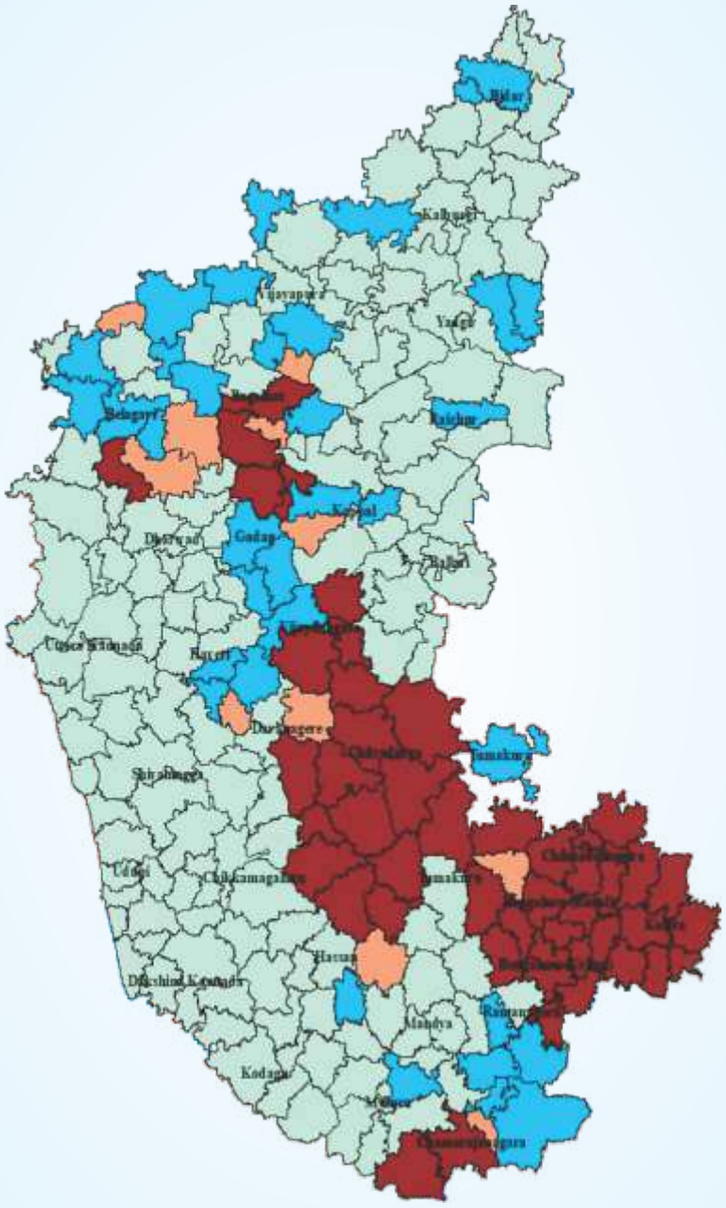
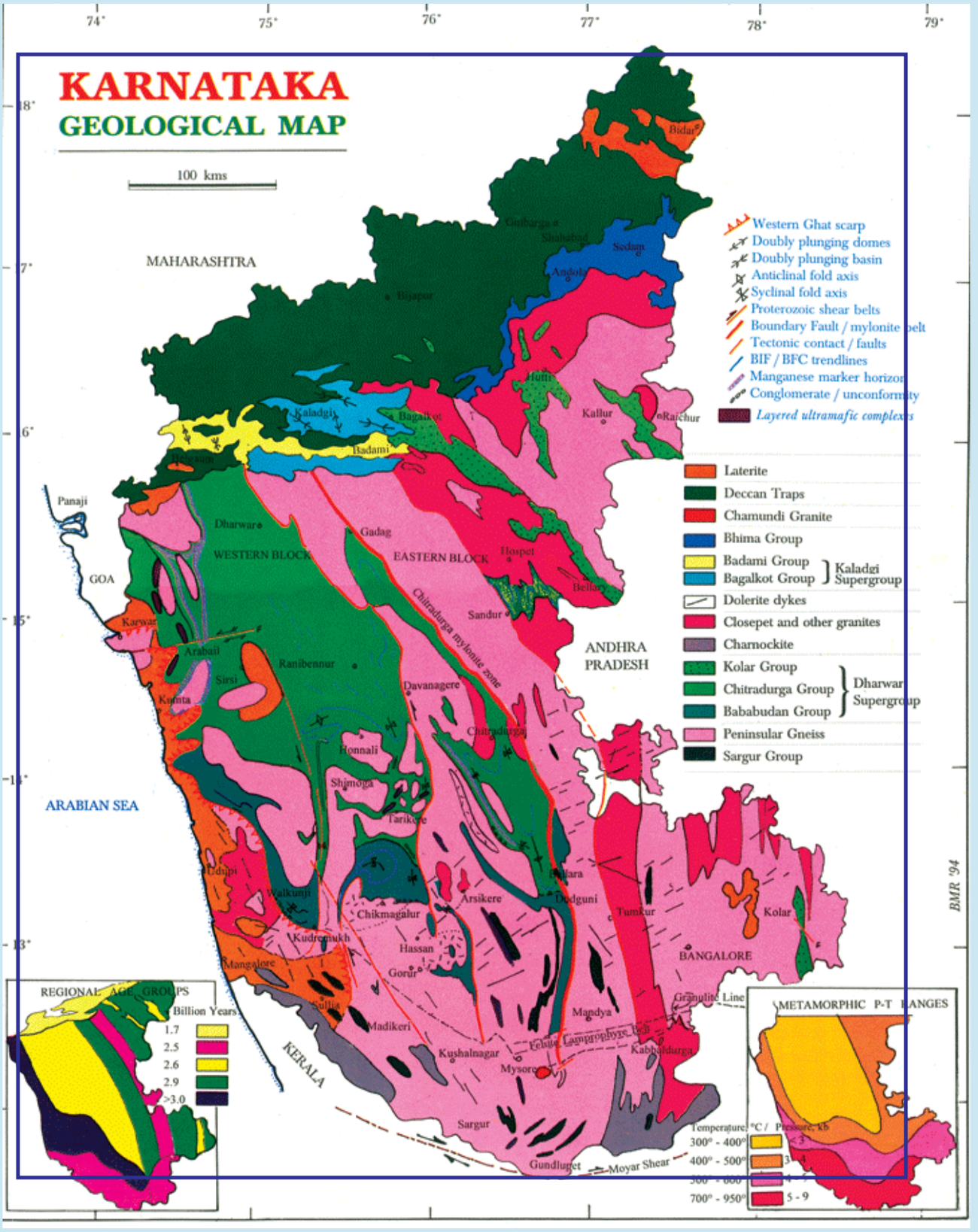
DYNAMIC GROUND WATER RESOURCES OF KARNATAKA AS ON MARCH 2022

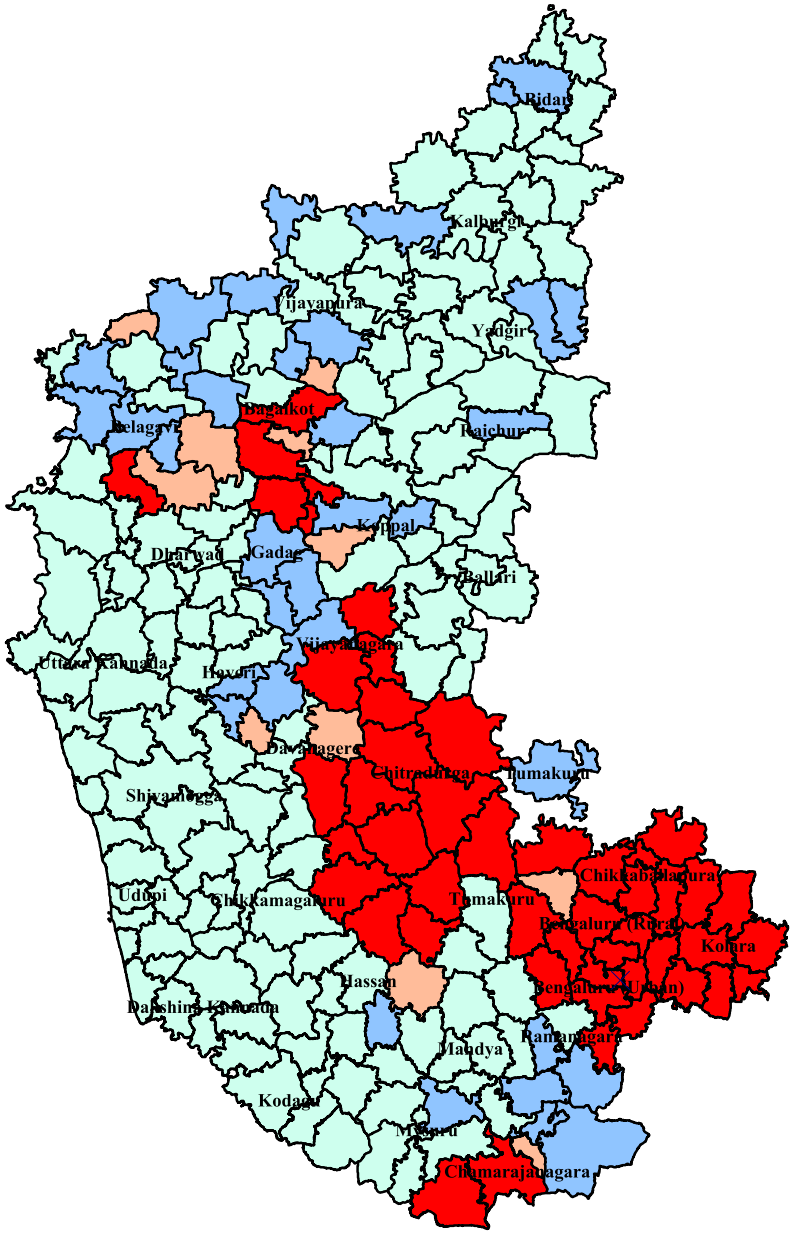


GROUND WATER DIRECTORATE
MINOR IRRIGATION AND GROUND WATER DEVELOPMENT DEPARTMENT
GOVERNMENT OF KARNATAKA
&
CENTRAL GROUND WATER BOARD
SOUTH WESTERN REGION, BENGALURU

FEBRUARY 2023


KARNATAKA
GEOLOGICAL MAP
100 kms
74°
75°
76°
77°
78°
79°
18°
17°
16°
15°
14°
13°
MAHARASHTRA
GOA
ARABIAN SEA
KERALA
ANDHRA PRADESH
WESTERN BLOCK
EASTERN BLOCK
Chitradurga mylonite zone
Bidar
Gulbarga
Shahabad
Sedam
Angole
Bijapur
Jutti
Kallur
Raichur
Kaladgi
Bagalkot
Badami
Panaji
Dharwar
Gadag
Hospet
Bellary
Karwar
Arabail
Sirsi
Kumta
Ranibennur
Sandur
Davanagere
Chitradurga
Honnali
Shimoga
Tarikere
Udupi
Malkunji
Chikmagalur
Arsikere
Kudremukh
Hassan
Mangalore
Gorur
Sullia
Madikeri
Kushalnagar
Mysore
Sargur
Gundlupet
Moyar Shear
Ballara
Dodguni
Tumkur
Kolar
BANGALORE
Mandya
Granulite Line
Kabbaldurga
Western Ghat scarp
Doubly plunging domes
Doubly plunging basin
Anticlinal fold axis
Syclinal fold axis
Proterozoic shear belts
Boundary Fault / mylonite belt
Tectonic contact / faults
BIF / BFC trendlines
Manganese marker horizon
Conglomerate / unconformity
Layered ultramafic complexes
Laterite
Deccan Traps
Chamundi Granite
Bhima Group
Badami Group
Bagalkot Group
Kaladgi Supergroup
Dolerite dykes
Closepet and other granites
Charnockite
Kolar Group
Chitradurga Group
Bababudan Group
Dharwar Supergroup
Peninsular Gneiss
Sargur Group
REGIONAL AGE GROUPS
Billion Years
1.7
2.5
2.6
2.9
>3.0
METAMORPHIC P-T RANGES
Temperature °C / Pressure, kb
300° - 400°
400° - 500°
700° - 950°
5 - 9
BMR '94

DYNAMIC GROUND WATER RESOURCES OF KARNATAKA AS ON MARCH 2022



GROUND WATER DIRECTORATE
MINOR IRRIGATION AND GROUND WATER DEVELOPMENT DEPARTMENT
GOVERNMENT OF KARNATAKA
&
CENTRAL GROUND WATER BOARD
SOUTH WESTERN REGION, BENGALURU

FEBRUARY 2023

Prepared by

Ground Water Directorate, Bengaluru,
Govt. of Karnataka
&
Central Ground Water Board, South Western Region,
Bengaluru, Govt. of India

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ಶಾಸನ ರಚನೆ ಹಾಗೂ ಸಣ್ಣ ನೀರಾವರಿ ಸಚಿವರು

ಸಂಖ್ಯೆ: ಕಾ.ಸಂ.ಶಾ.ಕಸ.ಸಚ/162/2023

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ಸಂದೇಶ

"ಹರಿಯುವ ನೀರನ್ನು ನಿಲ್ಲಿಸಿ, ನಿಂತ ನೀರನ್ನು ಇಂಗಿಸಿ ಅಂತರ್ಜಲವನ್ನು ಹೆಚ್ಚಿಸಿ, ರೈತರ ಬದುಕನ್ನು ಹಸನುಗೊಳಿಸಿ"

ರಾಜ್ಯದಲ್ಲಿ ಅಂತರ್ಜಲ ಸಂಪನ್ಮೂಲದ ವಿವೇಚನಾ ರಹಿತ ಬಳಕೆಯಿಂದ ಅಂತರ್ಜಲ ಮಟ್ಟವು ಗಣನೀಯವಾಗಿ ಕುಸಿದು ಅಂತರ್ಜಲ ಮಟ್ಟದಲ್ಲಿ ತೀವ್ರತರದ ಇಳಿಕೆ ಉಂಟಾಗಿದೆ. ನಿರೀಕ್ಷಿತ ವಾಡಿಕೆ ಮಳೆ ಬರುತ್ತಿದ್ದರೂ ಸಹ ರಾಜ್ಯದಲ್ಲಿ ತೀವ್ರ ಅಂತರ್ಜಲದ ಕೊರತೆಯನ್ನು ಎದುರಿಸಲಾಗುತ್ತಿದೆ. ಈ ಬಗ್ಗೆ ಅಂತರ್ಜಲ ನಿರ್ದೇಶನಾಲಯದಿಂದ ಅಂತರ್ಜಲ ಸಂರಕ್ಷಣೆಗಾಗಿ ವೈಜ್ಞಾನಿಕವಾಗಿ ಸಮೀಕ್ಷೆ ನಡೆಸುವುದು, ಅಂತರ್ಜಲ ಅತಿಬಳಕೆ ನಿಯಂತ್ರಿಸುವುದು, ಮರುಪೂರಣ ಮಾಡುವುದರ ಕುರಿತು ಸಾರ್ವಜನಿಕರಲ್ಲಿ ಅರಿವು ಮೂಡಿಸುವ ಕಾರ್ಯಕ್ರಮವನ್ನು ಕೈಗೊಳ್ಳಲಾಗುತ್ತಿದೆ. ಈ ನಿಟ್ಟಿನಲ್ಲಿ ಅಂತರ್ಜಲ ನಿರ್ದೇಶನಾಲಯವು ಕೇಂದ್ರೀಯ ಅಂತರ್ಜಲ ಮಂಡಳಿಯವರ ಸಹಯೋಗದೊಂದಿಗೆ ಕರ್ನಾಟಕ ರಾಜ್ಯದ "ಅಂತರ್ಜಲ ಸಂಪನ್ಮೂಲ ಮೌಲೀಕರಣ ವರದಿ ಮಾರ್ಚ್-2022 ಎಂಬ ಶೀರ್ಷಿಕೆಯಡಿಯಲ್ಲಿ ಪ್ರಕಟಿಸಲಾಗುತ್ತಿದೆ.

ಸದರಿ ಅಧ್ಯಯನಗಳ ವರದಿಗಳನುಸಾರ ರಾಜ್ಯದಲ್ಲಿ ಅಂತರ್ಜಲ ಅಧಿನಿಯಮವನ್ನು ಜಾರಿಗೊಳಿಸಲು ಅತಿಬಳಕೆ ತಾಲ್ಲೂಕುಗಳನ್ನು ಅಧಿಸೂಚಿಸಿ, ಅನುಷ್ಠಾನಗೊಳಿಸಲಾಗುತ್ತಿದೆ. ಅಧ್ಯಯನದ ವರದಿಯನ್ವಯ 41 ಅಂತರ್ಜಲ ಶೋಷಿತ ತಾಲ್ಲೂಕುಗಳಲ್ಲಿ ಕೇಂದ್ರ ವಲಯ ಯೋಜನೆಯಡಿ ಅಂತರ್ಜಲ ನೀರಿನ ಸುಸ್ಥಿರ ನಿರ್ವಹಣೆಯಲ್ಲಿ ಬೇಡಿಕೆ ಹಾಗೂ ಸರಬರಾಜು ನಿರ್ವಹಣೆಗೆ ಸಮುದಾಯ ಸಹಭಾಗಿತ್ವದಲ್ಲಿ ಒತ್ತು ನೀಡುವ ಅಟಲ್ ಭೂಜಲ್ ಯೋಜನೆಯ ಕಾರ್ಯಕ್ರಮವನ್ನು ಕರ್ನಾಟಕ ರಾಜ್ಯದಲ್ಲಿ ಜಾರಿಗೊಳಿಸಲಾಗುತ್ತಿರುವುದು ಹೆಮ್ಮೆಯ ಸಂಗತಿ.

2../-

ಅಂತರ್ಜಲ ನೈಸರ್ಗಿಕ ಸಂಪನ್ಮೂಲವಾಗಿದ್ದು, ಈ ಸಂಪತ್ತನ್ನು ವಿವೇಚನೆಯಿಂದ ಬಳಸಬೇಕಾಗಿರುತ್ತದೆ. ಮಾರ್ಚ್-2020ರ ಅಂತರ್ಜಲ ಮೌಲೀಕರಣ ವರದಿಯಲ್ಲಿ ಅಂತರ್ಜಲ ಬಳಕೆ ಹಂತ ಶೇ.66ರಷ್ಟಿದ್ದು, ಪ್ರಸ್ತುತ ಮಾರ್ಚ್-2022ರ ಮೌಲೀಕರಣದಲ್ಲಿ ಅಂತರ್ಜಲ ಬಳಕೆ ಹಂತ ಶೇ.69ಕ್ಕೆ ತಲುಪಿರುತ್ತದೆ. ರಾಜ್ಯ ಸರ್ಕಾರದಿಂದ ಹೆಚ್ಚು-ಹೆಚ್ಚು ಕೃತಕ ಅಂತರ್ಜಲ ಮರುಪೂರ್ಯೆಕೆ ರಚನೆಗಳ ನಿರ್ಮಾಣ, ಕೆರೆ ತುಂಬಿಸುವ ಯೋಜನೆಗಳು ಹಾಗೂ ಕೃಷಿಯಲ್ಲಿ ಆಧುನಿಕ ಪದ್ಧತಿಗಳನ್ನು ಅಳವಡಿಸಿಕೊಳ್ಳುವಲ್ಲಿ ಹೆಚ್ಚಿನ ಪ್ರಗತಿ ಸಾಧಿಸಿರುವುದರಿಂದ ಅಂತರ್ಜಲ ಸಂಪನ್ಮೂಲದ ಲಭ್ಯತೆ ಪ್ರಮಾಣದಲ್ಲಿ ಸುಸ್ಥಿರತೆಯನ್ನು ಕಾಪಾಡಿಕೊಳ್ಳಬಹುದಾಗಿರುತ್ತದೆ.

ಅಂತರ್ಜಲ ನಿರ್ದೇಶನಾಲಯವು ಕೇಂದ್ರೀಯ ಅಂತರ್ಜಲ ಮಂಡಳಿಯವರ ಸಹಯೋಗದೊಂದಿಗೆ ಕರ್ನಾಟಕ ರಾಜ್ಯದ **"ಅಂತರ್ಜಲ ಸಂಪನ್ಮೂಲ ಮೌಲೀಕರಣ ವರದಿ ಮಾರ್ಚ್-2022"** ಎಂಬ ಶೀರ್ಷಿಕೆಯಡಿಯಲ್ಲಿ ಪ್ರಕಟಿಸುತ್ತಿದ್ದು, ಸದರಿ ವರದಿಯು ಸಾರ್ವಜನಿಕರಿಗೆ ಮತ್ತು ಸರ್ಕಾರಕ್ಕೆ ಹೆಚ್ಚಿನ ಉಪಯುಕ್ತತೆವುಳ್ಳ ಮಾಹಿತಿಯನ್ನು ಹೊಂದಿರುತ್ತದೆ ಎಂದು ತಿಳಿಸಲು ಹರ್ಷಿಸುತ್ತೇನೆ. ಮುಂದಿನ ದಿನಗಳಲ್ಲಿ ಆಧುನಿಕ ತಂತ್ರಜ್ಞಾನಗಳನ್ನು ಬಳಸಿ, ಅಂತರ್ಜಲ ಸಂಪನ್ಮೂಲದ ಸ್ಥಿತಿಗತಿಯನ್ನು ಸಾರ್ವಜನಿಕರಿಗೆ ಪರಿಣಾಮಕಾರಿಯಾಗಿ ತಲುಪಿಸಲು ಕಾರ್ಯಕ್ರಮಗಳನ್ನು ಹಮ್ಮಿಕೊಳ್ಳಲು ಹಾಗೂ ವರದಿಗಳನ್ನು ಪ್ರಕಟಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳಲೆಂದು ಆಶಿಸುತ್ತೇನೆ. ಅಂತರ್ಜಲ ಪ್ರಕೃತಿಯ ಅತ್ಯಮೂಲ್ಯವಾದ ಕೊಡುಗೆಯಾಗಿದ್ದು ಇದನ್ನು ಸಂರಕ್ಷಿಸಿ, ಮಿತವಾಗಿ ಬಳಸಿ, ಮುಂದಿನ ಪೀಳಿಗೆಗಾಗಿ ಉಳಿಸಿ, ಅಂತರ್ಜಲ ಹಾಹಾಕಾರವನ್ನು ತಪ್ಪಿಸುವ ಜವಾಬ್ದಾರಿ ನಮ್ಮೆಲ್ಲರ ಹೊಣೆಯಾಗಿರುತ್ತದೆ ಎಂದು ಈ ಮೂಲಕ ತಿಳಿಸಲು ಇಚ್ಛಿಸುತ್ತೇನೆ.

(ಜೆ.ಸಿ. ಮಾಧುಸ್ವಾಮಿ)

ಸಿ. ಮೃತ್ಯುಂಜಯಸ್ವಾಮಿ ಕ.ಇ.ಎಸ್.,
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ಕೊಠಡಿ ಸಂಖ್ಯೆ: 208, 2ನೇ ಮಹಡಿ
ವಿಕಾಸಸೌಧ, ಬೆಂಗಳೂರು - 560 001

FOREWORD

It is gratifying to note that Dynamic Ground Water Resources of Karnataka as on March 2022 is being published with the coordination of the Groundwater Directorate, Minor Irrigation and Ground Water Development Department, Government of Karnataka and Central Ground Water Board, South Western Region.

The report mainly provides Taluk wise information on ground water resources available and status of utilization as on March 2022 with 2020-21 as base year. The methodology adopted is improved as the estimations are carried out on taluk basis for both command and non-command areas separately. The report is very resourceful for Planning, Decision Making, implementation of Minor Irrigation Schemes, Financing Well Schemes etc. The report is hopeful of according concentration on such areas where immediate protective measures are to be adopted for conjunctive and conservation of supply to irrigation and drinking water supply in order to sustain and preserve the available ground water resource.

The Present estimation reveals 49 taluks are over-exploited, 11 taluks are Critical, 35 taluks are semi-critical and 139 taluks are safe. The situation in 2020 was, 52 taluks were over exploited, 35 taluks were semi-critical and 10 taluks were critical, 130 taluks were safe.

Based on this categorization, the taluks are notified under Karnataka Groundwater Authority for regulation, control and management of overuse of groundwater.

There is an increase in groundwater utilization of the state from 65% to 69% of resources which is apparent. Additional Over exploited taluks Magadi and Harohalli taluks in Ramanagara District have been identified. In these taluks construction of water conservation Structures should be taken up on top priority. Due to good rainfall during 2020 and 2021 Guledagudda taluk of Bagalkote district, Kagavada, Ramadurga, Savadatti taluks of Belagavi district, Kukanuru taluk of Koppal district and Koratagere taluk of tumakuru district have shown improvement in Stage of Development and moved out from Over Exploited to Critical Category.

Comparison of ground water assessment of 2020 & 2022 reveals that more number of taluks need appropriate attention as the aquifer system in these areas are affected by steep decline of ground water resources. This calls for a focused and co-ordinated effort from all the water related sectors to mitigate, conserve and develop groundwater resources in the State for the future generation.

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ವಿಕಾಸಸೌಧ, ಬೆಂಗಳೂರು – 560 001

KC Valley and HN Valley tank filling program has played a vital role in improvement of groundwater condition in taluks of Kolar and Chikkaballapura Districts.

I hope that this data will be utilized by the public and State agencies to conserve ground water, which is a precious natural resources.

C. MRUTHYUNJAYA SWAMY
Secretary to Government
Minor Irrigation and Ground Water
Development Department

Central Ground Water Board
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सत्यमेव जयते
भारत सरकार
GOVERNMENT OF INDIA

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एच.एस.आर. लेआउट, सेक्टर १,
बेंगलूरु - ५६० १०२

PREFACE

About 90% of the drinking water needs in the rural areas, 50% of urban water needs and more than 80% of irrigation needs in our country are met by ground water. There is a tremendous growth of ground water structures after independence to meet the requirement of food to the ever-growing population. This has put severe stress on the ground water aquifer system resulting in a declining trend of ground water level in many parts of the country. The ground water condition in the state of Karnataka is no different. Almost entire state is underlined by crystalline formations except few patches of alluvium which is restricted along the coastal tract. In the crystalline formations the ground water movement and availability is controlled by the secondary porosity developed due to the tectonic movements and intensity of weathering. The density of the fractures and fissures decrease with depth. As such there is limited scope for storage of large quantities of ground water in these formations.

Unlike surface water the ground water is developed by individual farmers with their own financial resources. There is a need to manage this resource in a systematic, scientific and sustainable manner. No resource can be managed unless it is quantified. It is necessary to precisely estimate the available ground water resources. Central Ground Water Board (CGWB), SWR, Bangalore and Ground Water Directorate (GWD), Bangalore assessed the ground water resources of the State of Karnataka for 2022 as per the ground water estimation committee methodology – 2015 on taluk basis as assessment unit.

As per the Dynamic Ground Water Resource Assessment 2022 of Karnataka, the Annual Ground Water Recharge has been assessed as 17.74 BCM and the Annual Extractable Ground Water resource is 16.04 BCM. The Current Annual Ground Water Extraction is 11.22BCM and the Stage of Ground Water Extraction is 69.93% for the State. Out of the 234 assessment units (taluks), 49 units (20.94 %) have been categorized as 'Over exploited', 11 units (4.70 %) as 'Critical', 35 units (14.96 %) as 'Semi critical' and 139 units (59.40 %) have been categorized as 'Safe'.

This report provides an in-depth information on the various recharge and extraction components like ground water availability and extraction scenario at taluk level along with the resource assessment for Bangalore city which has been done for the first time and quality tagging of the assessment units for contamination. I am confident that this report will be of immense use to the state/central agencies involved in the scientific and sustainable management and development of ground water in the State for devising implementable strategies.

This assessment could be completed due to the sincere efforts, mutual co-operations and interaction between the officers of CGWB & GWD. I appreciate the efforts put in by the officers of CGWB, Bangalore; GWD, Bangalore and District Level Officers of GWD, Karnataka who were involved in the assessment. This report could be brought out in this shape with the sincere and untiring efforts put forth by Ms. Dhyamalar, Scientist-E, Sh. Rahul R. Shende, Scientist -C, Dr. Lubna Kouser, Scientist -C, Sh. Abdul Razik, Assistant Hydrogeologist of CGWB. The resource assessment exercise could be completed due to the able and continues guidance provided by Shri C. Mruthunjaya Swamy, Secretary, Minor Irrigation and Development & Chairman of SLC. The efforts put in by Shri. B. G. Ramachandraiah, Director, Sh. G. Jayanna, Deputy Director; Smt. Jagadeshwari M, Sr. Geologist & Sh. Nagaraja H.M., Sr. Geologist of GWD, Karnataka in the ground water resource assessment is highly appreciated.

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MESSAGE

Increasing demand for water has caused more strain on the precious ground water resources in the recent years. Over 60 % of the irrigation and about 85% of the rural drinking water supply is mainly dependent upon ground water resources.

The ground water resources estimation is made once in two years. I am happy to note that the Ground Water Directorate is bringing out the report on the "Dynamic Ground Water Resources of Karnataka as on 31 March 2022" based on the estimation jointly with the Central Ground Water Board, South-western Region (SWR) Bangalore as per the Ground water Estimation Methodology (GEM), set by the Ground water Estimation Committee-2015. This will greatly help future development and planning in minor irrigation sector.

As per the State Level Committee decision the Dynamic Ground Water Resources of Karnataka as on 31 March 2022 was carried out with taluk as Assessment Unit. For the current assessment Bengaluru city assessment is carried out separately under Urban Assessment Category. March 2022 assessment was carried out for 233 taluks + Bengaluru city totally for 234 Assessment Units.The present re-estimation has revealed that out of 234Assessment Units, 49 taluks spread over in different parts of the State are found to be over exploited, 11 taluks have reached critical stage, 35 taluks are semi critical and 139 taluks are under safe category of stage of groundwaterextraction.

Extraction of groundwater has increased from 65% in 2020 to 69.97% in 2022. Till date assessment was carried out with watershed as the assessment unit. Dynamic Ground Water Resources of Karnataka as on 31 March 2022 was carried out with taluk as Assessment Unit. Since from the data collection, compilation, data uploading and computations triggering were done purely on taluk basis, the Stage of Groundwater thus obtained represents the near to truth field condition and hence there is increase in Stage of groundwater extraction from 65% in 2020 to 69.97% in 2022. Scientifically suitable sites should be selected for construction of water conservation structures. Effective irrigation practices such as drip irrigation, sprinkle irrigation and less water intensive crops should be grown and rotation of crops should be followed for reducing burden on groundwater and to maintain sustainability.

DIRECTOR
Groundwater Directorate
Bangalore

CONTENTS

ABBREVIATIONS

1	mbgl	Meter below ground level
2	SLC	State Level Committee for Re-estimation of Groundwater Resources
3	GEC-15	Ground Water Estimation Methodology-2015
4	GWD	Ground Water Directorate
5	CGWB	Central Ground Water Board
6	INGRES	INDIA - Groundwater Resource Estimation System
7	CLEG	Central Level Expert Group
8	KSRSAC	Karnataka State Remote Sensing Application Centre
9	KSNDMC	Karnataka State Natural Disaster Monitoring Centre
10	DES	Directorate of Economics and Statistics
11	ACIWRM	Advanced Centre for Integrated Water Resources Management
12	WNW-ESE	West North West - East South East
13	mg/L	milligrams per litre
14	DEM	Digital Elevation Model
15	EGR	Extractable Ground Water Resource
16	SGWR	Static or in-storage Ground Water Resources
17	RDPR	Rural Development and Panchayat Raj
18	BBMP	Bhruhat Bangalore Mahanagara Palike
19	KC valley	Koramangala - Challaghatta Valley
20	HN valley	Hebbal - Nagawara Valley
21	MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
22	ΔS	Change is storage
23	R_{RF}	Rainfall recharge
24	R_{STR}	Recharge from stream channels
25	Rc	Recharge from canals
26	R_{SWI}	Recharge from surface water irrigation
27	R_{GWI}	Recharge from ground water irrigation
28	R_{TP}	Recharge from Tanks & Ponds
29	R_{WCS}	Recharge from water conservation structures
30	VF	Vertical inter aquifer flow
31	LF	Lateral flow along the aquifer system (through flow)
32	GE	Ground Water Extraction
33	T	Transpiration
34	E	Evaporation
35	B	Base flow
36	Δh	rise in water level in the monsoon season/ Change in Piezometric head
37	A	Area for computation of recharge
38	Sy	Specific Yield
39	r	Monsoon season rainfall
40	R	Rainfall recharge in ham
41	R_{F}IF	Rainfall Infiltration Factor

42	R	Rainfall in mm
43	a	Minimum threshold value above which rainfall induces ground water recharge in mm
44	GE_{IRR}	Ground Water Extraction for Irrigation
45	RFF	Return Flow Factor
46	RF	Recharge Factor
47	AWSA	Average Water Spread Area
48	R_{WCS}	Recharge due to Water Conservation Structures
49	GS	Gross Storage = Storage Capacity multiplied by number of fillings
50	WA	Wetted Area = Wetted Perimeter X Length of Canal Reach
51	SF	Seepage Factor
52	AD	Average Discharge
53	GE_{ALL}	Ground water extraction for all uses
54	GE_{IRR}	Ground water extraction for irrigation
55	GE_{DOM}	Ground water extraction for domestic uses
56	GE_{IND}	Ground water extraction for industrial uses
57	Lg	Fractional Load on Ground Water for Domestic Water Supply
58	lpcd	litre per capita per day
59	Alloc	Allocation for domestic water requirement
60	Q	Spring Discharge
61	Z_2	Bottom of Unconfined Aquifer
62	Z_1	Pre-monsoon water level
63	Q_P	Ground Water Potential of Confined Aquifer
64	S	Storativity
65	h_t	Piezometric head at any particular time
66	h_0	Bottom of the top Confining Layer
67	Q_D	Dynamic Ground Water Resource of Confined Aquifer (m^3)
68	h_{post}	Piezometric head during post-monsoon period (m amsl)
69	h_{PRE}	Piezometric head during pre-monsoon period (m amsl)
70	m amsl	metres above mean sea level
71	mm	mili meter
72	Q_I	In storage Ground Water Resource of Confined Aquifer (m^3)
73	Q_P	In storage Ground Water Resource of the confined aquifer or the Quantity of water under pressure (m^3)

CONVERSIONS

Linear Conversion Factor	
1 feet	12 inchs
1 meter	3.2808 feet = 1.0936 yard
1 mile	1.6093 km = 1760 yards
1 $feet^2$	1728 $Inch^2$ = 100 Hectare
1 Killogram	2.2046 lb
1 hectare	2.4710 Acre
1 Km^2	247.10 Acre
1 mile	1.690 Killometer
1 Km^2	100 hectare
1 inch	25.4 mm
1 yard	3 feet
1 km	1000 m
1 $mile^2$	640 Acres
1 Carat	0.2 gram
1 ton	1000 kg
Volumetric Conversion Factor	
1 m^3	264.172 gallons (US) = 35.3146 $Inch^2$
1 TMC	2831.68 hectare
1 Litre	0.2641 gallons (US)
1 gal	4 quarts

1. INTRODUCTION

The estimation of ground water resources of the Karnataka state as on 2022 has been carried out as per the recommendations of Ground Water Estimation Methodology-2015 (GEC-15). Earlier methodology, GEC 97 is based on 'Water Balance Approach' and the GEC 97 norms were used for estimation of dynamic ground water resources of the country considering 2004, 2009, 2011 and 2013 as base years. The methodology underwent comprehensive revisions in 2015 and a revised methodology, namely GEC 2015 methodology has been prescribed for ground water assessment. This methodology is being followed for assessment carried out from 2017onwards. The revised methodology GEC 2015 recommends aquifer wise ground water resource assessment. Wherever the aquifer geometry has not been firmly established for unconfined aquifer, the in-storage ground water resources have to be assessed in alluvial areas upto depth of bed rock or 300 m whichever is less. In case of hard rock aquifers, the depth of assessment would be limited to 100m. In case of confined aquifers, if it is known that ground water extraction is being taken place from this aquifer, the dynamic as well in-storage resources are to be estimated. If it is firmly established that there is no ground water extraction from this confined aquifer, then only in-storage resources of that aquifer have to be estimated.

Groundwater resource assessment is the determination of the source, extent, dependability and quality of groundwater resources, on which the evaluation of the possibilities of the utilisation and control depends. Estimation of groundwater is also important for the construction and the maintenance of the State's water supply infrastructure, especially those that are dependent on groundwater. This report provides an overview of the groundwater resources of Karnataka for a vast range of activities like agricultural, domestic and industrial water supply. It will form the basis for understanding the existing and planning the future use of groundwater and to decide the management options on a holistic basis. These data also provide inputs that would be used to understand the dynamics of the various sector wise demands and ensure sustainability for different water sector activities.

The near approach accuracy in groundwater resource assessment will help the planners and policy makers in determining the extent and nature of:

- Co-ordinating and integrating mechanisms, now, required in the field of water sector.
- Regulations and new legislation, and
- Strategies and policies that deal with the priority of uses and conflict resolution mechanism (through mutually beneficial bargaining- basin/sub-basin water partnerships).

In short, groundwater resources assessment is a prerequisite for sustainable development of States water resources.

The present availability and requirement of water in the State of Karnataka is extremely uneven, both spatially and temporally and so will be case in the future. Rapid population growth and intensive anthropogenic activities have put both surface and groundwater under heavy stress, and significantly fresh water is becoming scarce and dearer in many areas. It is believed that in the coming decades most of the Earth's population will face a critical situation with regard to the availability of water. The water deficiency will become a factor affecting the living standards of populations adversely. To understand more about the water resource deficit that will face us in the future it is very important to analyse the present situation and understand rate of change in specific water resource availability in relation to socio-economic, geohydrologic and physiographic conditions.

In the State of Karnataka, groundwater is an essential component for many water strategies and systems. It is therefore essential that the groundwater resource estimation is accurate so as to prepare strategies for the long-term

management of this precious resource and for ensuring the long-term safety and wellbeing of all the sections of the society. Groundwater resource estimation is mainly dependent on the quality of the data. Many a times because of the lack of good quality data the resource assessment misleads the planners, administrators and technocrats in formulating various developmental activities.

1.1 Background

In the State of Karnataka, groundwater has emerged as an important source to meet the water requirements of various sectors. Demands for groundwater resources are ever increasing and competition amongst users has intensified. The sustainable development of groundwater requires precise quantitative assessment based on reasonably valid scientific principles. The occurrence, movement and storage of groundwater are quite complex, being governed by several factors like meteorology, geomorphology, geology, hydrogeology, and above all the human activities. All these factors make the precise assessment of groundwater very difficult and there is no direct technique available for precise assessment. Hence the methods applied for groundwater resource estimation are all indirect. There are several techniques and methodologies *in vogue* for estimation of groundwater resources. Quantification of groundwater resources is often critical and no single comprehensive technique is yet identified which is capable of estimating accurate groundwater potential. Since groundwater is a dynamic and replenishable resource, its proper and economic development on a sustainable basis, requires its realistic assessment. The estimation must be seen as an interactive procedure. Initial estimation are revised and refined by comparing these results with the results obtained by adopting alternative methods and third party studies.

The Ministry of Jal Shakti, Dept. of Water Resources, River Development & Ganga Rejuvenation, Govt. of India desires to reassess the Ground Water Resources for the entire country once in two years and hence the current re-estimation of resources as in March 2022 has been taken up in view of the changes that are observed in the ground water scenario. The data provided by the state agencies have been used in the present ground water assessment. During 2020 assessment, a software named INDIA – Groundwater Resource Estimation System "INGRES" has been introduced for assessing the ground water resources of India and the same is used for current assessment. The data collected were compiled as per format in INGRES and was uploaded in the software and the results generated were validated with the manual calculations for few sample assessment units to ensure the error-free functioning of software.

1.2 Constitution of State Level Committee for Karnataka

The assessment of ground water resources for the State of Karnataka had been assessed by the Ground Water Directorate (GWD) in collaboration with the Central Ground Water Board (CGWB), Bengaluru based on the revised Methodology known as Groundwater Estimation Committee 2015 (GEC-2015) Methodology. The present exercise on groundwater assessment as on March 2022 is also carried out in accordance with the protocol of GEC-2015 under the supervision of State level Committee (SLC) and under overall guidance of Central Level Expert Group (CLEG).

The State Level committee headed by the Secretary, Minor Irrigation & Ground Water Development Department as Chairman was constituted by the Government of Karnataka vide Government Order No. vide MID 22AAJAA2020 (E) Bangalore dated 20.08.2020 and the SLC has been continued vide letter dt. 03.02. 2022.The copy of the Government Order and Continuation Order is enclosed as ***Annexure I.*** The Committee is multi disciplinary in nature and comprises of the following members from various State and Central Govt. organisations:

S.No.	Designation	Committee Designation
1.	Secretary to Government, Minor Irrigation and Groundwater development department	Chairman
2.	Chief Engineer, Minor Irrigation & Groundwater Development Department, South Zone, Bangalore	Member
3.	Chief Engineer, Minor Irrigation & Groundwater Development Department, North Zone, Vijayapura	Member
4.	Director, Groundwater Directorate	Member
5.	Chief Engineer, Karnataka Urban Water Supply & Drainage Board	Member
6.	Director, Department of Agriculture	Member
7.	Chief Engineer, Water Resources Development Organization	Member
8.	Chief Engineer, Rural Water Supply & Sanitation Department	Member
9.	Commissioner/Director for department of Industries	Member
10.	General Manager, NABARD	Member
11.	Chief Engineer, Advanced Center for Integrated Water Resources and Management Center, Bangalore	Member
12.	Regional Director, Central Ground Water Board, Government of India, Bangalore	Member Secretary

Terms of reference: - The broad terms of reference of the committee would be as follow:

1. To re-assess annual replenishable Ground Water Resources of the State of Karnataka for the year 2022 in accordance with GEC-2015 Methodology.
2. To estimate the status of utilization of the annual replenishable ground water resources.
3. To submit the ground water resource estimates of the state to central level expert group (CLEG) after the approval of SLC for inclusion in national level report on assessment of ground water resources.

As suggested in the protocol, the Groundwater Assessment Cell was also formed at State Level within the Central Ground Water Board, SWR, Bangalore andDirectorate of Groundwater, GoK, Bengaluru. The updation, validation and scrutiny of database with respect to 2022 has been done by the GWRA Cells. The entire data base has been reconciled jointly by GWD and CGWB, Bengaluru in a series of online meetings, email correspondence and verification throughout the 2022 computation period. For the present assessment as on March 2022 preliminary evaluation about groundwater situation in each assessment unit was made jointly by GWD and CGWB during the reconciliation meetings.

1.1 Brief Outline of the Proceedings of the Committee

The first meeting of the State level Committee (SLC) for Ground Water Resources Assessment - 2022 of Karnataka State was held on 04.05.2022 at 11.00 hrs, room No. 317, Vikas Soudha, Bangalore. Shri C. Mruthyunjaya Swamy, Secretary, & Chairman of SLC, chaired the meeting. Based on the agenda and discussions held during the meeting, it was decided by the committee to consider the 233 taluks as assessment units. In addition to this, Bangalore city will also form 1 AU, thus total AU's will be 234.It was also decided that ground water draft data based

on consumptive pattern to be provided by the Industries Dept. based on the industries registered with the Dept.The Chairman and Member Secretary of the committee stressed to follow the timelines for GWRA and requested all the line departments to provide the necessary data for the same.It was decided during the meeting that the following members will be co-opted in the SLC for better co-ordination and data requirement. Based on the minutes of the meeting (***Annexure-II***), the Govt. Order is to be issued by Minor Irrigation Dept.

i. Director, Karnataka State Remote Sensing Application Centre (KSRSAC).

ii. Commissioner, Rural Development and Panchayat Raj.

iii. Director, Karnataka State Natural Disaster Monitoring Center (KSNDMC)

iv. Directorate of Economics and Statistics (DES)

v. Chief Engineer, Bangalore Water Supply and Sewerage Board

The Director, GWD suggested to reconsider the infiltration rates in K.C. Valley, H.N. Valley and other tank filling project areas in the state and sought technical advice from CGWB to proceed in the matter. It was discussed in the meeting that the Infiltration tests will be carried out to calculate the actual Infiltration rates in tank filling scheme areas to incorporate the same in the assessment 2022. The Chairman agreed for the same and asked to GWD and CGWB to work collaboratively to arrive at new Infiltration rates. These rates will be used for arriving at the recharge from tanks and ponds.

