorized as "**Safe**".

3.2 Chemical quality of ground water and contamination

Interpretation from Chemical Analysis results in ALUR TALUK is mentioned as underand the data is shown in Table.14.

- **ELECTRICAL CONDUCTIVITY:** In general, EC values range from 131 to 830 µ/mhos/cm in the aquifer-I at 25^{o}C (Fig.14).and range from 130 to 900 µ/mhos/cm in the aquifer-II.
- **CHLORIDE:** Chloride concentration in ground water ranges between 18 and 96 mg/l in the aquifer-I (Fig.15).and ranges between 12 and 128 mg/l in the aquifer-II.
- **NITRATE:** Nitrate concentration in ground water ranges from 2 and 20 mg/l in the Aquifer –I (Fig.16). and ranges from 0 and 52.7 mg/l in the Aquifer –II.
- **FLUORIDE:** Fluoride concentration in ground water ranges between 1.3 and 1.4 mg/l in the aquifer-I (Fig.17).and ranges between 0 and 1.6 mg/l in the aquifer-II.

Table-14: Quality of ground water in ALUR TALUK of HASSAN DISTRICT

S. No.	Location	pH	EC (mg/L)	Cl (mg/L)	NO3 (mg/L)	F (mg/L)
Aquifer-I						
1.	Alur1	9.5	727.0	78.0	7.0	1.3
2.	Harihalli	8.7	131.0	18.0	2.0	1.4
3.	Hosapalya	8.6	830.0	96.0	8.0	1.4
4.	KenchammanaHoskote	7.5	261.0	21.0	20.0	1.4
Aquifer-II						
5.	Berkanahalli	6.9	710.0	62.9	52.9	0.3
6.	Goudkati	7.4	622.0	73.4	32.7	0.4
7.	Bachinahalli	7.1	695.0	59.4	24.4	0.7
8.	Garigatte	7.6	629.0	31.5	4.2	0.2
9.	Chickenahalli	7.1	564.0	45.5	0.1	0.4
10.	Channapura	7.7	225.0	12.2	0.0	0.6
11.	Channahalli	7.0	750.0	78.0	7.7	0.3
12.	Alur	7.1	900.0	128.0	0.0	1.6
13.	Harihalli	6.2	130.0	7.0	0.0	0.0
14.	Kadlur	7.0	430.0	28.0	11.7	0.1

In general, ground water quality in ALUR TALUK is good for drinking purpose except at 2 places where nitrate is found to be greater than the permissible limit as per “Indian Standard Drinking Water Specification 2012”. Ground water samples have also been tested and found suitable for agriculture & irrigation purposes in major part of the taluk, where EC is less than 750 µ/mhos/cm.

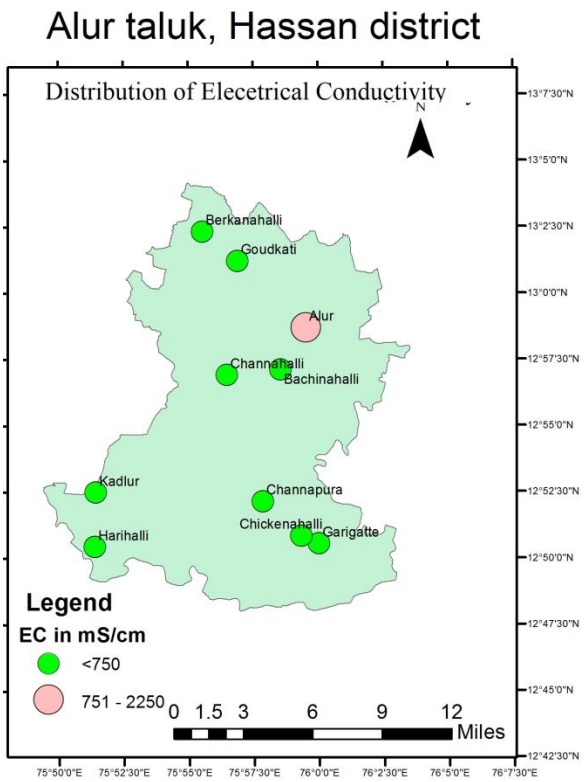


Fig-14 Distribution of Electrical Conductivity (Aq-I)