The second meeting of the SLC was held on 19.09.2022 at 14.00 hrs in room No. 123, Vikas Soudha, Bangalore. Shri C. Mruthyunjaya Swamy, Secretary, & Chairman of SLC, chaired the meeting.Shri N. Jyothi Kumar, Regional Director, CGWB, SWR, Bangalore & Member Secretary welcomed the Chairman, Members & Invitees to the State Level Committee Meeting. He appreciated the efforts put in by the officers of GWRA cells of CGWB, GWD and district level officers of GWD in providing the data required for the resource assessment and carrying out the mammoth task. He informed the committee that, some new features / estimations had been introduced for the first time for Karnataka State viz., resource assessment unit being taluka instead of watershed, Industrial draft computations, Bangalore city resource assessment and Quality Tagging for fluoride, salinity and nitrate. Shri. Rahul R Shende, Scientist – B, CGWB, presented the draft results and findings of GWRA 2022.

Shri C. Mruthyunjaya Swamy, Secretary (MI & GWDD) and Chairman of SLC and Chairman of the committee enquired about the number of days considered for tank / ponds recharge assessment. It was informed that, for the KC valley and HN valley tanks, the number of days were taken as 365 days and also the average water spread area was taken as 100% instead of 60% since these tanks are being filled round the year by secondary treated water. The Chairman also observed that the stage of extraction has increased from 65% in 2020 to 69.93% in 2022 and needs some rationalisation / validation especially in irrigation draft. It was informed to the committee that there is an increase of about 9% in number of irrigation wells as compared to last assessment resulting in increase in irrigation draft and stage of extraction. After the presentation and detailed discussions, the GWRA 2022 were provisionally approved by the SLC subject to rationalisation of irrigation draft, provided the data on the agricultural pump sets electrical connections is received from ACIWRM department. The mintes of the meeting are attached as ***Annexure III.***

However, the data from ACIWRM was not received for any further rationalisation or modification. Hence the GWRA 2022 are considered approved.

2. ABOUT KARNATAKA

2.1 Salient Features of Karnataka

A	***Location***	
	Latitude	11° 32' 00'' to 18° 29' 00'' E
	Longitude	74° 01' 00'' to 78° 32' 00''N
	Area	191791 sq km
B	***Physiography***	1. Northern plains 2. Southern plains 3. Coastal area 4. Hilly region
C	***Population (Census 2011)***	61,095,297 (61.09 million) (Male-30.96 million and Female-30.13 million)
	Urban Population	23.62 million (38.67%)
	Rural Population	37.47 million (61.33%)
C	***RainfallNormals***	
	State Range	303 to 4835 mm
	Coastal Area	3000 to 5000 mm
	Malnad Area	2000 to 4000 mm
	Northern Plains Area	400 to 800 mm
	Southern Plains Area	600 to 1000 mm
D	***Land Use***(2019-2020)	
	Area under Forest	30733 sq. km.
	Non-Agricultural Use	15110 sq. km.
	Net Area Sown	108024 sq. km.
	Gross Area Sown	138290sq. km.
	Net Irrigated Area	42348 sq.km.
	Gross Irrigated Area	50343 sq. km.
E	***Soils***	Shallow black soil, Medium black soil, Deep black soil, Red sandy soil, Mixed red and black soil, Red loamy soil, Lateritic soil, Lateritic gravelly soil
F	***Geology***	
	Quaternary Alluvium	748 sq km (0.39%)
	Laterite	3741 sq km (1.95%)
	Deccan Trap Basalt	35723 sq km (18.62%)
	Sedimentary Formation	6715 sq km (3.50%)
	Granite	14657 sq km (7.64%)

2.2 Location and Areal Extent

The state of Karnataka has a geographical area of 1, 91, 791 sq. km. and is situated between Latitudes 11° 32' 00'' to 18° 29' 00'' Eand Longitudes 74° 01' 00'' to 78° 32' 00''N. For administrative purposes, the state is divided into 31 districts and 233 taluks. The State has 1 urban district i.e., Bangalore Urban, whereas the remaining 30 districts are considered under rural for the current assessment.

2.3 Physiography and Drainage

Physiographically, the state is divided into four regions. These are, northern plains, southern plains both on the eastern side of the state, coastal area to the west of the Western Ghats and fourthly hilly region. In the narrow coastal belt in the extreme west the elevation ranges from 0 to 200 meters. In the hilly areas the elevation generally varies from 200 to 1900 metres. In the plains the elevation ranges from 300 to 1000 metres. Each of the physiographic regions has a distinct climate. While in the coastal and hilly areas per humid to sub humid climate prevails, in the plains the climate is sub humid to semiarid in nature. A large part of the state, area east of the ghats being in the rain shadow, is semi arid and hence drought prone.

2.4 Population

As per 2011 census, the population of the state is 61.09 million out of which 23.62 million is urban and 37.47 million is rural, whereas male population is 30.96 million and female population is 30.13 million. Karnataka is mainly an agriculture State with around 61% of rural population relying on agriculture and allied activities. The population of Karnataka which was 52.85 million in 2001 has increased by about 8.24 million @ 15.60 % during the span of ten years.

2.5 Agriculture

Agriculture is the mainstay of the rural population of the state of Karnataka. As per 2019-20 data, the Net Area Sown in the State is 108024 sq. km., Gross Area Sown is 138290 sq. km. Both food crops and cash crops are grown in the state. Principal crops include food crops lilerice, jowar, bajra, maize, ragi, pulses which constitute 81628 sq.km. (59%) area of total sown area. In addition to food crops oil seeds including groundnut and sunflower are grown in 7.72% of the area, fruits which mainly consists banana and mango are grown in 4037 sq.km area, whereas vegetables are sown in 4511 sq.km. area. The state has significant areas, under cotton (8172 sq. km.), sugarcane (4306 sq.km.), coconut (6103 sq.km.) and arecanut (5005 sq.km). The agriculture in state is predominantly rain-fed, whereas the net irrigated area is 42348 sq.km. and gross irrigated area is 50343 sq. km.

2.6 Hydrometeorology

2.6.1 Climate and Rainfall

In Karnataka typical monsoon is experienced. Bulk of the annual rainfall is received during the south-west (June to September) and north-east (October-December) monsoons. Pre-monsoon thunder storms also contribute significant to considerable rainfall. Humid to semiarid climatic conditions prevail in the state. In general rainfall varies from about 400 mm in the northern fringe of the state to more than 4000 mm in the west (**Fig.-1**). The state can be broadly classified into four distinct climatic zones. These are:

I. Narrow Coastal Zone along the West Coast: The whole of Dakshina Kannada, Udupi and western parts of Uttara Kannada district come under this zone. The rainfall generally increases from the coast towards the mountains on the east and from north to south and it ranges from 3000 to 5000 mm. Average rainfall is around 4000 mm and bulk of this rainfall occurs during the south west monsoon period lasting from June to September. July is the wettest month.

II. The Mountain (Malnad) Zone: Parts of Belagavi, Uttara Kannada, Shimoga, Chikamagalur, Hassan, Kodagu and Mysuru districts fall under this zone. The area is composed of series of mountains and dense tropical forests. Rainfall is over 4000 mm on hill tops and around 2000mm in the adjoining forest areas. The south west monsoon yields the bulk of the rainfall and July is the wettest month. The rainfall decreases from west to east.

III. The Northern Plains: Eastern part of Belagavi and whole of Bidar, Vijayapura, Bagalkote, Bellary, Kalaburagi, Dharwad, Gadag, Haveri, Raichur and Koppal fall in this zone. Bulk of the rainfall occurs in the winter months. The rainfall decreases from the west to east and it ranges from 400 to 800 mm. On an average about 600mm rainfall is received annually. September is usually the month of peak rainfall.

IV. The Southern Plains: Parts of Shimoga, Chikamagalur, Hassan, Mysuru and whole of Mandya, Tumkur, Bangalore, chikkaballpur and Kolar districts fall in this zone. In these parts, rainfall ranges from 600 mm to around 1000 mm. Considerable rainfall occurs during the pre-monsoon months due to thunder storms. Both the monsoons are active giving copious amounts of rainfall. The peak rainfall is found to occur in September/October with a secondary peak occurring in May. The average rain fall in these parts is around 700-800 mm.

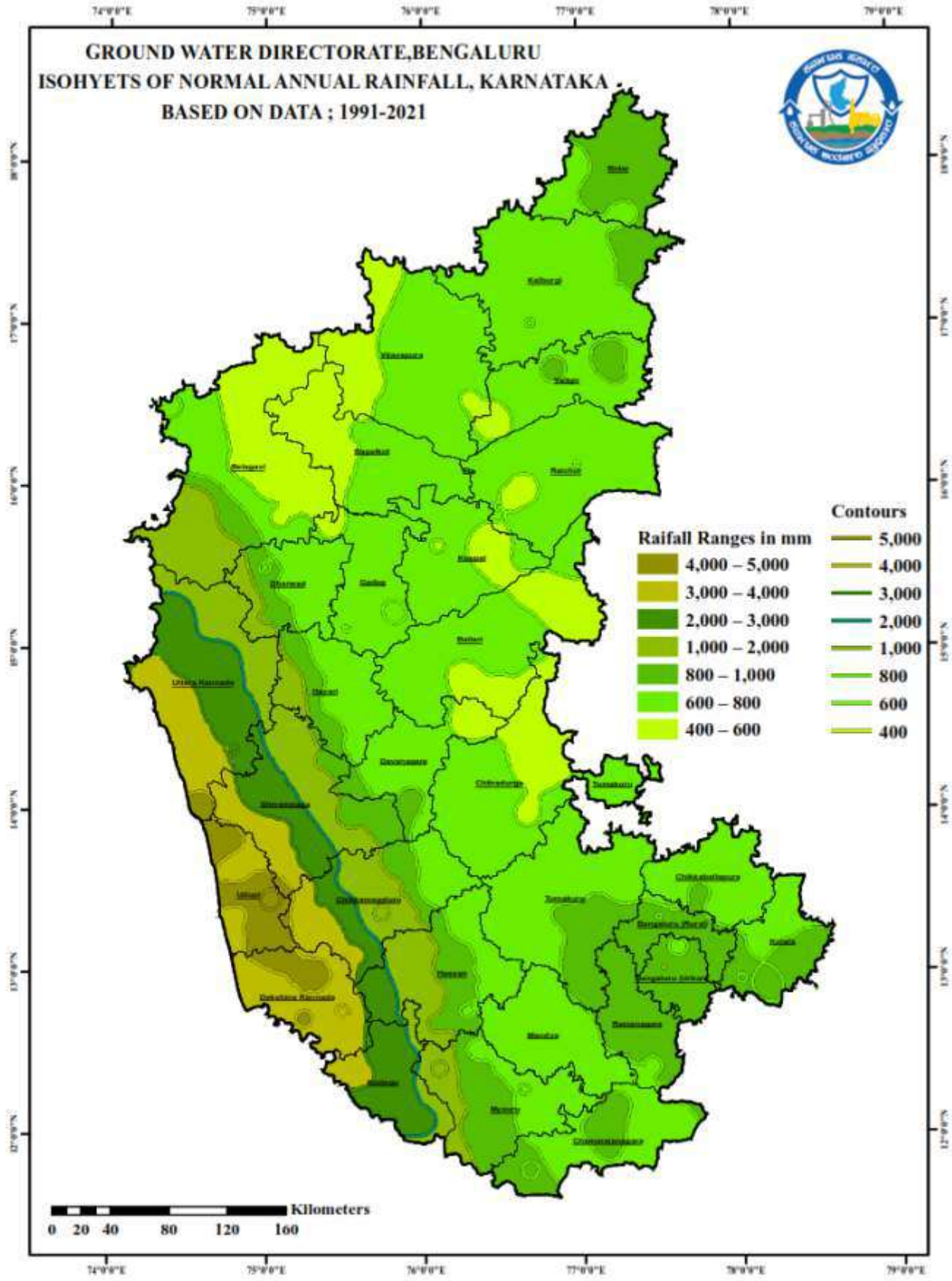

Fig.-1: Normal Annual Rainfall

2.7 Geology

Karnataka State comprises rock types of age from Archaean to Recent (Fig.-2). Major portion of the State is covered by Peninsular Gneisses, Granites and Dharwad Schists of Archaeanage. Substantial area in the northern part of Karnataka is underlain by basalts, which forms a continuation of the Deccan Traps occurring in Maharashtra. The sedimentary rocks comprising Bhima and Kaladgis occupy a small area in the northern districts. The recent alluvium is restricted to a narrow belt in the coastal area and along stream courses. The geological succession in the state is presented as below.

Table-1: Geological Succession

Age	Series/System	Formation
Recent	Soil & Alluvium	Sand and Clay
Pliestocene	Laterite	Laterite
Tertiary to Mesozoic	Deccan Trap Basalt	Hard massive & vesicular Basalts
	~~~~~~~~~~~~~~~~~~~~~~~~~Unconformity~~~~~~~~~~~~~~~~~~~~~~~~~	
Lower Palaeozoic to upper Precambrian	Bhima Series	Quartzites, Sandstones, Limestone, Shale and Conglomerates
	~~~~~~~~~~~~~~~~~~~~~~~~~Unconformity~~~~~~~~~~~~~~~~~~~~~~~~~	
Upper Precambrian	Kaladgi Series	Quartzites, Sandstones, Limestones, Shale and Conglomerates.
	~~~~~~~~~~~~~~~~~~~~~~~~~Unconformity~~~~~~~~~~~~~~~~~~~~~~~~~	
Lower Precambrian	Dharwad system Volcanic, meta sediments, Greenstone	Dharwad Schist's meta sediments, Green Stone Formations
	~~~~~~~~~~~~~~~~~~~~~~~~~Unconformity~~~~~~~~~~~~~~~~~~~~~~~~~	
Archaean	Peninsular Gneissic complex	Gneisses, Granites, Charnockites, Khondalites

The Archaean crystalline rocks occupy nearly 79% of the total geographical area of the state. Excepting Bidar district and northern parts of Belagavi, Bagalkote, Vijayapura and Kalaburagi district, Archaean crystalline rocks occur in the remaining parts of state. The gneissic complex is composed of composite gneisses, migmatites, granites and quartz veins. Charnockites are exposed over a limited extent in the southernmost parts of the state in kodagu and Mysuru districts. The weathered zone in these crystalline extends from less than a meter to about 20m the thickness in general and at places it is as deep as 60-90M. In parts of Belguam, Bengaluru and kolar districts the weathered material is more of clayey in nature.

The Dharwad mainly composed of slates, phyllites and schists form the second major group of rocks occurring in about 40000sq. km of the state. These are sub divided in to three main types namely Chitradurga group, Dharwad sub group and Sargur group. They are wide spread in parts of Uttara Kannada, Dharwad, Shimoga, Chitradurga and Chikamagalur districts where as in other districts their occurrence is limited in extent as small strips distributed throughout gneissic terrain.

This group consists of volcanic rocks such as rhyolites, felsites etc., limestone, conglomerates, quartzite (ferruginous), and Meta sediments as amphibolites sand's-chists. The schists and related argillites form the valley portions, but in general, the Dharwad form high grounds. The weathered zone extends down to about 20m in the valleys. The Dharwad rocks have regional strike of NNW-SSE, which tends to N-S in the southern part of Mysuru and even to NE-SW direction near the southern border.

Meta-Sedi mentary formations of Bhimas, Kaladgis and Badamis are exposed over an area of 9640sqkm in the state. The major litho units in the group are sand stone, quartzite, shale, slate, limestone and dolomite. The Kaladgi formations are exposed over length of 160km between Krishna and Malaprabha rivers in Belagavi and Vijayapura districts. The formation comprises of conglomerates, quartzite, limestone and shale's, which are divided into lower and upper series. The upper stand stone formations exposed at Badami and further east which are thick bedded and gritty are designated as Badami sand stone. This horizon is considered as younger and equivalent to Bhima/Vindyas. This formation however, occupies higher altitudes occupying ridges and hence is of less importance from groundwater point of view. In the central part of the basin the Kaladgis are well developed with the presence of all litho units while towards west only the lower series consisting mainly they are nacreous members are exposed. The Kaladgis are partly overlain by Deccan trap. The formations are folded giving rise to a series of ridges and valleys. The valleys are mainly occupied by limestone and shale. The limestone formation occupies a wide area in between Lokapur and Bagalkote. Generally, the lime stones are horizontally bedded and have very low permeability. At places it is karstified and cavernous. A narrow band of dolomite overlies the limestone. In the southern and northern valleys, i.e., South of Bilgi and at Kulgeri respectively, the shale's are purple in colour.

The regional trend of the formations and the axial planes of the folds are WNW-ESE. A major fault zone runs in limestone formation marking the contact between an anticline and syncline along Kaladgis-Kardigud in the Lokapur valley. Another major fault zone runs along Gaddanakeri in Bagalkote valley. A number of minor faults and major fracture zones are identified in the basin cutting the quartzite and the drainage in this area seems to be controlled by structure. The basin in the central part i.e. along Bilgi-Gaddankeri-Kulgeri is severely disturbed while towards east and west of zone, the tectonic intensity is not displayed. Exploratory drilling in this area revealed the presence of major fracture/shear zones down to a depth of 200m.

The Bhima basin lies east of the Kaladgis stretching in NE-SW direction. The major part of the basin lies in Kalaburagi district, except for a small strip in the Vijayapura district between Muddebihal and Talikot. The Bhimas are represented by conglomerates, sandstones, shales and lime stones, which could be sub divided in to three series lower, middle and upper. The lower and middle series consist of the sequence of these three lithological units, while the upper series is represented mainly in purple shale. Among the lower series the lime stones are well developed over a wide area and are popularly known as 'Shahabad' stones. The middle series form, narrow strip and are of little significance from groundwater point of view. The shales are purple colored and laminated and the lime stones are variegated but predominantly grey colored and thick bed deed. The formations do not show any metamorphism. They are in general horizontally bedded or dip at less than 5°towards west. However, this trend is not maintained in the distributed zones.

A number of faults of relatively lesser magnitude are identified in the basin at different places. The displaced block is also gently folded on the western side. Thrust faults and the gravity faults are also identified at a few places. The formations are highly fractured in these distributed zones. Certification marks fault zones in the limestone formations. The drainage in the Bhima basin is considered to be of tectonic origin. The curvilinear trend of Bhima river course seems to be controlled by the two axes of super posed folds and also faults. Similarly, the streams of lower orders are also influenced by the fracture system in granitic terrain and folding pattern in the Bhima formations.

Deccan trap forms the northern part of the State. Both massive basalts wells vesicular basalt is encountered in the area. The maximum thickness of about 600 to 800m trap is reported around Kolhapur in Maharashtra but

becomes thinner to about 70 m or less towards the fringe as observed in parts of Kalaburagi, Bagalkote and Belguam districts of Karnataka. The inter-trappean beds are of small extent and appear have been formed in local depressions only or near to the south western edge of the trap area. In Vijayapura district, three flows of zeolitic trap are observed between 506m and 610m contour each with a thickness of about 6m. In the southern part of Kalaburagi district only zeolitic trap unit is identified which is exposed at higher elevation in the southern most part and at the ground surface around Kalaburagi. The weathered zone in traps varies from traces about 15mbgl. Traps are considered to be not involved in any tectonic disturbances. It is also difficult to recognize any structural deformities in them as they are generally fine grained and massive. However, some faults identified in Bhima basin are considered to be extending into the traps also. At some places in Kaladgis the traps are reported to enclose fragment of quartzite.

Laterite perhaps of different genetic histories such as residual and transported are found overlying different formations in different parts of the state. It occurs along the coast in Dakshina Kannada, Udupi and Uttara Kannada districts overlying schists and granites with a maximum thickness of about 40m. In Kaladgis, Laterite also occurs as isolated patches in the valleys capping shales and basalt. The thickness in this part is 2 to10m. The Laterite capping on Deccan trap is extensive in parts of Bidar and Kalaburagi districts. However Laterite as an aquifer is having limited real extent of about 1300 sq. km. Its occurrence is also reported in the Belguam district. Generally, it is confined to the highest ridge sand peaks. The Laterite formed in the vesicular traps are deep yellow is brown in color. Localized patches of laterites are encountered in other parts of the state also, overlying the granites and Dharwads.

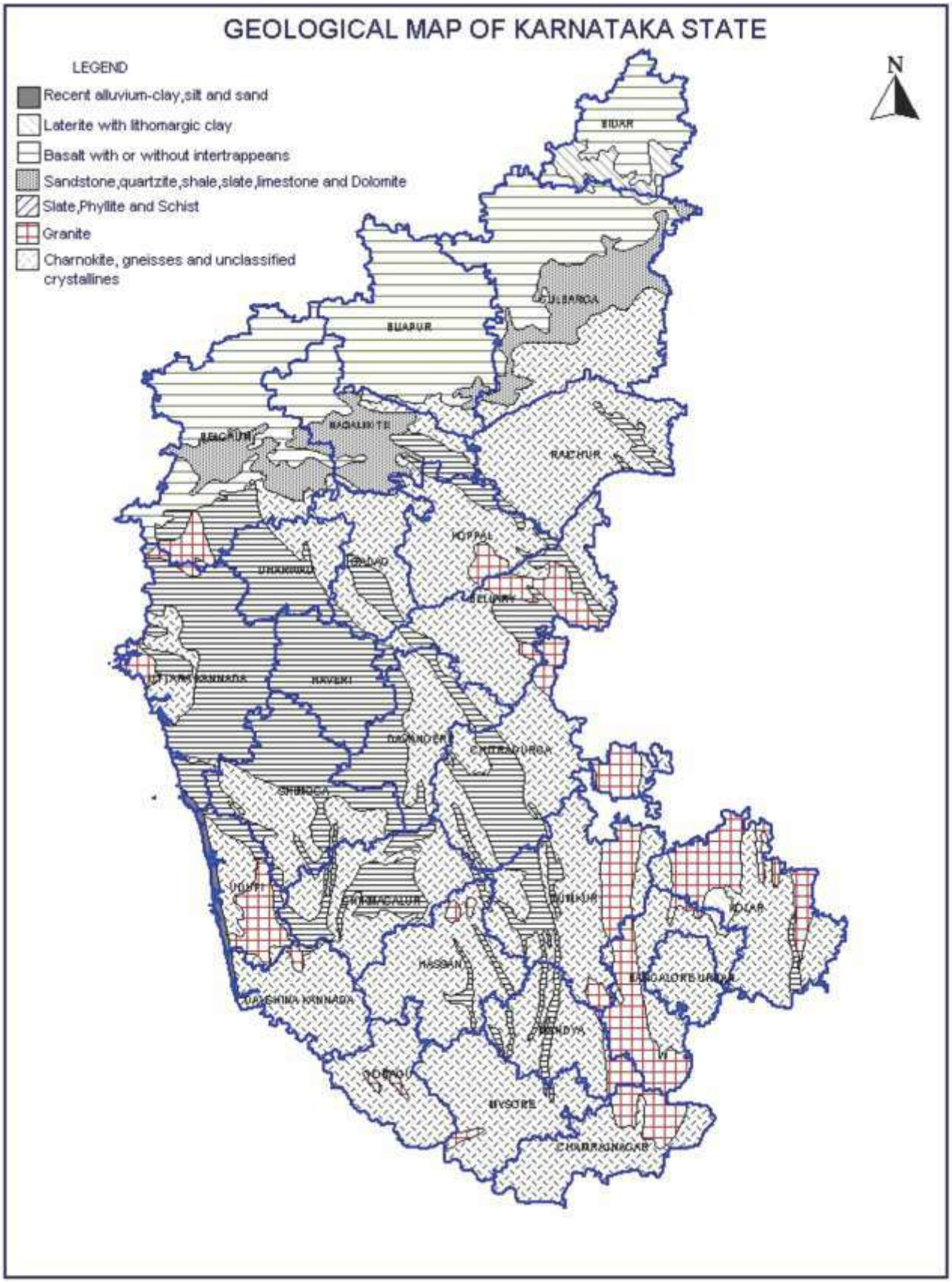

Fig.-2: Geology

The alluvium of recent age is limited to only certain river courses in the west coast. Alluvial patches are located along Tungabhadhra, Suvarnamukhi and Chitravathi river courses. The thickness of alluvium is variable generally and a maximum thickness of 15m is reported in the Chitravathi basin. The alluvium consists of unconsolidated sediments such as pebbles, gravel, sand, silt and clays. In the coastal area the thickness ranges from negligible to about 30m.

2.8 Hydrogeology

2.8.1 Ground Water Provinces of Karnataka

Karnataka State can be considered as having three major hydrogeological provinces. They are the Hard Rock province, Deccan Trap province and metamorphosed sedimentary province as described below. Groundwater occurs in these provinces under unconfined to semi-confined conditions and under confined conditions in depth. The rock units of provinces do not have the primary porosity, therefore the occurrence and movement of groundwater is through secondary porosity developed through weathering, fracturing and tectonic formation under gone by the rocks. The main source recharge to the aquifers is by precipitation and also by applied irrigation. In addition to these along the coast a thin band of alluvium is encountered (**Fig.-3**).

2.8.1.1 The Archaean Crystalline Hard Rock Province

Archaean crystalline hard rocks are represented by the gneisses, schists, granites and khondalites, which occupy up to 79% of the area of the state. The availability of groundwater in the phreatic zones in these formations is controlled by the degree of weathering and lithological unit of the area. The schists and khondalites are more susceptible to weathering and hence are having better yield in the phreatic zones compared to Granites. Generally, the depth of weathering goes down to 30m in this formation and they sustain dug wells. In contrast, the yield of bore wells is controlled by the tectonic history of the area and the lithology encountered. Thus equi-granular rocks when subjected to differential stress tend to develop open(tensile) joints in the direction of stress and shear joints at about 23°to the direction of stress, whereas rocks having linear mineral stand to absorb the stress and the linear minerals reorient along the stress direction. Thus Granites, Pegmatite and Charnockites yield better compared to Schists, Phyllites and Gneisses.

Further, the analysis of the results of groundwater exploration in the state indicated that the tectonic story has an important bearing on the yield of bore wells. Thus, all the lineaments are not equally potential. The NE-SW lineaments are the most potential followed by E-W, NNW-SSE and NW-SE in the order of preference even though the NW- SE lineament is the most commonly occurring one. The yield of bore well in the province is as high as 30lps with a transmissivity of upto 2000 m2/day in ideal conditions tapping tensile joints in granites/ pegmatite's and other equi- granular rocks.

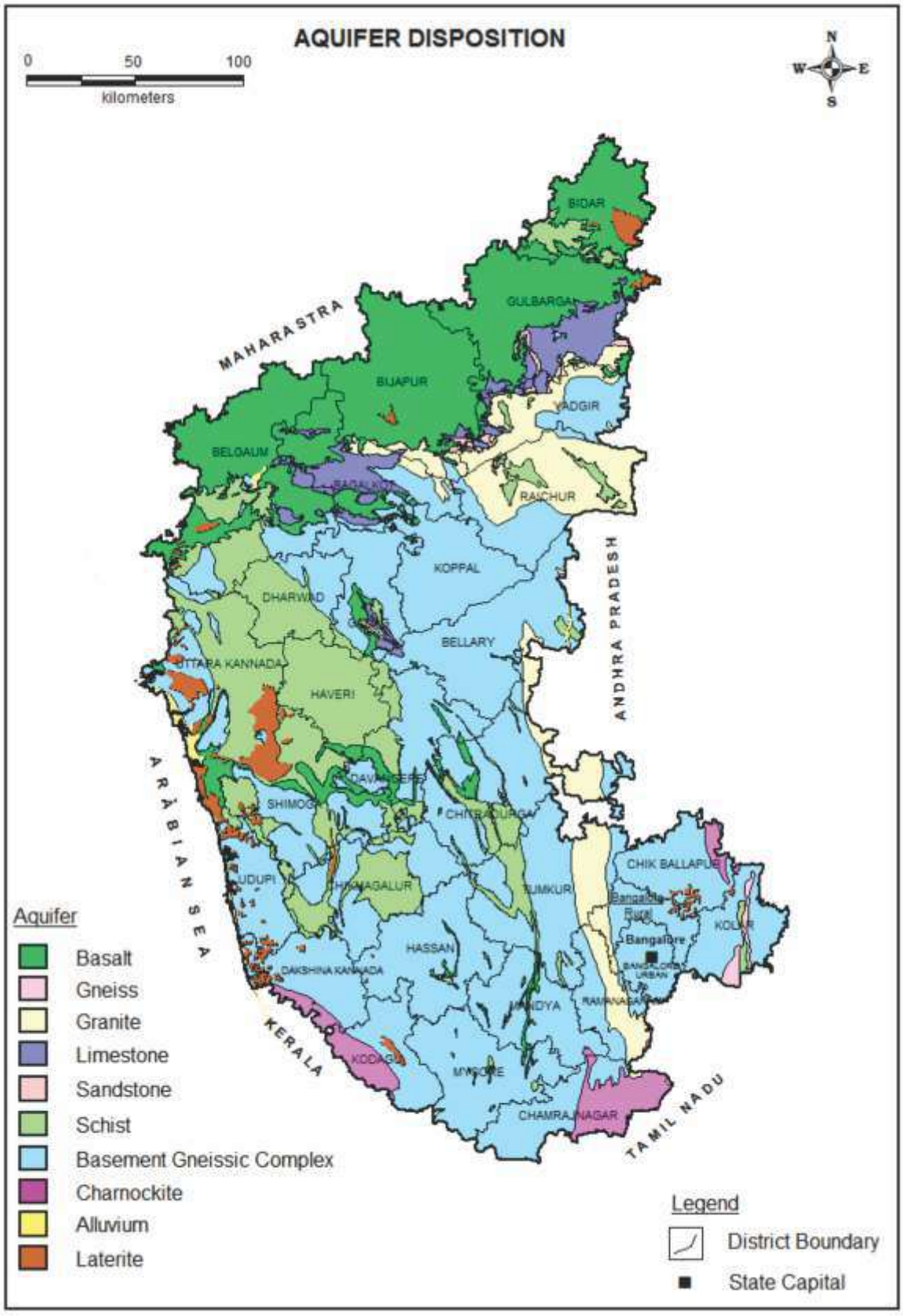

Fig.-3: Aquifer Systems

2.8.1.2 Deccan Traps

The Deccan trap constitutes about 15% area of the state occupying Bidar, Vijayapura, major parts of Kalaburagi, Belagavi and northern parts of Bagalkote districts. The vesicles and amygdales are the porous media for the traps. Generally, these porous media are filled with the secondary materials like Quartz, Zeolites, and Bauxites and Clays. The Deccan traps also act like a crystalline formation. Zeolitic traps and Amygdales and vesicular properties of the trap facilitate occurrence and movement of groundwater in traps. Further at the trap crystalline fringe area in Karnataka part, the traps have minor dip, which carry the water through contact zone of the flows. The intra trappean red bole beds act as an aquiclude. The weathered zone occurs up to a depth of 20mbgl and semi confined conditions occur below 20 to 40m in the Deccan trap. The jointed and fractured Deccan traps carry the groundwater to deeper depths. Depth of bore wells drilled in traps ranges from 40 to175m. The general yields of wells in traps is low and draw downsare high. The specific capacity of the wells in Deccan traps ranges from 0.05 to 34l/min/m draw down. The yield of bore wells ranges from 4 to1440m3/day. The transmissivity of the traps ranges from 1 to 369 m2/day.

2.8.1.3 The Sedimentary Provinces

The sedimentary rocks province is represented by the Kaladgis, Bhima sand Badamis, also known as consolidated sedimentary and it constitutes about 5% of the area of the state spread over parts of Kalaburagi, Bagalkote, Belagavi and Vijayapura districts. The primary porosity that usually exists in these formations has been lost due to the process of consolidation and compaction. Amongst these formations, lime stones form very poor aquifers as they are mostly horizontally bedded and devoid of solution activity except along the contact zones. Except in Ramdurg, Soundatti, Badami and Hungund areas the sand stones do not form aquifers because it occupies the higher altitudes as ridges. The shales are very rarely seen as aquifers but act as collector ponds than as an aquifer. Wherever sand stone occur as an aquifer it has a specific yield of 0.03. The lime stone of the Bhima series has specific yield of 0.005 to 0.04. Discharge of the bore wells drilled in lime stone ranges from 100 to 300m3/day. Depth of the bore wells drilled varies from 94 to 120 m.

2.8.1.4 Alluvium

Alluvial deposits occur as an aquifer comprised of fluvial materials like fine to coarse sand, gravel sand pebbles. It constitutes little over 1% area of the state. The river banks show the presence of alluvial deposits to a depth of 2m to 20m and the coastal tract accounts up to 40. The river that records alluvial/colluvial deposits are the Pennar, Kumudavati, the Tungabhadra, Suvarnavati, Chitravati and lower Hagari river. The yield of these river alluvial deposits ranges from 10 to 500m3/hour. The coastal alluvial deposits yield from 2400 to 4800m3/day. The transmissivity ranges from 2 to 4348 m2/d.

2.8.1.5 Laterite

Laterite is seen as a capping, scattered over the country rock in all the three Groundwater provinces. The demarcation of the area under Laterite is difficult as it forms potential aquifer only if it is having considerable thickness. In other places especially on the eastern parts of the state, it is absent or occurs as a thin capping over the country rock. However these are more predominant in the western parts of the state, where it forms potential phreatic aquifer. These are highly porous and permeable; as a result it gets fully recharged after monsoon. The aquifer drains out due to subsurface out flow in the post-monsoon period. The dug wells tapping these aquifers located in slopping ground gets dried up during summer months, even if the groundwater utilization in the area is on a low key.

2.9 Ground Water Levels

The ground water level scenario is the manifestation of the actual recharge and extraction taking place in the area and the groundwater abstraction or the natural discharge has a direct impact on the groundwater levels. During this assessment, the pre-monsoon and post-monsoon groundwater levels from 2017 to 2021 of about 1764 observation wells, which consists of 416 dugwells and 1348 borewells/piezometers monitored by Ground Water Direcotorate were utilised.

The map indicating the pre-monsoon groundwater levels of 2021 is presented in Fig.-4 and it indicates that water levels of 5 to 10 m bgl are mainly observed in north eastern parts, central and southern parts of the State. Such water levels are observed in parts of Yadgir, Raichur, Bellary (north eastern part) and parts of Mysuru district where canal command area is also more, thereby these areas are having less stress on ground water. In major part of the State, starting from north to south along the central and eastern axis, the deeper water levels ranging from 15 to 20 and more than 20 m bgl are observed. These parts also co-incide with the ground water stressed blocks as per current assessment.

The map indicating the post-monsoon groundwater levels of 2021 is presented in Fig.-5 and it indicates that shallow water levels of less than 5 m bgl are mainly observed in north eastern parts of the State in parts of Yadgir, Raichur and Bellary where canal command area is also more, thereby these areas are having less stress on ground water. In major part of the State, starting from north to south in the central portion, the water levels are ranging from 10 to 15 and 15 to 20 m bgl. The deeper water levels of more than 20 m bgl are mainly observed in south eastern dry land areas comprising parts of Tumkur, Ramnagar, Bangalore, Chikballapur and Kolar districts.

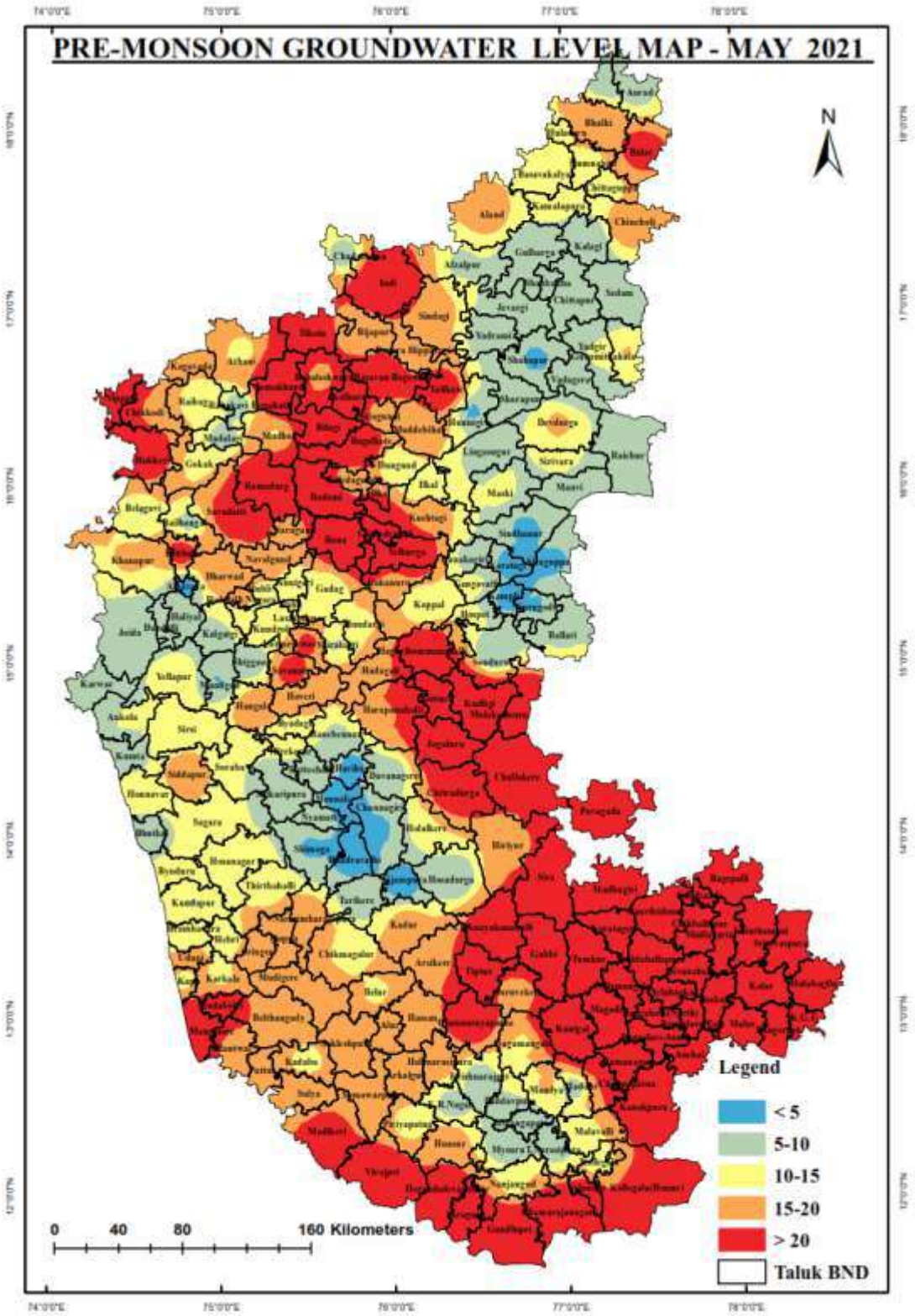

Fig.-4: Premonsoon Depth to Water Level (May 2021) of GWD observation wells.

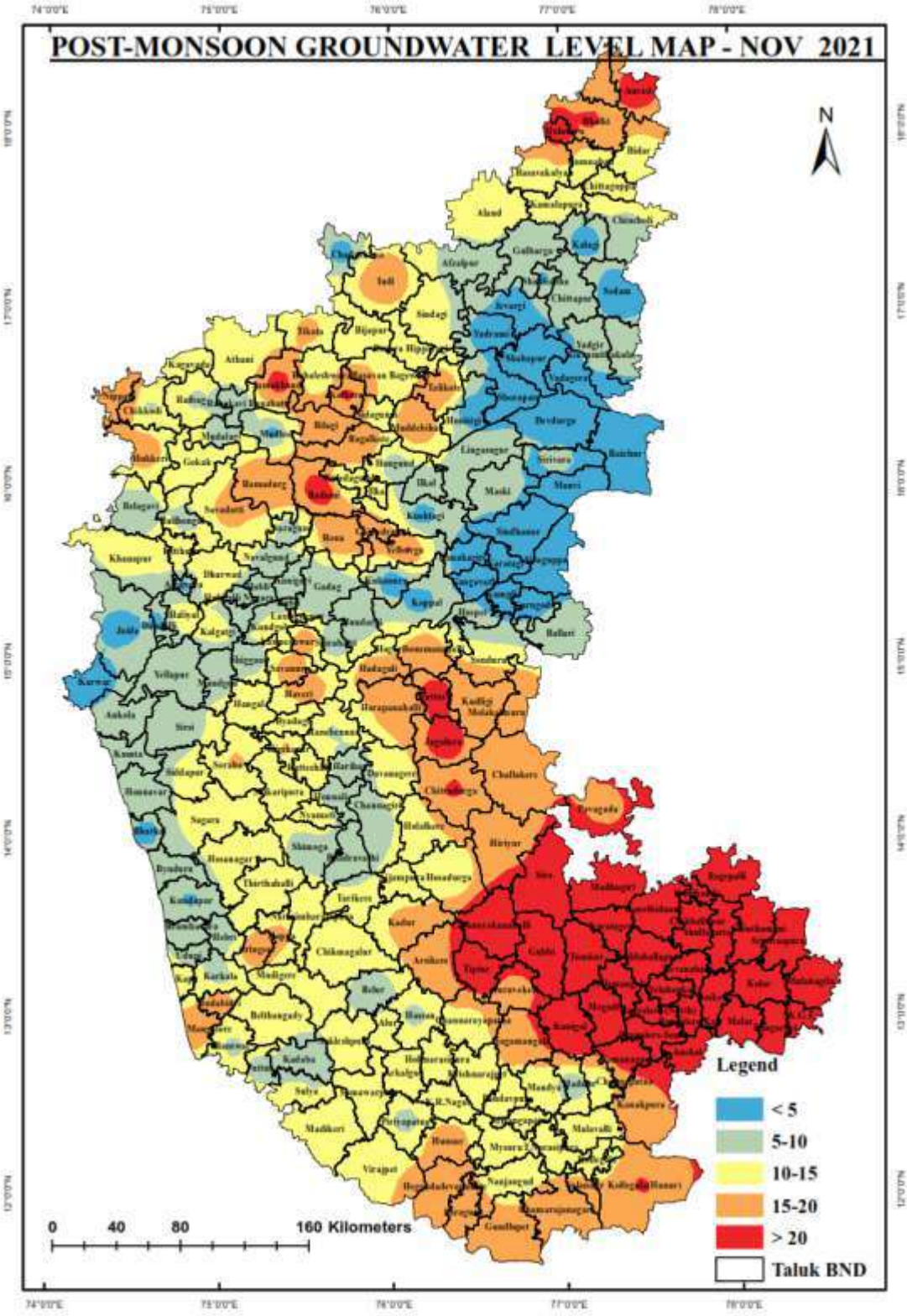

Fig.-5: Post-monsoon Depth to Water Level (May 2021) of GWD observation wells.

2.10 Ground Water Quality

The quality of ground water in Karnataka state has been evaluated by sampling and analysis of ground water samples collected by Ground Water Directorate(GWD), GoK, Bangalore. About 419 Ground Water Monitoring wells were monitored for water quality during May 2021 representing pre-monsoon water quality. The summarized results of ground water quality ranges are given in Table-2.

Table-2: Ground Water Quality of Karnataka collected by SGWD during May-2021

Sl. No	Parameters		Range	No. of sample	Percentage
1	Electrical Coductivity (ms/cm at 25°c)	Fresh	< 750	84	20.0
		Moderate	751- 2250	246	58.7
		Slightly mineralized	2251- 3000	46	11.0
		Highly mineralized	> 3000	43	10.3
2	Chloride (mg/L)	Desirable limit	< 250	267	63.7
		Permissible limit	251-1000	142	33.9
		Beyond permissible limit	> 1000	10	2.4
3	Fluoride (mg/L) (271 samples not analysed due to non functionality of instrument)	Desirable limit	< 1.0	101	68.9
		Permissible limit	1.0- 1.5	30	20.3
		Beyond permissible limit	>1.5	16	10.8
4	Nitrate (mg/L)	Permissible limit	<45	198	47.3
		Beyond permissible limit	> 45	219	52.7

In general, the ground water quality in the state is moderate in about 58.7% of the Ground Water Monitoring wells as indicated by the EC value is between 751-2250 s/cm at 25°C. In about 20% of the Ground Water Monitoring wells, the EC is less than 750s/cm at 25° C which is fresh in nature and 11% of Ground Water Monitoring wells are between 2251-3000 s/cm at 25° C indicating that the ground water is slightly mineralized and about 10.3 % of Ground Water Monitoring wells the EC is more than 3000 s/cm at 25°C indicating that the ground water is highly mineralized. The highest value 8060 s/cm at 25° C was observed in Nandavadagi, Bagalkot district.

The chloride content is less than 250 mg/l in about 63.7 % of the sample analyzed and 33.9 % of the sample are between 251 – 1000 mg/l and only 2.4 % shows more than 1000mg/l which are from the districts of Bagalkot, Belagavi, Vijayapura, and Raichur. The Fluoride content is less than 1.5 mg/l in about 89.2 % of the sample analyzed and about 10.8% of the sample shows more than 1.5 mg/l, which are from the districts of Bagalkot, Bengaluru Rural, Raichur, and Shivamogga. The Nitrate content is less than 45mg/l in about 47.7 % of the sample analyzed and 52.3 % of sample shows more than 45 mg/l which are from the district of Bagalkot, Bengaluru Rural, Bengaluru Urban, Belagavi, Chikkaballapur, Chamarajanagar, Chikkamagaluru, Chitradurga, Hassan, Hassan, Kodagu, Mysore, Raichur, Ramnagara, and Vijayapura.

3. Ground Water Resource Assessment Methodology, 2015

The ground water assessment of the State is being carried out jointly by State Ground Water Departments i.e., Groundwater Directorate (GWD) and Central Ground Water Board (CGWB) based on "Ground Water Estimation Methodology, 2015" (GEC-2015). Previous such joint exercises were carried out based on GEC-97 Methodology in 2004, 2009, 2011 and 2013. A number of changes have taken place since 1997 and with this background, the Ministry of Water Resources, River Development & Ganga Rejuvenation has constituted a committee headed by Chairman, CGWB to review and revise the existing GEC-97 Methodology and to incorporate new advancements/practices/tools so as to suggest a new methodology known as *"Ground Water Estimation Methodology, 2015" (GEC-2015 Methodology)*. The Committee has submitted a report on "Ground Water Estimation Methodology, 2015" incorporating refinement in the assessment methodology, database used for estimation and alternative approach for assessment involving Advanced Technology. The revised methodology as recommended has incorporated number of changes compared to the recommendations of Ground Water Estimation Committee- 1997.

3.1 Approach of GEC-2015

The revised methodology GEC 2015 recommends aquifer wise ground water resource assessment. Ground water resources have two components–Replenishable ground water resources or Dynamic ground water resources and In-storage resources or Static resources. GEC- 2015 recommends estimation of Replenishable and in-storage ground water resources for both unconfined and confined/ semi-confined aquifers. Wherever the aquifer geometry has not been firmly established for the unconfined aquifer, the in-storage ground water resources have to be assessed in the alluvial areas up to the depth of bed rock or 300m whichever is less. In case of hard rock aquifers, the depth of assessment would be limited to 100m. In case of confined aquifers, if it is known that ground water extraction is being taken place from this aquifer, the dynamic as well as in-storage resources are to be estimated. If it is firmly established that there is no ground water extraction from this confined aquifer, then only in-storage resources of that aquifer has to be estimated

3.2 Ground Water Assessment Unit and its Sub Units

This methodology recommends aquifer wise ground water resource assessment. An essential requirement for this is to demarcate lateral as well as vertical extent and disposition of different aquifers. A watershed with well-defined hydrological boundaries is an appropriate unit for ground water resource estimation if the principal aquifer is other than alluvium. Ground water resources worked out on watershed as a unit may be apportioned and presented on administrative units (block/ taluka/ mandal/ firka).

It is recommended that ground water recharge may be estimated for the entire assessment unit. Out of the total geographical area of the unit, hilly areas wherever slope is greater than 20%, are to be identified and subtracted as these areas have more runoff than infiltration. The hilly areas wherever slope is more than 20% may be demarcated using DEM data and geomorphological maps. Apart from this it is also important that the area where the quality of ground water is beyond the usable limits (for drinking water in particular) in terms of salinity is to be identified and handled separately. This methodology recommends that after the assessment is done, a quality flag may be added to the assessment unit for parameters salinity, fluoride and arsenic.

The ground water resource beyond the permissible quality limits in terms of the salinity has to be computed separately. The remaining area after excluding the area with poor ground water quality is to be delineated as follows:

(a) Non-command areas which do not come under major/medium surface water irrigation schemes.

(b) Command areas which come under major/medium surface water irrigation schemes which are actually supplying water.

3.3 Ground Water Resources of an Assessment Unit

The ground water resources of any assessment unit is the sum of the total ground water availability in the principal aquifer (mostly unconfined aquifer) and the total ground water availability of semi-confined and confined aquifers existing in that assessment unit. The total ground water availability of any aquifer is the sum of dynamic ground water resources and the in-storage or static resources of the aquifer.

3.4 Ground Water Assessment of an Unconfined Aquifer

Assessment of ground water resources includes the assessment of dynamic and in-storage ground water resources. The development planning should mainly depend on dynamic resource only as it gets replenished every year. Changes in static or in-storage resources reflect impacts of ground water mining. Such resources may not be replenishable annually and may be allowed to be extracted only during exigencies with proper recharge planning in the succeeding excess rainfall years.

3.5 Assessment of Dynamic Ground Water Resources

The methodology for ground water resources estimation is based on the principle of water balance as given below –

$$\textit{Inflow-Outflow = Change in Storage (if an aquifer)} \quad (1)$$

Equation 1 can be further elaborated as –

$$\Delta S = R_{RF}+R_{STR}+R_C+R_{SWI}+R_{GWI}+R_{TP}+R_{WCS} \pm VF \pm LF - GE - T - E - B \quad (2)$$

Where,

ΔS – Change is storage

R_{RF} – Rainfall recharge

R_{STR}- Recharge from stream channels

Rc – Recharge from canals

R_{SWI} – Recharge from surface water irrigation

R_{GWI}- Recharge from ground water irrigation

R_{TP}- Recharge from Tanks & Ponds

R_{WCS} – Recharge from water conservation structures

VF – Vertical inter aquifer flow

LF- Lateral flow along the aquifer system (through flow)

GE-Ground Water Extraction

T- Transpiration

E- Evaporation

B-Base flow

It is preferred that all the components of water balance equation should be estimated in an assessment unit.

3.5.1 Rainfall Recharge

It is recommended that ground water recharge should be estimated on ground water level fluctuation method and rainfall infiltration factor method during monsoon season and the rainfall recharge during non-monsoon season may be estimated using rainfall infiltration factor method only.

3.5.1.1 Ground water level fluctuation method

The ground water level fluctuation method is to be used for assessment of rainfall recharge in the monsoon season. The ground water balance equation is given by

$$\Delta S = R_{RF} + R_{STR} + R_C + R_{SWI} + R_{GWI} + R_{TP} + R_{WCS} \pm VF \pm LF - GE - T - E - B \quad (3)$$

Where,

ΔS – Change is storage

R_{RF} – Rainfall recharge

R_{STR}- Recharge from stream channels

R_C – Recharge due to Canals

R_{SWI} – Recharge from surface water irrigation (Lift Irrigation)

R_{GWI}- Recharge from ground water irrigation

R_{TP}- Recharge from tanks & ponds

R_{WCS} – Recharge from water conservation structures

VF – Vertical inter aquifer flow

LF- Lateral flow along the aquifer system (through flow)

GE-Ground water Extraction

T- Transpiration

E- Evaporation

B-Base flow

This change in storage can be estimated using the following equation:

$$\Delta S = \Delta h * A * Sy \quad (4)$$

Where

ΔS – Change is storage
Δh - rise in water level in the monsoon season
A - Area for computation of recharge
Sy - Specific Yield

Substituting the expression in equation 4 for increase in storage i.e.ΔS in terms of water level fluctuation and specific yield, the equations 3 becomes,

$$R_{RF} = h \times Sy \times A - R_{STR} - R_C - R_{SWI} - R_{GWI} - R_{TP} - R_{WCS} \pm VF \pm LF + GE + T + E + B \quad (5)$$

The recharge calculated from equation 5 gives the rainfall recharge for the particular monsoon season. This rainfall recharge is specific to a particular monsoon season for the associated monsoon season rainfall. This estimate is to be normalised for the normal monsoon season rainfall as per the procedure indicated below.

3.5.1.2 Normalization of Rainfall Recharge

Let Ri be the rainfall recharge and ri be the associated rainfall. The subscript i takes values 1 to N where N is the number of years for which data is available. This should be at least 5. The rainfall recharge, Ri is obtained as per equation 5 for which the normalization is to be done using any of the following two procedures. This normalisation procedure is to be carried out for obtaining the rainfall recharge corresponding to the normal monsoon season rainfall. Let r(normal) be the normal monsoon season rainfall obtained as the average of recent 30 to 50 years of monsoon season rainfall. Two methods are possible for the normalisation procedure.

The first method is based on a linear relationship between recharge and rainfall of the form

$$R = ar \quad (6)$$

Where,

R = Rainfall recharge during monsoon season

r = Monsoon season rainfall

a and b = constants.

The rainfall recharge during monsoon season for normal monsoon rainfall condition is computed as below:

$$R_f\,(normal) = axr\,(normal) \qquad (8)$$

Or

$$R_f\,(normal) = axr(normal) + b \qquad (9)$$

3.5.1.3 Rainfall Infiltration Factor method

Recharge from rainfall is estimated by using the following relationship –

$$R_{rf} = RFIF * A^{*} (R-a)/1000 \qquad (10)$$

Where,

R_{rf} = Rainfall recharge in ham

A = Area in Hactares

RFIF = Rainfall Infiltration Factor

R = Rainfall in mm

a = Minimum threshold value above which rainfall induces ground water recharge in mm

The threshold limit of minimum and maximum rainfall event which can induce recharge to the aquifer is to be considered while estimating ground water recharge using rainfall infiltration factor method. It is suggested that 10% of Normal annual rainfall may be taken as minimum rainfall threshold and 3000 mm as maximum rainfall limit. The same recharge factor may be used for both monsoon and non-monsoon rainfall, with the condition that the recharge due to non-monsoon rainfall may be taken as zero, if the normal rainfall during the non-monsoon season is less than 10% of normal annual rainfall.

3.5.2 Percent Deviation

After computing the rainfall recharge for normal monsoon season rainfall using the ground water level fluctuation method and rainfall infiltration factor method these two estimates have to be compared with each other. A term, Percent Deviation (PD) which is the difference between the two expressed as a percentage of the later is computed as

$$PD = \frac{R_{rf}\,(normal, wtfm) - R_{rf}\,(normal, rifm)}{R_{rf}\,(normal, rifm)} \times 100 \qquad (11)$$

Where,

Rrf (normal, wtfm) = Rainfall recharge for normal monsoon season rainfall estimated by the ground water level fluctuation method

Rrf (normal, rifm) = Rainfall recharge for normal monsoon season rainfall estimated by the rainfall infiltration factor method

The rainfall recharge for normal monsoon season rainfall is finally adopted as per the criteria given below:

- If PD is greater than or equal to -20%, and less than or equal to +20%, Rifm (normal) is taken as the value estimated by the ground water level fluctuation method.

- If PD is less than -20%, Rrf (normal) is taken as equal to 0.8 times the value estimated by the rainfall infiltration factor method.
- If PD is greater than +20%, Rrf (normal) is taken as equal to 1.2 times the value estimated by the rainfall infiltration factor method.

3.5.3 Recharge from other Sources

Recharge from other sources constitutes recharges from canals, surface water irrigation, ground water irrigation, tanks & ponds and water conservation structures in command areas where as in non-command areas it constitutes the recharge due to surface water irrigation, ground water irrigation, tanks & ponds and water conservation structures.

3.5.3.1 Recharge from Canals: Recharge due to canals is to be estimated based on the following formula:

$$R_C = WA * SF \quad (12)$$

Where:

R_C = Recharge from Canals

WA=Wetted Area = Wetted Perimeter X Length of Canal Reach.

SF= Seepage Factor

Days= Number of Canal Running Days.

3.5.3.2 Recharge from Surface Water Irrigation: Recharge due to applied surface water irrigation, either by means of canal outlets or by lift irrigation schemes is to be estimated based on the following formula:

$$R_{SWI} = AD * D_i \quad (13)$$

Where:

R_{SWI} = Recharge due to applied surface water irrigation

AD= Average Discharge

Days=Number of days water is discharged to the Fields

RFF= Return Flow Factor

3.5.3.3 Recharge from Ground Water Irrigation: Recharge due to applied ground water irrigation is to be estimated based on the following formula:

$$R_{GWI} = G \quad (14)$$

Where:

R_{GWI} = Recharge due to applied ground water irrigation

GE_{IRR}= Ground Water Extraction for Irrigation

RFF= Return Flow Factor

3.5.3.4 Recharge due to Tanks & Ponds: Recharge due to Tanks & Ponds is to be estimated based on the following formula:

$$R_{TP} = AWS \quad (15)$$

Where:

R_{TP} = Recharge due to Tanks & Ponds

AWSA= Average Water Spread Area

N=Number of days Water is available in the Tank/Pond

RF= Recharge Factor

3.5.3.5 Recharge due to Water Conservation Structures: Recharge due to Water Conservation Structures is to be estimated based on the following formula:

R_{WCS} (16)

Where:

R_{WCS} = Recharge due to Water Conservation Structures

GS= Gross Storage = Storage Capacity multiplied by number of fillings.

RF= Recharge Factor

3.5.3.6 Lateral flow along the aquifer system (Through flow)

If the area under consideration is a watershed, the lateral flow across boundaries can be considered as zero. If there is inflow and outflow across the boundary, theoretically, the net inflow may be calculated using Darcy law, by delineating the inflow and outflow sections of the boundary. Besides such delineation, the calculation also requires estimate of transmissivity and hydraulic gradient across the inflow and outflow sections.

3.5.3.7 Base flow and Stream Recharge

If stream gauge stations are located in the assessment unit, the base flow and recharge from streams can be computed using Stream Hydrograph Separation method, Numerical Modelling and Analytical solutions. If the assessment unit is a watershed, a single stream monitoring station at the mouth of the watershed can provide the required data for the calculation of base flow.

Base flow assessment and Stream recharge should be carried out in consultation with Central Water Commission in order to avoid any duplicity in the estimation of total water availability in a river basin.

3.5.3.8 Vertical Inter Aquifer Flow

This can be estimated provided aquifer geometry and aquifer parameters are known. This can be calculated using the Darcy's law if the hydraulic heads in both aquifers and the hydraulic conductivity and thickness of the aquitard separating both the aquifers are known.

3.5.3.9 Evaporation and Transpiration

Evaporation can be estimated for the aquifer in the assessment unit if water levels in the aquifer are within the capillary zone. It is recommended to compute the evaporation through field studies. If field studies are not possible, for areas with water levels within 1.0 mbgl, evaporation can be estimated using the evaporation rates available for other adjoining areas. If depth to water level is more than 1.0m bgl, the evaporation losses from the aquifer should be taken as zero.

Transpiration through vegetation can be estimated if water levels in the aquifer are within the maximum root zone of the local vegetation. It is recommended to compute the transpiration through field studies. Even though it varies from place to place depending on type of soil & vegetation, in the absence of field studies the following estimation can be followed. If water levels are within 3.5m bgl, transpiration can be estimated using the transpiration rates available for other areas. If it is greater than 3.5m bgl, the transpiration should be taken as zero.

3.5.3.10 Recharge/ Accumulations during Monsoon Season

The sum of normalized monsoon rainfall recharge and the recharge from other sources and lateral and vertical flows into the sub unit and stream inflows during monsoon season is the total recharge/ accumulation during monsoon season for the sub unit. Similarly, this is to be computed for all the sub units available in the assessment unit.

3.5.3.11 Recharge/ Accumulations during Non-Monsoon Season

The rainfall recharge during non-monsoon season is estimated using rainfall infiltration factor Method only

when the non-monsoon season rainfall is more than 10% of normal annual rainfall. The sum of non-monsoon rainfall recharge and the recharge from other sources and lateral and vertical flows into the sub unit and stream inflows during non-monsoon season is the total recharge/ accumulation during non-monsoon season for the sub unit. Similarly, this is to be computed for all the sub units available in the assessment unit.

3.6 Total Annual Ground Water Recharge

The sum of the recharge/ accumulations during monsoon and non-monsoon seasons is the total annual ground water recharge/ accumulations for the sub unit. Similarly, this is to be computed for all the sub units available in the assessment unit.

3.7 Annual Extractable Ground Water Resource (EGR)

The Total Annual Ground Water Recharge cannot be utilised for human consumption, since ecological commitments need to be fulfilled, before the extractable resources is defined. The National Water Policy, 2012 stresses that the ecological flow of rivers should be maintained. Therefore, ground water base flow contribution limited to the ecological flow of the river should be determined which will be deducted from Annual Ground Water Recharge to determine Annual Extractable Ground Water Resources (EGR). The ecological flows of the rivers are to be determined in consultation with Central Water Commission and other concerned river basin agencies.

In case base flow contribution to the ecological flow of rivers is not determined then following assumption is to be followed. If the rainfall recharge is assessed using water level fluctuation method this will be 5% of the annual recharge and if it is assessed using rainfall infiltration factor method, it will be 10% of the annual recharge. The balance will account for Annual Extractable Ground Water Resources (EGR).

3.8 Estimation of Ground Water Extraction

Ground water draft or extraction is to be assessed as follows.

$$GE_{ALL} = GE_{IRR} + GE_{DOM} \quad (17)$$

Where,

GE_{ALL}=Ground water extraction for all uses

GE_{IRR}=Ground water extraction for irrigation

GE_{DOM} =Ground water extraction for domestic uses

GE_{IND}= Ground water extraction for industrial uses

The single largest component of the ground water balance equation in large regions of India is the ground water extraction and the precise estimation of ground water extraction is riddled with uncertainties.

3.8.1 Ground Water Extraction for Irrigation (GE_{IRR})

The Ground Water Extraction for Irrigation is to be assessed employing at least two of the three methods recommended for estimation of ground water extraction for irrigation. The methods for estimation of ground water extraction are as follows.

Unit Draft Method:– In this method, season-wise unit draft of each type of well in an assessment unit is estimated. The unit draft of different types (eg. Dug well, Dug cum bore well, shallow tube well, deep tube well, bore well etc.) is multiplied with the number of wells of that particular type to obtain season-wise ground water extraction by that particular structure. This method is being widely practised in the country. There are several sources which maintain records on well census. These include Minor Irrigation Census conducted by MoWR, RD, GR, Government of India, and data maintained at the Tahsil level. It is recommended that a single source of well census should be maintained for resources computation at all India level. Minor Irrigation Census of MoWR, RD, GR would be the preferred option.

Crop Water Requirement Method:– For each crop, the season-wise net irrigation water requirement is determined. This is then multiplied with the area irrigated by ground water abstraction structures. The database on crop area is obtained from Revenue records in Tahsil office, Agriculture Census and also by using Remote Sensing techniques.

Power Consumption Method:– Ground water extraction for unit power consumption (electric) is determined. Extraction per unit power consumption is then multiplied with number of units of power consumed for agricultural pump sets to obtain total ground water extraction for irrigation.

3.8.2 Ground Water Extraction for Domestic Use (GE_{DOM})

There are several methods for estimation of extraction for domestic use (GE_{DOM}). Some of the commonly adopted methods are described here.

Unit Draft Method:– In this method, unit draft of each type of well is multiplied by the number of wells used for domestic purpose to obtain the domestic ground water extraction.

Consumptive Use Method:– In this method, population is multiplied with per capita consumption usually expressed in litre per capita per day (lpcd). It can be expressed using following equation.

Where,

Lg = Fractional Load on Ground Water for Domestic Water Supply

The Load on Ground water can be obtained from the Information based on Civic water supply agencies in urban areas.

3.8.3 Ground water Extraction for Industrial use (GE_{IND})

The commonly adopted methods for estimating the extraction for industrial use are as below:

Unit Draft Method: - In this method, unit draft of each type of well is multiplied by the number of wells used for industrial purpose to obtain the industrial ground water extraction.

Consumptive Use Pattern Method: **–** In this method, water consumption of different industrial units is determined. Numbers of Industrial units which are dependent on ground water are multiplied with unit water consumption to obtain ground water extraction for industrial use.

$$GE_{IND} = \text{Number of Industrial units} \times \text{Unit Water Consumpl} \quad (19)$$

Where,

Lg = Fractional load on ground water for industrial water supply

The load on ground water for industrial water supply can be obtained from water supply agencies in the Industrial belt. Other important sources of data on ground water extraction for industrial uses are - Central Ground Water Authority, State Ground Water Authority, National Green Tribunal and other Environmental Regulatory Authorities.

Ground water extraction obtained from different methods need to be compared and based on field checks, the seemingly best value may be adopted. At times, ground water extraction obtained by different methods may vary widely. In such cases, the value matching the field situation should be considered.

3.9 Stage of Ground Water Extraction

The stage of ground water extraction is defined by,

$$\text{Stage of Ground Water Extraction}(\%) = \frac{\text{Existing Gross Ground Water Extraction for all uses}}{\text{Annual Extractable Ground Water Resources}} \quad (20)$$

The existing gross ground water extraction for all uses refers to the total of existing gross ground water extraction for irrigation and all other purposes. The stage of ground water extraction should be obtained separately for command areas, non-command areas and poor ground water quality areas.

3.9.1 Validation of Stage of Ground Water Extraction

The assessment based on the stage of ground water extraction has inherent uncertainties. The estimation of ground water extraction is likely to be associated with considerable uncertainties as it is based on indirect assessment using factors such as electricity consumption, well census and area irrigated from ground water. The denominator in equation 20, namely Annual Extractable Ground Water Resources also has uncertainties due to limitations in the assessment methodology, as well as uncertainties in the data. In view of this, it is desirable to validate the 'Stage of Ground Water Extraction' with long term trend of ground water levels.

Long term water level trends are to be prepared for a minimum period of 10 years for both pre-monsoon and post-monsoon period. The water level trend would be average water level trend as obtained from the different observation wells in the area.

If the ground water resource assessment and the trend of long term water levels contradict each other, this anomalous situation requires a review of the ground water resource computation, as well as the reliability of water level data. The mismatch conditions are enumerated below in **Table-3**.

Table-3: Stage of GW Extraction and Trend Mismatch

SOGWE	Ground Water Level Trend	Remarks
[illegible]	Significant decline in trend in both pre-monsoon and post-monsoon	Not acceptable and needs reassessment
>100%	No significant decline in both pre-monsoon and post-monsoon long term trend	Not acceptable and needs reassessment

3.10 Categorization of Assessment Units Based on Quantity:

The categorization based on status of ground water quantity is defined by Stage of Ground Water Extraction as given below in Table-4.

Table-3: Stage of GW Extraction and Category

Stage of Ground Water Extraction	Category
≤ 70%	Safe
> 70% and ≤90%	Semi-Critical
> 90% and ≤100%	Critical
> 100%	Over Exploited

3.11 Quality Tag

If any of the three quality hazards in terms of Arsenic, Fluoride and Salinity are encountered in the assessment sub unit in mappable units on 1:50000 scale, the assessment sub unit may be tagged with the particular quality hazard.

3.12 Allocation of Ground Water Resource for Utilisation

The Annual Extractable Ground Water Resources are to be apportioned between domestic, industrial and irrigation uses. Among these, as per the National Water Policy, requirement for domestic water supply is to be accorded priority. This requirement has to be based on population as projected to the year 2025, per capita requirement of water for domestic use, and relative load on ground water for urban and rural water supply. The

estimate of allocation for domestic water requirement may vary from one sub unit to the other in different states. In situations where adequate data is not available to make this estimate, the following empirical relation is recommended.

$$Alloc = 22 X N X L_g \text{ mm} \quad (21)$$

Where,

Alloc= Allocation for domestic water requirement

N = population density in the unit in thousands per sq. km.

L_g = fractional load on ground water for domestic water supply (1.0)

In deriving equation 21, it is assumed that the requirement of water for domestic use is 60 lpd per head. The equation can be suitably modified in case per capita requirement is different. If by chance, the estimation of projected allocation for future domestic needs is less than the current domestic extraction due to any reason, the allocation must be equal to the present-day extraction. It can never be less than the present-day extraction as it is unrealistic.

3.13 Net Annual Ground Water Availability for Future Use

The water available for future use is obtained by deducting the allocation for domestic use and current extraction for Irrigation and Industrial uses from the Annual Extractable Ground Water Recharge. The resulting ground water potential is termed as the net annual ground water availability for future use. The Net annual ground water availability for future use should be calculated separately for non-command areas and command areas. As per the recommendations of the R&D Advisory committee, the ground water available for future use can never be negative. If it becomes negative, the future allocation of Domestic needs can be reduced to current extraction for domestic use. Even then if it is still negative, then the ground water available for future uses will be zero.

3.14 Additional Potential Resources Under Specific Conditions

Potential Resource Due to Spring Discharge: Spring discharge constitutes an additional source of ground water in hilly areas which emerges at the places where ground water level cuts the surface topography. Even though, the Spring Discharge is a form of 'Annual Extractable Ground Water Recharge', It is a considered as a potential resource because of the limited data available as on today. Spring discharge measurement is to be carried out by volumetric measurement of discharge of the springs. Spring discharges multiplied with time in days of each season will give the quantum of spring resources available during that season. The committee recommends that in hilly areas with substantial potential of spring discharges, the discharge measurement should be made at least 4 times a year in parity with the existing water level monitoring schedule.

$$\text{Potential ground water resource due to springs} = Q \times N \quad (22)$$

Where,

Q = Spring Discharge

No of days= No of days spring yields.

Potential Resource in Waterlogged and Shallow Water Table Areas: In the area where the ground water level is less than 5m below ground level or in waterlogged areas, the resources up to 5m below ground level are potential and would be available for development in addition to the annual recharge in the area. It is therefore recommended that in such areas, ground water resources may be estimated up to 5m bgl only assuming that where water level is less than 5m bgl, the same could be depressed by pumping to create space to receive recharge from natural resources. It is further evident that this potential recharge would be available mostly in the shallow water table areas which would have to be demarcated in each sub-basin/ watershed/ block/ taluka/ mandal/ Firka. The computation of potential resource of the ground water reservoir can be done by adopting the following equation:

Potential ground water resource in shallow water table areas = (5-D (23)

Where,

D= Depth to water table below ground surface in pre-monsoon period in shallow aquifers.

A= Area of shallow water table zone.

S_Y= Specific Yield

Potential Resource in Flood Prone Areas: Ground water recharge from a flood plain is mainly the function of the following parameters-

Areal extent of flood plain

Retention period of flood

Type of sub-soil strata and silt charge in the river water which gets deposited and controls seepage

Since collection of data on all these factors is time taking and difficult, in the meantime, the potential resource from flood plain may be estimated on the same norms as for ponds, tanks and lakes. This has to be calculated over the water spread area and only for the retention period using the following formula.

Potential ground water resource in Flood Prone Areas = 1.4 x N x (24)

Where,

N = No of Days Water is Retained in the Area

A = Flood Prone Area

3.15 Apportioning of Ground Water Assessment from Watershed to Development Unit:

Where the assessment unit is a watershed, there is a need to convert the ground water assessment in terms of an administrative unit such as block/ taluka/ mandal/ firka. This may be done as follows.

A block may comprise of one or more watersheds, in part or full. First, the ground water assessment in the subareas, command, non-command and poor ground water quality areas of the watershed may be converted into depth unit (mm), by dividing the annual recharge by the respective area. The contribution of this subarea of the watershed to the block, is now calculated by multiplying this depth with the area in the block occupied by this sub-area. This procedure must be followed to calculate the contribution from the sub-areas of all watersheds occurring in the block, to work out the total ground water resource of the block.

The total ground water resource of the block should be presented separately for each type of sub-area, namely for command areas, non-command areas and poor ground water quality areas, as in the case of the individual watersheds.

3.16 Assessment of In-Storage Ground Water Resources or Static Ground Water Resources

The quantum of ground water available for development is usually restricted to long term average recharge or dynamic resources. For sustainable ground water development, it is necessary to restrict it to the dynamic resources. Static or in-storage ground water resources could be considered for development during exigencies that also for drinking water purposes. It is also recommended that no irrigation development schemes based on static or in-storage ground water resources be taken up at this stage.

The computation of the static or in-storage ground water resources may be done after delineating the aquifer thickness and specific yield of the aquifer material. The computations can be done as follows: -

SGWR = A*(Z_2 · (25)

Where,

SGWR = Static or in-storage Ground Water Resources

A = Area of the Assessment Unit

Z_2 = Bottom of Unconfined Aquifer

Z_1 = Pre-monsoon water level

S_Y = Specific Yield in the In storage Zone

3.17 Assessment of Total Ground Water Availability in Unconfined Aquifer

The sum of Annual Exploitable Ground Water Resource and the In storage ground water resources of an unconfined aquifer is the Total Ground Water Availability of that aquifer.

3.18 Ground Water Assessment of Confined Aquifer System

Assessment of ground water resources of confined aquifers assumes crucial importance, since over-exploitation of these aquifers may lead to far more detrimental consequences than to those of shallow unconfined aquifers.

Most of the storage in confined aquifer is associated with compressibility of the aquifer matrix and compressibility of water. Once the piezometric head reaches below the top confining bed, it behaves like an unconfined aquifer and directly dewaters the aquifer and there is a possibility of damage to the aquifer as well as topography. Hence ground water potential of a confined aquifer is nothing but the water available for use without damaging the aquifer. Hence the resources available under pressure are only considered as the ground water potential. The quantity of water released in confined aquifer due to change in pressure can be computed between piezometric head (h_t) at any given time 't' and the bottom of the top confining layer (h_o) by using the following equation.

$$Q_p = SA\Delta h = SA \qquad (26)$$

Where,

Q_P = Ground Water Potential of Confined Aquifer

S = Storativity

A = Areal extent of the confined aquifer

h = Change in Piezometric head

h_t = Piezometric head at any particular time

h_0 = Bottom of the top Confining Layer

If any development activity is started in the confined aquifer, then there is a need to assess the dynamic as well as in storage resources of the confined aquifer. To assess the ground water resources of the confined aquifer, there is a need to have sufficient number of observation wells tapping exclusively that particular aquifer and proper monitoring of the piezometric heads is also needed.

To assess the dynamic ground water resources of the confined aquifer the following equation can be used with the pre and post monsoon piezometric heads of the particular aquifer.

$$Q_D = SA\Delta h = SA\,(h_{Pre} \qquad (27)$$

Where,

Q_D = Dynamic Ground Water Resource of Confined Aquifer (m^3)

S = Storativity

A = Areal extent of the confined aquifer (m^2)

h = Change in Piezometric head (m)

$h_{post=}$Piezometric head during post-monsoon period (m amsl)

h_{PRE} = Piezometric head during pre-monsoon period (m amsl)

3.18.1 In storage Ground Water Resources of Confined Aquifer

For assessing the in-storage ground water potential of a confined aquifer, one has to compute the resources between the pre-monsoon piezometric head and bottom of the top confining layer. That can be assessed using the following formula:

$$Q_l = SA\Delta h = SA(h_{PRE} - h_0) \quad (28)$$

Where,

Q_l =In storage Ground Water Resource of Confined Aquifer (m^3)

S = Storativity

A = Areal extent of the confined aquifer (m^2)

h = Change in Piezometric head (m)

h_0 = Bottom level of the top confining layer (m amsl)

h_{PRE} = Piezometric head during pre-monsoon period(m amsl)

If the confined aquifer is not being exploited for any purpose, the dynamic and static resources of the confined aquifer need not be estimated separately. Instead the in storage of the aquifer can be computed using the following formula.

$$Q_p = SA\Delta h = SA(h_{PRE} - h_0) \quad (29)$$

Where,

Q_p = In storage Ground Water Resource of the confined aquifer or the Quantity of water under pressure (m^3)

S = Storativity

A = Areal extent of the confined aquifer (m^2)

h = Change in Piezometric head (m)

$H_{POST=}$Piezometric head during post-monsoon period (m amsl)

h_0 = Bottom of the Top Confining Layer (m amsl)

The calculated resource includes small amount of dynamic resource of the confined aquifer also, which replenishes every year. But to make it simpler this was also computed as part of the static or in-storage resource of the confined aquifer.

3.18.2 Assessment of Total Ground Water Availability of Confined Aquifer

If the confined aquifer is being exploited, the Total Ground Water Availability of the confined aquifer is the sum of Dynamic Ground Water Resources and the in-storage ground water resources of that confined aquifer. Whereas if it is not being exploited, the Total Ground Water Availability of the confined aquifer comprises of only one component i.e. the in-storage of that confined aquifer.

3.19 Ground Water Assessment of Semi-Confined Aquifer System

The Assessment of Ground Water Resources of a semi-confined aquifer has some more complications. Unless and until, it is well studied that the recharge to this is not computed either in the over lying unconfined aquifer or underlying/overlying semi confined aquifers, it should not be assessed separately. If it is assessed separately, there is a possibility of duplication of estimating the same resource by direct computation in one aquifer and as leakage in the other aquifer. As it is advisable to under estimate rather than to overestimate the resources, it is recommended not to assess these resources separately as long as there is no study indicating its non-estimation. If it is found through field studies that the resources are not assessed in any of the aquifers in the area, these resources are to be assessed following the methodology similar to that used in assessing the resources of Confined aquifers.

3.20 Total Ground Water Availability of an Area

The Total Ground Water Availability in any area is the Sum of Dynamic Ground Water Resources, the static/in-storage ground water resources in the unconfined aquifer and the dynamic and In-storage resources of the Confined aquifers and semi-confined aquifers in the area.

TERMINOLOGY CHANGE There are minor changes in the terminology used in GEC-2015 methodology and the corresponding changes for the terms have been tabulated below in **Table-5**.

Table-5: Change in Terminologies in GEC 2015 vis-à-vis GEC 1997 methodology

GEC- 97 Methodology	GEC-2015 methodology
Annual Replenishable Resources	Total Annual Groundwater Recharge
Net Groundwater Availability	Annual Extractable Groundwater Resources
Groundwater Draft	Groundwater Extraction
Annual Groundwater Draft for all uses	Current Annual GW Extraction for all uses
Projected Demand for Domestic and Industrial uses up to 2025	Annual ground water allocation for domestic water supply as on 2025
Groundwater Availability for future irrigation	Net Annual GW Availability for future Use
Stage of Groundwater Development	Stage of Ground Water Extraction

4. PROCEDURE FOLLOWED FOR GROUNDWATER ASSESSMENT 2022

4.1 Data Source

4.1.1 Area

Since inception, watershed was being used as a unit of assessment in the State irrespective of the Methodology.The results were later apportioned to administrative unit of assessment. In the present assessment the data collection and computation of results are carried out considering Taluk as assessment unit. The areas of the taluk have been computed by KSRSAC, GoK provided shape files. The command areas of the Irrigation Project as per the command area map of NWIC, GoI and district level offices of Water Resources Department, GoK have been used in this assessment. No poor-quality areas were considered in the current assessment. This data base was used for sub-dividing the assessment unit into command, non-command and poor-quality area.

4.1.2 Well Census

For estimation of ground water extraction for Irrigation purpose, the minor irrigation well census data as well as the data from district administration was collected. Since last decade, instead of dug wells the borewells are being drilled on large scale in the State. The borewells drilled in hard rock terrain are tapping the shallow as well as deeper aquifers. Hence the irrigation borewells have been considered for the draft purpose.

For estimation of ground water extraction for domestic purpose, consumptive method based on population (2011) was used.

For estimation of ground water extraction for industrial purpose, the data on number of wells being used by industries and their annual requirement was considered to arrive at unit draft. This data was acquired from KSPCB, Dept. of Industries & Commerce, by KGWA.

4.1.3 Canals, Tanks & Ponds

The data base related to canals, command area, number of rotations, and volume of water released into the canals etc have been collected at district level from the Water Resources Dept. The data on tanks and ponds was also collected at district level from Minor Irrigation Department, District Administration, Agriculture Dept. and Bruhat Bangalore MahanagarPalike (BBMP). The data is as of the year 2021-22.

4.1.4 Water Conservation Structures

The data base related to WCS was collected at district level from Rural Development and Panchayat Raj (RDPR), District Administration, Agriculture Dept. and Bruhat Bangalore MahanagarPalike (BBMP). The data is as of the year 2021-22.

Apart from the conventional water conservation structures, roof top rain water harvesting structures constructed in Bangalore City and Farm Ponds constructed in rural areas have also been included as water conservation measures.

4.1.5 Cropping Pattern

The village wise crop data and irrigated agriculture data, as on 2021-22 season, collected from district offices of the State Agriculture department have been used for the computations of irrigation return flow.

4.1.6 Rainfall

The rainfall data has been sourced from 3 different agencies i.e., Karnataka State natural Disaster Monitoring Centre (KSNDMC), Directorate of Economics and Statistics (DES) and Water Resources Development Organisation

(WRDO). The normal as well as yearly actual monsoon and non monsoon rainfall measured at various station within the assessment unit upto 2021 has been used for the data entry.

4.1.7 Ground Water Levels

The Ground Water Direcotorateis monitoring the groundwater levels in the State on a monthly basis for all the 12 moths of a year. There are about 1764 observation wells, which consists of 416 dugwells and 1348 borewells/piezometers. The groundwater level data up to November 2021 has been considered for the Estimation.

4.1.8 Population

The 2011 census data has been used in the computations for estimation of ground water extraction for domestic purpose based on consumptive method.

4.2 Various Norms Used

4.2.1 Assessment area

Out of the total geographical area, the hilly area (slope > 20%), hill tops and rocky waste land were identified and subtracted and the remaining area is considered as recharge worthy or assessment area.

4.2.2 Specific yield

The specific yield value recommended values as per prescribed norms of GEC-2015 methodology were taken.

4.2.3 Rainfall infiltration factor

In all the watersheds, the coefficients for RIF are as per the recommended values of GEC-2015 methodology norms.

4.2.4 Recharge due to canal seepage

The prescribed norms of GEC-2015 methodology i.e., 3.5 Ham per day/million sq. m wetted area for all canals in hard rock has been considered.

4.2.5 Recharge from Tanks and Ponds

The prescribed norms of GEC-2015 methodology i.e., Average water spread area (60% of total water spread area) * No. of days * **0.00144** meters per day per Ha, has been considered. However, in case of the KC valley and HN valley tanks, the numbers of days were taken as 365 days and also the average water spread area was taken as 100% instead of 60% since these tanks are being filled round the year by secondary treated water.

4.2.6 Recharge from water conservation structure

The recharge considered due to water conservation structures was considered as per norms i.e., 40% of the gross storage capacity of the water conservation structure. The numbers of fillings considered are ranging from 1 or 6 depending on the local conditions.

4.2.7 Unit Draft or Extraction

The unit draft computed for different abstraction structures representing typical geological formations has been used for the estimation. The unit draft for irrigation dug well fitted with electric pump, during monsoon ranges from 0.05 to 0.47 hams and during non-monsoon it ranges from 0.13 to 0.96 hams.For irrigation bore wells (with electric pump), the unit draft considered for monsoon ranges from 0.05 to 0.40 hams and for non-monsoon it ranges from 0.13 to 0.9hams. For irrigation Dug cum bore wells, the unit draft considered for monsoon ranges from 0.15 to 0.30 hams and for non-monsoon it ranges from 0.3 to 0.67hams. The unit draft considered for the various types of abstraction structures is given below in **Table – 6**.

Table-6: GW abstraction structure wise unit draft values for Irrigation draft

STRUCTURE	UNIT DRAFT (HAM/ANNUM)
DUG WELL	0. 3 - 0.9
BORE WELL	0. 4 - 1.2
DUG CUM BORE WELL	0. 3 -1.12

For Industrial bore wells (with electric pump), the unit draft considered for monsoon ranges from 0.000033 to 7.026 hams and for non-monsoon it ranges from 0.000067 to 14.34475 hams. For Industrial dug wells, the unit draft considered for monsoon ranges from 0.008 to 0.3 hams and for non-monsoon it ranges from 0.016 to 0.6hams. The unit draft considered for the various types of abstraction structures is given below in **Table – 7**.

Table-7: GW abstraction structure wise unit draft values for Industrial draft

STRUCTURE	UNIT DRAFT (HAM/ANNUM)
DUG WELL	0. 04 – 0.90
BORE WELL	0. 02 – 21.37

4.2.8 Return flow from irrigation

The prescribed norms of GEC-2015 methodology have been adopted for estimation of recharge due to return flow from surface water and ground water irrigation.

4.3 Stage of Ground water Extraction and Categorisation

The norms of GEC-2015 methodology have been used for the computation of the Stage of Ground water Extraction and Categorisation.

Stage of Ground Water Extraction	Category
≤ 70%	Safe
> 70% and ≤90%	Semi-Critical
> 90% and ≤100%	Critical
> 100%	Over Exploited

4.4 Data Variable Used

The resource assessment in INGRES involved huge data sets which needed to be compiled, scrutinised and validated. It is very difficult to pinpoint the errors/mistakes unless the results are triggered in the INGRES. During the assessment 5 input data sheets viz., basic data, rainfall data, water level data, recharge data sheet and extraction data sheet were compiled, scrutinised, validated and uploaded in INGRES to obtain the results. The total data variables in these 5 sheets were 97299 and their sheet wise statistics are given in Table-8.

Table-8: Data variables used during GWRA 2022

Input Sheet	Data Variables
BASIC SHEET	7584
RAINFALL SHEET	21060
WATER LEVEL SHEET	10485
RECHARGE SHEET	
SWI	8550
Canal Seepage	14807
Tanks & Ponds	5503
Water Conservation Structures	6070
GWI	6072
EXTRACTION SHEET	
Domestic	5748
Industrial	5446
Irrigation	5974
TOTAL	97299

5. COMPUTATION OF GROUNDWATER RESOURCES ASSESSMENT IN THE STATE

The salient features of the dynamic groundwater resources of Karnataka 2022 are as under:

5.1 Resources assessment unit and Area

Taluk is the type of groundwater assessment unit which was used in the State for the purpose of groundwater estimation and evaluation. There were 234 assessment units in the State, which included 233 taluks and 1 urban assessment unit i.e., Bangalore city urban area. Out of these233 taluks, 3 taluks comes under only command area, 90 taluks comes under only non command area and in remaining 140 units both command and non-command units are present. However, no taluks are considered under poor-quality area.

Out of the total area of the taluka the non-worthy area (hilly area) is deducted and only the worthy area is considered for this assessment. The recharge worthy area is further sub-divided into command and Non-command areas and their percentages for the State are 30% &70% respectively. The taluka wise details of these areas along with the rainfall are given in ***Annexure IV*** and the State area break up is shown in **Fig.-6.** The recharge is estimated for the groundwater worthy area of all the sub-units.