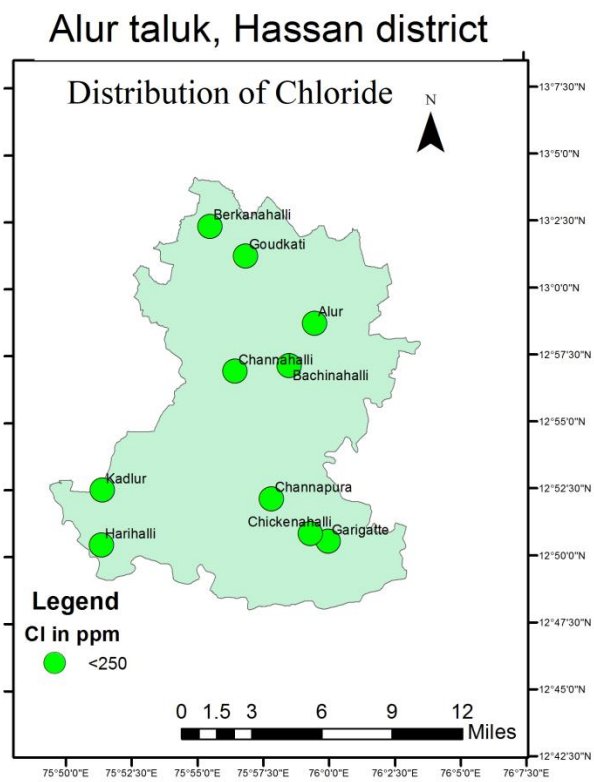


Fig-15 Distribution of Chloride (Aq-I)

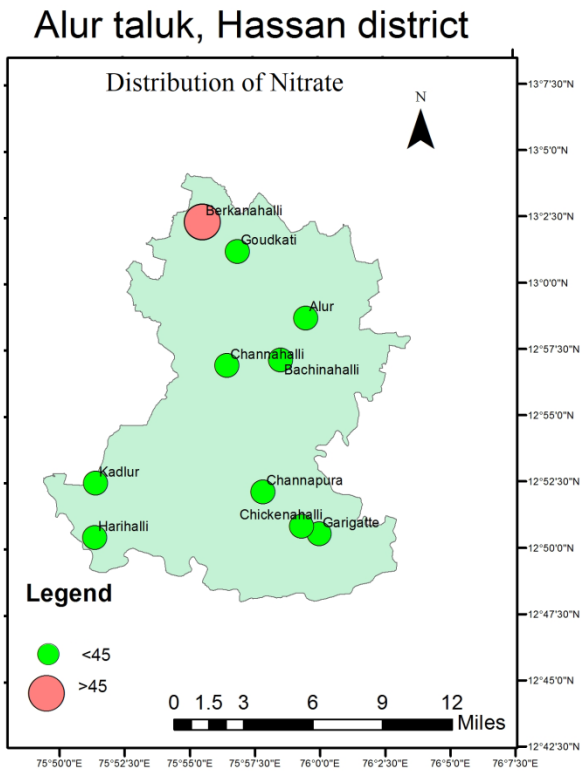


Fig-16 Distribution of Nitrate (Aq-I)