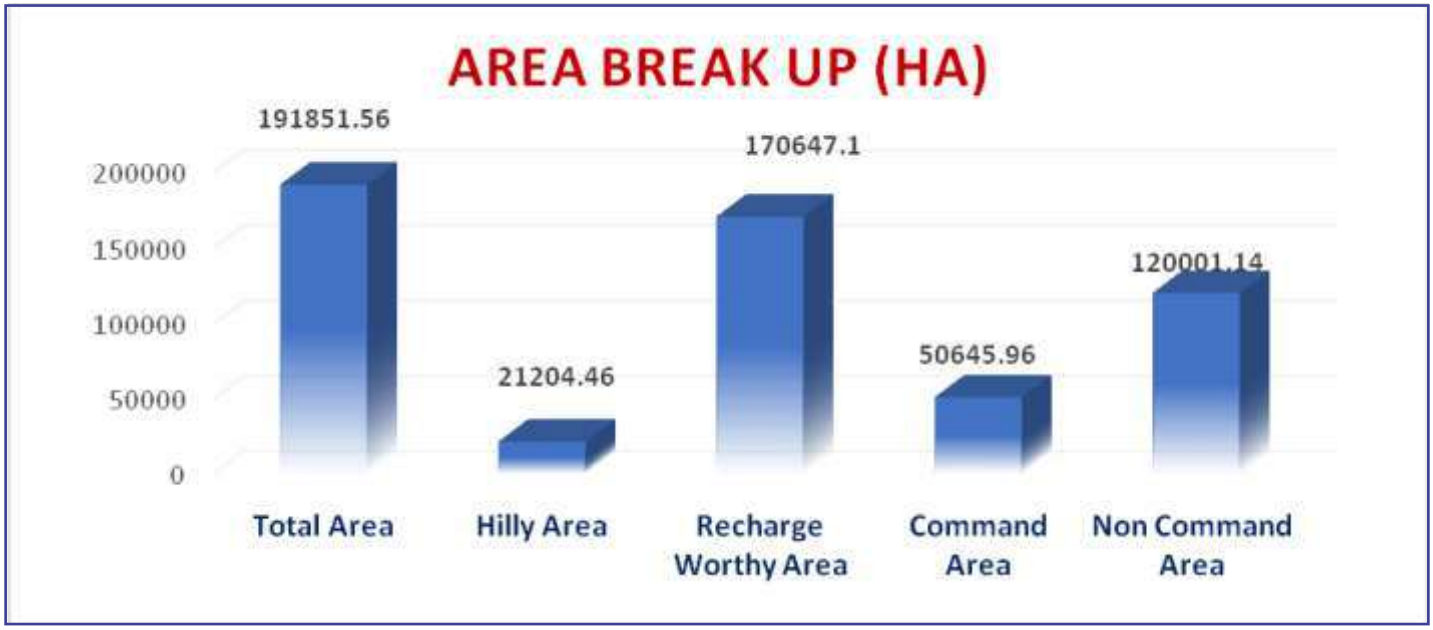

Fig.-6: Areas under different categories

5.2 Base year of data

The rainfall and water levels data for the past 5 years 2017 to 2021 has been considered in the computations. Based on this database the sub-unit wise average pre-monsoon and post-monsoon groundwater levels and fluctuations are calculated and used in the assessment. The canal, tanks, ponds and water conservation structures data of the year 2021-22 was utilised. The 2011 census data has been used in the computations for estimation of ground water extraction for domestic purpose based on consumptive method.

5.3 Total Annual Ground Water Recharge

Recharge to ground water from different sources was computed based on the GEC 2015 methodology. As per assessment it was observed that the total recharge from all sources is 17.73 BCM and the recharge due to rainfall is the major contributor with 10.01 BCM, followed by recharge due to return flow from surface water irrigation and

ground water irrigation @ 4.55 BCM and 2.16 BCM. The recharge due to water conservation structures, tanks & ponds and canal is pegged at 0.39 BCM, 0.34 BCM and 0.26 BCM respectively shown in Fig.-7. The district wise recharge is also presented in Fig.-8 and it indicates that maximum recharge is taking place in Belagavi district (131883 ham) and minimum recharge is taking place in Bengaluru (Rural) district (21631 ham). In almost all the districts, rainfall recharge is the major contributor except in Ballari, Davangere, Koppal, Mandya, Raichur and Yadgir districts where recharge due to surface water irrigation is more due to more command area and lesser rainfall. The assessment unit wise ground water resources 2022 (recharge component) is presented in *Annexure-VA*.

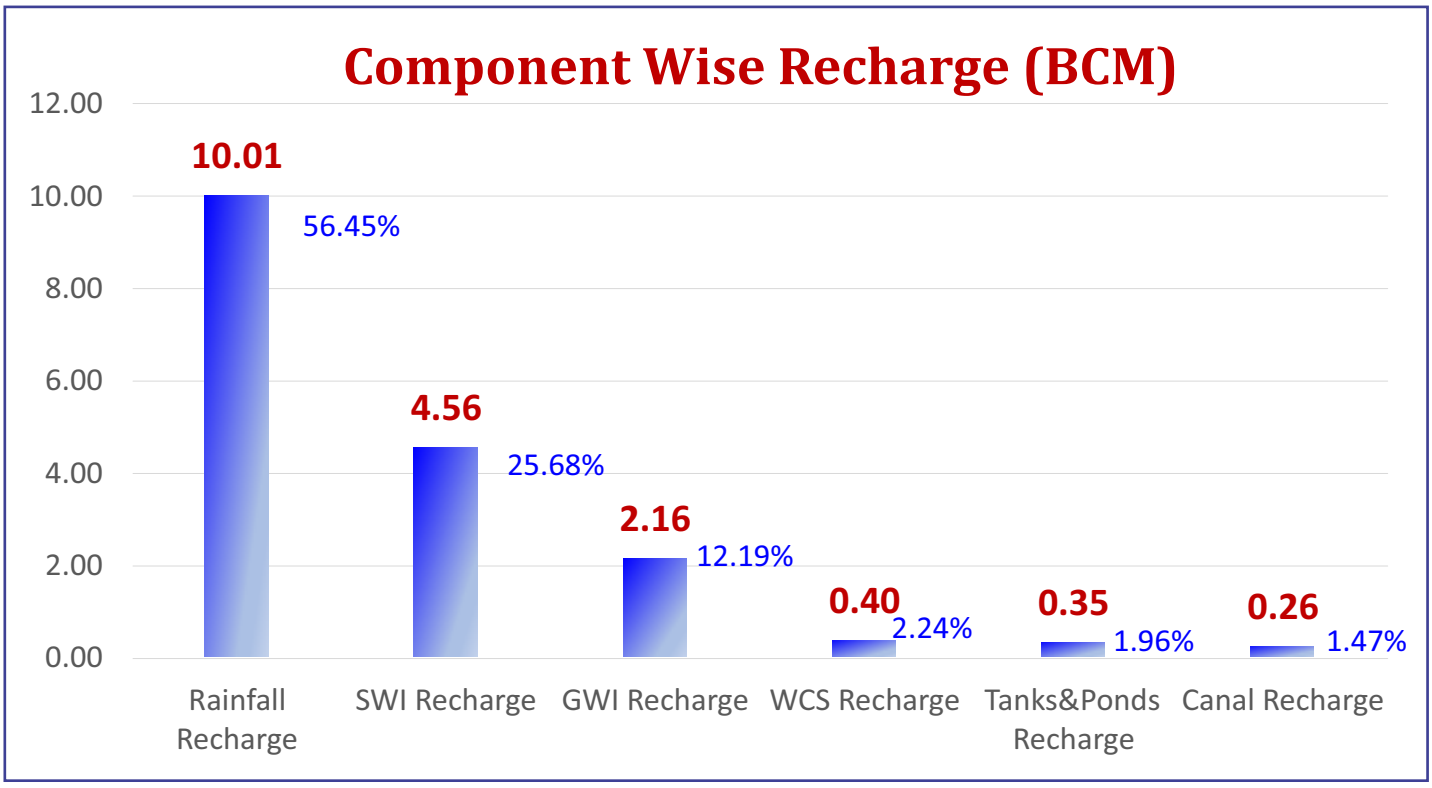

Fig.-7: Recharge by Different Sources

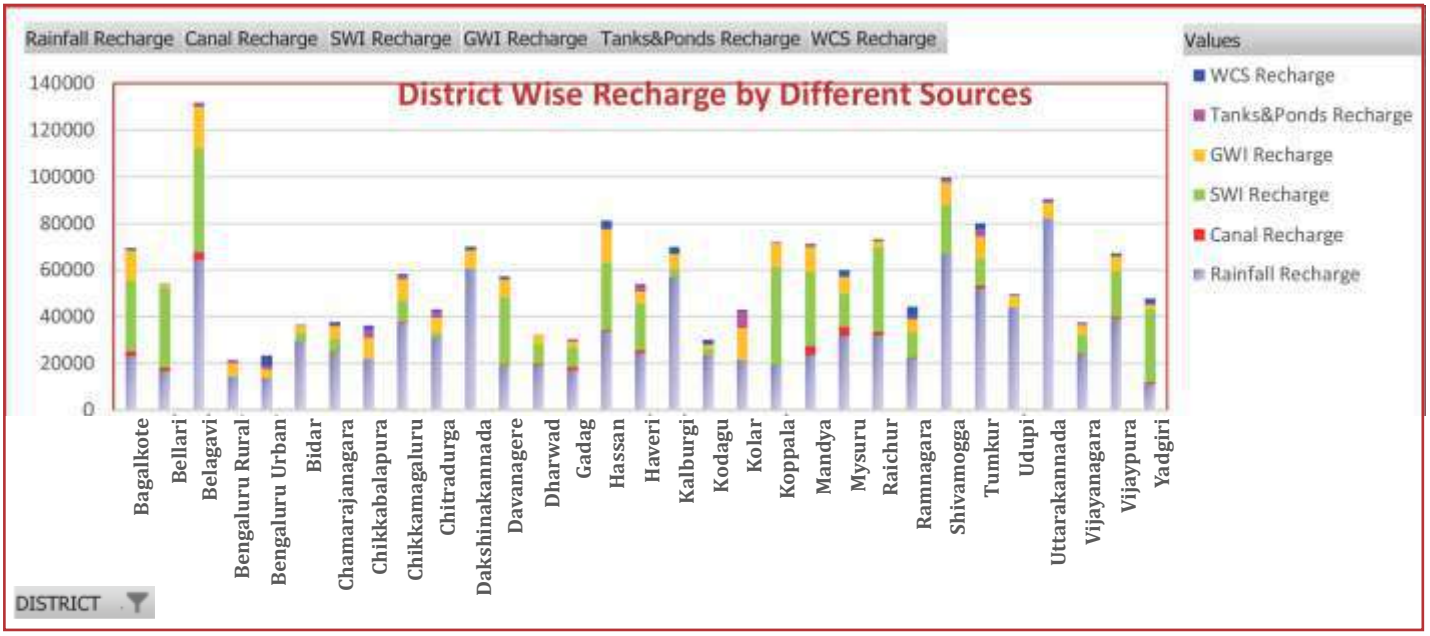

Fig.-8: District Wise Recharge by Different Sources

5.4 Annual Extractable Groundwater Resources

The entire quantum of ground water recharge cannot be considered for extraction since ecological commitments need to be fulfilled, before the extractable resources are defined. To cater to the ecological requirements, some percentage of ground water recharge is substracted from annual ground water recharge based on the GEC 2015 guidelines. If the rainfall recharge is assessed using water level fluctuation method this will be 5% of the annual recharge and if it is assessed using rainfall infiltration factor method, it will be 10% of the annual recharge. The balance accounts for Annual Extractable Ground Water Resources (EGR). As per assessment data, the annual extractable ground water resources for the State are 16.04 BCM and it ranges from 120261.70 ham at Belagavi district to 19468.31 ham in Bengaluru (Rural) district.

5.5 Ground Water Extraction

For estimation of ground water extraction for Irrigation purpose, the minor irrigation well census data as well as the data from district administration was collected and utilised. As per this database, it is found that in all there are 11.68 lakh abstraction structures being used for irrigation purpose withdrawing 10.06 BCM of groundwater yearly. This includes 2.12 lakhs of dug wells and 9.54lakhs borewells and 1930 dug-cum-borewells. The district wise number of irrigation wells also vary widely, Belgavi district is having highest number of the irrigation wells (88885), whereas Kodagu is having lowest number of the irrigation wells (9027). The ground water extraction for irrigation purpose also varies accordingly. The district wise number of the irrigation wells and corresponding ground water extraction for irrigation purpose is shown in Fig. -9.The assessment unit wise ground water resources 2022 is presented in Annexure-VB.

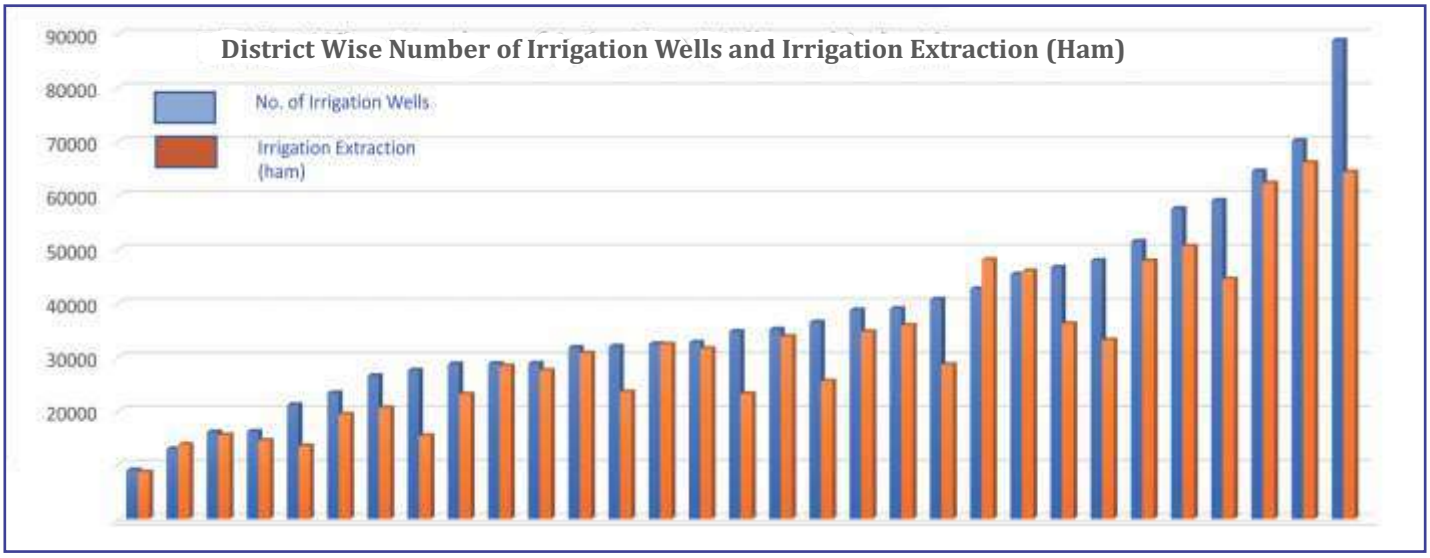

Fig.-9: District Wise Number of Irrigation Wells and Irrigation Extraction

In case of Industrial wells, it is found that in all there are 21418 abstraction structures being used for industrial purpose withdrawing 0.13 BCM of groundwater yearly. However, this number could be much higher as the exact data on industrial wells is not available with any single agency. This includes 166 dug wells and 21258 borewells. The district wise numbers of irrigation wells also vary widely, Bengaluru Urban district is having highest number of the industrial wells (16262), whereas Raichur is having lowest number of the irrigation wells (15).

The ground water extraction for various uses viz., irrigation, domestic and industrial has also been assessed as shown in Fig.-10 and it indicates that major extraction about 89% is for irrigation @ 1000644 ham, whereas 10% is for domestic @ 108771 ham and 1% for industrial purpose @ 12563 ham.

The district wise ground water extraction for various uses has also been assessed as shown in Fig.-11 and it indicated that ground water extraction for irrigation and domestic uses is highest in Belagavi district, whereas

industrial consumption is highest in Bengaluru Urban district. The lowest ground water extraction for irrigation and domestic uses is in Kodugu District.

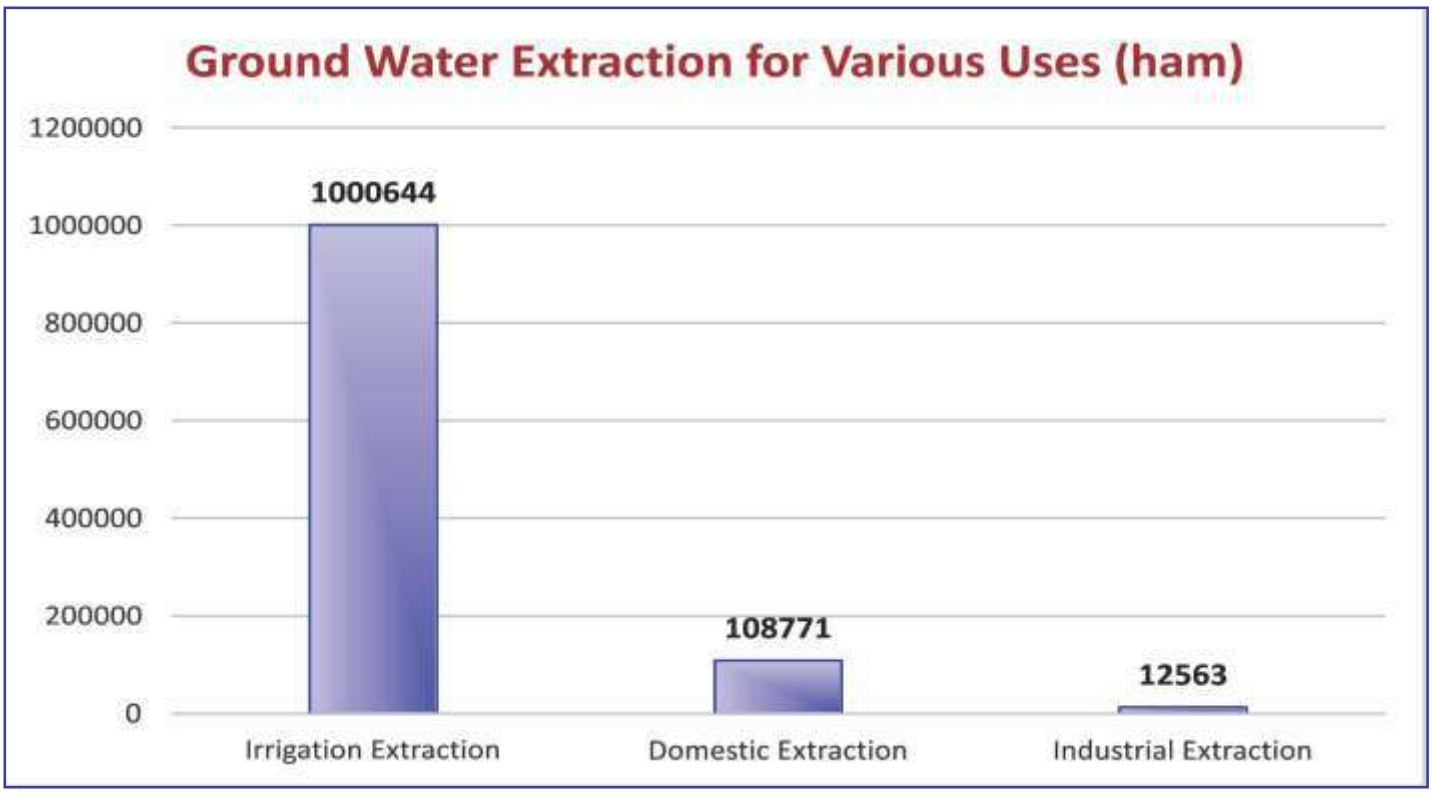

Fig.-10: Ground Water Extraction for Various Uses

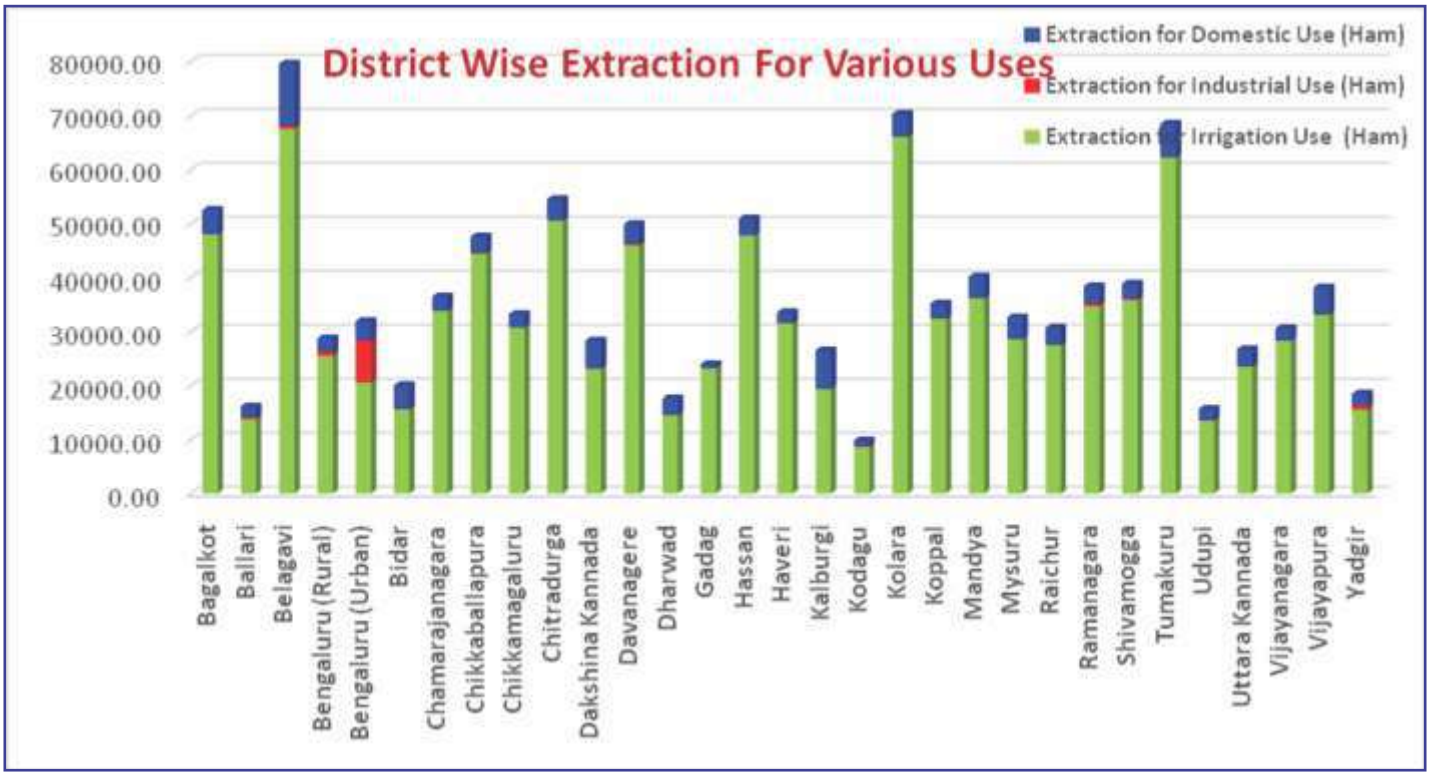

Fig.-11: District Wise Ground Water Extraction for Various Uses

5.6 Ground Water Availability and Extraction

The ground water availability and extraction should be balanced, however in 6 districts viz., Bengaluru (Rural), Bengaluru (Urban), Chamarajanagara, Chikkaballapura, Chitradurga and Kolara it is more than the availability (>100%). In 4 districts viz., Davanagere, Ramanagara, Tumakuru and Vijayanagara, the extraction is between 90% and 100% of recharge. Thus, these areas (10 districts) need special attention for ground water management. All these districts are located in central part, southern and eastern dryland areas of Karnataka where the dependency on groundwater is very high owing to limited surface water availability.

The comparison of district wise groundwater recharge and withdrawal clearly shows that in Bagalkot and Gadag district the groundwater development is between 70 to 90 %. However, in Belagavi, Bidar, Chikkamagaluru, Dharwad, Hassan, Haveri, Koppal, Mandya, Mysuru and Vijayapura districts, the development is between 50 to 70% and in rest 9 districts it is <50% %(Fig 12). The district wise ground water resources 2022 is presented in *Annexure-VI*.

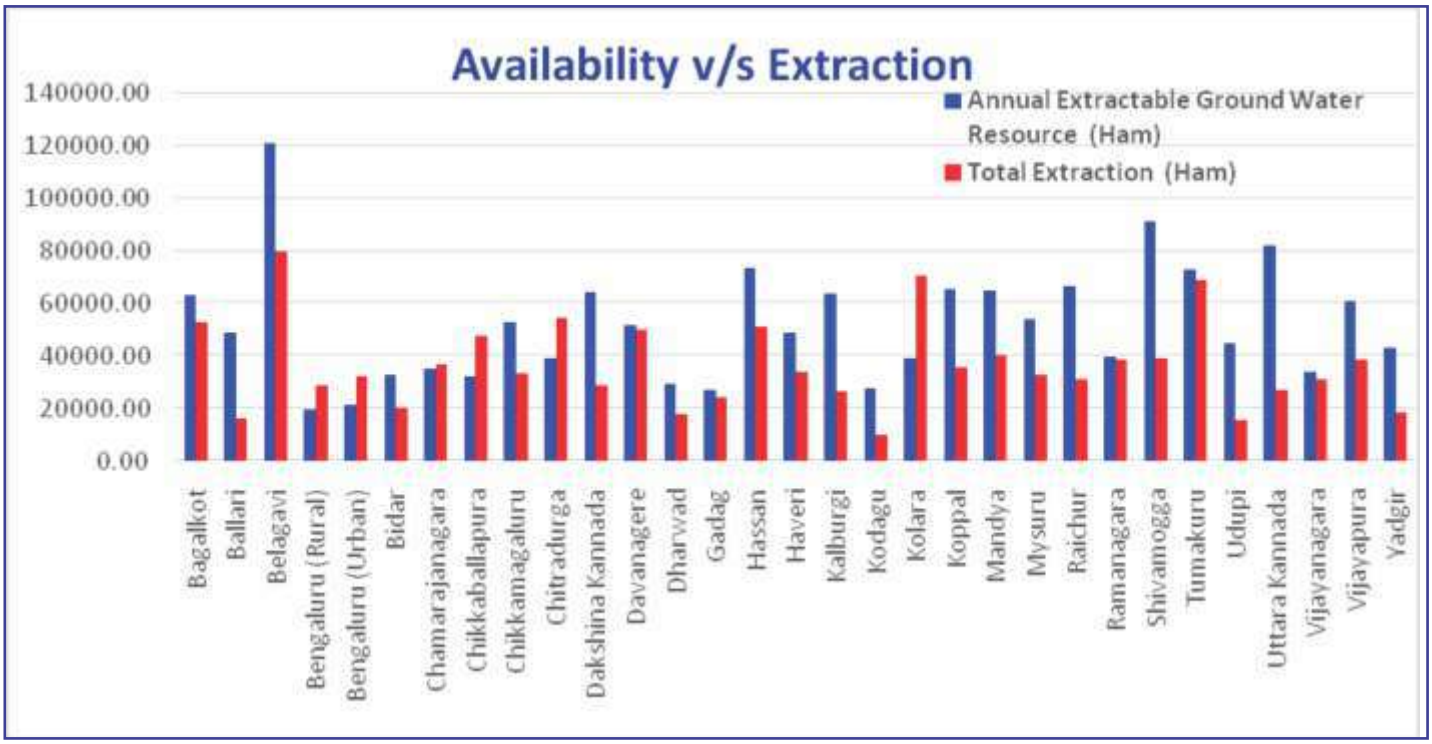

Fig.-12: District Wise Ground Water Availability and Extraction

5.7 Future Allocations for Domestic Use

The Future Domestic & Industrial Allocations is more than the existing Domestic draft even where there is no groundwater balance after deducting the actual drafts for different usages. The future allocation for domestic use for projected year 2025 ranges from 55.68 ham at Shirahatti taluk, Gadag district and 2790.97 ham at Gulbarga taluk in Kalburgi district.

5.8 Categorization of Talukas

The categorization of talukas is done as per the norms mentioned in GEC-2015 methodology. Based on these computations, it is observed that 139 talukas are falling in Safe category, 35 in Semi-Critical, 11 in Critical, 49 in Over-Exploited category. Taluka wise categorization are given in *Annexure VB*. The categorization of talukas is also shown in Fig.13 and it reveals that over-exploited, Critical and Semi-Critical talukas are falling in the same pattern as previous assessments in the northern, central, southern and eastern dry regions of the State, where the rainfall is

between 400 to 800 mm only. The district wise abstract showing number of OE/Critical/SC/Safe & PQ talukas is given in *Annexure VII*.

The ground water development i.e., number of over-exploited, critical and semi-critical taluks are highest in Belagavi (8), Tumkuru (7), 6 blocks each in Bagalkot, Bengaluru (Urban), Chikkaballapura, Kolara, 5 blocks each in Chamarajanagara, Chitradurga, Gadag, Ramanagara and Vijayapura. The district wise number and names of over-exploited, critical and semi-critical taluks are given in Table-8. The over withdrawal of groundwater in these districts can be attributed to absence of surface water irrigation sources and cultivation of water intensive cash crop like paddy, sugarcane, cocunut, arecanut, vegetables and fruits etc., which are mostly groundwater dependent. Whereas in case of Bangalore Urban district it can be attributed to both high domestic demand and irrigation.

Table-8: District wise distribution of over-exploited, critical and semi-critical taluks.

Sl. No.	Name of District	Name of Semi-Critical Assessment Units	Name of Critical Assessment Units	Name of Over-exploited Assessment Units
1	**Bagalkot**	Mudhol	Guledagudda	Badami
		Hungund		Bagalkote
		RabakaviBanahatti		
2	**Belagavi**	Athani	Kagavada	Bailhongal
		Yaragatti	Savadatti	
		Chikkodi		
		Gokak		
		Hukkeri		
3	**Bengaluru (Rural)**			Nelamangala
				Doddaballapura
				Devanahalli
				Hoskote
4	**Bengaluru (Urban)**			Bangalore City
				Anekal
				Yelahanka
				Bangalore-East
				Bangalore (North)
				Bangalore-South
5	**Bidar**	Bhalki		
		Hulasuru		
6	**Chamarajanagara**	Kollegala	Yalandur	Chamarajanagara
		Kollegala(Hanur)		Gundlupet
7	**Chikkaballapura**			Shidlagatta
				Chinthamani
				Bagepalli
				Chikballapur
				Gudibande
				Gauribidanur
8	**Chikkamagaluru**			Ajjampura
				Kadur
9	**Chitradurga**			Challakere
				Hosadurga
				Chitradurga
				Holalkere
				Hiriyur

Sl. No.	Name of District	Name of Semi-Critical Assessment Units	Name of Critical Assessment Units	Name of Over-exploited Assessment Units
10	**Davanagere**	Honnali	Davanagere	Channagiri
				Jagaluru
11	**Gadag**	Gadag		Gajendragad
		Mundargi		Rona
		Shirahatti		
12	**Hassan**		Channarayapatna	Arsikere
13	**Haveri**	Ranebennur	Ratteehalli	
		Hirekerur		
		Byadagi		
14	**Kalburgi**	Afzalpur		
15	**Kolara**			Kolar
				K.G.F
				Malur
				Srinivaspura
				BANGARPET
				Mulabagilu
16	**Koppal**	Yelburga	Kukanuru	
		Kanakagiri		
17	**Mandya**	Malavalli		
18	**Mysuru**	Mysuru		
19	**Raichur**	Sirivara		
20	**Ramanagara**	Channapatna	Ramanagar	Magadi
		Kanakpura		Harohalli
21	**Tumakuru**	Pavagada	Koratagere	Madhugiri
				Sira
				Chiknayakanahalli
				Tiptur
				Tumkur
22	**Vijayanagara**	Hadagali		Hagaribommanahalli
				Kotturu
				Harapanahalli
23	**Vijayapura**	BasavanBagewadi	Nidagundi	
		Tikota		
		Chadachana		
		Kolhara		
24	**Yadgir**	Gurumithakala		
		Yadgir		

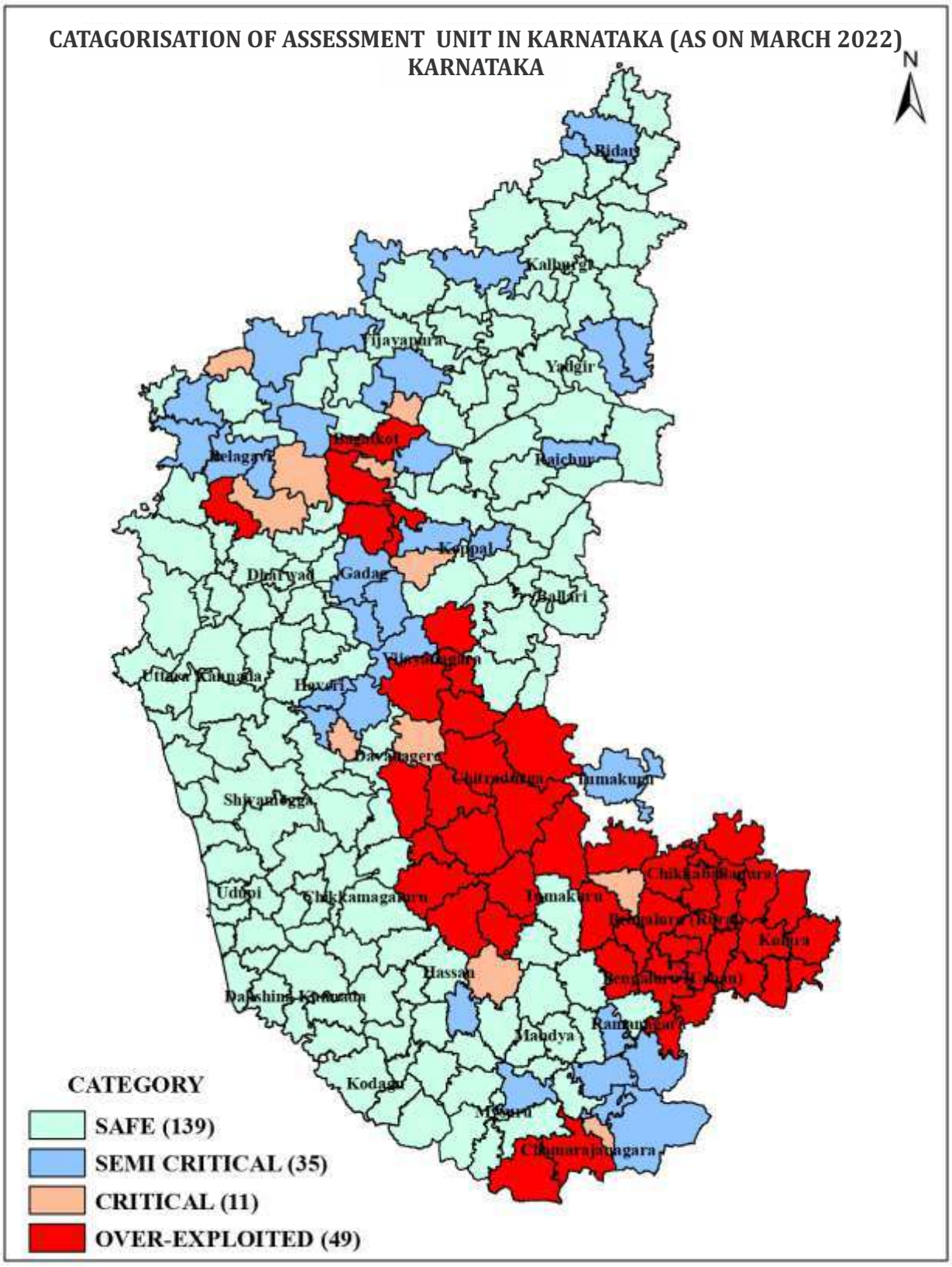

Fig.-13: Categorisation of Assessment Units

5.9 Ground Water Quality Tagging

The ground water quality data of both CGWB and GWD was utilised for quality tagging of the assessment unit. The fluoride contamination is observed in 9 taluks mostly in northern Karnataka, whereas salinity is observed in Holalkere taluk of Chitradurga district and Yelburga taluk of Koppal district. The nitrate contamination which is mostly due to anthropogenic activities is observed in 13 taluks as detailed in Table – 9.

Table - 9: Qulaity Tagging of Assessment Units

S. No.	District	Taluka	Quality Tag
1.	Ballari	Ballari	Fluoride
2.	Chitradurga	Molakalmuru	Fluoride
3.	Davanagere	Davanagere	Fluoride
4.	Kalburgi	Chincholi	Fluoride
5.	Kolara	Mulabagilu	Fluoride
6.	Raichur	Devdurga	Fluoride
7.	Raichur	Lingasugur	Fluoride
8.	Raichur	Maski	Fluoride
9.	Vijayanagara	Kudligi	Fluoride
10.	Chitradurga	Holalkere	Salinity
11.	Koppal	Yelburga	Salinity
12.	Chikkaballapura	Gauribidanur	Nitrate
13.	Chitradurga	Challakere	Nitrate
14.	Chitradurga	Molakalmuru	Nitrate
15.	Gadag	Gajendragad	Nitrate
16.	Gadag	Rona	Nitrate
17.	Raichur	Maski	Nitrate
18.	Raichur	Sirivara	Nitrate
19.	Vijayapura	Alamela	Nitrate
20.	Vijayapura	Chadachana	Nitrate
21.	Vijayapura	Tikota	Nitrate
22.	Yadgir	Gurumithakala	Nitrate
23.	Yadgir	Shahapur	Nitrate
24.	Yadgir	Vadagera	Nitrate

5.10 Spatial Variation

5.10.1 Ground Water Recharge

The groundwater recharge is a function of rainfall, geomorphology and geology. The State is having heterogeneity in all these parameters. Hence the recharge to groundwater is not uniform in all the talukas. Based on the total Annual Groundwater Recharge and the Area of Assessment Unit, the talukwise annual groundwater

resources in hecta meter has been computed. The results are commensurate with the field conditions. Around 50% talukas have annual recharge up to 100 mm, 24% between 100 to 150 mm, 17 % between 150 to 200 mm, 6% between 200 to 250 mm and only 3 taluks have annual recharge of 250 to 500 mm.These details have been shown in the Table -10 and taluka map of the State (Fig.-14).

Table- 10: Distribution of Assessment Units as per Unit Recharge

Unit GW Recharge (mm)	No. of Assessment Units	Percentage of Assessment Units
0 to 50	14	6
50 to 100	102	44
100 to 150	56	24
150 to 200	39	17
200 to 250	15	6
250 to 500	8	3

The perusal of the map re-iterates the fact that the recharge in coastal areas and Malnad region is higher in the range of 150 to 200 mm and 200 to 250 mm. In most of the areas / taluks of north-eastern, northern and central drylands, the unit recharge is on lower side and ranging between 50 and 100 mm. whereas in most of the areas/taluks of southern dry region and eastern dry region it is moderately placed ranging from 100 to 200 mm.

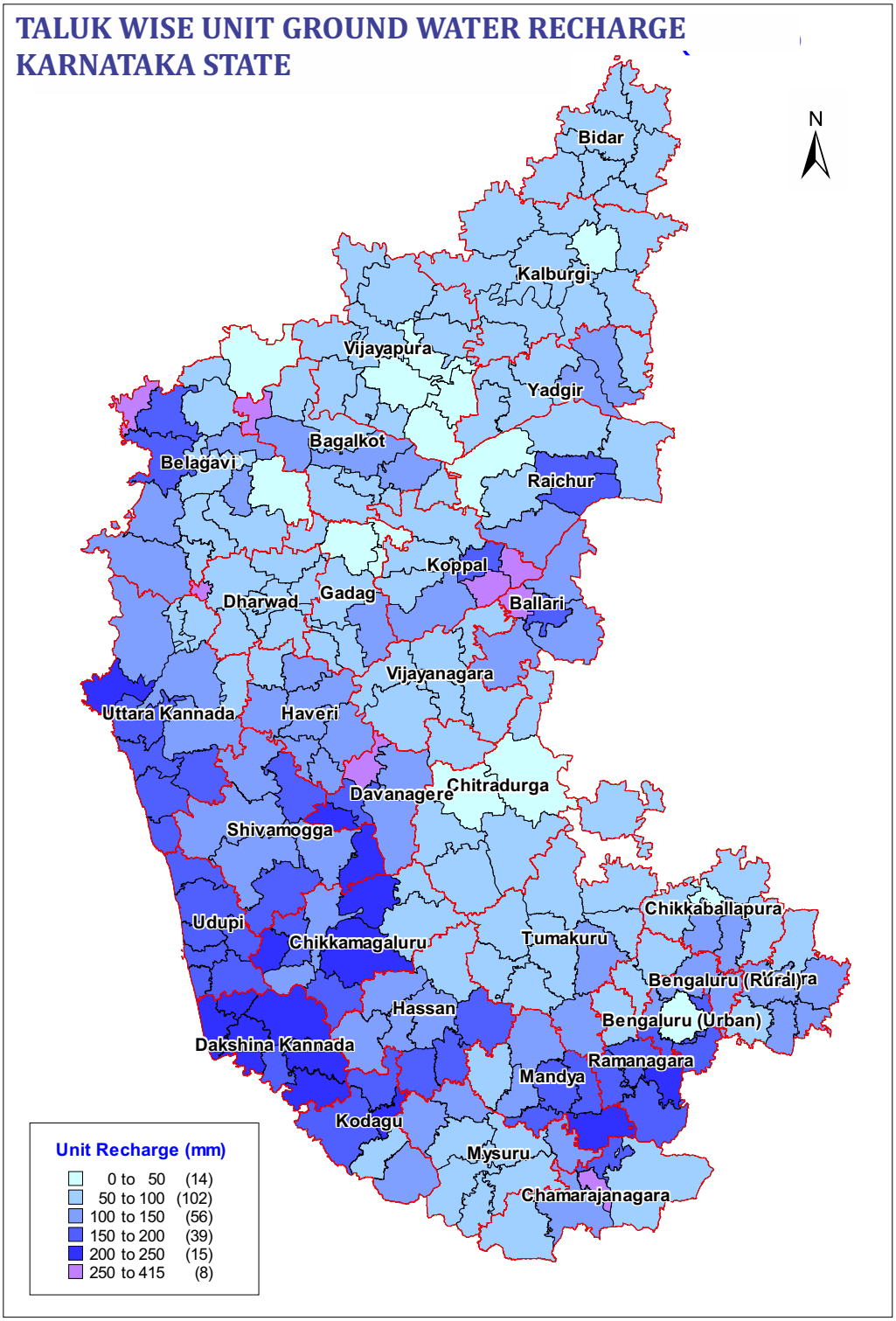

Fig.-14: Unit Annual Ground Water Recharge

5.11 Dynamic Ground Water Resources – at a glance

The groundwater estimation is carried out for 31 districts of Karnataka and Bangalore city. As per the protocol the groundwater availability and use has been computed for the taluk wise assessment-units, and the categorization has been done for the Taluk. The State abstract showing details of Dynamic Groundwater Resources 2022 is given in Table 11.

TABLE 11- Information at a Glance of Ground Water Resource Assessment 2022

Sl. No	Description	Details
1.	Total No. of Districts Assessed in the State	31
2.	Total No. of Assessment Units in the State	234 (233 taluks + 1 Bangalore City)
3.	Total No. of Assessment Sub Units	376(C144+NC232)
4.	Annual Groundwater Recharge (BCM)	17.74
5.	Annual Extractable Ground Water Resource (BCM)	16.04
6.	Total Extraction (BCM)	11.22
7.	Ground Water Extraction for Irrigation Use (BCM)	10.01
8.	Ground Water Extraction for Industrial Uses (BCM)	0.13
9.	Ground Water Extraction for Domestic Uses (BCM)	1.09
10.	No. of Irrigation Dugwells in Use	211980
11.	No. of Irrigation Borewells in Use	954548
12.	No. of Irrigation Dug cum borewells in Use	1930
13.	Total No. of Irrigation Wells in Use	1168458
14.	No. of Existing Industrial Dugwells in Use	166
15.	No. of Existing Industrial Borewells in Use	21258
16.	Total No. of Industrial Wells	21418
17.	No. of Over Exploited Talukas	49
18.	No. of Critical Talukas	11
19.	No. of Semi Critical Talukas	35
20.	No. of Safe Talukas	139
21.	Quality Tagged Taluks – Fluoride	9
22.	Quality Tagged Taluks – Salinity	2
23.	Quality Tagged Taluks – Nitrate	13

As per the assessment, the total rechargeable fresh groundwater resource in the State is computed as 17.74 BCM and the Annual Extractable Ground Water Resource is to the tune of 16.045 BCM. The Total Extraction is 11.22 BCM. The Stage of groundwater development for the State, as whole, is 69.93%. This indicates that on an average 69.93% of yearly replenishable groundwater is being used in the State.

Considering the domestic and industrial requirement the annual ground water allocation for domestic water supply as on March 2025 is 1.17 BCM. Leaving this allocation, the net groundwater availability for future use development is around 6.34 BCM. The taluka wise details of groundwater recharge from rainfall & other sources in monsoon and non-monsoon season are given in ***Annexure-V A***. The recharge from rainfall during monsoon and non-monsoon (Annexure V A Col 4 & 6 has been computed separately unit wise. Whereas the total annual groundwater recharge, annual extractable groundwater resources, stage of ground water extraction and categorisation are given in ***Annexure –V B.***

5.12 Comparison with Earlier Assessments

5.12.1 Recharge

Compared to 2020 there is increase in annual groundwater recharge by Water Conservation Structures (WCS) from 0.37 bcm to 0.40 bcm an increase of 9%, in case of Tanks & Ponds it has increased by 10% and recharge due to canals has increased by whopping 32% as depicted in **Fig. 15**. The increase in recharge from tanks and ponds could be possible as many of the tanks/ponds are being provided with perennial source of water through out the year for 365 days instead of tanks getting filled only during monsoon season for 120 days. The source of water for such perennial tanks/ponds is either through treated water or surface water under the flagship scheme of Minor Irrigation Dept. and BWSSB. The recharge due to WCS has also increased by 9% due to the increased number of WCS structures constructed under the various water conservation schemes taken by State Govt. like Jal Jeevan Mission etc., as well as de-silting of structures taken up by State Govt. under various district levels schemes including MGNREGA.

The operationalisation and distribution of surface water through newly constructed major, medium minor and lift irrigation projects/schemes have directly contributed to increase in the recharge due to canals. Considerable increase of 32% in recharge is due to increase in canal seepage due to new canals and its corresponding return seepage contributing to overall recharge.

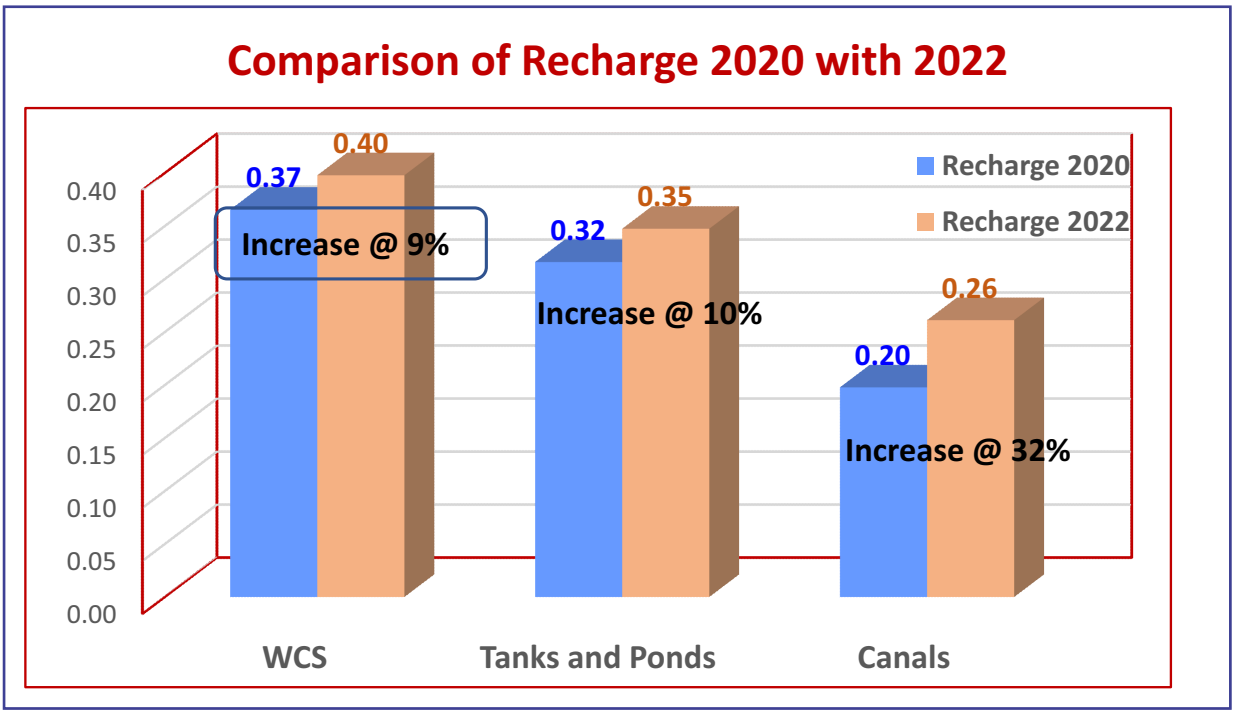

Fig.-15: Comparison of Recharge due to Water Conservation, Tanks & Ponds and Canals

The past good rainfall years supported by the development of new surface irrigation systems, use of treated and surface water for tank fillings has replenished the groundwater in the non-monsoon period also. The initiatives taken up by the Govt. of Karnataka and community in developing and maintaining the water conservation structures, tanks & ponds, canal network is being reflected in the increased recharge due to other sources over the period of last decade or so. The comparison of historical recharge due to rainfall and other sources has also been carried out for the ground water resource assessments from 2009 to 2022 and is presented in Fig. 16. It indicates that the recharge due to rainfall has increased @ 0.157 bcm/year, whereas recharge due to other sources has continuously increased @ 0.072 bcm/year.

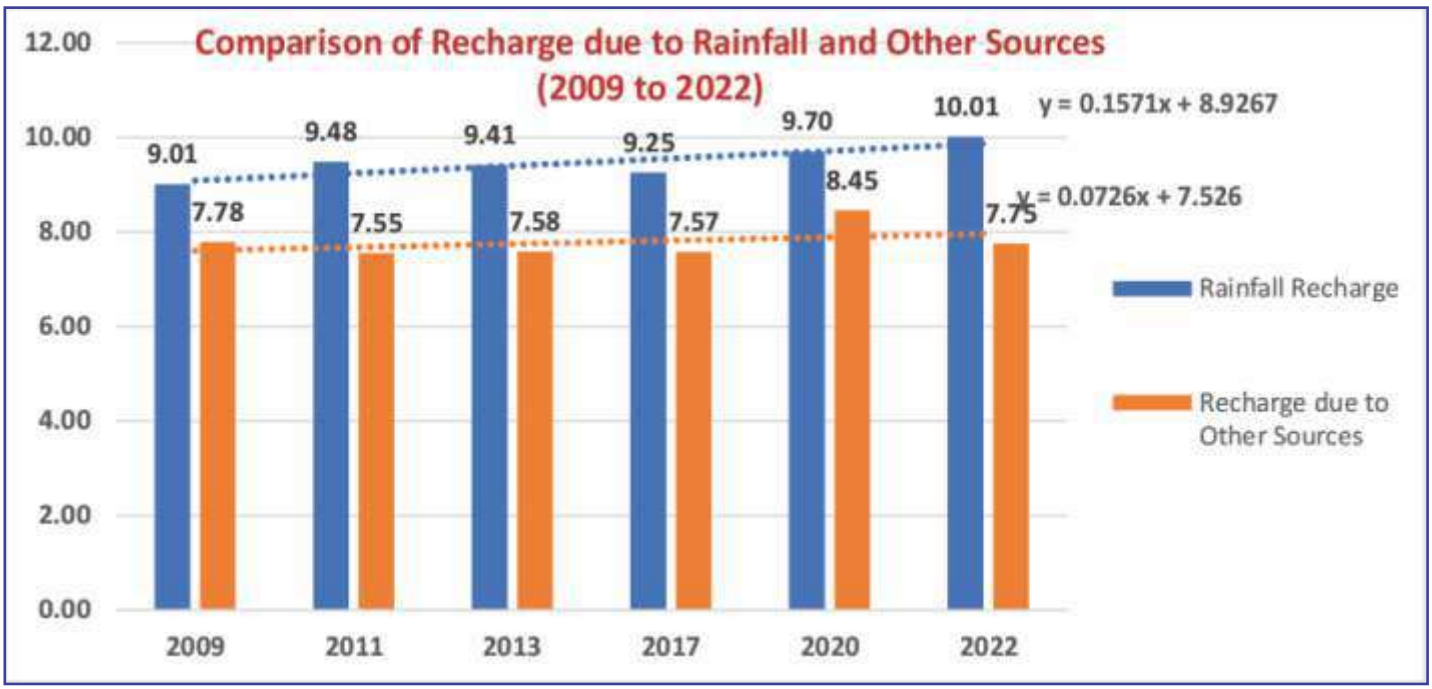

Fig.-16: Comparison of Recharge due to Rainfall and Other Sources (2009 to 2022)

5.12.2 Irrigation Draft

The importance of groundwater resource for irrigation purposes is critical since about 85 to 90% of the draft is for irrigation purpose and hence the development has been receiving the attention from the farmers. It is generally observed that from the year 1990 onwards there is a trend to use bore wells for irrigation instead of dug wells. The increase in number of irrigation bore wells with pump sets is very high. It is observed that the total number of irrigation bore wells in the State as a whole has increased from 7.67 lakhs in 2009 to 9.54 lakhs in 2022, whereas the number of dug wells has decreased from 3.01 lakh to 2.11 lakh in 2022.

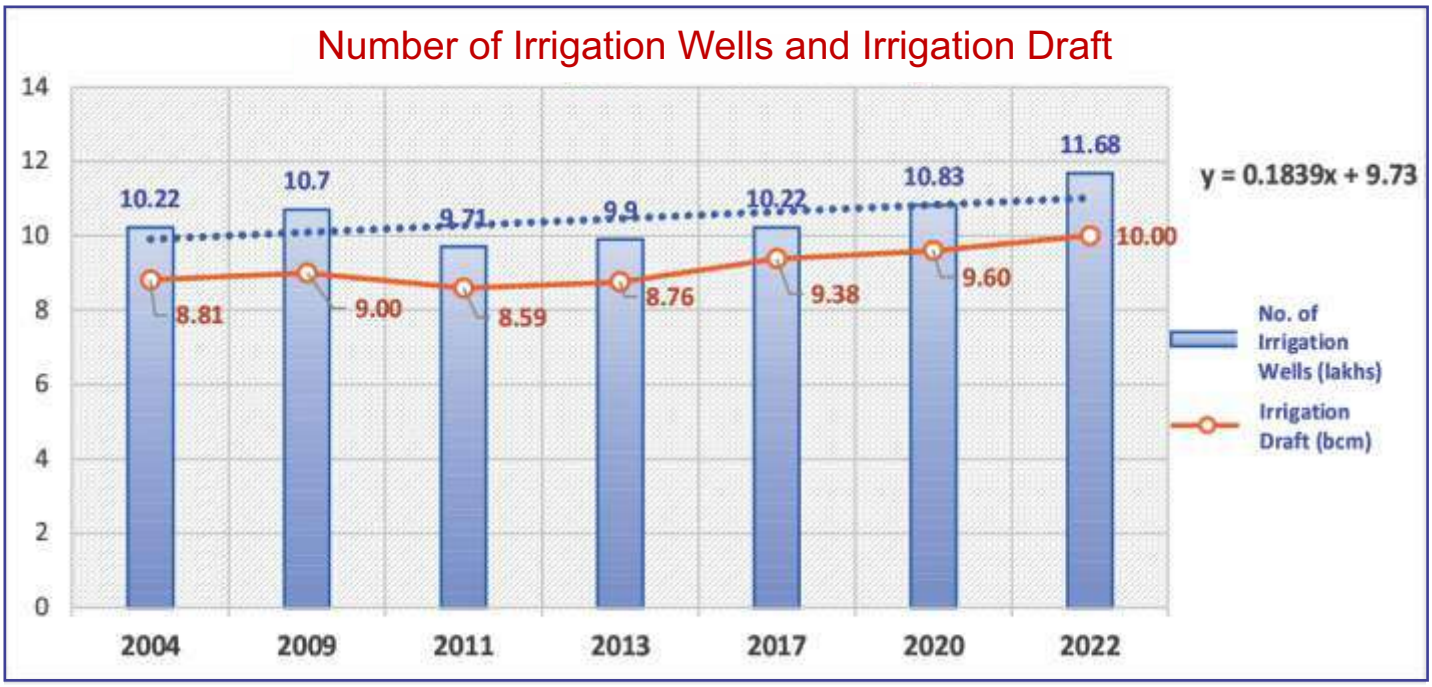

Fig.-17: Comparison of Irrigation Wells and Draft (2004 to 2022)

The increase in number of irrigation wells and draft from 2004 to 2022 is plotted in Fig.-17 and it indicates that the number of irrigation wells have increased from 10.22 lakhs in 2004 to 10.70 lakhs in 2009, however in 2011 it has decreased down to 9.71 lakhs, this may be due to the failure of dugwells and shifting from dugwells to borewells as evident above from the further bifurcation of number of wells. Since 2011, the number of irrigation wells is continously increasing from 9.71 lakh to 11.68 lakh in 2022, whereas over a complete period of 2004 to 2022 the increase is @ 0.184 lakhs/annum.

5.12.3 Assessment Units

Since 2004, watershed is being used as a unit for assessment in the State irrespective of the methodology, which were later apportioned to taluk. However, in the current assessment (2022) it was changed to taluk in consultation with State Govt. for ease of data collection and as the ultimate reflection of the results for the planners and administrators needs to be done in the form of administrative unit. The comparison of over exploited, critical, semi-critical (OCS) and safe assessment units over the period of 2004 to 2022 as presented in Fig.-18 clearly shows that with the increasing ground water development; there is increase in percentage of OCS units from 39.07% (2004) to 44.89% (2017). However, since 2017, there is marginal decrease in the number of OCS taluks from 44.89% in 2017 to 40.60% in 2022. This is due to consistency in the rainfall for the last five years resulted in enhanced rainfall recharge and because of increase in recharge from other sources (except recharge from return flow of surface water irrigation and ground water irrigation in 2022).

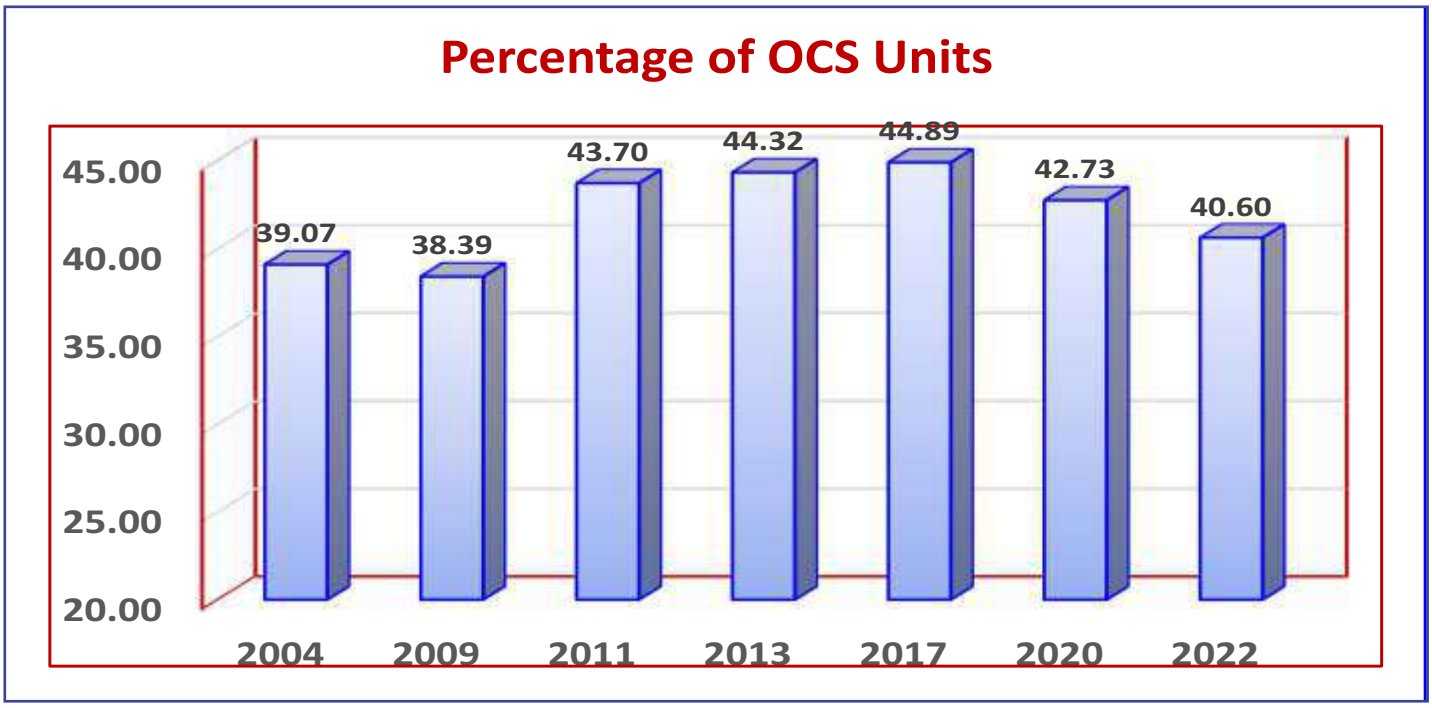

Fig.-18: Comparison of Assessment Units (2004 to 2022)

5.12.4 Improvement and Deterioration in Categorisation of Assessment Units

It was observed that, as compared to GWRA 2020, there is improvement in categorisation of 14 assessment units, whereas deterioration has been noticed in 3 assessment units. The details are given in Table-11. The main reason for improvement is increase in recharge due to rainfall, canal, surface water irrigation, WCS and tanks & ponds, whereas reasons for deterioration are increase in extraction for domestic and irrigation purpose.

Table- 11: Improved and Deteriorated Assesment Units in GWRA 2022 as compared to GWRA 2020.

District	Assessment Unit	Stage of Ground WaterExtraction (%)2020	Categorization in2020	Stage of Ground WaterExtraction (%)2022	Categorization in2022	Improved/ Deteriorated	Reasons
Bagalkot	Guledagudda	122	OE	91	Critical	IMPROVED	Increase in recharge due to RF, Canal, SWI & WCS recharge
Bagalkot	Mudhol	99	Critical	76	Semi Critical	IMPROVED	Increase in recharge due to RF, Canal, SWI & WCS recharge
Belagavi	Athani	98	Critical	73	Semi Critical	IMPROVED	Increase in recharge due to RF, Canal & SWI recharge
Belagavi	Kagavada	119	OE	96	Critical	IMPROVED	Increase in recharge due to RF, Canal, SWI recharge & WCS
Belagavi	Mudalagi	71	SC	57	Safe	IMPROVED	Increase in recharge due to RF, Canal, SWI recharge & WCS

District	Assessment Unit	Stage of Ground WaterExtraction (%)2020	Categorization in 2020	Stage of Ground Water Extraction (%)2022	Categorization in 2022	Improved/ Deteriorated	Reasons
Belagavi	Ramadurg	55	Safe	110	Over Exploited	IMPROVED	Increase in recharge due to RF, Canal & SWI recharge
Davanagere	Nyamati	70	SC	67	Safe	IMPROVED	Increase in recharge due to RF, Canal & SWI recharge
Gadag	Gadag	95	Critical	81	Semi Critical	IMPROVED	Increase in recharge due to RF & Tanks and Ponds
Gadag	Naragund	81	SC	58	Safe	IMPROVED	Increase in recharge due to RF, Canal & SWI recharge
Koppal	Kukanuru	103	OE	99	Critical	IMPROVED	Increase in recharge due to SWI, GWI
Raichur	Raichur	72	SC	67	Safe	IMPROVED	Increase in recharge due to RF, Canal & SWI recharge
Ramanagara	Kanakpura	92	Critical	80	Semi Critical	IMPROVED	Bifurcation of Kanakpura taluk
Tumakuru	Koratagere	115	OE	97	Critical	IMPROVED	Increase in recharge due to RF & Tanks and Ponds
Vijayapura	Chadachana	94	Critical	83	Semi Critical	IMPROVED	Increase in recharge due to RF & SWI recharge
Haveri	Ratteehalli	86	SC	91	critical	DETEORATED	Increase in Domestic and Irrigation Draft
Ramanagara	Magadi	93	Critical	103	Over Exploited	DETEORATED	Increase in Domestic and Irrigation Draft
Vijayapura	Nidagundi	89	SC	91	Critical	DETEORATED	Increase in Domestic and Irrigation Draft

ANNEXURES

Annexure-I: GOVERNMENT ORDER NO. MID/6/AJA/2022 DATED 03/02/2022

GOVERNMENT OF KARNATAKA

No: MID/6/AJA/2022

Karnataka Government Secretariat,
Vikasa Soudha,
Bangalore, dated:03.02.2022

From:
Secretary to Government,
Minor Irrigation & Ground Water
Development Department,
Government of Karnataka,
Vikasa Soudha,
Bangalaore-560001.

To,
The Regional Director,
Central Groundwater Board,
27th Main, Sector 1, 7th Cross,
HSR Layout, Bengaluru-560 102.

Dear Sir,

Sub: Constitution of State Level Committee for re-estimation of Groundwater Resources-Estimation of Annual Replenishable Ground Water Resources-reg

Ref: 1. Government Order No.MID 22 AAJAA 2020 (E) Bangalore, dated :20 August, 2020 for constitution of State Level Committee for re-estimation of Groundwater Resources.
2. Government of India, Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation, Faridabad letter No: CGWB/ M (South) /CHQ/ 2022-6379 date: 21.12.2021.
3. CGWB, Bengaluru letter No. TA -25/CGWB / SWR/DGWRA/2021-2022-928 dated: 28.12.2021.

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With reference to above cited subject, in reference (3) it is requested to constitute a State Level Standing Committee for Re-estimation of Ground Water Resources of Karnataka.

Under reference (1) State Level Committee has already been constituted for the estimation of Ground Water Resources. The committee so formed is still in existence and stands until further orders.

This is for your information and further needful action.

Thanking you,

Yours faithfully,

(M.S.JYOTHY)
Under Secretary to Government,
Minor Irrigation & Ground Water
Development Department.

Annexure-II: MINUTES OF FIRST STATE LEVEL COMMITTEE (SLC) MEETING.

MINUTES OF THE 1st STATE LEVEL COMMITTEE FOR GROUND WATER RESOURCES ASSESSMENT – 2022 OF KARNATAKA STATE

The meeting of the 1st State level Committee (SLC) for Ground Water Resources Assessment - 2022 of Karnataka State was held on 04.05.2022 at 11.00 hrs, room No. 317, Vikas Soudha, Bangalore. Shri C. Mruthyunjaya Swamy, Secretary, & Chairman of SLC, chaired the meeting. Director, GWD narrated to the committee that State Level committee headed by the Secretary, Minor Irrigation & Ground Water Development Department as Chairman was constituted by the Government of Karnataka vide Government Order No. vide MID 22AAJAA2020 (E) Bangalore dated 20.08.2020 and the SLC has been continued vide letter dt. 03.02.2022. The meeting was attended by various committee members or their representatives as per the attached list.

Shri Jyothi Kumar, H.O.O, CGWB, SWR, Bangalore & Member Secretary welcomed the Chairman, Members & Invitees to the State Level Committee Meeting. He informed to the committee that the Ground Water Resources Assessment is the time bound process and requested the committee members to speed up the data collections process.

Director, Groundwater Directorate, Government of Karnataka informed that Ground Water Resources Assessment should reflect the improvement in resources due to various recharge works and water conservation works taken up by the State Govt; especially wherever the tanks/ponds are filled up by pumping of treated water or from any river / reservoir/canal. He narrated very good examples of the K.C. Valley, H.N. Valley and Anekal tank filling projects for which the improved strategies regarding recharging need to be adopted with case studies. He suggested to utilise the DWLR water level data in ABHY taluks for 2022 for arriving at resource assessment. Further, the Director, GWD informed that the Ground Water Resource Estimation as on 2022 is to be assessed based on the revised 233 taluks instead of 227 taluks previously mentioned and the updated taluk boundary is to be furnished to assessment committee by Ground Water Directorate from the concerned State agency.

In this regard, Shri. G. Jayanna, Deputy Director, GWD and Smt. Jagadeshwari M, Senior Geologist, GWD informed about the availability of the shape files of 233 taluks, data compilation from various State Govt. Dept.'s based on the In-gres spreadsheets.

Shri Jyothi Kumar informed the Chairman that average water level data of last 5 years for pre and post monsoon is considered for GWRA. Shri. B. G. Ramachandra, Director, Ground Water Directorate informed the committee that the data collection process has already begun at district level by GWD. Further it was informed that the ABHY water level data being gathered from last season itself may not serve the purpose. Chairman informed that if water level data is available only for one-year suitable weightage to be given and incorporated in the proposed assessment.

Shri. Rahul R Shende, Scientist – B, CGWB, presented the Groundwater Estimation Methodology-2015 and suggested measures to be adopted in resource assessment of 2022 which will be compared with the final results of previous assessment of 2020. Shri Rahul R Shende, Scientist – B, CGWB informed the committee that, the resources in Karnataka were assessed watershed wise further sub-divided into command and non-command later apportioned to taluk. It was also informed that the assessment for Bangalore city is to be taken up during GWRA 2022. Further details of the data required for the present 2022 resource assessment was briefed to the

committee member with the details of time line to be followed. He also explained in details the various recharge and draft aspects involved in the methodology with special reference to the tanks/ponds.

Dr. Lubna Kouser, Assistant Hydrologist, CGWB, SWR, Bangalore informed that during the GWRA 2020, the additional recharge due to tank filling in K.C. Valley and H.N. Valley project area has been considered. It was suggested that the number of recharging days has been increased from 120 to 365 days.

Shri. M.S. Ravi Prakash, Principal Co-ordinator, AICWRM suggested to include Directorate of Economics and Statistics (DES) as member of the Groundwater Resource Assessment Committee as most of the data required for assessment will be available with them. Shri. Rahul R Shende informed that the exercise will be mutually beneficial as the CGWB is also proposing to include the GWRA data in district / state wise socio-economic review reports released by DES.

With respect to industrial ground water draft data, Shri A. Venkataramana, Deputy Director, Industries and Commerce informed that all the industries are not mandated to be registered with the Industries Dept. and only medium and large industries are registered with them.

Based on the agenda and discussions held during the meeting, following decisions were taken.

1. **Finalisation of assessment units** - Regarding the finalisation of the assessment units, it was decided by the committee to consider the 233 taluks as assessment units for the Groundwater Resource assessment of 2022. In addition to this, Bangalore city will also form 1 AU, thus total AU's will be 234. The shape file of 233 AU's had been provided by GWD and the same has been forwarded to CGWB, CHQ, IIT-H and Vassar Labs by CGWB.
2. **Data requirement from various Agencies/Departments** –As per the timelines, the committee was of the opinion that the data compilation was to be completed by 30th April 2022. However, the same is yet to be completed, thus the GWD will direct its field/district level offices to fast track the data collection and compilation from concerned State Govt. offices. The concerned State Govt. Departments especially Minor Irrigation, agriculture, WRDO, RWS will provide information to GWD officials on priority.
3. **Industrial Data** - Ground water draft data based on consumptive pattern to be provided by the Industries Dept. based on the industries registered with the Dept. The spreadsheet for the same will be provided by CGWB.
4. **Time lines to be followed** – The Chairman and Member Secretary of the committee stressed to follow the timelines for GWRA and requested all the line departments to provide the necessary data for the same. They also stressed on the pro-active role to be adopted by GWD and CGWB for its timely completion.
5. Recharge parameters to be taken into due consideration by taking into account tank filling projects initiated by various departments ie., Water Resources Department and Minor Irrigation and Groundwater Development Department

5. **Co-opting of additional Members for data acquisition** – It was decided during the meeting that the following members will be co-opted in the SLC for better co-ordination and data requirement. Based on the minutes of the meeting, the GO is to be issued by Minor Irrigation Dept.

   i. Director, Karnataka State Remote Sensing Application Centre (KSRSAC).
   ii. Commissioner, Rural Development and Panchayat Raj.
   iii. Director, Karnataka State Natural Disaster Monitoring Center (KSNDMC)
   iv. Directorate of Economics and Statistics (DES)
   v. Chief Engineer, Bangalore Water Supply and Sewerage Board

Any other item –

a) The Director, GWD suggested to reconsider the currently used recharge rates for *Recharge due to tanks and ponds* in K.C. Valley, H.N. Valley and other tank filling project areas in the state and sought technical advice from CGWB to proceed in the matter. It was discussed in the meeting that; the infiltration tests and other related studies needs to be carried out to reassess the recharge *factor* considered for *Recharge due to Tanks and Ponds* to calculate the actual recharge taking place in tank filling scheme areas to incorporate the same in the GWRA 2022 computations. The Chairman agreed for the same and asked GWD and CGWB to work collaboratively to arrive at new Infiltration rates. These rates may be used for arriving at the recharge from tanks and ponds after following due procedure.

The meeting concluded with vote of thanks

(C. Mruthyunjaya Swamy)
Secretary (MI & GWDD) &
Chairman of SLC

Members attending the State Level Committee meeting for Ground Water Resource Assessment of Karnataka - 2022 on 22.04.2022 in Room No. 317, 3rd Floor, Vikas Soudha, Bangalore

S. No.	Name	Designation	Department	Contact No.	Email id	Signature
1.	C. Mrithunjaya Swamy	Secretary MI & GWD	MI & GWD	080 22254961		
2.	JYOTHI KUMAR N	Sci E & HOD	CGWB	9717449044		
3.	M S RAVI PRAKASH	Principal Coordinator (representing CE) ACIWRM	ACIWRM	7483024726	registrar@aciwrm.org	
4.	A. Venkataramana	Deputy Director	Industries & Commerce	9986187183		
5.	Vishwanatha. V	EE	RDWSD	9449022028		
6.	B. G. Ramachandra	Director	GWD	9448026139		
7.	G. Jayanna	Deputy Director	GWD	9482582269		
8.	Jagadeshwari. M	Senior Geologist	GWD	9916951		
9.	Nagaraja. H. M.	Senior Geologist	GWD	9980514977		
10.	Veena. L S	AEE	WRDO	9448581848	hydrologyunit@gmail.com	

S. No.	Name	Designation	Department	Contact No.	Email id	Signature
11.	Rashma Kulkarni	AE	WRDO	9611214924	hydrologyunit@gmail.com	
12.	Jyothi M S	V.S MI Expt		9480675350		
13.	Akhila. V	A.E	ACIWRM	7483024739	registrar@aciwrm.org akhilave@aciwrm.org	
14.	Rahul R. Shende	Sc-B	CGWB	9850393338	rdswr-cgwb@nic.in rahulrsm@yahoo.co.in	
15.	Dr. Lubna Kouser	A.H	CGWB	9980150164	lubnakouser-cgwb@gov.in lubnakouser@gmail.com	
16.						
17.						
18.						
19.						
20.						

Annexure-III: MINUTES OF SECOND STATE LEVEL COMMITTEE (SLC) MEETING.

GOVERNMENTOFKARNATAKA

No:MID/24/AJA/2022

Karnataka Government Secretariat
Vikasa Soudha
Bangalore, dated:17.11.2022

From
Secretary to Government
Minor Irrigation Ground Water
Development Department
Government of Karnataka
Vikasa Soudha
Bangalaore560001

To
The Regional Director
Central Ground water Board
27th Main Sector, 17th Cross
HSR Layout Bengaluru-560102

Dear Sir

Sub: Proceedings of the meeting of State Level Committee For Ground Water Resources Assessment- 2022 of Karnataka State held on 19.09.2022.

***

Please find herewith enclosed proceedings of the 2nd meeting of State Level Committee for Ground Water Resources Assessment 2022 for the Karnataka State held on 19.09.2022 under the Chairmanship of the Secretary to Government, Minor Irrigation and Ground water development Department; for kind information and further needful action.

Thanking you

Yours faithfully

(**M.S.JYOTHI**)
Under Secretary to Government
Minor Irrigation Ground Water
Development Department

Copy to:

The Director Ground Water Directorate, 2nd floor, KSFC Bhavan, Thimmaiah Rd Bengaluru, Karnataka560052

MINUTES OF THE 2nd STATE LEVEL COMMITTEE FOR APPROVAL OF GROUND WATER RESOURCES ASSESSMENT – 2022 OF KARNATAKA STATE

The meeting of the 2nd State level Committee (SLC) for Ground Water Resources Assessment - 2022 of Karnataka State was held on 19.09.2022 at 14.00 hrs in room No. 123, Vikas Soudha, Bangalore. Shri C. Mruthyunjaya Swamy, Secretary, Minor Irrigation and Ground Water Development & Chairman of SLC, chaired the meeting. The meeting was attended by various committee members their representatives as per the attached list.

At the outset, Shri N. Jyothi Kumar, Regional Director, CGWB, SWR, Bangalore & Member Secretary welcomed the Chairman, Members & Invitees to the State Level Committee Meeting. He appreciated the efforts put in by the officers of GWRA cells of CGWB, GWD and district level officers of GWD in providing the data required for the resource assessment and carrying out the mammoth task. He informed the committee that, some new features / estimations had been introduced for the first time for Karnataka State viz., resource assessment unit being taluka instead of watershed, Industrial draft computations, Bangalore city resource assessment and Quality Tagging for fluoride, salinity and nitrate.

Shri. Rahul R Shinde, Scientist – B, CGWB, presented the draft results and findings of GWRA 2022. The presentation provided exhaustive information on background, basic concepts, thematic layers and norms used, the break up for areas, recharge and extraction components, comparison with previous resource assessment and improved and deteriorated units etc. He also stressed that enormous data inputs variables to the tune of 97,000 units were dealt in and the resources were assessed based on GEC 2015 methodology using the INGRES software.

During the course of the presentation discussions were held on various topics/issues as listed below:

Number of Assessment Units: Chairman of SLC enquired whether the latest number of taluks has been considered. It was informed by CGWB and GWD that the number of assessment units are the latest and the shape file / layer was obtained from KSRSAC. Representative from Dept. of Economics and Statistics also confirmed the figures.

Command Area: Representative from WRD enquired whether the command area details had also been obtained from CADA. It was informed that the command area map is the latest and was obtained from NWIC and the data was also collected from WRD, GoK at district level.

Recharge from Tanks and Ponds: The Chairman of the committee enquired about the number of days considered for tank / ponds recharge assessment. It was informed that, for the KC valley and HN valley tanks, the number of days were taken as 365 days and also the average water spread area was taken as 100% instead of 60% since these tanks are being filled round the year by secondary treated water. The Chairman advised WRDO to provide the data of tanks/ponds which are being continuously filled with surface water. In response to this CE, WRDO informed that their tanks are getting filled during monsoon only.

Number of irrigation wells: Director ACIWRM enquired whether the electric connections of agriculture sector has been taken into account while estimating the irrigation draft. Smt. Jagadeshwari M, Senior Geologist, GWD informed that the data was collected but could not be used as the source of water for the connection, whether it is for surface water or ground water was not

mentioned. The Chairman of the committee requested ACIWRM to provide that data on number of connections for rationalising the number of irrigation wells at the earliest by 24.09.2022 considering the urgency of the finalisation of the GWRA 2022.

Extraction / Draft for various uses: The Chairman of the committee advised to include, the percentages of various uses in addition to the quantum. The necessary correction in the PPT has been done it was informed that the same is shared with MI dept.

Comparison of GWRA 2022 with 2020: During the presentation, the committee inquired on the reduction of recharge from other sources. It was informed that the recharge due to other sources comprises of recharge due to Canals, SWI, GWI, Tanks and Ponds, WCS, Pipelines etc. It was informed that the reduction is in SWI and GWI recharge only due to less return flow factor being considered based on GWD water level data (which is primarily borewell data), whereas during the last assessment, CGWB water level data was used (which is primarily dugwell data). It was also informed by Shri N. Jyothi Kumar that there is improvement in number of OE and Safe blocks owing to the higher rainfall recharge and increase in recharge due to other sources.

Rationalisation of Stage of Extraction: The Chairman observed that the stage of extraction has increased from 65% in 2020 to 69.93% in 2022 and needs some rationalisation / validation especially in irrigation draft. It was informed to the committee that there is an increase of about 9% in number of irrigation wells as compared to last assessment resulting in increase in irrigation draft and stage of extraction.

Results of Chikkaballapur **and Kolar Districts:** The comparison of GWRA 2020 and 2022 for these districts was also discussed. It was informed that the SOE has improved in Kolar from 200% to 181%, whereas in Chikkaballapur, it has slightly increased from 145% to 146%.

Approval of GWRA 2022: After the presentation and detailed discussions, the GWRA 2022 were provisionally approved by the SLC subject to rationalisation of irrigation draft, data is received from ACIWRM

Any other item –

Pilot Study for Recharge from Tanks and Ponds: The Chairman of the committee enquired whether any pilot / special study can be taken up to assess the impact of the recharge from KC valley and HN valley tanks / ponds to phreatic as well as deeper aquifers in Chikkaballapur and Kolar districts. Dr. K. Sooryanarayana, Consultant, CGWB informed that CGWB has done impact assessment of artificial recharge projects under Central Sector Scheme, however those studies were done long back and the same results may not be applicable in recent scenario. It was informed by Shri N. Jyothi Kumar that scope will be explored in NAQUIM 2.0 for incorporating any special joint study (by CGWB and GWD) in consultation with CGWB, CHQ, Faridabad.

The meeting concluded with the vote of thanks proposed by Shri. G. Jayanna, Deputy Director, GWD, Bangalore.