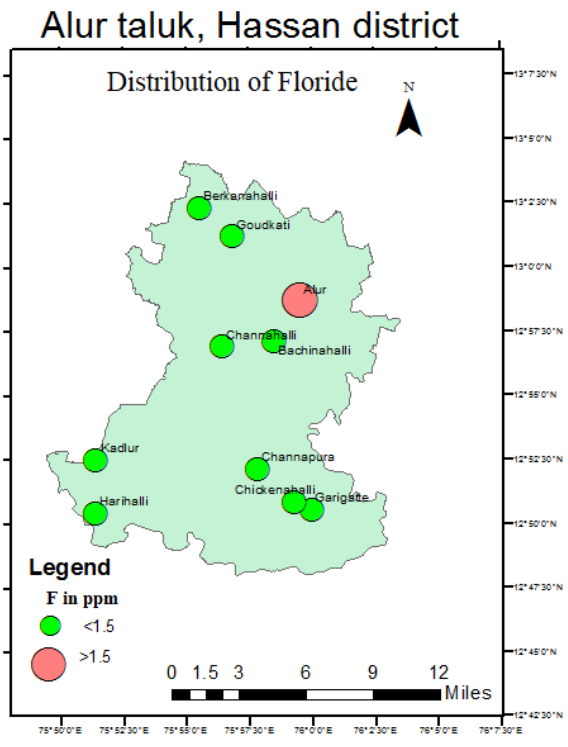


Fig-17 Distribution of Fluoride (Aq-I)

4 GROUND WATERMANAGEMENT PLAN

4.1 Resource Enhancement by Supply Side Interventions

Recharge to dry **phreatic aquifer zone (Aq-I)** through construction of artificial recharge structures, viz; check dams, percolation tanks & Sub surface dyke (**Table-15**) is recommended. 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. The area feasible for artificial recharge are given in **Fig. 18.**

The entire area of ALUR TALUK is feasible for rechargei.e., 428 sq.km. and the surface surplus non-committed runoff availability is 59.605 MCM, which is considered for planning of AR structures. For this, a total of 2 sub-surface dykes, 54 percolation tanks, 8 filter bedsand 315 Check dams are proposed. The volume of water expected to be conserved/recharged @75% efficiency is 44.704 MCM through these AR structures. The approximate cost estimate for construction of these AR structures is Rs. 42.66 Cr. The additional area which can be brought under assured ground water irrigation will be about 5400 hectares. However, the figures given are tentative and pre-fieldstudies / DPR are recommended prior to implementation of these recharge structures.

Table-15: Quantity of non-committed surface runoff & expected recharge through AR structures

Artificial Recharge Structures Proposed	**ALUR TALUK**
Area feasible for artificial recharge (sq.km)	**428**
Non committed monsoon runoff available (MCM)	59.605
Total no. of existing artificial recharge structures	9
Number of Check Dams	3
Number of Percolation Tanks	0
Number of Sub surface dyke	6
Tentative total cost of the project (Rs. in Cr)	4266.66 Lakhs
Excepted recharge (MCM)	44.704
Additional irrigation potential (Hectares)	5400

Note: The numbers proposed are tentative and detailed feasibility studies are required in field to finalize the actual locations for the construction of AR structures.