(C. Mruthyunjaya Swamy)
Secretary (MI & GWDD) & Chairman of SLC

Members attending the 2nd State Level Committee meeting for Ground Water Resource Assessment of Karnataka - 2022 on 19.09.2022 in Room No. 123, Vikas Soudha, Bangalore

S. No.	Name	Designation	Department	Contact No.	Email id	Signature
1.	Sh. C. Mrutyunjaya Swamy	Secretary	MI, GWD			
2.	Shri. Ramachandraiah	Director, GWD	GWD			
3.	Jyothi Kumar Nelli	Regional Director	CGWB	9717449144	[illegible] - cgwb.gov.in	
4.	K.M. Jagadeesh Additional Director	Additional Director	Dept of I&C	9611171199	addldir.pp@gmail.com	
5.	Mohammed Saleem Scientific Officer	Scientific Officer	KSRSAC	9721700708	salim_sirid@yahoo.co.in	
6.	Basavaraj -S-	Additional Director	DES, Bangalore	9448533079		
7.	Shivakumar	JDA	Agriculture	8277229821	agrijt2012@gmail.com	
8.	Dr. P. Somasekhar Rao	Director(T) for Registration	ACIWRM			
9.	Aravind. D. Kanagil	CE ARDO	WRD	9845326025	bngardo@gmail.com	
10.	Shanmukha. V. Bugati	SE RWSLS Dept Bijapur	RWS	9731460321	cerws14@gmail.com	

S. No.	Name	Designation	Department	Contact No.	Email Id	Signature
11.	RANGASWAMY	CE (Design)	B.A.S.S.B	9845[illegible]138	CE design@[illegible].Gov.in	
12.	Bhagyashree	DD	RDPR	9538701289	prcdirdev@gmail.com	
13.	M.S. RAVIPRAKASH	Principal Coordinator-CBE	ACIWRM WRD	74830 24126	raviprakash@aciwrm.org	
14.	SHYLAJA SHIVARAM	EG, AETDD	ACIWRM	9900095247	shylashivaram@aciwrm.org	
15.	Raghavan	CE MI (South)				
16.	Prakash Sahoji	CE MI (North)	MI	9901125305	Sriharip67@gmail.com	
17.	G. Jayanna.	Deputy Director	GWD	9449542169	gwdkar@gmail.com	
18.	Jagadeshwari. M	Senior Geologist	GWD	9916951339	gwdkar@gmail.com	
19.	Nagaraja H.M.	Senior Geologist	GWD	9980514977	gwdkar@gmail.com	
20.	Rahul R. Shende	SC-B	CGWB	9850393338	rdswr-cgwb@wic.in	

Annexure IV: GENERAL DESCRIPTION OF THE GROUND WATER ASSESSMENT UNITS OF KARNATAKA 2022

Sl. No.	District	Taluk	Total Geographical Area (ha)					Rainfall (mm)		
			Recharge Worthy Area (ha)			Hilly Area	Total	Command	Non - Command	Total
			Command	Non - Command	Total					
1	Bagalkot	Badami	35767	70249	106016	560	106576	690.00	470.00	544.22
2	Bagalkot	Bagalkote	5259	81752	87011	6010	93021	695.50	663.50	665.43
3	Bagalkot	Bilagi	58599	10075	68674	9095	77769	745.30	985.70	780.57
4	Bagalkot	Guledagudda	9880	21993	31873	636	32509	640.00	640.00	640.00
5	Bagalkot	Hungund	38820	28376	67196	2937	70133	823.90	699.90	771.54
6	Bagalkot	Ilkal	8072	56948	65020	109	65129	746.20	715.20	719.05
7	Bagalkot	Jamakhandi	30828	48750	79578	6413	85991	652.60	661.60	658.11
8	Bagalkot	Mudhol	49756	35437	85193	1919	87112	664.60	669.10	666.47
9	Bagalkot	RabakaviBanahatti	31517	6302	37819	133	37952	646.20	602.50	638.92
10	Ballari	Ballari	69278	41898	111176	3276	114452	519.00	519.00	519.00
11	Ballari	Kampli	31885	410	32295	185	32480	531.10	531.10	531.10
12	Ballari	Kurugodu	43891	2818	46709	1	46710	499.20	499.20	499.20
13	Ballari	Siraguppa	104419	0	104419	134	104553	667.00	0.00	667.00
14	Ballari	Sonduru	4253	77039	81292	43130	124422	817.00	817.00	817.00
15	Belagavi	Athani	76782	79028	155810	0	155810	449.58	437.53	443.46
16	Belagavi	Bailhongal	4494	71464	75958	58	76016	1165.43	750.00	774.58
17	Belagavi	Belagavi	551	101397	101948	1243	103191	1471.90	1253.81	1254.98
18	Belagavi	Chikkodi	26111	58208	84319	0	84319	753.09	686.97	707.44
19	Belagavi	Gokak	70112	28188	98300	33	98333	332.81	512.94	384.46
20	Belagavi	Hukkeri	15853	82519	98372	0	98372	526.56	789.44	747.08
21	Belagavi	Kagavada	23523	20279	43802	0	43802	353.25	775.85	548.90
22	Belagavi	Khanapur	0	133534	133534	38790	172324	0.00	2094.20	2094.20
23	Belagavi	Kitthuru	0	34014	34014	1981	35995	0.00	1240.05	1240.05
24	Belagavi	Mudalagi	51642	3527	55169	0	55169	715.01	801.30	720.53
25	Belagavi	Nippani	6715	35859	42574	0	42574	1142.00	1267.50	1247.71
26	Belagavi	Raibag	62562	32681	95243	0	95243	428.69	422.36	426.52
27	Belagavi	Ramadurg	69668	50804	120472	914	121386	530.00	530.00	530.00

Sl. No.	District	Taluk	Total Geographical Area (ha)					Rainfall (mm)		
			Recharge Worthy Area (ha)			Hilly Area	Total	Command	Non - Command	Total
			Command	Non - Command	Total					
28	Belagavi	Savadatti	53551	60815	114366	517	114883	578.59	1029.00	818.10
29	Belagavi	Yaragatti	28335	13413	41748	726	42474	859.50	943.10	886.36
30	Bengaluru (Rural)	Devanahalli	0	44710	44710	246	44956	0.00	1207.00	1207.00
31	Bengaluru (Rural)	Doddaballapura	0	74357	74357	5201	79558	0.00	925.00	925.00
32	Bengaluru (Rural)	Hoskote	0	54593	54593	0	54593	0.00	953.00	953.00
33	Bengaluru (Rural)	Nelamangala	0	49991	49991	939	50930	0.00	924.00	924.00
34	Bengaluru (Urban)	Anekal	0	48557	48557	4421	52978	0.00	1060.87	1060.87
35	Bengaluru (Urban)	Bangalore (North)	0	17693	17693	18	17711	0.00	1158.19	1158.19
36	Bengaluru (Urban)	Bangalore City	0	70967	70967	102	71069	0.00	850.57	850.57
37	Bengaluru (Urban)	Bangalore-East	0	13024	13024	0	13024	0.00	1100.00	1100.00
38	Bengaluru (Urban)	Bangalore-South	0	31898	31898	1950	33848	0.00	1055.93	1055.93
39	Bengaluru (Urban)	Yelahanka	0	30887	30887	42	30929	0.00	1008.77	1008.77
40	Bidar	Aurad	3553	73535	77088	0	77088	833.70	833.70	833.70
41	Bidar	Basavakalyan	2902	96160	99062	139	99201	790.00	790.00	790.00
42	Bidar	Bhalki	4760	107424	112184	0	112184	939.40	939.40	939.40
43	Bidar	Bidar	5127	85835	90962	0	90962	854.30	854.30	854.30
44	Bidar	Chittaguppa	1536	44191	45727	0	45727	739.30	739.30	739.30
45	Bidar	Hulasuru	0	21470	21470	0	21470	0.00	859.40	859.40
46	Bidar	Humnabad	1143	51442	52585	0	52585	750.00	750.00	750.00
47	Bidar	Kamalanagara	3376	42860	46236	0	46236	902.30	902.30	902.30
48	Chamarajanagara	Chamarajanagara	30044	74682	104726	16275	121001	1350.00	1350.00	1350.00
49	Chamarajanagara	Gundlupet	2124	112548	114672	23402	138074	829.65	829.65	829.65

Sl. No.	District	Taluk	Total Geographical Area (ha)					Rainfall (mm)		
			Recharge Worthy Area (ha)			Hilly Area	Total	Command	Non - Command	Total
			Command	Non - Command	Total					
50	Chamarajanagara	Kollegala	25060	6483	31543	7292	38835	1050.00	1050.00	1050.00
51	Chamarajanagara	Kollegala(Hanur)	10093	85907	96000	142880	238880	1150.00	1150.00	1150.00
52	Chamarajanagara	Yalandur	11874	2125	13999	13137	27136	1350.00	1350.00	1350.00
53	Chikkaballapura	Bagepalli	0	75818	75818	17430	93248	0.00	975.00	975.00
54	Chikkaballapura	Chikballapur	0	47015	47015	16943	63958	0.00	1150.00	1150.00
55	Chikkaballapura	Chinthamani	0	84882	84882	4443	89325	0.00	856.60	856.60
56	Chikkaballapura	Gauribidanur	0	80266	80266	8625	88891	0.00	814.70	814.70
57	Chikkaballapura	Gudibande	0	20705	20705	2098	22803	0.00	480.00	480.00
58	Chikkaballapura	Shidlagatta	0	64796	64796	2084	66880	0.00	970.00	970.00
59	Chikkamagaluru	Ajjampura	0	48057	48057	2269	50326	0.00	638.84	638.84
60	Chikkamagaluru	Chikmagalur	0	69833	69833	89184	159017	0.00	2073.50	2073.50
61	Chikkamagaluru	Kadur	0	121719	121719	8758	130477	0.00	590.30	590.30
62	Chikkamagaluru	Kalasa	0	4731	4731	38924	43655	0.00	2317.60	2317.60
63	Chikkamagaluru	Koppa	0	26633	26633	29612	56245	0.00	3062.60	3062.60
64	Chikkamagaluru	Mudigere	0	34027	34027	38867	72894	0.00	2317.60	2317.60
65	Chikkamagaluru	Narasimharajapura	0	52321	52321	28544	80865	0.00	1698.40	1698.40
66	Chikkamagaluru	Sringeri	0	14405	14405	30318	44723	0.00	3861.50	3861.50
67	Chikkamagaluru	Tarikere	14356	37412	51768	30978	82746	1390.00	1390.00	1390.00
68	Chitradurga	Challakere	0	206197	206197	1345	207542	0.00	450.00	450.00
69	Chitradurga	Chitradurga	0	125725	125725	12547	138272	0.00	611.72	611.72
70	Chitradurga	Hiriyur	14440	154389	168829	1734	170563	517.00	517.00	517.00
71	Chitradurga	Holalkere	0	98269	98269	11795	110064	0.00	810.00	810.00
72	Chitradurga	Hosadurga	0	138698	138698	4784	143482	0.00	608.00	608.00
73	Chitradurga	Molakalmuru	0	62743	62743	10807	73550	0.00	670.00	670.00
74	Dakshina Kannada	Bantwal	0	63276	63276	10454	73730	0.00	3727.95	3727.95
75	Dakshina Kannada	Belthangady	0	83704	83704	53054	136758	0.00	4437.63	4437.63

Sl. No.	District	Taluk	Total Geographical Area (ha)					Rainfall (mm)		
			Recharge Worthy Area (ha)			Hilly Area	Total	Command	Non - Command	Total
			Command	Non - Command	Total					
76	Dakshina Kannada	Kadaba	0	41658	41658	31938	73596	0.00	4502.70	4502.70
77	Dakshina Kannada	Mangalore	0	56196	56196	450	56646	0.00	3594.90	3594.90
78	Dakshina Kannada	Mudabidri	0	25816	25816	3860	29676	0.00	4250.38	4250.38
79	Dakshina Kannada	Puttur	0	34334	34334	7761	42095	0.00	4450.00	4450.00
80	Dakshina Kannada	Sulya	0	25883	25883	46110	71993	0.00	4450.00	4450.00
81	Davanagere	Channagiri	25855	74143	99998	20737	120735	1010.00	1010.00	1010.00
82	Davanagere	Davanagere	49725	45074	94799	740	95539	641.00	641.00	641.00
83	Davanagere	Harihar	41751	4620	46371	2244	48615	728.00	728.00	728.00
84	Davanagere	Honnali	23008	20190	43198	5854	49052	662.00	662.00	662.00
85	Davanagere	Jagaluru	0	92168	92168	4685	96853	0.00	528.00	528.00
86	Davanagere	Nyamati	8541	24477	33018	4152	37170	825.00	825.00	825.00
87	Dharwad	Alnavara	0	10066	10066	1597	11663	0.00	1401.98	1401.98
88	Dharwad	ANNIGERI	11029	27452	38481	0	38481	663.99	663.99	663.99
89	Dharwad	Dharwad	0	95456	95456	4136	99592	0.00	898.63	898.63
90	Dharwad	Hubballi Nagara	0	17920	17920	109	18029	0.00	691.44	691.44
91	Dharwad	Hubli	4352	50267	54619	665	55284	662.76	662.76	662.76
92	Dharwad	Kalgatgi	0	65719	65719	2650	68369	0.00	865.84	865.84
93	Dharwad	Kundgol	0	64796	64796	0	64796	0.00	592.84	592.84
94	Dharwad	Navalgund	55583	13688	69271	0	69271	795.89	797.20	796.15
95	Gadag	Gadag	28697	79180	107877	1412	109289	714.53	714.53	714.53
96	Gadag	Gajendragad	29	41755	41784	88	41872	647.00	647.00	647.00
97	Gadag	Laxmeshwar	0	42978	42978	383	43361	0.00	801.00	801.00
98	Gadag	Mundargi	42685	38436	81121	7336	88457	592.00	592.00	592.00
99	Gadag	Naragund	43554	0	43554	0	43554	601.00	0.00	601.00
100	Gadag	Rona	55234	31876	87110	0	87110	550.00	550.00	550.00
101	Gadag	Shirahatti	0	48475	48475	3397	51872	0.00	800.00	800.00
102	Hassan	Alur	10559	27056	37615	5292	42907	1149.00	1149.00	1149.00
103	Hassan	Arkalgud	35868	31110	66978	141	67119	886.00	886.00	886.00

Sl. No.	District	Taluk	Total Geographical Area (ha)					Rainfall (mm)		
			Recharge Worthy Area (ha)			Hilly Area	Total	Command	Non - Command	Total
			Command	Non - Command	Total					
104	Hassan	Arsikere	0	115726	115726	10959	126685	0.00	820.00	820.00
105	Hassan	Belur	2707	76432	79139	5245	84384	1020.00	1020.00	1020.00
106	Hassan	Channarayapatna	18439	85639	104078	320	104398	827.00	827.00	827.00
107	Hassan	Hassan	14640	75311	89951	3660	93611	846.00	846.00	846.00
108	Hassan	Holenarasipura	35129	23705	58834	1115	59949	950.00	950.00	950.00
109	Hassan	Sakleshpura	0	43976	43976	58837	102813	0.00	2247.00	2247.00
110	Haveri	Byadagi	6128	36111	42239	1109	43348	718.38	718.38	718.38
111	Haveri	Hangal	20227	56181	76408	528	76936	905.30	905.30	905.30
112	Haveri	Haveri	49929	29388	79317	225	79542	880.60	880.60	880.60
113	Haveri	Hirekerur	0	37600	37600	1455	39055	0.00	1126.24	1126.24
114	Haveri	Ranebennur	69477	19754	89231	585	89816	623.60	623.60	623.60
115	Haveri	Ratteehalli	14083	23253	37336	3571	40907	834.10	834.10	834.10
116	Haveri	Savanur	19448	34170	53618	108	53726	731.72	731.72	731.72
117	Haveri	Shiggaon	7949	50056	58005	429	58434	905.30	905.30	905.30
118	Kalburgi	Afzalpur	41136	89807	130943	0	130943	671.00	671.00	671.00
119	Kalburgi	Aland	6333	152418	158751	0	158751	924.00	924.00	924.00
120	Kalburgi	Chincholi	23506	101224	124730	0	124730	962.00	962.00	962.00
121	Kalburgi	Chittapur	22490	84008	106498	1195	107693	768.00	768.00	768.00
122	Kalburgi	Gulbarga	31401	93889	125290	0	125290	823.00	823.00	823.00
123	Kalburgi	Jevargi	107930	148	108078	0	108078	827.00	827.00	827.00
124	Kalburgi	Kalagi	15598	56376	71974	0	71974	862.60	862.60	862.60
125	Kalburgi	Kamalapura	8990	61198	70188	0	70188	839.50	839.50	839.50
126	Kalburgi	Sedam	3665	98844	102509	67	102576	886.00	886.00	886.00
127	Kalburgi	Shahbadha	20679	702	21381	0	21381	789.50	789.50	789.50
128	Kalburgi	Yadrami	70084	5841	75925	0	75925	799.10	799.10	799.10
129	Kodagu	Kushalanagara	5287	18032	23319	8106	31425	962.00	1266.63	1197.57
130	Kodagu	Madikeri	0	37652	37652	108397	146049	0.00	3966.07	3966.07
131	Kodagu	Ponnampete	0	79173	79173	23289	102462	0.00	2066.53	2066.53

Sl. No.	District	Taluk	Total Geographical Area (ha)					Rainfall (mm)		
			Recharge Worthy Area (ha)			Hilly Area	Total	Command	Non - Command	Total
			Command	Non - Command	Total					
132	Kodagu	Somavarapete	0	28703	28703	39952	68655	0.00	1983.38	1983.38
133	Kodagu	VIRAJPET	0	33736	33736	29012	62748	0.00	1511.39	1511.39
134	Kolara	BANGARPET	0	49825	49825	3151	52976	0.00	764.30	764.30
135	Kolara	K.G.F	0	32939	32939	414	33353	0.00	889.70	889.70
136	Kolara	Kolar	0	75620	75620	3677	79297	0.00	840.00	840.00
137	Kolara	Malur	0	63095	63095	1405	64500	0.00	798.40	798.40
138	Kolara	Mulabagilu	0	81337	81337	1076	82413	0.00	895.00	895.00
139	Kolara	Srinivaspura	0	79947	79947	6507	86454	0.00	757.50	757.50
140	Koppal	Gangavathi	25825	9899	35724	8953	44677	577.15	585.50	579.46
141	Koppal	Kanakagiri	1890	44938	46828	2406	49234	700.00	700.00	700.00
142	Koppal	Karatagi	37115	2579	39694	0	39694	616.25	616.25	616.25
143	Koppal	koppal	56943	75431	132374	5895	138269	620.59	626.90	624.19
144	Koppal	Kukanuru	51	65679	65730	0	65730	661.80	661.80	661.80
145	Koppal	Kushtagi	86038	49766	135804	437	136241	604.83	658.30	624.42
146	Koppal	Yelburga	22257	61455	83712	47	83759	594.60	596.80	596.22
147	Mandya	Krishnarajpet	60965	27618	88583	386	88969	691.97	691.97	691.97
148	Mandya	Maddur	43440	17697	61137	269	61406	1019.68	1019.68	1019.68
149	Mandya	Malavalli	38662	33810	72472	8956	81428	960.00	960.00	960.00
150	Mandya	Mandya	64899	6045	70944	379	71323	728.55	728.55	728.55
151	Mandya	Nagamangala	52867	49820	102687	869	103556	632.26	632.26	632.26
152	Mandya	Pandavpura	38982	12679	51661	1719	53380	739.49	739.49	739.49
153	Mandya	Srirangapatna	22279	11980	34259	1250	35509	772.85	772.85	772.85
154	Mysuru	Heggadadevanakote	20117	79383	99500	5147	104647	832.00	832.00	832.00
155	Mysuru	Hunsur	21318	67990	89308	202	89510	796.00	796.00	796.00
156	Mysuru	K.R.Nagar	36487	24232	60719	0	60719	829.00	829.00	829.00
157	Mysuru	Mysuru	28107	51946	80053	1003	81056	823.00	823.00	823.00
158	Mysuru	Nanjangud	42765	52784	95549	2204	97753	711.00	711.00	711.00
159	Mysuru	Piriyapatna	14182	63786	77968	2767	80735	848.00	848.00	848.00

Sl. No.	District	Taluk	Total Geographical Area (ha)					Rainfall (mm)		
			Recharge Worthy Area (ha)			Hilly Area	Total	Command	Non - Command	Total
			Command	Non - Command	Total					
160	Mysuru	Saraguru	5134	43579	48713	8025	56738	832.00	832.00	832.00
161	Mysuru	T.Narasipura	52868	6967	59835	63	59898	748.00	748.00	748.00
162	Raichur	Devdurga	60829	85575	146404	4248	150652	410.00	410.00	410.00
163	Raichur	Lingasugur	53815	91381	145196	337	145533	410.00	410.00	410.00
164	Raichur	Manvi	76768	1077	77845	0	77845	660.00	660.00	660.00
165	Raichur	Maski	33484	80851	114335	1606	115941	565.00	565.00	565.00
166	Raichur	Raichur	59662	95972	155634	938	156572	495.00	495.00	495.00
167	Raichur	Sindhanur	111525	13992	125517	616	126133	634.00	634.00	634.00
168	Raichur	Sirivara	47505	26231	73736	580	74316	572.00	572.00	572.00
169	Ramanagara	Channapatna	6121	41069	47190	6905	54095	861.40	1198.50	1154.77
170	Ramanagara	Harohalli	1355	28381	29736	20519	50255	1183.80	1183.80	1183.80
171	Ramanagara	Kanakpura	11222	58995	70217	35730	105947	1173.80	1173.80	1173.80
172	Ramanagara	Magadi	102	72158	72260	7225	79485	950.00	950.00	950.00
173	Ramanagara	Ramanagar	4843	49752	54595	8433	63028	1177.00	1177.00	1177.00
174	Shivamogga	Bhadravathi	37141	18141	55282	13975	69257	732.89	865.70	776.47
175	Shivamogga	Hosanagar	0	100540	100540	41848	142388	0.00	3070.80	3070.80
176	Shivamogga	Sagara	119	139350	139469	53778	193247	2494.50	2494.50	2494.50
177	Shivamogga	Shikaripura	20234	60127	80361	10825	91186	981.73	975.20	976.85
178	Shivamogga	Shimoga	23581	70589	94170	17454	111624	726.36	842.30	813.27
179	Shivamogga	Soraba	0	112423	112423	2368	114791	0.00	1541.00	1541.00
180	Shivamogga	Thirthahalli	0	92486	92486	32338	124824	0.00	2866.80	2866.80
181	Tumakuru	Chiknayakanahalli	0	103246	103246	9509	112755	0.00	760.70	760.70
182	Tumakuru	Gubbi	61562	49281	110843	11292	122135	809.40	809.40	809.40
183	Tumakuru	Koratagere	0	59858	59858	4925	64783	0.00	777.30	777.30
184	Tumakuru	Kunigal	46588	47191	93779	4485	98264	824.90	824.90	824.90
185	Tumakuru	Madhugiri	0	100636	100636	10808	111444	0.00	730.30	730.30
186	Tumakuru	Pavagada	0	120395	120395	16113	136508	0.00	670.00	670.00
187	Tumakuru	Sira	0	153702	153702	1568	155270	0.00	637.70	637.70

Sl. No.	District	Taluk	Total Geographical Area (ha)					Rainfall (mm)		
			Recharge Worthy Area (ha)			Hilly Area	Total	Command	Non - Command	Total
			Command	Non - Command	Total					
188	Tumakuru	Tiptur	15414	60609	76023	2382	78405	730.70	730.70	730.70
189	Tumakuru	Tumkur	12334	83007	95341	7496	102837	830.40	830.40	830.40
190	Tumakuru	Turuvekere	66249	11525	77774	150	77924	772.10	772.10	772.10
191	Udupi	Bramhavara	0	40109	40109	3	40112	0.00	4131.76	4131.76
192	Udupi	Bynduru	0	34691	34691	22814	57505	0.00	4752.95	4752.95
193	Udupi	Hebri	0	24881	24881	20102	44983	0.00	4835.20	4835.20
194	Udupi	Kapu	0	21996	21996	66	22062	0.00	3868.07	3868.07
195	Udupi	Karkala	0	57885	57885	14444	72329	0.00	4762.02	4762.02
196	Udupi	Kundapur	0	76746	76746	12174	88920	0.00	4391.66	4391.66
197	Udupi	Udupi	0	30690	30690	471	31161	0.00	3901.77	3901.77
198	Uttara Kannada	Ankola	0	35471	35471	55903	91374	0.00	3587.00	3587.00
199	Uttara Kannada	Bhatkal	0	17566	17566	18536	36102	0.00	4610.00	4610.00
200	Uttara Kannada	Dandelli	0	27449	27449	314	27763	0.00	1850.00	1850.00
201	Uttara Kannada	Haliyal	0	56818	56818	600	57418	0.00	1328.00	1328.00
202	Uttara Kannada	Honnavar	0	33896	33896	41300	75196	0.00	3729.00	3729.00
203	Uttara Kannada	Joida	0	97825	97825	92663	190488	0.00	2398.00	2398.00
204	Uttara Kannada	Karwar	0	28890	28890	45398	74288	0.00	3240.00	3240.00
205	Uttara Kannada	Kumta	0	30548	30548	28461	59009	0.00	3588.00	3588.00
206	Uttara Kannada	Mundgod	0	65442	65442	2286	67728	0.00	1403.00	1403.00
207	Uttara Kannada	Siddapur	0	58810	58810	27455	86265	0.00	3071.00	3071.00
208	Uttara Kannada	Sirsi	0	101953	101953	30329	132282	0.00	2489.00	2489.00
209	Uttara Kannada	Yellapur	0	103880	103880	27898	131778	0.00	2771.00	2771.00
210	Vijayanagara	Hadagali	27349	63882	91231	3256	94487	642.00	642.00	642.00
211	Vijayanagara	Hagaribommanahalli	4926	82120	87046	390	87436	717.00	717.00	717.00
212	Vijayanagara	Harapanahalli	5714	131263	136977	6634	143611	769.10	769.10	769.10
213	Vijayanagara	Hospet	19650	42578	62228	9877	72105	700.00	700.00	700.00
214	Vijayanagara	Kotturu	0	54714	54714	347	55061	0.00	680.00	680.00
215	Vijayanagara	Kudligi	0	107557	107557	6508	114065	0.00	604.00	604.00

Sl. No.	District	Taluk	Total Geographical Area (ha)					Rainfall (mm)		
			Recharge Worthy Area (ha)			Hilly Area	Total	Command	Non - Command	Total
			Command	Non - Command	Total					
216	Vijayapura	Alamela	59724	58	59782	0	59782	619.00	619.00	619.00
217	Vijayapura	Babaleshwara	67602	15706	83308	0	83308	626.00	626.00	626.00
218	Vijayapura	BasavanBagewadi	97225	6477	103702	0	103702	567.00	567.00	567.00
219	Vijayapura	Bijapur	67459	27917	95376	0	95376	626.00	626.00	626.00
220	Vijayapura	Chadachana	54788	14499	69287	0	69287	602.00	602.00	602.00
221	Vijayapura	DevaraHipparagi	71823	219	72042	0	72042	522.00	522.00	522.00
222	Vijayapura	Indi	147329	6073	153402	0	153402	602.00	602.00	602.00
223	Vijayapura	Kolhara	37084	6978	44062	0	44062	623.00	623.00	623.00
224	Vijayapura	Muddebihal	84276	8198	92474	0	92474	400.00	400.00	400.00
225	Vijayapura	Nidagundi	31253	6407	37660	0	37660	623.00	623.00	623.00
226	Vijayapura	Sindagi	80897	37	80934	0	80934	570.00	570.00	570.00
227	Vijayapura	Talikote	72356	101	72457	0	72457	586.00	586.00	586.00
228	Vijayapura	Tikota	67983	17835	85818	0	85818	626.00	626.00	626.00
229	Yadgir	Gurumithakala	0	66927	66927	3698	70625	0.00	969.95	969.95
230	Yadgir	Hunisigi	65492	17597	83089	0	83089	770.24	770.24	770.24
231	Yadgir	Shahapur	99979	0	99979	0	99979	1000.00	1000.00	1000.00
232	Yadgir	Shorapur	87390	13844	101234	0	101234	874.00	874.00	874.00
233	Yadgir	Vadagera	70722	276	70998	0	70998	880.00	880.00	880.00
234	Yadgir	Yadgir	25695	67360	93055	8519	101574	1021.00	935.00	958.75
total			5064596	12000114	17064710	2120446	19185156	**692.92**	**1195.48**	**1046.33**

Annexure VA: ASSESSMENT OF DYNAMIC GROUND WATER RESOURCES OF *KARNATAKA(RECHARGE COMPONENT) – GWRA 2022*

Sl. No.	District	Assessment Unit Name	Recharge from Rainfall-Monsoon (Ham)	Recharge from Other Sources-Monsoon (Ham)	Recharge from Rainfall-Non-Monsoon (Ham)	Recharge from Other Sources-Non-Monsoon (Ham)	Total AnnualGround Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource(Ham)
1	Bagalkot	Badami	2866.54	2231.48	149.84	1656.96	6904.82	690.48	6214.34
2	Bagalkot	Bagalkote	3239.04	3544.43	349.14	5149.24	12281.85	1228.19	11053.66
3	Bagalkot	Bilagi	2306.97	982.37	135.96	1605.52	5030.82	503.09	4527.73
4	Bagalkot	Guledagudda	939.03	883.7	45.32	991	2859.05	216.22	2642.83
5	Bagalkot	Hungund	2263.18	1348.62	438.68	2759.28	6809.76	680.98	6128.78
6	Bagalkot	Ilkal	2475.49	886.1	424.91	1678.54	5465.04	546.5	4918.54
7	Bagalkot	Jamakhandi	2696	1759.53	332.86	1795.15	6583.54	658.35	5925.19
8	Bagalkot	Mudhol	2766.26	3117.4	486.51	3726.67	10096.84	1009.69	9087.15
9	Bagalkot	RabakaviBanahatti	1263.19	5962.44	127.89	6096.6	13450.12	1345.01	12105.11
10	Ballari	Ballari	3221.51	5371.34	661.68	4773.21	14027.74	1402.78	12624.96
11	Ballari	Kampli	847.6	4591.58	110.75	4828.35	10378.28	1037.83	9340.45
12	Ballari	Kurugodu	1128.66	4029.21	190.56	3563.38	8911.81	891.17	8020.64
13	Ballari	Siraguppa	3583.76	7488.94	316.49	618.46	12007.65	1200.77	10806.88
14	Ballari	Sonduru	5820.81	743.94	827.2	1542.5	8934.45	893.44	8041.01
15	Belagavi	Athani	2576.33	1967.52	1169.66	1387	7100.51	710.05	6390.46
16	Belagavi	Bailhongal	2703.39	791.44	1016.64	1239.52	5750.99	521.58	5229.41
17	Belagavi	Belagavi	6605.7	2704.06	1550.58	3264.42	14124.76	706.24	13418.52
18	Belagavi	Chikkodi	3003.9	3289.44	690.66	6219.19	13203.19	1320.31	11882.88
19	Belagavi	Gokak	1847.44	2304.99	576.85	2843.9	7573.18	757.32	6815.86
20	Belagavi	Hukkeri	3747.32	4039.46	992.77	6422.98	15202.53	1520.26	13682.27
21	Belagavi	Kagavada	1048.64	457.01	472.54	428.7	2406.89	240.69	2166.19

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22	Belagavi	Khanapur	12255.61	1329.56	1916.97	880.82	16382.96	831.12	15551.84
23	Belagavi	Kitthuru	1806.01	277.32	857.02	380.33	3320.68	332.06	2988.62
24	Belagavi	Mudalagi	1903.92	1981.19	617.34	2443.96	6946.41	694.64	6251.77
25	Belagavi	Nippani	2139.17	3363.62	835.54	4428.14	10766.47	1076.65	9689.82
26	Belagavi	Raibag	2059.52	2699.97	558.61	3428.51	8746.61	874.66	7871.95
27	Belagavi	Ramadurg	2521.85	516.17	898.64	842.76	4779.42	477.95	4301.48
28	Belagavi	Savadatti	3758.97	1719.57	2107.03	3192.88	10778.45	1077.85	9700.6
29	Belagavi	Yaragatti	1297.15	1199.12	917.24	1386.56	4800.07	480.01	4320.06
30	Bengaluru (Rural)	Devanahalli	2282.49	603.45	739.55	1269.21	4894.7	489.47	4405.23
31	Bengaluru (Rural)	Doddaballapura	2433.33	836.67	1418.36	1652.21	6340.57	634.06	5706.51
32	Bengaluru (Rural)	Hoskote	2224.18	696.68	1505.12	1407.82	5833.8	583.38	5250.42
33	Bengaluru (Rural)	Nelamangala	1826.09	370.93	1647.52	717.85	4562.39	456.24	4106.15
34	Bengaluru (Urban)	Anekal	2786.06	1676.25	1050.54	1893.13	7405.98	740.6	6665.38
35	Bengaluru (Urban)	Bangalore (North)	1091.08	240.85	439.44	370.96	2142.33	214.23	1928.1
36	Bengaluru (Urban)	Bangalore City	1871.48	246.49	120.47	264.59	2503.03	125.15	2377.88
37	Bengaluru (Urban)	Bangalore-East	790.82	439.93	272.2	804.12	2307.07	230.71	2076.36
38	Bengaluru (Urban)	Bangalore-South	1710.34	1154.67	826.1	1560.49	5251.6	525.16	4726.44
39	Bengaluru (Urban)	Yelahanka	1879.27	350.76	862.62	734.24	3826.89	382.69	3444.2
40	Bidar	Aurad	4145.38	387.87	117.8	363.42	5014.47	501.46	4513.01
41	Bidar	Basavakalyan	5109.59	411.93	82.52	493.34	6097.38	609.74	5487.64

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42	Bidar	Bhalki	5808.65	566.08	141.83	868.78	7385.34	738.53	6646.81
43	Bidar	Bidar	5128.54	561.02	37.38	577.24	6304.18	630.42	5673.76
44	Bidar	Chittaguppa	2232.04	451.24	22.63	326.51	3032.42	303.25	2729.17
45	Bidar	Hulasuru	1224.49	583.56	12.86	325.72	2146.63	214.67	1931.96
46	Bidar	Humnabad	2760.72	108.77	0	156.98	3026.47	302.65	2723.82
47	Bidar	Kamalanagara	2796.23	141.91	6.05	513.48	3457.67	345.76	3111.91
48	Chamarajanagara	Chamarajanagara	7023.46	694.57	1903.09	2442.55	12063.67	1206.37	10857.3
49	Chamarajanagara	Gundlupet	4918.5	936.29	1177.45	1450.42	8482.66	429.37	8053.29
50	Chamarajanagara	Kollegala	1891.82	1289.03	649.15	2039.09	5869.09	586.9	5282.18
51	Chamarajanagara	Kollegala(Hanur)	4388.45	431.97	1474.73	1412.16	7707.31	451.61	7255.7
52	Chamarajanagara	Yalandur	1325.4	369.68	370.31	1582.5	3647.89	343.21	3304.68
53	Chikkaballapura	Bagepalli	3996.37	920.93	971.23	1422.17	7310.7	731.07	6579.63
54	Chikkaballapura	Chikballapur	2823.72	832.23	674.67	1458.51	5789.13	578.92	5210.21
55	Chikkaballapura	Chinthamani	3793.86	1170.03	677.53	2452.58	8094	809.4	7284.6
56	Chikkaballapura	Gauribidanur	3833.22	1086.29	467.64	1998.94	7386.09	738.61	6647.48
57	Chikkaballapura	Gudibande	577.42	143.84	75.37	222.96	1019.59	101.96	917.63
58	Chikkaballapura	Shidlagatta	3452.64	911.04	541.95	1615.05	6520.68	652.07	5868.61
59	Chikkamagaluru	Ajjampura	1635.37	1109.73	356.43	1383.77	4485.3	448.53	4036.77
60	Chikkamagaluru	Chikmagalur	11077.46	2290.61	383.41	1343.62	15095.1	1509.51	13585.59
61	Chikkamagaluru	Kadur	2805.87	2290.8	1189.18	1807.37	8093.22	404.66	7688.56
62	Chikkamagaluru	Kalasa	475.65	5.04	19.45	5.68	505.82	50.58	455.24
63	Chikkamagaluru	Koppa	3737.57	871.78	0	317.87	4927.22	492.73	4434.49

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64	Chikkamagaluru	Mudigere	4276.3	984.05	139.91	382.96	5783.22	578.33	5204.89
65	Chikkamagaluru	Narasimharajapura	3847.53	968.14	166.86	359.18	5341.71	534.17	4807.54
66	Chikkamagaluru	Sringeri	2178.04	631.39	0	239.25	3048.68	304.87	2743.81
67	Chikkamagaluru	Tarikere	4278.94	2956.41	1039.5	2633.44	10908.29	1090.83	9817.46
68	Chitradurga	Challakere	5328.3	1070.05	1052.84	1263.9	8715.09	871.51	7843.58
69	Chitradurga	Chitradurga	4171.57	488.25	830.55	758.03	6248.4	624.84	5623.56
70	Chitradurga	Hiriyur	4653.6	1095.83	978.01	2422.96	9150.4	915.04	8235.36
71	Chitradurga	Holalkere	4284.14	1190.94	887.37	516.66	6879.11	687.91	6191.2
72	Chitradurga	Hosadurga	4394.62	868.17	1060.21	1714.11	8037.11	803.71	7233.4
73	Chitradurga	Molakalmuru	2392.01	174.78	1033.38	454.28	4054.45	405.45	3649
74	Dakshina Kannada	Bantwal	10783.85	798.05	1260.7	1548.26	14390.86	719.55	13671.31
75	Dakshina Kannada	Belthangady	12656.04	894.75	2889.33	1636.67	18076.79	1807.68	16269.11
76	Dakshina Kannada	Kadaba	6298.69	328.93	1608.85	519.91	8756.38	875.64	7880.74
77	Dakshina Kannada	Mangalore	8860.99	547.77	1130.76	840.81	11380.33	1138.04	10242.29
78	Dakshina Kannada	Mudabidri	3903.38	270.71	613.99	420.09	5208.17	520.82	4687.35
79	Dakshina Kannada	Puttur	4660.79	317.27	1339.03	500.57	6817.66	340.88	6476.78
80	Dakshina Kannada	Sulya	3578.07	332.96	1076.73	530.8	5518.56	551.85	4966.71
81	Davanagere	Channagiri	5058.41	2470.43	1042.98	2462.24	11034.06	1103.4	9930.66
82	Davanagere	Davanagere	3058.67	3485.29	609.84	4142.05	11295.85	1129.58	10166.27
83	Davanagere	Harihar	2031.12	13325.14	414.47	198.13	15968.86	1596.89	14371.97
84	Davanagere	Honnali	1397.99	2708.68	322.95	3029.17	7458.79	745.88	6712.91
85	Davanagere	Jagaluru	2564.19	555.48	588.4	1175.67	4883.74	488.38	4395.36
86	Davanagere	Nyamati	1524.69	2346.23	197.61	2560.79	6629.32	662.93	5966.39

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87	Dharwad	Alnavara	489.28	1198.32	301.02	951.67	2940.29	294.03	2646.26
88	Dharwad	ANNIGERI	893.81	843.1	319.63	694.38	2750.92	183.83	2567.09
89	Dharwad	Dharwad	4698.7	786.93	888.07	1668.75	8042.45	804.24	7238.21
90	Dharwad	Hubballi Nagara	558.96	240.82	134.92	28.04	962.74	96.28	866.46
91	Dharwad	Hubli	1827.74	862.54	462.48	601.5	3754.26	375.43	3378.83
92	Dharwad	Kalgatgi	3262.42	517.04	467.84	963.65	5210.95	521.1	4689.85
93	Dharwad	Kundgol	1969.21	972.86	510.14	786.01	4238.22	423.83	3814.39
94	Dharwad	Navalgund	1791.76	877.95	848.7	883.08	4401.49	440.15	3961.34
95	Gadag	Gadag	3054.63	2096.11	1416.24	2085.72	8652.7	865.27	7787.42
96	Gadag	Gajendragad	1194.32	22.73	518.58	221.89	1957.52	195.7	1761.82
97	Gadag	Laxmeshwar	1598.94	172.02	595.37	398.19	2764.52	276.46	2488.06
98	Gadag	Mundargi	1856.54	4837.72	919.89	1085.21	8699.36	869.94	7829.42
99	Gadag	Naragund	890.85	311.58	304.66	683.92	2191.01	219.1	1971.91
100	Gadag	Rona	1803.17	505.59	413.77	441.85	3164.38	316.44	2847.94
101	Gadag	Shirahatti	1766.04	82.07	668.96	382.42	2899.49	289.95	2609.54
102	Hassan	Alur	2008.78	1888.51	73.99	1298.72	5270	527	4743
103	Hassan	Arkalgud	3399.26	5044.79	212.86	2765.5	11422.41	1142.23	10280.18
104	Hassan	Arsikere	6007.57	2137.82	307.83	2149.23	10602.45	1060.25	9542.2
105	Hassan	Belur	3352.26	3055.73	365.63	1854.14	8627.76	862.78	7764.98
106	Hassan	Channarayapatna	5237.43	4470.3	322.75	6412.88	16443.36	1644.35	14799.01
107	Hassan	Hassan	3483.74	4576.55	312.33	3512.7	11885.32	1188.53	10696.79

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108	Hassan	Holenarasipura	3938.45	3226.83	266.69	3231.32	10663.29	949.76	9713.53
109	Hassan	Sakleshpura	4556.65	1174.04	0	488.63	6219.32	621.93	5597.39
110	Haveri	Byadagi	1301.61	1848.83	587.68	926.54	4664.66	466.46	4198.2
111	Haveri	Hangal	3316.57	5144.74	982.26	1529.69	10973.26	1097.32	9875.93
112	Haveri	Haveri	3477.5	2787.75	1013.49	864.79	8143.53	814.36	7329.17
113	Haveri	Hirekerur	2439.83	400.08	541.37	692.53	4073.81	407.38	3666.43
114	Haveri	Ranebennur	1794.04	7176.56	1238.92	1475.23	11684.75	1168.48	10516.27
115	Haveri	Ratteehalli	1487.98	1718.64	503.96	525.9	4236.48	423.64	3812.84
116	Haveri	Savanur	1711.84	2255.28	770.53	674.08	5411.73	541.18	4870.55
117	Haveri	Shiggaon	2573.82	862.46	745.68	427.59	4609.55	460.96	4148.59
118	Kalburgi	Afzalpur	5608.5	530.67	246.57	892.18	7277.92	727.79	6550.13
119	Kalburgi	Aland	9875.96	896.49	0	1677.08	12449.53	1244.95	11204.58
120	Kalburgi	Chincholi	6620.9	493.75	0	959.1	8073.75	807.37	7266.38
121	Kalburgi	Chittapur	5304.24	598.08	142.59	656.04	6700.95	670.09	6030.86
122	Kalburgi	Gulbarga	6553.02	451.59	230.81	781.76	8017.18	801.72	7215.46
123	Kalburgi	Jevargi	5455.6	916.27	173.35	1194.27	7739.49	773.95	6965.54
124	Kalburgi	Kalagi	3192.56	98.86	43.7	169.5	3504.62	175.23	3329.39
125	Kalburgi	Kamalapura	3873.83	239.07	71.49	310.04	4494.43	449.45	4044.98
126	Kalburgi	Sedam	5582.1	576.96	2.9	532.02	6693.98	344.05	6349.93
127	Kalburgi	Shahbadha	945.86	139.22	29.55	45.79	1160.42	116.05	1044.37
128	Kalburgi	Yadrami	2716.69	543.8	125.05	494.27	3879.81	214.29	3665.51
129	Kodagu	Kushalanagara	1567.19	2510.08	25.46	1389.76	5492.49	549.26	4943.23
130	Kodagu	Madikeri	6099.62	106.04	0	91.67	6297.33	629.74	5667.59

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131	Kodagu	Ponnampete	9764.72	447.07	0	508.1	10719.89	1071.99	9647.9
132	Kodagu	Somavarapete	3305.13	559.71	0	596.75	4461.59	446.16	4015.43
133	Kodagu	VIRAJPET	2521.47	358.09	0	348.84	3228.4	322.84	2905.56
134	Kolara	BANGARPET	2236.01	469.05	634.79	1948.95	5288.8	528.88	4759.92
135	Kolara	K.G.F	1551.79	465.38	441.75	1581.47	4040.39	404.04	3636.35
136	Kolara	Kolar	3150.63	1766.41	931.64	3618.91	9467.59	946.76	8520.83
137	Kolara	Malur	2678.4	461.57	589	2144.1	5873.07	587.31	5285.76
138	Kolara	Mulabagilu	4048.34	1444.91	935.94	5614.26	12043.45	1204.35	10839.1
139	Kolara	Srinivaspura	3452.03	520.27	708.45	1559.32	6240.07	624.01	5616.06
140	Koppal	Gangavathi	1048.26	12176.2	110.98	1414.79	14750.23	1475.03	13275.2
141	Koppal	Kanakagiri	1560.72	3392.45	262.23	2472.26	7687.66	768.77	6918.89
142	Koppal	Karatagi	1247.37	8212.81	122.47	443.81	10026.46	1002.64	9023.81
143	Koppal	koppal	4082.19	7040.78	544.87	2509.47	14177.31	1417.73	12759.58
144	Koppal	Kukanuru	2493.53	1138.3	358.06	1949.74	5939.63	593.96	5345.67
145	Koppal	Kushtagi	3996.68	4103.43	564.34	4208.49	12872.94	1046.32	11826.62
146	Koppal	Yelburga	2817.34	1910.39	339.26	1544.18	6611.17	661.11	5950.06
147	Mandya	Krishnarajpet	2909.9	2288.02	377.73	2345	7920.65	486.9	7433.75
148	Mandya	Maddur	3273.89	3317.7	396.32	3897.27	10885.18	1088.51	9796.67
149	Mandya	Malavalli	5418.36	5144.37	410.48	4702.94	15676.15	1567.62	14108.53
150	Mandya	Mandya	2617.84	5106.7	276.58	4695.52	12696.64	1269.66	11426.98
151	Mandya	Nagamangala	3731.21	2758.47	362.63	3454.56	10306.87	811.76	9495.11
152	Mandya	Pandavpura	1997.46	2361.39	326.49	2404.7	7090.04	709	6381.03
153	Mandya	Srirangapatna	1161.07	2766.03	234.35	2457.95	6619.4	661.94	5957.46

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154	Mysuru	Heggadadevanakote	4845.97	1897.95	597.59	1176.01	8517.52	851.75	7665.77
155	Mysuru	Hunsur	4264.06	3293.84	427.61	534.17	8519.68	851.96	7667.72
156	Mysuru	K.R.Nagar	3009.74	2513.78	310.7	1211.39	7045.61	704.56	6341.05
157	Mysuru	Mysuru	3884.71	1357.72	452.22	860.9	6555.55	655.55	5900
158	Mysuru	Nanjangud	4060.41	2585.44	420.7	1509.39	8575.94	857.6	7718.34
159	Mysuru	Piriyapatna	3508.38	2581.7	377.68	1471.18	7938.94	481.95	7456.99
160	Mysuru	Saraguru	2330.81	883.04	292.57	507.29	4013.71	401.36	3612.35
161	Mysuru	T.Narasipura	2551.77	3355.15	294.03	2611.68	8812.63	881.26	7931.37
162	Raichur	Devdurga	4391.49	1791.92	493.85	1178.5	7855.76	785.57	7070.19
163	Raichur	Lingasugur	4061.97	944.28	458.67	169.89	5634.81	405.88	5228.93
164	Raichur	Manvi	3668.17	7469.25	531.7	69.22	11738.34	1173.83	10564.51
165	Raichur	Maski	4104.4	2404.17	480.09	1583.26	8571.92	857.19	7714.73
166	Raichur	Raichur	5405.11	2558.46	399.53	1785.65	10148.75	1014.87	9133.88
167	Raichur	Sindhanur	3723.97	12727.06	813.61	282.56	17547.2	1754.72	15792.47
168	Raichur	Sirivara	3124.8	7944.46	583	58.06	11710.32	1171.04	10539.28
169	Ramanagara	Channapatna	2034.16	2660.62	1017.49	1747.59	7459.86	745.98	6713.87
170	Ramanagara	Harohalli	1726.24	2968.1	782.61	1461.55	6938.5	693.85	6244.65
171	Ramanagara	Kanakpura	4842.19	4166.67	1922.28	2911.95	13843.09	1384.3	12458.79
172	Ramanagara	Magadi	2935.45	2575.8	903.8	675.04	7090.09	709.02	6381.07
173	Ramanagara	Ramanagar	4187.33	1568.75	1734.38	1533	9023.46	902.33	8121.13
174	Shivamogga	Bhadravathi	2143.86	5638.19	259.94	4085.47	12127.46	1212.74	10914.72
175	Shivamogga	Hosanagar	14313.76	455.55	0	132.92	14902.23	1490.22	13412.01
176	Shivamogga	Sagara	16139.52	1968.38	0	880.97	18988.87	1898.89	17089.98