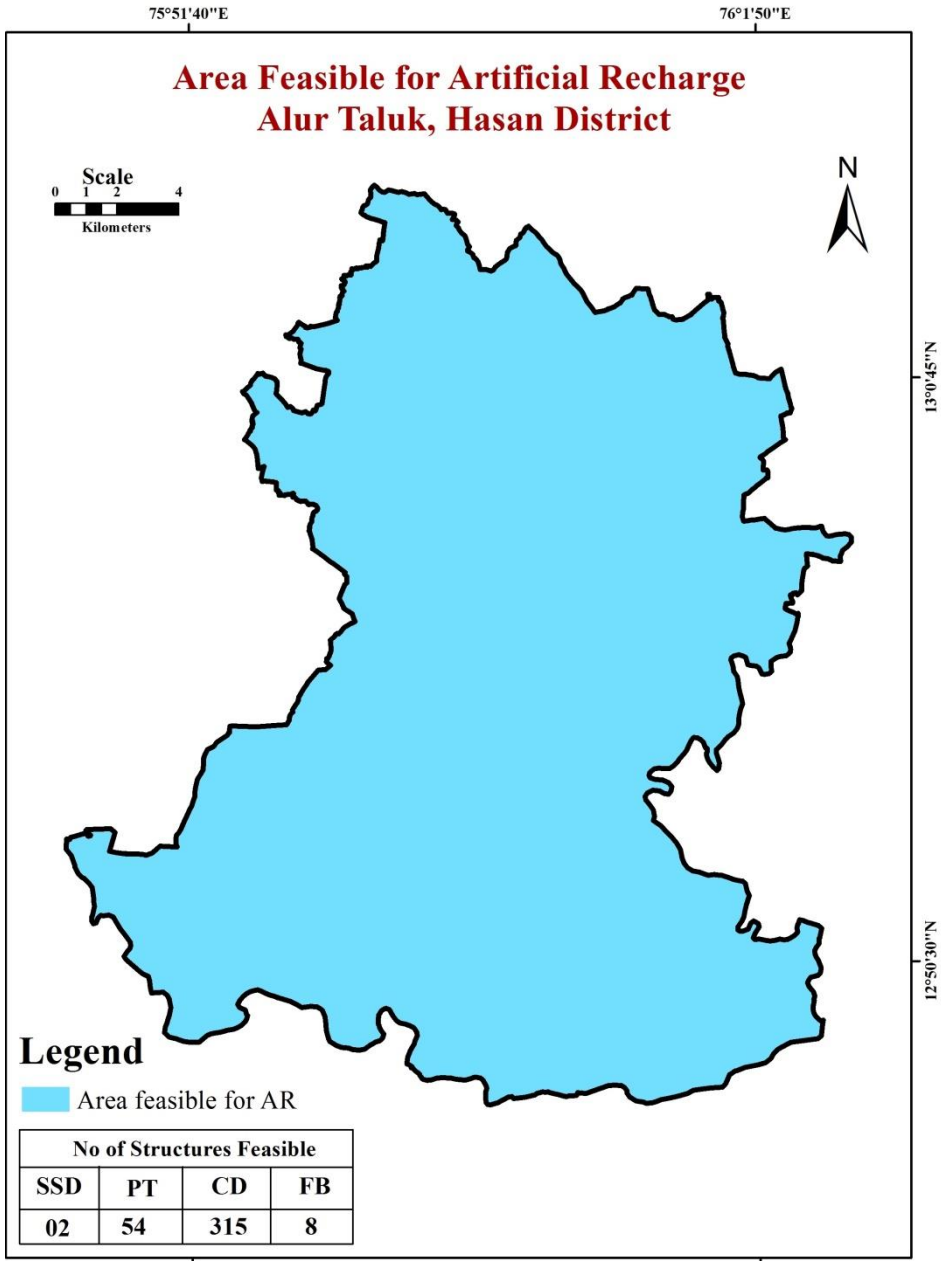


Fig. 18: Locations of Proposed Representative Artificial Recharge Structures

4.2 Resource Savings by Demand Side Interventions

4.2.1 Water Use Efficiency by Micro Irrigation Practices

It is observed that dug wells and bore wellscontribute66% of the source for irrigation in Alur Taluk. The water efficient methodology may be applied for growing paddy which is grown in 1849ha and is ground water dependent as compared to the other crops which are mainly grown during kharif. Initially, the micro irrigation techniques (drip) are proposed in 25% of paddy cultivated area of 1849 ha i.e., 462 ha. Considering the crop water requirement of 2.00 m and savings of 25% i.e., 0.50 m by drip irrigation, it will contribute in saving ground water by 231 ham and thus will improve stage of development marginally. However, in long run the practice of Efficient irrigation techniques will add to the ground water resource in large extent. **(Table-16).**

Table 16: Improvement in GW availability (2020) due to savings by adopting water use efficiency

Annual Extractable GW Resource(Ham)	Total GW extraction for all uses	Stage of ground water extraction	Paddy Area proposed for WUE	Unit savings	Total Saving due to adopting WUE measures	Cumulative annual Extractable GW Resource	Expected improvement in stage of ground water extraction after the implementation of the project	Expected improvement in overall stage of ground water extraction
HAM	HAM	%	HA	M	HAM	HAM	%	%
4181.34	1287.38	30.79	462	0.50	231	4412	1.62	30.79 to 29.17

4.2.2 Change in cropping pattern

Water intensive crop like paddy are grown in 13% of total cropped area. At present, the stage of ground water extraction is also on lower side @ 30.79% (2020), thus change in cropping pattern has not been suggested.

4.3 Ground Water Development Plan

In Alur Taluk, the present stage of ground water extraction (2020) is merely 30.79 %, say 31% with net ground water availability for future use of 2892.04ham and total extraction of 1287.38ham. The ground water draft for irrigation purpose is estimated to be 1135.46ham and there is further scope for developing the resource for irrigation as a part of development with appropriate scientific backing.The implementation of the plan should be based on site specific detailed hydrogeological and scientific surveys for pinpointing the sites for construction additional abstraction structures.

As per tentative estimates, 305 dug wells and 732bore wells are recommended to be constructed in feasible areas which is likely to create about1878hectares of additional irrigation potential.

Table – 17: Feasibility of Additional GW abstraction structures based on GWRA 2020 availability

Annual Extractable GW Resource (Ham)	4181.34
Net GW Availability for future use (Ham)	2892.04
Stage of GW Extraction (%)	30.79
GW Resources available to increase SOE to 60% (Ham)	2508.80

Total Extraction / Draft (Ham)	1287.38
Balance GWR available to enhance SOE 60% (Ham)	1221.42
DW unit draft(Ham)	1.00
BW unit draft(Ham)	1.25
No. of DW feasible considering 25% of balance GWR with unit draft of 1 ham	305
No. of BWs feasible considering 75% of balance GWR with unit draft of 1.25 ham	**732**
Additional irrigation potential created by DW's considering crop water requirement of 0.65 m (Ha)	**469**
Additional irrigation potential created by BW's considering crop water requirement of 0.65 m (Ha)	1407
Total irrigation potential created by DW's and BW's (Ha)	1878

Note- Hydrogeological and scientific intervention is needed for pinpointing the sites for construction of dugwells and Borewells

4.4 Regulation and Control

Alur Talukhas been categorizedas **"Safe".** However, the mandatory guidelines like rainwater harvesting and artificial recharge issued by Karnataka Ground Water Authority(KGWA) needs to be strictly implemented to avoid the taluk from safe category to semi critical or higher category in the future.

4.5 Other interventions proposed

- **Periodical maintenance of artificial recharge structures** should also be incorporated in the Recharge Plan.
- Excess nitrate concentration is found in ground water samples require remedial measures viz.
  - Dilution of nitrate rich ground water through artificial recharge & water conservation.
  - Roof top rain water harvesting.
  - Improving quality by proper drainage and limited usage of Nitrogenous fertilizers
- Excess fluoride concentration is found in ground water samples of deeper aquifer require remedial measures viz.
  - Alternate source
  - Removal technology

5 SUMMARY AND RECOMMENDATIONS

The main ground water issues are Low Ground Water Development, Limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, Deeper Water Levels particularly in Aquifer-II in some parts, hilly and plateau areas which are all inter-related or inter dependent and Inferior Ground Water Quality due to fluoride contamination especially in deeper aquifer. The summary of ground water management plan of Alur Talukis given in **Table-18.**

Table 18: Summary of Management plan of ALUR TALUK

Present stage of Ground water Extraction and Category as per GEC-2020(%)	30.79, Safe
Annual Extractable Ground Water Resources (ham)	4181.34

Existing Gross Ground Water Extraction for all uses	1287.38
Total Ground water Resources (Dynamic & Static upto the depth of 200 mbgl) (ham)	30657
Ground Water Resource Enhancement by Supply side Interventions	
Area Feasible for Artificial Recharge (ha)	42800
Expected additional recharge from monsoon surplus runoff (ham)	44704
Additional irrigation potential (Hectares)	5400
Ground Water Resource Savings by Demand side Interventions	
Paddy Area proposed for WUE (ha)	462
Expected Saving due to adopting WUE measures (ham)	231
Expected improvement in stage of ground water extraction after adopting WUE measures and implementation of the project (%)	30.79 to 29.17
Government to take initiatives to encourage at least 70% farmers to adopt water use efficiency irrigations practices like dip & sprinkler irrigation	-
Ground Water Resource Development Plan	
Balance GWR available to enhance SOE 60% (Ham)	1221.42
No. of DW feasible considering 25% of balance GWR with unit draft of 1 ham	305
No. of BWs feasible considering 75% of balance GWR with unit draft of 1.25 ham	732
Additional irrigation potential created by DW's considering crop water requirement of 0.65 m (Ha)	469
Additional irrigation potential created by BW's considering crop water requirement of 0.65 m (Ha)	1407
Total irrigation potential created by DW's and BW's (Ha)	1878
Excess Nitrate concentration	In limited places especially in shallow aquifer Dilution of nitrate rich ground water through artificial recharge & water conservation. Roof top rain water harvesting Improving quality by controlling usage of Nitrogenous fertilizers in agriculture field and maintaining the proper domestic drainage network system
Excess Fluoride concentration	In limited places especially in deeper aquifer Alternate source Removal technology