Sl. No.	District	Assessment Unit Name	Recharge from Rainfall-Monsoon (Ham)	Recharge from Other Sources-Monsoon (Ham)	Recharge from Rainfall-Non-Monsoon (Ham)	Recharge from Other Sources-Non-Monsoon (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource(Ham)
177	Shivamogga	Shikaripura	4698.92	5629.81	480.25	1713.73	12522.71	1252.28	11270.43
178	Shivamogga	Shimoga	4378.45	3853.62	496.23	3094.74	11823.04	1182.31	10640.74
179	Shivamogga	Soraba	11489.87	2257.19	55.09	1614.61	15416.76	770.84	14645.92
180	Shivamogga	Thirthahalli	12436.95	780.34	0	811.56	14028.85	1402.89	12625.96
181	Tumakuru	Chiknayakanahalli	4121.51	880.68	963.61	719.61	6685.41	668.54	6016.87
182	Tumakuru	Gubbi	4536.29	2617.94	1021.55	1879.09	10054.87	665.36	9389.51
183	Tumakuru	Koratagere	3504.83	483.31	875.96	512.57	5376.67	537.66	4839.01
184	Tumakuru	Kunigal	3961.64	2113.28	1030.69	2596.45	9702.06	970.2	8731.86
185	Tumakuru	Madhugiri	5590.4	964.48	1103.3	1144.33	8802.51	880.25	7922.26
186	Tumakuru	Pavagada	5582.48	585.51	510.47	611.72	7290.18	729.02	6561.16
187	Tumakuru	Sira	4370.69	1498.73	1118.2	2064.56	9052.18	905.22	8146.96
188	Tumakuru	Tiptur	2673.34	1038.56	883.02	953.26	5548.18	554.82	4993.36
189	Tumakuru	Tumkur	5637.5	1909.95	979.78	2244.32	10771.55	1077.16	9694.39
190	Tumakuru	Turuvekere	2995.32	1202.72	866.66	1748.11	6812.81	681.28	6131.53
191	Udupi	Bramhavara	6064.48	400.33	0	654.64	7119.45	711.94	6407.51
192	Udupi	Bynduru	5245.28	264.58	0	384.01	5893.87	589.39	5304.48
193	Udupi	Hebri	3762.01	363.87	49.66	630.15	4805.69	480.57	4325.12
194	Udupi	Kapu	3325.8	113.91	5.44	148.46	3593.61	359.36	3234.25
195	Udupi	Karkala	8752.21	413.34	570.02	764.31	10499.88	1049.98	9449.9
196	Udupi	Kundapur	11604	449.67	0	594.76	12648.43	1264.85	11383.58
197	Udupi	Udupi	4640.33	218.42	2.77	273.02	5134.54	513.46	4621.08
198	Uttara Kannada	Ankola	5593.07	577.04	0	777.15	6947.26	694.73	6252.53
199	Uttara Kannada	Bhatkal	2655.98	129.38	135.26	269.93	3190.55	319.06	2871.49

Sl. No.	District	Assessment Unit Name	Recharge from Rainfall-Monsoon (Ham)	Recharge from Other Sources-Monsoon (Ham)	Recharge from Rainfall-Non-Monsoon (Ham)	Recharge from Other Sources-Non-Monsoon (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource(Ham)
200	Uttara Kannada	Dandelli	2021.34	16.52	317.04	26.36	2381.26	238.13	2143.13
201	Uttara Kannada	Haliyal	4654.35	450.95	346.82	101.73	5553.85	555.39	4998.46
202	Uttara Kannada	Honnavar	5454.54	288.02	0	557.36	6299.92	630	5669.92
203	Uttara Kannada	Joida	10869.84	239.32	0	286.93	11396.09	1139.61	10256.48
204	Uttara Kannada	Karwar	5366.61	576.32	0	761.03	6703.96	670.39	6033.57
205	Uttara Kannada	Kumta	5311.69	138.25	0	220.9	5670.84	567.08	5103.76
206	Uttara Kannada	Mundgod	4829.17	405.31	397.17	513.55	6145.2	307.26	5837.94
207	Uttara Kannada	Siddapur	8549.56	240.85	0	356.77	9147.18	914.72	8232.46
208	Uttara Kannada	Sirsi	11887.48	489.21	0	137.78	12514.47	1251.45	11263.02
209	Uttara Kannada	Yellapur	13606.04	314.84	0	576.7	14497.58	1449.76	13047.82
210	Vijayanagara	Hadagali	3189.54	2112.09	593.89	2645.82	8541.34	854.13	7687.21
211	Vijayanagara	Hagaribommanahalli	2947.37	1312.58	580.68	834.33	5674.96	567.49	5107.47
212	Vijayanagara	Harapanahalli	4845.7	1226.43	1093.94	1562.36	8728.43	872.84	7855.59
213	Vijayanagara	Hospet	2453.41	1133.08	261.36	1598.84	5446.69	388.91	5057.78
214	Vijayanagara	Kotturu	2215.26	262.71	237.46	123.2	2838.63	283.87	2554.76
215	Vijayanagara	Kudligi	4804.44	562.57	673.74	288.27	6329.02	632.9	5696.12
216	Vijayapura	Alamela	1685.09	2018.81	0	1696.35	5400.25	540.03	4860.22
217	Vijayapura	Babaleshwara	3438.76	1522.4	54.81	1411.78	6427.75	642.78	5784.97
218	Vijayapura	BasavanBagewadi	2275.52	992.25	64.09	612.96	3944.82	394.48	3550.34
219	Vijayapura	Bijapur	3824.58	705.96	71.72	647.81	5250.07	318.37	4931.7
220	Vijayapura	Chadachana	2827.4	1483.45	0	1111.04	5421.89	542.2	4879.69

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221	Vijayapura	DevaraHipparagi	2516.23	696.38	9.08	157.71	3379.4	337.94	3041.46
222	Vijayapura	Indi	6259.9	3539.67	0	3275.7	13075.27	1307.53	11767.74
223	Vijayapura	Kolhara	1783.34	491.43	14.15	481.66	2770.58	277.06	2493.52
224	Vijayapura	Muddebihal	2840.65	694.1	244.89	756.26	4535.9	453.58	4082.32
225	Vijayapura	Nidagundi	1590.18	963.89	14.47	881.23	3449.77	344.98	3104.79
226	Vijayapura	Sindagi	3011.72	1048.06	73.65	801.38	4934.81	493.49	4441.32
227	Vijayapura	Talikote	2808.25	425.35	37.53	146.15	3417.28	341.72	3075.56
228	Vijayapura	Tikota	3542.37	859.47	56.47	752.39	5210.7	521.08	4689.62
229	Yadgir	Gurumithakala	3633.36	1489.83	417.39	89.65	5630.23	563.02	5067.21
230	Yadgir	Hunisigi	311.8	3377.97	121.92	3354.69	7166.38	716.64	6449.74
231	Yadgir	Shahapur	0	5389.44	0	3124.11	8513.55	851.36	7662.2
232	Yadgir	Shorapur	374.78	8260.97	60.8	462.06	9158.61	915.86	8242.75
233	Yadgir	Vadagera	10.47	3678.4	3.13	3435.96	7127.96	712.79	6415.17
234	Yadgir	Yadgir	5160.23	2601.11	886.78	1572.6	10220.72	1022.06	9198.66
	Total		**882717.15**	**429045.74**	**118665.79**	**343466.55**	**1773895.23**	**169505.82**	**1604389.35**

Annexure VA_1: ASSESSMENT OF DYNAMIC GROUND WATER RESOURCES OF KARNATAKA (RECHARGE COMPONENT) – GWRA 2022 in TMC

Sl. No.	District	Assessment Unit Name	Recharge from Rainfall-Monsoon (TMC)	Recharge from Other Sources-Monsoon (TMC)	Recharge from Rainfall-Non-Monsoon (TMC)	Recharge from Other Sources-Non-Monsoon (TMC)	Total Annual Ground Water Recharge (TMC)	Total Natural Discharges (TMC)	Annual Extractable Ground Water Resource (TMC)
1	Bagalkot	Badami	1.0123	0.7880	0.0529	0.5851	2.4384	0.2438	2.1946
2	Bagalkot	Bagalkote	1.1439	1.2517	0.1233	1.8184	4.3373	0.4337	3.9036
3	Bagalkot	Bilagi	0.8147	0.3469	0.0480	0.5670	1.7766	0.1777	1.5990
4	Bagalkot	Guledagudda	0.3316	0.3121	0.0160	0.3500	1.0097	0.0764	0.9333
5	Bagalkot	Hungund	0.7992	0.4763	0.1549	0.9744	2.4048	0.2405	2.1644
6	Bagalkot	Ilkal	0.8742	0.3129	0.1501	0.5928	1.9300	0.1930	1.7370
7	Bagalkot	Jamakhandi	0.9521	0.6214	0.1175	0.6340	2.3250	0.2325	2.0925
8	Bagalkot	Mudhol	0.9769	1.1009	0.1718	1.3161	3.5657	0.3566	3.2091
9	Bagalkot	Rabakavi Banahatti	0.4461	2.1056	0.0452	2.1530	4.7499	0.4750	4.2749
10	Ballari	Ballari	1.1377	1.8969	0.2337	1.6856	4.9538	0.4954	4.4585
11	Ballari	Kampli	0.2993	1.6215	0.0391	1.7051	3.6651	0.3665	3.2985
12	Ballari	Kurugodu	0.3986	1.4229	0.0673	1.2584	3.1472	0.3147	2.8325
13	Ballari	Siraguppa	1.2656	2.6447	0.1118	0.2184	4.2405	0.4240	3.8164
14	Ballari	Sonduru	2.0556	0.2627	0.2921	0.5447	3.1552	0.3155	2.8397
15	Belagavi	Athani	0.9098	0.6948	0.4131	0.4898	2.5075	0.2508	2.2568
16	Belagavi	Bailhongal	0.9547	0.2795	0.3590	0.4377	2.0309	0.1842	1.8467
17	Belagavi	Belagavi	2.3328	0.9549	0.5476	1.1528	4.9881	0.2494	4.7387
18	Belagavi	Chikkodi	1.0608	1.1617	0.2439	2.1963	4.6627	0.4663	4.1964
19	Belagavi	Gokak	0.6524	0.8140	0.2037	1.0043	2.6744	0.2674	2.4070
20	Belagavi	Hukkeri	1.3234	1.4265	0.3506	2.2683	5.3687	0.5369	4.8318
21	Belagavi	Kagavada	0.3703	0.1614	0.1669	0.1514	0.8500	0.0850	0.7650
22	Belagavi	Khanapur	4.3280	0.4695	0.6770	0.3111	5.7856	0.2935	5.4921

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23	Belagavi	Kitthuru	0.6378	0.0979	0.3027	0.1343	1.1727	0.1173	1.0554
24	Belagavi	Mudalagi	0.6724	0.6997	0.2180	0.8631	2.4531	0.2453	2.2078
25	Belagavi	Nippani	0.7554	1.1879	0.2951	1.5638	3.8021	0.3802	3.4219
26	Belagavi	Raibag	0.7273	0.9535	0.1973	1.2108	3.0888	0.3089	2.7800
27	Belagavi	Ramadurg	0.8906	0.1823	0.3174	0.2976	1.6878	0.1688	1.5191
28	Belagavi	Savadatti	1.3275	0.6073	0.7441	1.1276	3.8064	0.3806	3.4257
29	Belagavi	Yaragatti	0.4581	0.4235	0.3239	0.4897	1.6951	0.1695	1.5256
30	Bengaluru (Rural)	Devanahalli	0.8061	0.2131	0.2612	0.4482	1.7285	0.1729	1.5557
31	Bengaluru (Rural)	Doddaballapura	0.8593	0.2955	0.5009	0.5835	2.2392	0.2239	2.0152
32	Bengaluru (Rural)	Hoskote	0.7855	0.2460	0.5315	0.4972	2.0602	0.2060	1.8542
33	Bengaluru (Rural)	Nelamangala	0.6449	0.1310	0.5818	0.2535	1.6112	0.1611	1.4501
34	Bengaluru (Urban)	Anekal	0.9839	0.5920	0.3710	0.6686	2.6154	0.2615	2.3539
35	Bengaluru (Urban)	Bangalore (North)	0.3853	0.0851	0.1552	0.1310	0.7566	0.0757	0.6809
36	Bengaluru (Urban)	Bangalore City	0.6609	0.0870	0.0425	0.0934	0.8839	0.0442	0.8397
37	Bengaluru (Urban)	Bangalore-East	0.2793	0.1554	0.0961	0.2840	0.8147	0.0815	0.7333
38	Bengaluru (Urban)	Bangalore-South	0.6040	0.4078	0.2917	0.5511	1.8546	0.1855	1.6691
39	Bengaluru (Urban)	Yelahanka	0.6637	0.1239	0.3046	0.2593	1.3515	0.1351	1.2163
40	Bidar	Aurad	1.4639	0.1370	0.0416	0.1283	1.7708	0.1771	1.5938
41	Bidar	Basavakalyan	1.8044	0.1455	0.0291	0.1742	2.1533	0.2153	1.9379
42	Bidar	Bhalki	2.0513	0.1999	0.0501	0.3068	2.6081	0.2608	2.3473
43	Bidar	Bidar	1.8111	0.1981	0.0132	0.2039	2.2263	0.2226	2.0037
44	Bidar	Chittaguppa	0.7882	0.1594	0.0080	0.1153	1.0709	0.1071	0.9638
45	Bidar	Hulasuru	0.4324	0.2061	0.0045	0.1150	0.7581	0.0758	0.6823

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46	Bidar	Humnabad	0.9749	0.0384	0.0000	0.0554	1.0688	0.1069	0.9619
47	Bidar	Kamalanagara	0.9875	0.0501	0.0021	0.1813	1.2211	0.1221	1.0990
48	Chamarajanagara	Chamarajanagara	2.4803	0.2453	0.6721	0.8626	4.2602	0.4260	3.8342
49	Chamarajanagara	Gundlupet	1.7370	0.3306	0.4158	0.5122	2.9956	0.1516	2.8440
50	Chamarajanagara	Kollegala	0.6681	0.4552	0.2292	0.7201	2.0726	0.2073	1.8654
51	Chamarajanagara	Kollegala(Hanur)	1.5498	0.1525	0.5208	0.4987	2.7218	0.1595	2.5623
52	Chamarajanagara	Yalandur	0.4681	0.1306	0.1308	0.5589	1.2882	0.1212	1.1670
53	Chikkaballapura	Bagepalli	1.4113	0.3252	0.3430	0.5022	2.5817	0.2582	2.3236
54	Chikkaballapura	Chikballapur	0.9972	0.2939	0.2383	0.5151	2.0444	0.2044	1.8400
55	Chikkaballapura	Chinthamani	1.3398	0.4132	0.2393	0.8661	2.8584	0.2858	2.5725
56	Chikkaballapura	Gauribidanur	1.3537	0.3836	0.1651	0.7059	2.6084	0.2608	2.3475
57	Chikkaballapura	Gudibande	0.2039	0.0508	0.0266	0.0787	0.3601	0.0360	0.3241
58	Chikkaballapura	Shidlagatta	1.2193	0.3217	0.1914	0.5703	2.3028	0.2303	2.0725
59	Chikkamagaluru	Ajjampura	0.5775	0.3919	0.1259	0.4887	1.5840	0.1584	1.4256
60	Chikkamagaluru	Chikmagalur	3.9120	0.8089	0.1354	0.4745	5.3308	0.5331	4.7977
61	Chikkamagaluru	Kadur	0.9909	0.8090	0.4200	0.6383	2.8581	0.1429	2.7152
62	Chikkamagaluru	Kalasa	0.1680	0.0018	0.0069	0.0020	0.1786	0.0179	0.1608
63	Chikkamagaluru	Koppa	1.3199	0.3079	0.0000	0.1123	1.7400	0.1740	1.5660
64	Chikkamagaluru	Mudigere	1.5102	0.3475	0.0494	0.1352	2.0423	0.2042	1.8381
65	Chikkamagaluru	Narasimharajapura	1.3587	0.3419	0.0589	0.1268	1.8864	0.1886	1.6978
66	Chikkamagaluru	Sringeri	0.7692	0.2230	0.0000	0.0845	1.0766	0.1077	0.9690
67	Chikkamagaluru	Tarikere	1.5111	1.0440	0.3671	0.9300	3.8522	0.3852	3.4670
68	Chitradurga	Challakere	1.8817	0.3779	0.3718	0.4463	3.0777	0.3078	2.7699

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69	Chitradurga	Chitradurga	1.4732	0.1724	0.2933	0.2677	2.2066	0.2207	1.9859
70	Chitradurga	Hiriyur	1.6434	0.3870	0.3454	0.8557	3.2314	0.3231	2.9083
71	Chitradurga	Holalkere	1.5129	0.4206	0.3134	0.1825	2.4293	0.2429	2.1864
72	Chitradurga	Hosadurga	1.5519	0.3066	0.3744	0.6053	2.8383	0.2838	2.5545
73	Chitradurga	Molakalmuru	0.8447	0.0617	0.3649	0.1604	1.4318	0.1432	1.2886
74	Dakshina Kannada	Bantwal	3.8083	0.2818	0.4452	0.5468	5.0821	0.2541	4.8280
75	Dakshina Kannada	Belthangady	4.4694	0.3160	1.0204	0.5780	6.3838	0.6384	5.7454
76	Dakshina Kannada	Kadaba	2.2244	0.1162	0.5682	0.1836	3.0923	0.3092	2.7831
77	Dakshina Kannada	Mangalore	3.1292	0.1934	0.3993	0.2969	4.0189	0.4019	3.6170
78	Dakshina Kannada	Mudabidri	1.3785	0.0956	0.2168	0.1484	1.8392	0.1839	1.6553
79	Dakshina Kannada	Puttur	1.6459	0.1120	0.4729	0.1768	2.4076	0.1204	2.2873
80	Dakshina Kannada	Sulya	1.2636	0.1176	0.3802	0.1875	1.9489	0.1949	1.7540
81	Davanagere	Channagiri	1.7864	0.8724	0.3683	0.8695	3.8966	0.3897	3.5070
82	Davanagere	Davanagere	1.0802	1.2308	0.2154	1.4628	3.9891	0.3989	3.5902
83	Davanagere	Harihar	0.7173	4.7057	0.1464	0.0700	5.6393	0.5639	5.0754
84	Davanagere	Honnali	0.4937	0.9566	0.1140	1.0697	2.6340	0.2634	2.3706
85	Davanagere	Jagaluru	0.9055	0.1962	0.2078	0.4152	1.7247	0.1725	1.5522
86	Davanagere	Nyamati	0.5384	0.8286	0.0698	0.9043	2.3411	0.2341	2.1070
87	Dharwad	Alnavara	0.1728	0.4232	0.1063	0.3361	1.0384	0.1038	0.9345
88	Dharwad	ANNIGERI	0.3156	0.2977	0.1129	0.2452	0.9715	0.0649	0.9066
89	Dharwad	Dharwad	1.6593	0.2779	0.3136	0.5893	2.8402	0.2840	2.5561
90	Dharwad	Hubballi Nagara	0.1974	0.0850	0.0476	0.0099	0.3400	0.0340	0.3060
91	Dharwad	Hubli	0.6455	0.3046	0.1633	0.2124	1.3258	0.1326	1.1932

Sl. No.	District	Assessment Unit Name	Recharge from Rainfall-Monsoon (TMC)	Recharge from Other Sources-Monsoon (TMC)	Recharge from Rainfall-Non-Monsoon (TMC)	Recharge from Other Sources-Non-Monsoon (TMC)	Total Annual Ground Water Recharge (TMC)	Total Natural Discharges (TMC)	Annual Extractable Ground Water Resource (TMC)
92	Dharwad	Kalgatgi	1.1521	0.1826	0.1652	0.3403	1.8402	0.1840	1.6562
93	Dharwad	Kundgol	0.6954	0.3436	0.1802	0.2776	1.4967	0.1497	1.3470
94	Dharwad	Navalgund	0.6328	0.3100	0.2997	0.3119	1.5544	0.1554	1.3989
95	Gadag	Gadag	1.0787	0.7402	0.5001	0.7366	3.0557	0.3056	2.7501
96	Gadag	Gajendragad	0.4218	0.0080	0.1831	0.0784	0.6913	0.0691	0.6222
97	Gadag	Laxmeshwar	0.5647	0.0607	0.2103	0.1406	0.9763	0.0976	0.8787
98	Gadag	Mundargi	0.6556	1.7084	0.3249	0.3832	3.0722	0.3072	2.7649
99	Gadag	Naragund	0.3146	0.1100	0.1076	0.2415	0.7737	0.0774	0.6964
100	Gadag	Rona	0.6368	0.1785	0.1461	0.1560	1.1175	0.1117	1.0057
101	Gadag	Shirahatti	0.6237	0.0290	0.2362	0.1351	1.0239	0.1024	0.9216
102	Hassan	Alur	0.7094	0.6669	0.0261	0.4586	1.8611	0.1861	1.6750
103	Hassan	Arkalgud	1.2004	1.7816	0.0752	0.9766	4.0338	0.4034	3.6304
104	Hassan	Arsikere	2.1216	0.7550	0.1087	0.7590	3.7442	0.3744	3.3698
105	Hassan	Belur	1.1838	1.0791	0.1291	0.6548	3.0469	0.3047	2.7422
106	Hassan	Channarayapatna	1.8496	1.5787	0.1140	2.2647	5.8069	0.5807	5.2262
107	Hassan	Hassan	1.2303	1.6162	0.1103	1.2405	4.1973	0.4197	3.7775
108	Hassan	Holenarasipura	1.3909	1.1395	0.0942	1.1411	3.7657	0.3354	3.4303
109	Hassan	Sakleshpura	1.6092	0.4146	0.0000	0.1726	2.1963	0.2196	1.9767
110	Haveri	Byadagi	0.4597	0.6529	0.2075	0.3272	1.6473	0.1647	1.4826
111	Haveri	Hangal	1.1712	1.8168	0.3469	0.5402	3.8752	0.3875	3.4877
112	Haveri	Haveri	1.2281	0.9845	0.3579	0.3054	2.8759	0.2876	2.5883
113	Haveri	Hirekerur	0.8616	0.1413	0.1912	0.2446	1.4387	0.1439	1.2948
114	Haveri	Ranebennur	0.6336	2.5344	0.4375	0.5210	4.1264	0.4126	3.7138

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115	Haveri	Ratteehalli	0.5255	0.6069	0.1780	0.1857	1.4961	0.1496	1.3465
116	Haveri	Savanur	0.6045	0.7964	0.2721	0.2380	1.9111	0.1911	1.7200
117	Haveri	Shiggaon	0.9089	0.3046	0.2633	0.1510	1.6278	0.1628	1.4651
118	Kalburgi	Afzalpur	1.9806	0.1874	0.0871	0.3151	2.5702	0.2570	2.3132
119	Kalburgi	Aland	3.4877	0.3166	0.0000	0.5923	4.3965	0.4396	3.9569
120	Kalburgi	Chincholi	2.3381	0.1744	0.0000	0.3387	2.8512	0.2851	2.5661
121	Kalburgi	Chittapur	1.8732	0.2112	0.0504	0.2317	2.3664	0.2366	2.1298
122	Kalburgi	Gulbarga	2.3142	0.1595	0.0815	0.2761	2.8312	0.2831	2.5481
123	Kalburgi	Jevargi	1.9266	0.3236	0.0612	0.4218	2.7332	0.2733	2.4599
124	Kalburgi	Kalagi	1.1274	0.0349	0.0154	0.0599	1.2376	0.0619	1.1758
125	Kalburgi	Kamalapura	1.3680	0.0844	0.0252	0.1095	1.5872	0.1587	1.4285
126	Kalburgi	Sedam	1.9713	0.2038	0.0010	0.1879	2.3640	0.1215	2.2425
127	Kalburgi	Shahbadha	0.3340	0.0492	0.0104	0.0162	0.4098	0.0410	0.3688
128	Kalburgi	Yadrami	0.9594	0.1920	0.0442	0.1745	1.3701	0.0757	1.2945
129	Kodagu	Kushalanagara	0.5534	0.8864	0.0090	0.4908	1.9397	0.1940	1.7457
130	Kodagu	Madikeri	2.1541	0.0374	0.0000	0.0324	2.2239	0.2224	2.0015
131	Kodagu	Ponnampete	3.4484	0.1579	0.0000	0.1794	3.7857	0.3786	3.4071
132	Kodagu	Somavarapete	1.1672	0.1977	0.0000	0.2107	1.5756	0.1576	1.4180
133	Kodagu	VIRAJPET	0.8904	0.1265	0.0000	0.1232	1.1401	0.1140	1.0261
134	Kolara	BANGARPET	0.7896	0.1656	0.2242	0.6883	1.8677	0.1868	1.6809
135	Kolara	K.G.F	0.5480	0.1643	0.1560	0.5585	1.4269	0.1427	1.2842
136	Kolara	Kolar	1.1126	0.6238	0.3290	1.2780	3.3434	0.3343	3.0091
137	Kolara	Malur	0.9459	0.1630	0.2080	0.7572	2.0741	0.2074	1.8666

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138	Kolara	Mulabagilu	1.4297	0.5103	0.3305	1.9827	4.2531	0.4253	3.8278
139	Kolara	Srinivaspura	1.2191	0.1837	0.2502	0.5507	2.2037	0.2204	1.9833
140	Koppal	Gangavathi	0.3702	4.3000	0.0392	0.4996	5.2090	0.5209	4.6881
141	Koppal	Kanakagiri	0.5512	1.1980	0.0926	0.8731	2.7149	0.2715	2.4434
142	Koppal	Karatagi	0.4405	2.9003	0.0432	0.1567	3.5408	0.3541	3.1867
143	Koppal	koppal	1.4416	2.4864	0.1924	0.8862	5.0067	0.5007	4.5060
144	Koppal	Kukanuru	0.8806	0.4020	0.1264	0.6885	2.0976	0.2098	1.8878
145	Koppal	Kushtagi	1.4114	1.4491	0.1993	1.4862	4.5460	0.3695	4.1765
146	Koppal	Yelburga	0.9949	0.6746	0.1198	0.5453	2.3347	0.2335	2.1012
147	Mandya	Krishnarajpet	1.0276	0.8080	0.1334	0.8281	2.7972	0.1719	2.6252
148	Mandya	Maddur	1.1562	1.1716	0.1400	1.3763	3.8441	0.3844	3.4597
149	Mandya	Malavalli	1.9135	1.8167	0.1450	1.6608	5.5360	0.5536	4.9824
150	Mandya	Mandya	0.9245	1.8034	0.0977	1.6582	4.4838	0.4484	4.0354
151	Mandya	Nagamangala	1.3177	0.9741	0.1281	1.2200	3.6398	0.2867	3.3532
152	Mandya	Pandavpura	0.7054	0.8339	0.1153	0.8492	2.5038	0.2504	2.2534
153	Mandya	Srirangapatna	0.4100	0.9768	0.0828	0.8680	2.3376	0.2338	2.1039
154	Mysuru	Heggadadevanakote	1.7113	0.6703	0.2110	0.4153	3.0079	0.3008	2.7071
155	Mysuru	Hunsur	1.5058	1.1632	0.1510	0.1886	3.0087	0.3009	2.7078
156	Mysuru	K.R.Nagar	1.0629	0.8877	0.1097	0.4278	2.4881	0.2488	2.2393
157	Mysuru	Mysuru	1.3719	0.4795	0.1597	0.3040	2.3151	0.2315	2.0836
158	Mysuru	Nanjangud	1.4339	0.9130	0.1486	0.5330	3.0286	0.3029	2.7257
159	Mysuru	Piriyapatna	1.2390	0.9117	0.1334	0.5195	2.8036	0.1702	2.6334
160	Mysuru	Saraguru	0.8231	0.3118	0.1033	0.1791	1.4174	0.1417	1.2757

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161	Mysuru	T.Narasipura	0.9011	1.1849	0.1038	0.9223	3.1122	0.3112	2.8009
162	Raichur	Devdurga	1.5508	0.6328	0.1744	0.4162	2.7742	0.2774	2.4968
163	Raichur	Lingasugur	1.4345	0.3335	0.1620	0.0600	1.9899	0.1433	1.8466
164	Raichur	Manvi	1.2954	2.6377	0.1878	0.0244	4.1454	0.4145	3.7308
165	Raichur	Maski	1.4495	0.8490	0.1695	0.5591	3.0271	0.3027	2.7244
166	Raichur	Raichur	1.9088	0.9035	0.1411	0.6306	3.5840	0.3584	3.2256
167	Raichur	Sindhanur	1.3151	4.4945	0.2873	0.0998	6.1967	0.6197	5.5771
168	Raichur	Sirivara	1.1035	2.8056	0.2059	0.0205	4.1355	0.4135	3.7219
169	Ramanagara	Channapatna	0.7184	0.9396	0.3593	0.6172	2.6344	0.2634	2.3710
170	Ramanagara	Harohalli	0.6096	1.0482	0.2764	0.5161	2.4503	0.2450	2.2053
171	Ramanagara	Kanakpura	1.7100	1.4714	0.6788	1.0283	4.8886	0.4889	4.3998
172	Ramanagara	Magadi	1.0366	0.9096	0.3192	0.2384	2.5038	0.2504	2.2535
173	Ramanagara	Ramanagar	1.4787	0.5540	0.6125	0.5414	3.1866	0.3187	2.8680
174	Shivamogga	Bhadravathi	0.7571	1.9911	0.0918	1.4428	4.2828	0.4283	3.8545
175	Shivamogga	Hosanagar	5.0549	0.1609	0.0000	0.0469	5.2627	0.5263	4.7364
176	Shivamogga	Sagara	5.6996	0.6951	0.0000	0.3111	6.7059	0.6706	6.0353
177	Shivamogga	Shikaripura	1.6594	1.9881	0.1696	0.6052	4.4224	0.4422	3.9801
178	Shivamogga	Shimoga	1.5462	1.3609	0.1752	1.0929	4.1753	0.4175	3.7577
179	Shivamogga	Soraba	4.0576	0.7971	0.0195	0.5702	5.4444	0.2722	5.1722
180	Shivamogga	Thirthahalli	4.3921	0.2756	0.0000	0.2866	4.9542	0.4954	4.4588
181	Tumakuru	Chiknayakanahalli	1.4555	0.3110	0.3403	0.2541	2.3609	0.2361	2.1248
182	Tumakuru	Gubbi	1.6020	0.9245	0.3608	0.6636	3.5508	0.2350	3.3159
183	Tumakuru	Koratagere	1.2377	0.1707	0.3093	0.1810	1.8988	0.1899	1.7089

Sl. No.	District	Assessment Unit Name	Recharge from Rainfall-Monsoon (TMC)	Recharge from Other Sources-Monsoon (TMC)	Recharge from Rainfall-Non-Monsoon (TMC)	Recharge from Other Sources-Non-Monsoon (TMC)	Total Annual Ground Water Recharge (TMC)	Total Natural Discharges (TMC)	Annual Extractable Ground Water Resource (TMC)
184	Tumakuru	Kunigal	1.3990	0.7463	0.3640	0.9169	3.4263	0.3426	3.0836
185	Tumakuru	Madhugiri	1.9742	0.3406	0.3896	0.4041	3.1086	0.3109	2.7977
186	Tumakuru	Pavagada	1.9714	0.2068	0.1803	0.2160	2.5745	0.2575	2.3171
187	Tumakuru	Sira	1.5435	0.5293	0.3949	0.7291	3.1967	0.3197	2.8771
188	Tumakuru	Tiptur	0.9441	0.3668	0.3118	0.3366	1.9593	0.1959	1.7634
189	Tumakuru	Tumkur	1.9909	0.6745	0.3460	0.7926	3.8039	0.3804	3.4235
190	Tumakuru	Turuvekere	1.0578	0.4247	0.3061	0.6173	2.4059	0.2406	2.1653
191	Udupi	Bramhavara	2.1417	0.1414	0.0000	0.2312	2.5142	0.2514	2.2628
192	Udupi	Bynduru	1.8524	0.0934	0.0000	0.1356	2.0814	0.2081	1.8733
193	Udupi	Hebri	1.3285	0.1285	0.0175	0.2225	1.6971	0.1697	1.5274
194	Udupi	Kapu	1.1745	0.0402	0.0019	0.0524	1.2691	0.1269	1.1422
195	Udupi	Karkala	3.0908	0.1460	0.2013	0.2699	3.7080	0.3708	3.3372
196	Udupi	Kundapur	4.0979	0.1588	0.0000	0.2100	4.4668	0.4467	4.0201
197	Udupi	Udupi	1.6387	0.0771	0.0010	0.0964	1.8132	0.1813	1.6319
198	Uttara Kannada	Ankola	1.9752	0.2038	0.0000	0.2744	2.4534	0.2453	2.2081
199	Uttara Kannada	Bhatkal	0.9380	0.0457	0.0478	0.0953	1.1267	0.1127	1.0141
200	Uttara Kannada	Dandelli	0.7138	0.0058	0.1120	0.0093	0.8409	0.0841	0.7568
201	Uttara Kannada	Haliyal	1.6437	0.1593	0.1225	0.0359	1.9613	0.1961	1.7652
202	Uttara Kannada	Honnavar	1.9263	0.1017	0.0000	0.1968	2.2248	0.2225	2.0023
203	Uttara Kannada	Joida	3.8386	0.0845	0.0000	0.1013	4.0245	0.4024	3.6220
204	Uttara Kannada	Karwar	1.8952	0.2035	0.0000	0.2688	2.3675	0.2367	2.1307
205	Uttara Kannada	Kumta	1.8758	0.0488	0.0000	0.0780	2.0026	0.2003	1.8024
206	Uttara Kannada	Mundgod	1.7054	0.1431	0.1403	0.1814	2.1702	0.1085	2.0616

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207	Uttara Kannada	Siddapur	3.0192	0.0851	0.0000	0.1260	3.2303	0.3230	2.9073
208	Uttara Kannada	Sirsi	4.1980	0.1728	0.0000	0.0487	4.4194	0.4419	3.9775
209	Uttara Kannada	Yellapur	4.8049	0.1112	0.0000	0.2037	5.1198	0.5120	4.6078
210	Vijayanagara	Hadagali	1.1264	0.7459	0.2097	0.9344	3.0163	0.3016	2.7147
211	Vijayanagara	Hagaribommanahalli	1.0409	0.4635	0.2051	0.2946	2.0041	0.2004	1.8037
212	Vijayanagara	Harapanahalli	1.7112	0.4331	0.3863	0.5517	3.0824	0.3082	2.7742
213	Vijayanagara	Hospet	0.8664	0.4001	0.0923	0.5646	1.9235	0.1373	1.7861
214	Vijayanagara	Kotturu	0.7823	0.0928	0.0839	0.0435	1.0025	0.1002	0.9022
215	Vijayanagara	Kudligi	1.6967	0.1987	0.2379	0.1018	2.2351	0.2235	2.0116
216	Vijayapura	Alamela	0.5951	0.7129	0.0000	0.5991	1.9071	0.1907	1.7164
217	Vijayapura	Babaleshwara	1.2144	0.5376	0.0194	0.4986	2.2699	0.2270	2.0429
218	Vijayapura	Basavan Bagewadi	0.8036	0.3504	0.0226	0.2165	1.3931	0.1393	1.2538
219	Vijayapura	Bijapur	1.3506	0.2493	0.0253	0.2288	1.8540	0.1124	1.7416
220	Vijayapura	Chadachana	0.9985	0.5239	0.0000	0.3924	1.9147	0.1915	1.7232
221	Vijayapura	Devara Hipparagi	0.8886	0.2459	0.0032	0.0557	1.1934	0.1193	1.0741
222	Vijayapura	Indi	2.2107	1.2500	0.0000	1.1568	4.6175	0.4617	4.1557
223	Vijayapura	Kolhara	0.6298	0.1735	0.0050	0.1701	0.9784	0.0978	0.8806
224	Vijayapura	Muddebihal	1.0032	0.2451	0.0865	0.2671	1.6018	0.1602	1.4417
225	Vijayapura	Nidagundi	0.5616	0.3404	0.0051	0.3112	1.2183	0.1218	1.0964
226	Vijayapura	Sindagi	1.0636	0.3701	0.0260	0.2830	1.7427	0.1743	1.5684
227	Vijayapura	Talikote	0.9917	0.1502	0.0133	0.0516	1.2068	0.1207	1.0861
228	Vijayapura	Tikota	1.2510	0.3035	0.0199	0.2657	1.8401	0.1840	1.6561
229	Yadgir	Gurumithakala	1.2831	0.5261	0.1474	0.0317	1.9883	0.1988	1.7895

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230	Yadgir	Hunisigi	0.1101	1.1929	0.0431	1.1847	2.5308	0.2531	2.2777
231	Yadgir	Shahapur	0.0000	1.9033	0.0000	1.1033	3.0065	0.3007	2.7059
232	Yadgir	Shorapur	0.1324	2.9173	0.0215	0.1632	3.2343	0.3234	2.9109
233	Yadgir	Vadagera	0.0037	1.2990	0.0011	1.2134	2.5172	0.2517	2.2655
234	Yadgir	Yadgir	1.8223	0.9186	0.3132	0.5554	3.6094	0.3609	3.2485
	Total		**311.7286**	**151.5161**	**41.9064**	**121.2941**	**626.4452**	**59.8604**	**566.5848**

ANNEXURE- VB (CONTD.): ASSESSMENT OF DYNAMIC GROUND WATER RESOURCES OF KARNATAKA– GWRA 2022

Sl. No.	District	Assessment Unit Name	Annual Extractable Ground Water Resource (Ham)	Irrigation Use (Ham)	Industrial Use (Ham)	Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation forDomestic Use as on 2025 (Ham)	Net Ground Water Availability for futureuse (Ham)	Stage of Ground WaterExtraction (%)	Categorization (OE/Critical/ Semi Critical/ Safe)
1	Bagalkot	Badami	6214.34	6427.54	10.95	533.81	6972.31	564.54	1322.52	112.20	Over Exploited
2	Bagalkot	Bagalkote	11053.66	12029.80	3.65	608.36	12641.81	643.38	465.91	114.37	Over Exploited
3	Bagalkot	Bilagi	4527.73	2475.60	4.56	406.74	2886.90	435.85	2116.41	63.76	Safe
4	Bagalkot	Guledagudda	2642.83	2139.00	0.00	274.57	2413.57	290.37	458.24	91.33	Critical
5	Bagalkot	Hungund	6128.78	4585.70	0.00	379.69	4965.39	399.85	1247.41	81.02	Semi Critical
6	Bagalkot	Ilkal	4918.54	2893.65	0.91	404.90	3299.47	426.39	1911.48	67.08	Safe
7	Bagalkot	Jamakhandi	5925.19	2414.50	0.91	572.30	2987.71	605.24	2904.54	50.42	Safe
8	Bagalkot	Mudhol	9087.15	6367.50	6.39	559.25	6933.14	596.61	2665.85	76.30	Semi Critical
9	Bagalkot	RabakaviBanahatti	12105.11	8794.80	0.91	601.88	9397.59	639.28	6494.96	77.63	Semi Critical
10	Ballari	Ballari	12624.96	4647.50	145.24	514.97	5307.72	575.33	7256.88	42.04	Safe
11	Ballari	Kampli	9340.45	1705.00	0.00	186.25	1891.24	195.89	7439.57	20.25	Safe
12	Ballari	Kurugodu	8020.64	1267.90	0.00	214.80	1482.70	227.17	6678.15	18.49	Safe
13	Ballari	Siraguppa	10806.88	1795.20	2.98	433.87	2232.05	459.24	8549.46	20.65	Safe
14	Ballari	Sonduru	8041.01	4397.40	222.21	551.35	5170.95	651.33	2831.69	64.31	Safe
15	Belagavi	Athani	6390.46	3707.85	0.37	938.29	4646.52	1086.96	1661.93	72.71	Semi Critical
16	Belagavi	Bailhongal	5229.41	5420.89	2.06	703.87	6126.82	840.13	146.72	117.16	Over Exploited
17	Belagavi	Belagavi	13418.52	4602.67	66.70	1909.66	6579.03	2200.95	6559.47	49.03	Safe
18	Belagavi	Chikkodi	11882.88	7718.26	213.71	867.17	8799.14	1012.45	3955.83	74.05	Semi Critical
19	Belagavi	Gokak	6815.86	4008.70	0.00	1036.87	5045.57	1170.62	1636.54	74.03	Semi Critical
20	Belagavi	Hukkeri	13682.27	8883.45	112.06	840.13	9835.64	994.99	4477.87	71.89	Semi Critical
21	Belagavi	Kagavada	2166.19	1749.90	0.00	333.49	2083.39	379.72	57.02	96.18	Critical
22	Belagavi	Khanapur	15551.84	1712.13	2.22	761.66	2476.01	916.46	12921.03	15.92	Safe

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23	Belagavi	Kitthuru	2988.62	1205.20	0.00	322.16	1527.37	383.18	1400.23	51.11	Safe
24	Belagavi	Mudalagi	6251.77	3048.75	29.90	504.48	3583.13	566.61	2606.51	57.31	Safe
25	Belagavi	Nippani	9689.82	4656.60	7.30	666.87	5330.78	783.77	4419.36	55.01	Safe
26	Belagavi	Raibag	7871.95	4178.05	62.90	894.29	5135.24	1015.53	2615.47	65.23	Safe
27	Belagavi	Ramadurg	4301.48	1611.10	20.56	682.99	2314.65	786.96	1882.86	53.81	Safe
28	Belagavi	Savadatti	9700.60	8884.40	15.09	703.98	9603.46	809.70	2815.67	99.00	Critical
29	Belagavi	Yaragatti	4320.06	3021.20	0.00	234.52	3255.72	269.93	1028.93	75.36	Semi Critical
30	Bengaluru(Rural)	Devanahalli	4405.23	6101.90	74.18	525.98	6702.05	555.23	0.00	152.14	Over Exploited
31	Bengaluru(Rural)	Doddaballapura	5706.51	8078.00	264.31	604.77	8947.08	641.41	0.00	156.79	Over Exploited
32	Bengaluru(Rural)	Hoskote	5250.42	7901.60	129.54	731.60	8762.73	848.69	0.00	166.90	Over Exploited
33	Bengaluru(Rural)	Nelamangala	4106.15	3486.00	311.86	508.43	4306.28	526.79	0.00	104.87	Over Exploited
34	Bengaluru(Urban)	Anekal	6665.38	5188.50	2627.10	763.21	8578.81	794.06	0.00	128.71	Over Exploited
35	Bengaluru(Urban)	Bangalore (North)	1928.10	2993.25	62.10	230.89	3286.24	244.75	0.00	170.44	Over Exploited
36	Bengaluru(Urban)	Bangalore City	2377.88	0.00	3405.00	1175.34	4580.34	1230.60	0.00	192.62	Over Exploited
37	Bengaluru(Urban)	Bangalore-East	2076.36	4029.75	759.60	178.19	4967.53	185.38	0.00	239.24	Over Exploited
38	Bengaluru(Urban)	Bangalore (North)	4726.44	4141.80	159.30	795.29	5096.38	842.26	0.00	107.83	Over Exploited