As per the resource estimation – 2020, ALUR TALUK falls under Safe category with the stage of ground water extraction is 30.79 %. However, there is need to formulate management strategy to tackle the water scarcity related issues in the taluk in the coming days to avoid water crisis in the future. It is suggested to adopt ascientific and multi-pronged ground water management strategy covering supply side interventions, demand side interventions, ground water development interventions and ground water qualityprotection aspects as mentioned in the management plan suggested above

Ground water resource enhancement by supply side interventions: The surface surplus non-committed runoff availability is 59.605 MCM, which is considered for planning of AR structures. For this, a total of 2 sub-surface dykes, 54 percolation tank, 8 filter beds and 315 Check dams are proposed. The volume of water expected to be conserved/recharged @75% efficiency is 44.703 MCM through these AR structures. The approximate cost estimate for construction of these AR structures is Rs. 42.66 Cr. The additional area which can be brought under assured ground water irrigation will be about 5400 hectares. However, the figures given are tentative and pre-fieldstudies / DPR are recommended prior to implementation of these recharge structures.

Ground water resource enhancement by demand side interventions: It is observed that dug wells and bore wellscontribute66% of the source for irrigation in Alur Taluk. The water efficient methodology may

be applied for growing paddy which is grown in 1849 ha and is ground water dependent as compared to the other crops which are mainly grown during kharif. Initially, the micro irrigation techniques (drip) are proposed in 25% of paddy cultivated area of 1849 ha i.e., 462 ha. Considering the crop water requirement of 2.00 m and savings of 25% i.e., 0.50 m by drip irrigation, it will contribute in saving ground water by 231 ham and thus will improve stage of development marginally.

Change in cropping pattern: Water intensive crop like paddy are grown in 13% of total cropped area. At present, the stage of ground water extraction is also on lower side @ 30.79% (2020), **thus change in cropping pattern has not been suggested**.

Ground Water Resource Development Plan: the present stage of ground water extraction (2020) is merely 30.79 %, say 31% with net ground water availability for future use of 2892.05ham and total extraction of 1287.39 ham. The ground water draft for irrigation purpose is estimated to be 1135.46 ham and there is further scope for developing the resource for irrigation as a part of development with appropriate scientific backing.The implementation of the plan should be based on site specific detailed hydrogeological and scientific surveys for pinpointing the sites for construction additional abstraction structures. As per tentative estimates, 305 dug wells and 732 bore wells are recommended to be constructed in feasible an area which is likely to create about 1878 hectares of additional irrigation potential.

Nitrate Contamination: Proper drainage of sewage and scientific disposal of sewage water by the concerned urban/rural agency needs to be adopted along withlimited usage of Nitrogenous fertilizersby farmers to avoid nitrate contamination. All the ground water sources for drinking water supply may be checked for ground water quality parameters as per BIS norms.

WUE in Domestic Sector: WUE practices are the prime management option in domestic sector as well in view of having high density clusters of urban households and establishments. In premium apartments and infrastructure projects, use of three-way line for fresh water, bathroom water and toilet water will enable reuse of grey water for gardening, car washing and flushes etc. The water saver fixtures/ aerators can be used for kitchen & bathroom pipes, bath showers and water free urinals.

Regulation and Control:Taluk is categorised as "Safe". However, the mandatory guidelines like rainwater harvesting and artificial recharge issued by Karnataka Ground Water Authority needs to be strictly implemented to avoid the taluk from deteriorating from safe category to semi critical category in the future.

Water Linkages with other Activities: Water sector has strong linkages with other developmental activities. Hence, the proposed management plans cannot be considered as static and needs to be reviewed and improved from time to time.