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39	Bengaluru (Urban)	Yelahanka	3444.20	4254.00	812.70	343.41	5410.10	362.61	0.00	157.08	Over Exploited
40	Bidar	Aurad	4513.01	1620.15	3.07	397.72	2020.95	412.14	2477.64	44.78	Safe
41	Bidar	Basavakalyan	5487.64	2180.60	0.00	689.89	2870.49	723.51	2583.53	52.31	Safe
42	Bidar	Bhalki	6646.81	4491.85	2.68	697.42	5191.95	725.52	1532.88	78.11	Semi Critical
43	Bidar	Bidar	5673.76	2106.34	22.78	1407.33	3536.46	1488.33	2056.30	62.33	Safe
44	Bidar	Chittaguppa	2729.17	1174.69	0.00	337.21	1511.89	348.10	1206.39	55.40	Safe
45	Bidar	Hulasuru	1931.96	1303.43	0.00	68.30	1371.74	71.06	557.46	71.00	Semi Critical
46	Bidar	Humnabad	2723.82	1147.65	20.77	425.80	1594.21	441.23	1268.74	58.53	Safe
47	Bidar	Kamalanagara	3111.91	1427.25	0.00	267.51	1694.76	277.20	1407.46	54.46	Safe
48	Chamarajanagara	Chamarajanagara	10857.30	11810.84	0.00	832.45	12643.29	990.19	0.00	116.45	Over Exploited
49	Chamarajanagara	Gundlupet	8053.29	9029.34	0.00	587.32	9616.66	747.31	52.21	119.41	Over Exploited
50	Chamarajanagara	Kollegala	5282.18	3926.80	0.00	587.32	4514.12	747.31	1761.92	85.46	Semi Critical
51	Chamarajanagara	Kollegala(Hanur)	7255.70	6085.34	0.00	398.28	6483.61	431.03	739.34	89.36	Semi Critical
52	Chamarajanagara	Yalandur	3304.68	3022.46	0.00	217.38	3239.83	257.48	143.91	98.04	Critical
53	Chikkaballapura	Bagepalli	6579.63	7473.32	1.88	381.40	7856.60	386.14	0.00	119.41	Over Exploited
54	Chikkaballapura	Chikballapur	5210.21	6607.44	48.42	533.11	7188.97	560.10	0.00	137.98	Over Exploited
55	Chikkaballapura	Chinthamani	7284.60	12099.20	7.99	716.93	12824.12	750.25	0.00	176.04	Over Exploited
56	Chikkaballapura	Gauribidanur	6647.48	10085.76	30.49	686.42	10802.68	776.60	0.00	162.51	Over Exploited
57	Chikkaballapura	Gudibande	917.63	920.50	2.30	121.75	1044.55	125.51	0.00	113.83	Over Exploited

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58	Chikkaballapura	Shidlagatta	5868.61	7337.40	4.44	519.76	7861.60	551.61	0.00	133.96	Over Exploited
59	Chikkamagaluru	Ajjampura	4036.77	5739.76	0.00	192.97	5932.73	194.44	0.00	146.97	Over Exploited
60	Chikkamagaluru	Chikmagalur	13585.59	4958.25	0.14	772.91	5731.30	895.99	7731.21	42.19	Safe
61	Chikkamagaluru	Kadur	7688.56	9582.90	0.00	552.72	10135.62	572.08	0.00	131.83	Over Exploited
62	Chikkamagaluru	Kalasa	455.24	17.10	0.00	57.95	75.05	58.40	379.74	16.49	Safe
63	Chikkamagaluru	Koppa	4434.49	1069.88	0.00	159.75	1229.63	160.97	3203.64	27.73	Safe
64	Chikkamagaluru	Mudigere	5204.89	1165.56	0.00	183.19	1348.75	184.59	3854.74	25.91	Safe
65	Chikkamagaluru	Narasimharaja pura	4807.54	1072.17	0.00	132.23	1204.40	135.89	3599.48	25.05	Safe
66	Chikkamagaluru	Sringeri	2743.81	704.25	0.00	68.77	773.02	69.29	1970.27	28.17	Safe
67	Chikkamagaluru	Tarikere	9817.46	6485.59	0.00	325.73	6811.32	353.89	3100.62	69.38	Safe
68	Chitradurga	Challakere	7843.58	9786.30	28.25	843.09	10657.64	897.04	0.00	135.88	Over Exploited
69	Chitradurga	Chitradurga	5623.56	6960.30	20.40	982.51	7963.21	1048.14	0.00	141.60	Over Exploited
70	Chitradurga	Hiriyur	8235.36	11807.00	24.94	660.75	12492.70	703.64	0.00	151.70	Over Exploited
71	Chitradurga	Holalkere	6191.20	11174.44	0.72	475.91	11651.07	505.48	0.00	188.19	Over Exploited
72	Chitradurga	Hosadurga	7233.40	9290.37	2.40	540.90	9833.67	575.00	0.00	135.95	Over Exploited
73	Chitradurga	Molakalmuru	3649.00	1607.70	0.72	324.42	1932.84	344.57	1696.01	52.97	Safe
74	Dakshina Kannada	Bantwal	13671.31	5996.53	14.67	869.14	6880.34	905.92	6754.19	50.33	Safe
75	Dakshina Kannada	Belthangady	16269.11	6486.20	2.57	579.04	7067.82	602.88	9177.45	43.44	Safe
76	Dakshina Kannada	Kadaba	7880.74	2386.38	0.00	256.72	2643.10	269.46	5224.90	33.54	Safe
77	Dakshina Kannada	Mangalore	10242.29	2806.17	8.73	2256.88	5071.78	2550.21	4877.18	49.52	Safe

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78	Dakshina Kannada	Mudabidri	4687.35	1665.77	0.00	276.07	1941.83	298.81	2722.78	41.43	Safe
79	Dakshina Kannada	Puttur	6476.78	1737.60	13.83	496.91	2248.36	532.84	4192.49	34.71	Safe
80	DakshinaKannada	Sulya	4966.71	2138.40	0.35	327.96	2466.70	341.48	2486.49	49.66	Safe
81	Davanagere	Channagiri	9930.66	15027.60	12.30	650.42	15690.31	676.63	0.00	158.00	Over Exploited
82	Davanagere	Davanagere	10166.27	7775.75	158.27	1477.68	9411.71	1537.22	3046.33	92.58	Critical
83	Davanagere	Harihar	14371.97	9292.80	19.32	584.56	9896.68	608.12	5136.88	68.86	Safe
84	Davanagere	Honnali	6712.91	4632.20	26.86	323.65	4982.70	335.20	3277.88	74.23	Semi Critical
85	Davanagere	Jagaluru	4395.36	5517.60	4.19	375.91	5897.72	391.06	0.00	134.18	Over Exploited
86	Davanagere	Nyamati	5966.39	3813.60	7.11	177.69	3998.40	184.03	3284.84	67.02	Safe
87	Dharwad	Alnavara	2646.26	846.90	0.00	78.76	925.65	82.26	1717.11	34.98	Safe
88	Dharwad	ANNIGERI	2567.09	1583.00	0.91	190.46	1774.37	198.92	784.26	69.12	Safe
89	Dharwad	Dharwad	7238.21	3729.60	32.96	1132.62	4895.18	1182.96	2292.69	67.63	Safe
90	Dharwad	Hubballi Nagara	866.46	147.00	7.10	278.35	432.45	290.73	421.63	49.91	Safe
91	Dharwad	Hubli	3378.83	1730.00	22.61	336.14	2088.76	351.08	1275.13	61.82	Safe
92	Dharwad	Kalgatgi	4689.85	2096.95	5.28	341.72	2443.95	356.91	2230.71	52.11	Safe
93	Dharwad	Kundgol	3814.39	2025.00	0.00	365.82	2390.82	382.08	1407.31	62.68	Safe
94	Dharwad	Navalgund	3961.34	2395.80	0.00	243.70	2639.50	254.53	1311.01	66.63	Safe
95	Gadag	Gadag	7787.42	6089.80	10.57	217.75	6318.13	240.66	1446.38	81.13	Semi Critical
96	Gadag	Gajendragad	1761.82	2587.50	1.36	75.18	2664.04	96.59	1.04	151.21	Over Exploited
97	Gadag	Laxmeshwar	2488.06	1615.80	4.80	64.22	1684.81	66.77	800.70	67.72	Safe
98	Gadag	Mundargi	7829.42	6568.20	1.85	81.35	6651.41	91.27	2587.23	84.95	Semi Critical

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99	Gadag	Naragund	1971.91	1080.80	0.00	53.37	1134.18	56.23	834.87	57.52	Safe
100	Gadag	Rona	2847.94	3249.60	1.08	104.14	3354.80	126.42	0.00	117.80	Over Exploited
101	Gadag	Shirahatti	2609.54	1951.60	6.86	53.93	2012.40	55.68	595.39	77.12	Semi Critical
102	Hassan	Alur	4743.00	1495.50	4.40	156.85	1656.74	158.05	3085.06	34.93	Safe
103	Hassan	Arkalgud	10280.18	3356.07	1.36	434.84	3792.26	463.68	6459.08	36.89	Safe
104	Hassan	Arsikere	9542.20	11253.00	5.83	604.11	11862.94	644.75	0.00	124.32	Over Exploited
105	Hassan	Belur	7764.98	4298.40	2.24	322.76	4623.40	325.23	3139.11	59.54	Safe
106	Hassan	Channarayapatna	14799.01	13210.50	20.43	464.09	13695.03	467.63	1973.97	92.54	Critical
107	Hassan	Hassan	10696.79	6647.90	4.88	435.76	7088.54	439.09	3604.92	66.27	Safe
108	Hassan	Holenarasipura	9713.53	6022.60	2.37	386.48	6411.45	432.88	4030.29	66.01	Safe
109	Hassan	Sakleshpura	5597.39	1598.75	1.46	209.79	1810.00	211.39	3785.79	32.34	Safe
110	Haveri	Byadagi	4198.20	3520.00	11.40	64.85	3596.25	72.18	594.62	85.66	Semi Critical
111	Haveri	Hangal	9875.93	4792.32	2.16	468.34	5262.82	563.09	4518.36	53.29	Safe
112	Haveri	Haveri	7329.17	4597.44	2.17	306.80	4906.40	377.03	2352.54	66.94	Safe
113	Haveri	Hirekerur	3666.43	2935.68	1.12	241.49	3178.29	247.86	481.77	86.69	Semi Critical
114	Haveri	Ranebennur	10516.27	8248.32	6.36	165.12	8419.80	212.96	2986.74	80.06	Semi Critical
115	Haveri	Ratteehalli	3812.84	3419.52	0.00	55.13	3474.66	56.59	1166.39	91.13	Critical
116	Haveri	Savanur	4870.55	2288.64	0.45	258.23	2547.32	293.89	2287.57	52.30	Safe
117	Haveri	Shiggaon	4148.59	1780.80	49.35	348.94	2179.08	361.08	1957.37	52.53	Safe
118	Kalburgi	Afzalpur	6550.13	4846.66	0.00	581.36	5428.02	646.46	1107.60	82.87	Semi Critical
119	Kalburgi	Aland	11204.58	5345.80	3.60	771.62	6121.03	820.61	5034.56	54.63	Safe
120	Kalburgi	Chincholi	7266.38	1605.11	0.00	501.72	2106.83	531.28	5129.99	28.99	Safe

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121	Kalburgi	Chittapur	6030.86	1346.99	3.60	638.24	1988.84	678.38	4001.88	32.98	Safe
122	Kalburgi	Gulbarga	7215.46	2198.90	18.90	2515.30	4733.11	2790.97	2206.68	65.60	Safe
123	Kalburgi	Jevargi	6965.54	1143.37	0.00	489.04	1632.41	549.39	5586.86	23.44	Safe
124	Kalburgi	Kalagi	3329.39	518.51	0.00	252.41	770.92	263.28	2547.60	23.15	Safe
125	Kalburgi	Kamalapura	4044.98	872.38	1.80	295.45	1169.63	308.58	2862.22	28.92	Safe
126	Kalburgi	Sedam	6349.93	830.60	17.10	536.89	1384.59	562.32	4939.91	21.80	Safe
127	Kalburgi	Shahbadha	1044.37	232.92	0.00	293.59	526.51	339.45	576.83	50.41	Safe
128	Kalburgi	Yadrami	3665.51	460.64	0.00	155.78	616.42	162.50	3042.37	16.82	Safe
129	Kodagu	Kushalanagara	4943.23	1867.46	1.47	166.76	2035.69	170.90	2903.40	41.18	Safe
130	Kodagu	Madikeri	5667.59	1697.90	182.56	183.70	2064.15	211.28	3575.86	36.42	Safe
131	Kodagu	Ponnampete	9647.90	2678.40	0.57	197.43	2876.41	199.56	6769.36	29.81	Safe
132	Kodagu	Somavarapete	4015.43	1519.89	31.89	177.72	1729.50	182.00	2281.65	43.07	Safe
133	Kodagu	VIRAJPET	2905.56	904.70	16.66	189.92	1111.28	192.49	1791.71	38.25	Safe
134	Kolara	BANGARPET	4759.92	7022.76	0.00	555.93	7578.69	575.03	0.00	159.22	Over Exploited
135	Kolara	K.G.F	3636.35	6097.10	1.82	713.64	6812.56	742.23	0.00	187.35	Over Exploited
136	Kolara	Kolar	8520.83	14022.45	27.30	1062.06	15111.81	1131.01	0.00	177.35	Over Exploited
137	Kolara	Malur	5285.76	8064.22	29.12	601.08	8694.41	663.18	0.00	164.49	Over Exploited
138	Kolara	Mulabagilu	10839.10	25605.30	4.55	657.01	26266.86	705.16	0.00	242.33	Over Exploited
139	Kolara	Srinivaspura	5616.06	5373.00	1.82	461.44	5836.27	480.99	0.00	103.92	Over Exploited
140	Koppal	Gangavathi	13275.20	2085.31	0.00	296.48	2381.78	318.21	10871.69	17.94	Safe
141	Koppal	Kanakagiri	6918.89	4984.00	0.33	195.85	5180.18	201.18	1894.23	74.87	Semi Critical
142	Koppal	Karatagi	9023.81	1064.77	0.00	274.07	1338.84	284.10	7674.94	14.84	Safe
143	Koppal	koppal	12759.58	7688.00	20.43	764.15	8472.59	860.30	4190.84	66.40	Safe
144	Koppal	Kukanuru	5345.67	5001.85	30.00	237.09	5268.94	244.68	69.14	98.56	Critical

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145	Koppal	Kushtagi	11826.62	7002.00	0.00	627.59	7629.58	683.34	4141.29	64.51	Safe
146	Koppal	Yelburga	5950.06	4595.00	0.00	318.68	4913.67	335.03	1020.04	82.58	Semi Critical
147	Mandya	Krishnarajpet	7433.75	2946.23	7.96	563.39	3517.60	577.30	3902.24	47.32	Safe
148	Mandya	Maddur	9796.67	4148.88	29.89	633.52	4812.31	649.16	4968.72	49.12	Safe
149	Mandya	Malavalli	14108.53	10513.80	9.91	608.08	11131.79	623.09	4292.06	78.90	Semi Critical
150	Mandya	Mandya	11426.98	5541.45	18.16	918.32	6477.93	941.00	4926.37	56.69	Safe
151	Mandya	Nagamangala	9495.11	6133.76	0.92	402.15	6536.83	412.09	3324.45	68.84	Safe
152	Mandya	Pandavpura	6381.03	3943.90	0.00	392.94	4336.85	402.64	2491.11	67.96	Safe
153	Mandya	Srirangapatna	5957.46	2991.96	0.00	388.56	3380.52	398.15	3102.45	56.74	Safe
154	Mysuru	Heggadadevanakote	7665.77	3520.90	5.08	284.40	3810.39	287.24	3852.54	49.71	Safe
155	Mysuru	Hunsur	7667.72	4198.35	3.85	487.62	4689.81	508.28	2957.25	61.16	Safe
156	Mysuru	K.R.Nagar	6341.05	3414.65	0.51	158.61	3573.79	161.37	2764.50	56.36	Safe
157	Mysuru	Mysuru	5900.00	2559.10	17.03	2111.02	4687.16	2343.72	980.14	79.44	Semi Critical
158	Mysuru	Nanjangud	7718.34	4519.50	5.21	126.36	4651.07	130.02	3063.61	60.26	Safe
159	Mysuru	Piriyapatna	7456.99	4510.95	0.89	423.42	4935.26	437.45	2507.70	66.18	Safe
160	Mysuru	Saraguru	3612.35	1093.20	0.00	82.54	1175.73	83.36	2435.80	32.55	Safe
161	Mysuru	T.Narasipura	7931.37	4832.65	4.80	260.18	5097.63	278.98	2814.94	64.27	Safe
162	Raichur	Devdurga	7070.19	2637.36	0.00	509.76	3147.13	609.09	3823.73	44.51	Safe
163	Raichur	Lingasugur	5228.93	2859.80	0.00	446.06	3305.86	466.64	1902.49	63.22	Safe
164	Raichur	Manvi	10564.51	2327.03	0.00	274.32	2601.35	327.59	8170.55	24.62	Safe
165	Raichur	Maski	7714.73	3231.52	46.08	245.05	3522.66	256.36	4180.76	45.66	Safe
166	Raichur	Raichur	9133.88	5336.78	11.52	739.64	6087.94	829.72	2955.86	66.65	Safe
167	Raichur	Sindhanur	15792.47	3159.95	6.48	681.45	3847.88	775.25	12034.50	24.37	Safe

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168	Raichur	Sirivara	10539.28	7997.80	0.00	179.45	8177.25	214.30	4209.91	77.59	Semi Critical
169	Ramanagara	Channapatna	6713.87	5067.88	0.18	666.85	5734.91	684.40	961.41	85.42	Semi Critical
170	Ramanagara	Harohalli	6244.65	7155.30	473.40	343.22	7971.92	376.19	0.00	127.66	Over Exploited
171	Ramanagara	Kanakpura	12458.79	9349.50	0.90	657.79	10008.18	719.99	2415.24	80.33	Semi Critical
172	Ramanagara	Magadi	6381.07	6000.60	5.40	574.60	6580.60	635.10	0.00	103.13	Over Exploited
173	Ramanagara	Ramanagar	8121.13	7179.15	61.20	838.06	8078.41	932.47	261.88	99.47	Critical
174	Shivamogga	Bhadravathi	10914.72	5051.80	6.51	426.80	5485.11	437.11	5419.30	50.25	Safe
175	Shivamogga	Hosanagar	13412.01	2830.20	0.00	250.72	3080.92	254.21	10327.60	22.97	Safe
176	Shivamogga	Sagara	17089.98	4668.17	3.42	301.56	4973.14	305.00	12113.40	29.10	Safe
177	Shivamogga	Shikaripura	11270.43	7138.50	2.52	425.74	7566.76	444.73	3684.68	67.14	Safe
178	Shivamogga	Shimoga	10640.74	5039.40	244.80	564.17	5848.37	590.53	4766.01	54.96	Safe
179	Shivamogga	Soraba	14645.92	7423.20	0.00	470.32	7893.53	494.48	6728.23	53.90	Safe
180	Shivamogga	Thirthahalli	12625.96	3782.45	0.00	221.46	4003.91	223.91	8619.60	31.71	Safe
181	Tumakuru	Chiknayakana halli	6016.87	6140.40	1.05	487.10	6628.54	517.36	0.00	110.17	Over Exploited
182	Tumakuru	Gubbi	9389.51	4281.00	0.66	591.42	4873.09	622.82	5222.61	51.90	Safe
183	Tumakuru	Koratagere	4839.01	4329.84	0.38	379.37	4709.60	400.36	108.42	97.33	Critical
184	Tumakuru	Kunigal	8731.86	5151.90	6.60	518.54	5677.04	550.82	3229.53	65.02	Safe
185	Tumakuru	Madhugiri	7922.26	8580.60	0.18	606.37	9187.13	639.90	0.00	115.97	Over Exploited
186	Tumakuru	Pavagada	6561.16	4707.60	1.95	552.39	5261.94	581.71	1269.90	80.20	Semi Critical
187	Tumakuru	Sira	8146.96	9456.33	11.43	703.45	10171.21	739.25	0.00	124.85	Over Exploited
188	Tumakuru	Tiptur	4993.36	6150.60	6.99	511.48	6669.06	543.26	738.59	133.56	Over Exploited
189	Tumakuru	Tumkur	9694.39	10007.30	22.35	1373.12	11402.77	1464.84	1901.49	117.62	Over Exploited
190	Tumakuru	Turuvekere	6131.53	3538.60	7.50	388.05	3934.16	412.16	2173.26	64.16	Safe

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191	Udupi	Bramhavara	6407.51	2558.11	2.94	437.01	2998.07	450.27	3396.18	46.79	Safe
192	Udupi	Bynduru	5304.48	1603.35	0.75	313.92	1918.02	323.44	3376.94	36.16	Safe
193	Udupi	Hebri	4325.12	2257.50	0.26	117.15	2374.91	120.70	1946.66	54.91	Safe
194	Udupi	Kapu	3234.25	701.10	0.36	339.05	1040.51	349.34	2183.45	32.17	Safe
195	Udupi	Karkala	9449.90	2431.16	8.65	226.49	2666.30	233.36	6776.73	28.22	Safe
196	Udupi	Kundapur	11383.58	2718.90	16.07	329.42	3064.39	339.42	8309.19	26.92	Safe
197	Udupi	Udupi	4621.08	1286.20	6.88	318.43	1611.51	328.09	2999.91	34.87	Safe
198	Uttara Kannada	Ankola	6252.53	3627.46	3.51	227.84	3858.81	234.32	2387.24	61.72	Safe
199	Uttara Kannada	Bhatkal	2871.49	798.42	7.19	342.99	1148.58	352.74	1713.16	40.00	Safe
200	Uttara Kannada	Dandelli	2143.13	102.78	0.29	140.68	243.76	144.68	1895.37	11.37	Safe
201	Uttara Kannada	Haliyal	4998.46	2722.05	0.29	223.22	2945.57	229.56	2046.55	58.93	Safe
202	Uttara Kannada	Honnavar	5669.92	1778.90	2.23	352.94	2134.06	362.97	3525.83	37.64	Safe
203	Uttara Kannada	Joida	10256.48	1519.73	0.00	122.68	1642.40	126.17	8610.59	16.01	Safe
204	Uttara Kannada	Karwar	6033.57	3576.83	4.96	329.48	3911.26	338.85	2112.94	64.82	Safe
205	Uttara Kannada	Kumta	5103.76	842.39	5.07	327.50	1174.96	336.81	3919.49	23.02	Safe
206	Uttara Kannada	Mundgod	5837.94	1438.50	0.08	250.42	1688.99	257.55	4141.82	28.93	Safe
207	Uttara Kannada	Siddapur	8232.46	1750.86	1.29	206.59	1958.74	212.47	6267.84	23.79	Safe
208	Uttara Kannada	Sirsi	11263.02	2675.35	5.97	396.76	3078.08	408.04	8173.66	27.33	Safe
209	Uttara Kannada	Yellapur	13047.82	2735.48	1.03	185.53	2922.05	190.81	10120.49	22.39	Safe
210	Vijayanagara	Hadagali	7687.21	6024.46	1.43	388.03	6413.92	414.14	2911.01	83.44	Semi Critical
211	Vijayanagara	Hagaribommanahalli	5107.47	5592.65	4.92	341.98	5939.55	369.14	20.68	116.29	Over Exploited
212	Vijayanagara	Harapanahalli	7855.59	8267.13	4.53	570.53	8842.20	599.07	0.00	112.56	Over Exploited
213	Vijayanagara	Hospet	5057.78	2770.00	9.37	277.15	3056.52	309.33	1969.08	60.43	Safe

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214	Vijayanagara	Kotturu	2554.76	2768.01	0.00	176.55	2944.57	184.70	0.00	115.26	Over Exploited
215	Vijayanagara	Kudligi	5696.12	2951.00	2.06	425.93	3378.98	450.25	2292.82	59.32	Safe
216	Vijayapura	Alamela	4860.22	2105.91	0.91	275.88	2382.69	291.76	2665.11	49.02	Safe
217	Vijayapura	Babaleshwara	5784.97	1575.59	11.86	293.21	1880.66	310.08	3887.44	32.51	Safe
218	Vijayapura	BasavanBagewadi	3550.34	2503.20	0.00	388.28	2891.47	410.62	1421.87	81.44	Semi Critical
219	Vijayapura	Bijapur	4931.70	2300.82	0.91	1061.40	3363.12	1122.49	1985.33	68.19	Safe
220	Vijayapura	Chadachana	4879.69	3790.20	0.00	276.83	4067.03	292.77	1115.76	83.35	Semi Critical
221	Vijayapura	DevaraHipparagi	3041.46	1290.99	0.00	245.50	1536.49	259.64	1660.43	50.52	Safe
222	Vijayapura	Indi	11767.74	6726.74	1.83	681.12	7409.69	720.33	4742.98	62.97	Safe
223	Vijayapura	Kolhara	2493.52	1617.65	0.00	185.57	1803.22	196.26	887.12	72.32	Semi Critical
224	Vijayapura	Muddebihal	4082.32	1776.96	0.00	407.89	2184.86	431.38	2275.12	53.52	Safe
225	Vijayapura	Nidagundi	3104.79	2641.67	0.00	198.20	2839.86	209.60	1251.62	91.47	Critical
226	Vijayapura	Sindagi	4441.32	1786.65	0.00	352.43	2139.08	372.72	2614.21	48.16	Safe
227	Vijayapura	Talikote	3075.56	1284.07	0.00	300.58	1584.65	317.89	1745.36	51.52	Safe
228	Vijayapura	Tikota	4689.62	3813.27	0.00	285.50	4098.77	301.94	724.64	87.40	Semi Critical
229	Yadgir	Gurumithakala	5067.21	4143.85	2.70	308.22	4454.77	343.13	577.53	87.91	Semi Critical
230	Yadgir	Hunisigi	6449.74	1553.10	0.06	263.77	1816.93	278.96	4617.62	28.17	Safe
231	Yadgir	Shahapur	7662.20	1617.10	255.00	424.64	2296.74	451.02	5339.08	29.97	Safe
232	Yadgir	Shorapur	8242.75	1310.75	16.56	483.17	1810.48	524.96	6390.48	21.96	Safe
233	Yadgir	Vadagera	6415.17	1114.05	1.80	206.86	1322.71	230.29	5069.03	20.62	Safe
234	Yadgir	Yadgir	9198.66	5831.20	523.20	440.71	6795.11	490.63	2353.63	73.87	Semi Critical
		Total	**1604389.35**	**1000644.50**	**12563.44**	**108770.56**	**1121978.47**	**117404.55**	**634407.92**	**17134.73**	

ANNEXURE - VB_1 (CONTD.): ASSESSMENT OF DYNAMIC GROUND WATER RESOURCES OF KARNATAKA – GWRA 2022 in TMC
(Extraction Components, Allocation and Balance available)

Sl. No	District	Assessment Unit Name	Annual Extractable Ground Water Resource (TMC)	Irrigation Use (TMC)	Industrial Use (TMC)	Domestic Use (TMC)	Total Extraction (TMC)	Annual GW Allocation for Domestic Use as on 2025 (TMC)	Net Ground Water Availability for future use (TMC)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/ Semi Critical/ Safe)
1	Bagalkot	Badami	2.1946	2.2699	0.0039	0.1885	2.4622	0.1994	0.4670	112.2	Over Exploited
2	Bagalkot	Bagalkote	3.9036	4.2483	0.0013	0.2148	4.4644	0.2272	0.1645	114.37	Over Exploited
3	Bagalkot	Bilagi	1.5990	0.8742	0.0016	0.1436	1.0195	0.1539	0.7474	63.76	Safe
4	Bagalkot	Guledagudda	0.9333	0.7554	0.0000	0.0970	0.8523	0.1025	0.1618	91.33	Critical
5	Bagalkot	Hungund	2.1644	1.6194	0.0000	0.1341	1.7535	0.1412	0.4405	81.02	Semi Critical
6	Bagalkot	Ilkal	1.7370	1.0219	0.0003	0.1430	1.1652	0.1506	0.6750	67.08	Safe
7	Bagalkot	Jamakhandi	2.0925	0.8527	0.0003	0.2021	1.0551	0.2137	1.0257	50.42	Safe
8	Bagalkot	Mudhol	3.2091	2.2487	0.0023	0.1975	2.4484	0.2107	0.9414	76.3	Semi Critical
9	Bagalkot	Rabakavi Banahatti	4.2749	3.1059	0.0003	0.2126	3.3187	0.2258	2.2937	77.63	Semi Critical
10	Ballari	Ballari	4.4585	1.6412	0.0513	0.1819	1.8744	0.2032	2.5627	42.04	Safe
11	Ballari	Kampli	3.2985	0.6021	0.0000	0.0658	0.6679	0.0692	2.6273	20.25	Safe
12	Ballari	Kurugodu	2.8325	0.4478	0.0000	0.0759	0.5236	0.0802	2.3584	18.49	Safe
13	Ballari	Siraguppa	3.8164	0.6340	0.0011	0.1532	0.7882	0.1622	3.0192	20.65	Safe
14	Ballari	Sonduru	2.8397	1.5529	0.0785	0.1947	1.8261	0.2300	1.0000	64.31	Safe
15	Belagavi	Athani	2.2568	1.3094	0.0001	0.3314	1.6409	0.3839	0.5869	72.71	Semi Critical
16	Belagavi	Bailhongal	1.8467	1.9144	0.0007	0.2486	2.1637	0.2967	0.0518	117.16	Over Exploited
17	Belagavi	Belagavi	4.7387	1.6254	0.0236	0.6744	2.3234	0.7773	2.3165	49.03	Safe
18	Belagavi	Chikkodi	4.1964	2.7257	0.0755	0.3062	3.1074	0.3575	1.3970	74.05	Semi Critical
19	Belagavi	Gokak	2.4070	1.4157	0.0000	0.3662	1.7818	0.4134	0.5779	74.03	Semi Critical
20	Belagavi	Hukkeri	4.8318	3.1372	0.0396	0.2967	3.4734	0.3514	1.5813	71.89	Semi Critical

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21	Belagavi	Kagavada	0.7650	0.6180	0.0000	0.1178	0.7357	0.1341	0.0201	96.18	Critical
22	Belagavi	Khanapur	5.4921	0.6046	0.0008	0.2690	0.8744	0.3236	4.5630	15.92	Safe
23	Belagavi	Kitthuru	1.0554	0.4256	0.0000	0.1138	0.5394	0.1353	0.4945	51.11	Safe
24	Belagavi	Mudalagi	2.2078	1.0767	0.0106	0.1782	1.2654	0.2001	0.9205	57.31	Safe
25	Belagavi	Nippani	3.4219	1.6445	0.0026	0.2355	1.8825	0.2768	1.5607	55.01	Safe
26	Belagavi	Raibag	2.7800	1.4755	0.0222	0.3158	1.8135	0.3586	0.9236	65.23	Safe
27	Belagavi	Ramadurg	1.5191	0.5690	0.0073	0.2412	0.8174	0.2779	0.6649	53.81	Safe
28	Belagavi	Savadatti	3.4257	3.1375	0.0053	0.2486	3.3914	0.2859	0.9943	99	Critical
29	Belagavi	Yaragatti	1.5256	1.0669	0.0000	0.0828	1.1497	0.0953	0.3634	75.36	Semi Critical
30	Bengaluru (Rural)	Devanahalli	1.5557	2.1549	0.0262	0.1857	2.3668	0.1961	0.0000	152.14	Over Exploited
31	Bengaluru (Rural)	Doddaballapura	2.0152	2.8527	0.0933	0.2136	3.1596	0.2265	0.0000	156.79	Over Exploited
32	Bengaluru (Rural)	Hoskote	1.8542	2.7904	0.0457	0.2584	3.0945	0.2997	0.0000	166.9	Over Exploited
33	Bengaluru (Rural)	Nelamangala	1.4501	1.2311	0.1101	0.1796	1.5207	0.1860	0.0000	104.87	Over Exploited
34	Bengaluru (Urban)	Anekal	2.3539	1.8323	0.9278	0.2695	3.0296	0.2804	0.0000	128.71	Over Exploited
35	Bengaluru (Urban)	Bangalore (North)	0.6809	1.0571	0.0219	0.0815	1.1605	0.0864	0.0000	170.44	Over Exploited
36	Bengaluru (Urban)	Bangalore City	0.8397	0.0000	1.2025	0.4151	1.6175	0.4346	0.0000	192.62	Over Exploited
37	Bengaluru (Urban)	Bangalore-East	0.7333	1.4231	0.2683	0.0629	1.7543	0.0655	0.0000	239.24	Over Exploited
38	Bengaluru (Urban)	Bangalore-South	1.6691	1.4627	0.0563	0.2809	1.7998	0.2974	0.0000	107.83	Over Exploited
39	Bengaluru (Urban)	Yelahanka	1.2163	1.5023	0.2870	0.1213	1.9106	0.1281	0.0000	157.08	Over Exploited
40	Bidar	Aurad	1.5938	0.5722	0.0011	0.1405	0.7137	0.1455	0.8750	44.78	Safe
41	Bidar	Basavakalyan	1.9379	0.7701	0.0000	0.2436	1.0137	0.2555	0.9124	52.31	Safe
42	Bidar	Bhalki	2.3473	1.5863	0.0009	0.2463	1.8335	0.2562	0.5413	78.11	Semi Critical
43	Bidar	Bidar	2.0037	0.7438	0.0080	0.4970	1.2489	0.5256	0.7262	62.33	Safe
44	Bidar	Chittaguppa	0.9638	0.4148	0.0000	0.1191	0.5339	0.1229	0.4260	55.4	Safe
45	Bidar	Hulasuru	0.6823	0.4603	0.0000	0.0241	0.4844	0.0251	0.1969	71	Semi Critical
46	Bidar	Humnabad	0.9619	0.4053	0.0073	0.1504	0.5630	0.1558	0.4481	58.53	Safe
47	Bidar	Kamalanagara	1.0990	0.5040	0.0000	0.0945	0.5985	0.0979	0.4970	54.46	Safe
48	Chamaraja nagara	Chamaraja nagara	3.8342	4.1710	0.0000	0.2940	4.4649	0.3497	0.0000	116.45	Over Exploited

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49	Chamaraja nagara	Gundlupet	2.8440	3.1887	0.0000	0.2074	3.3961	0.2639	0.0184	119.41	Over Exploited
50	Chamaraja nagara	Kollegala	1.8654	1.3867	0.0000	0.2074	1.5941	0.2639	0.6222	85.46	Semi Critical
51	Chamaraja nagara	Kollegala (Hanur)	2.5623	2.1490	0.0000	0.1407	2.2897	0.1522	0.2611	89.36	Semi Critical
52	Chamaraja nagara	Yalandur	1.1670	1.0674	0.0000	0.0768	1.1441	0.0909	0.0508	98.04	Critical
53	Chikkaballapura	Bagepalli	2.3236	2.6392	0.0007	0.1347	2.7745	0.1364	0.0000	119.41	Over Exploited
54	Chikkaballapura	Chikballapur	1.8400	2.3334	0.0171	0.1883	2.5388	0.1978	0.0000	137.98	Over Exploited
55	Chikkaballapura	Chinthamani	2.5725	4.2728	0.0028	0.2532	4.5288	0.2649	0.0000	176.04	Over Exploited
56	Chikkaballapura	Gauribidanur	2.3475	3.5618	0.0108	0.2424	3.8149	0.2743	0.0000	162.51	Over Exploited
57	Chikkaballapura	Gudibande	0.3241	0.3251	0.0008	0.0430	0.3689	0.0443	0.0000	113.83	Over Exploited
58	Chikkaballapura	Shidlagatta	2.0725	2.5912	0.0016	0.1836	2.7763	0.1948	0.0000	133.96	Over Exploited
59	Chikkamagaluru	Ajjampura	1.4256	2.0270	0.0000	0.0681	2.0951	0.0687	0.0000	146.97	Over Exploited
60	Chikkamagaluru	Chikmagalur	4.7977	1.7510	0.0000	0.2730	2.0240	0.3164	2.7303	42.19	Safe
61	Chikkamagaluru	Kadur	2.7152	3.3842	0.0000	0.1952	3.5794	0.2020	0.0000	131.83	Over Exploited
62	Chikkamagaluru	Kalasa	0.1608	0.0060	0.0000	0.0205	0.0265	0.0206	0.1341	16.49	Safe
63	Chikkamagaluru	Koppa	1.5660	0.3778	0.0000	0.0564	0.4342	0.0568	1.1314	27.73	Safe
64	Chikkamagaluru	Mudigere	1.8381	0.4116	0.0000	0.0647	0.4763	0.0652	1.3613	25.91	Safe
65	Chikkamagaluru	Narasimharajapura	1.6978	0.3786	0.0000	0.0467	0.4253	0.0480	1.2711	25.05	Safe
66	Chikkamagaluru	Sringeri	0.9690	0.2487	0.0000	0.0243	0.2730	0.0245	0.6958	28.17	Safe
67	Chikkamagaluru	Tarikere	3.4670	2.2904	0.0000	0.1150	2.4054	0.1250	1.0950	69.38	Safe
68	Chitradurga	Challakere	2.7699	3.4560	0.0100	0.2977	3.7637	0.3168	0.0000	135.88	Over Exploited
69	Chitradurga	Chitradurga	1.9859	2.4580	0.0072	0.3470	2.8122	0.3701	0.0000	141.6	Over Exploited
70	Chitradurga	Hiriyur	2.9083	4.1696	0.0088	0.2333	4.4118	0.2485	0.0000	151.7	Over Exploited
71	Chitradurga	Holalkere	2.1864	3.9462	0.0003	0.1681	4.1145	0.1785	0.0000	188.19	Over Exploited
72	Chitradurga	Hosadurga	2.5545	3.2809	0.0008	0.1910	3.4727	0.2031	0.0000	135.95	Over Exploited
73	Chitradurga	Molakalmuru	1.2886	0.5678	0.0003	0.1146	0.6826	0.1217	0.5989	52.97	Safe
74	Dakshina Kannada	Bantwal	4.8280	2.1177	0.0052	0.3069	2.4298	0.3199	2.3852	50.33	Safe
75	Dakshina Kannada	Belthangady	5.7454	2.2906	0.0009	0.2045	2.4960	0.2129	3.2410	43.44	Safe
76	Dakshina Kannada	Kadaba	2.7831	0.8427	0.0000	0.0907	0.9334	0.0952	1.8452	33.54	Safe
77	Dakshina Kannada	Mangalore	3.6170	0.9910	0.0031	0.7970	1.7911	0.9006	1.7224	49.52	Safe

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78	Dakshina Kannada	Mudabidri	1.6553	0.5883	0.0000	0.0975	0.6858	0.1055	0.9615	41.43	Safe
79	Dakshina Kannada	Puttur	2.2873	0.6136	0.0049	0.1755	0.7940	0.1882	1.4806	34.71	Safe
80	Dakshina Kannada	Sulya	1.7540	0.7552	0.0001	0.1158	0.8711	0.1206	0.8781	49.66	Safe
81	Davanagere	Channagiri	3.5070	5.3069	0.0043	0.2297	5.5410	0.2389	0.0000	158	Over Exploited
82	Davanagere	Davanagere	3.5902	2.7460	0.0559	0.5218	3.3237	0.5429	1.0758	92.58	Critical
83	Davanagere	Harihar	5.0754	3.2817	0.0068	0.2064	3.4950	0.2148	1.8141	68.86	Safe
84	Davanagere	Honnali	2.3706	1.6358	0.0095	0.1143	1.7596	0.1184	1.1576	74.23	Semi Critical
85	Davanagere	Jagaluru	1.5522	1.9485	0.0015	0.1328	2.0828	0.1381	0.0000	134.18	Over Exploited
86	Davanagere	Nyamati	2.1070	1.3468	0.0025	0.0628	1.4120	0.0650	1.1600	67.02	Safe
87	Dharwad	Alnavara	0.9345	0.2991	0.0000	0.0278	0.3269	0.0290	0.6064	34.98	Safe
88	Dharwad	ANNIGERI	0.9066	0.5590	0.0003	0.0673	0.6266	0.0702	0.2770	69.12	Safe
89	Dharwad	Dharwad	2.5561	1.3171	0.0116	0.4000	1.7287	0.4178	0.8097	67.63	Safe
90	Dharwad	Hubballi Nagara	0.3060	0.0519	0.0025	0.0983	0.1527	0.1027	0.1489	49.91	Safe
91	Dharwad	Hubli	1.1932	0.6109	0.0080	0.1187	0.7376	0.1240	0.4503	61.82	Safe
92	Dharwad	Kalgatgi	1.6562	0.7405	0.0019	0.1207	0.8631	0.1260	0.7878	52.11	Safe
93	Dharwad	Kundgol	1.3470	0.7151	0.0000	0.1292	0.8443	0.1349	0.4970	62.68	Safe
94	Dharwad	Navalgund	1.3989	0.8461	0.0000	0.0861	0.9321	0.0899	0.4630	66.63	Safe
95	Gadag	Gadag	2.7501	2.1506	0.0037	0.0769	2.2312	0.0850	0.5108	81.13	Semi Critical
96	Gadag	Gajendragad	0.6222	0.9138	0.0005	0.0265	0.9408	0.0341	0.0004	151.21	Over Exploited
97	Gadag	Laxmeshwar	0.8787	0.5706	0.0017	0.0227	0.5950	0.0236	0.2828	67.72	Safe
98	Gadag	Mundargi	2.7649	2.3195	0.0007	0.0287	2.3489	0.0322	0.9137	84.95	Semi Critical
99	Gadag	Naragund	0.6964	0.3817	0.0000	0.0188	0.4005	0.0199	0.2948	57.52	Safe
100	Gadag	Rona	1.0057	1.1476	0.0004	0.0368	1.1847	0.0446	0.0000	117.8	Over Exploited
101	Gadag	Shirahatti	0.9216	0.6892	0.0024	0.0190	0.7107	0.0197	0.2103	77.12	Semi Critical
102	Hassan	Alur	1.6750	0.5281	0.0016	0.0554	0.5851	0.0558	1.0895	34.93	Safe
103	Hassan	Arkalgud	3.6304	1.1852	0.0005	0.1536	1.3392	0.1637	2.2810	36.89	Safe
104	Hassan	Arsikere	3.3698	3.9740	0.0021	0.2133	4.1894	0.2277	0.0000	124.32	Over Exploited
105	Hassan	Belur	2.7422	1.5180	0.0008	0.1140	1.6327	0.1149	1.1086	59.54	Safe
106	Hassan	Channarayapatna	5.2262	4.6652	0.0072	0.1639	4.8364	0.1651	0.6971	92.54	Critical

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107	Hassan	Hassan	3.7775	2.3477	0.0017	0.1539	2.5033	0.1551	1.2731	66.27	Safe
108	Hassan	Holenarasipura	3.4303	2.1269	0.0008	0.1365	2.2642	0.1529	1.4233	66.01	Safe
109	Hassan	Sakleshpura	1.9767	0.5646	0.0005	0.0741	0.6392	0.0747	1.3369	32.34	Safe
110	Haveri	Byadagi	1.4826	1.2431	0.0040	0.0229	1.2700	0.0255	0.2100	85.66	Semi Critical
111	Haveri	Hangal	3.4877	1.6924	0.0008	0.1654	1.8585	0.1989	1.5956	53.29	Safe
112	Haveri	Haveri	2.5883	1.6236	0.0008	0.1083	1.7327	0.1331	0.8308	66.94	Safe
113	Haveri	Hirekerur	1.2948	1.0367	0.0004	0.0853	1.1224	0.0875	0.1701	86.69	Semi Critical
114	Haveri	Ranebennur	3.7138	2.9129	0.0022	0.0583	2.9734	0.0752	1.0548	80.06	Semi Critical
115	Haveri	Ratteehalli	1.3465	1.2076	0.0000	0.0195	1.2271	0.0200	0.4119	91.13	Critical
116	Haveri	Savanur	1.7200	0.8082	0.0002	0.0912	0.8996	0.1038	0.8078	52.3	Safe
117	Haveri	Shiggaon	1.4651	0.6289	0.0174	0.1232	0.7695	0.1275	0.6912	52.53	Safe
118	Kalburgi	Afzalpur	2.3132	1.7116	0.0000	0.2053	1.9169	0.2283	0.3911	82.87	Semi Critical
119	Kalburgi	Aland	3.9569	1.8879	0.0013	0.2725	2.1616	0.2898	1.7779	54.63	Safe
120	Kalburgi	Chincholi	2.5661	0.5668	0.0000	0.1772	0.7440	0.1876	1.8116	28.99	Safe
121	Kalburgi	Chittapur	2.1298	0.4757	0.0013	0.2254	0.7024	0.2396	1.4133	32.98	Safe
122	Kalburgi	Gulbarga	2.5481	0.7765	0.0067	0.8883	1.6715	0.9856	0.7793	65.6	Safe
123	Kalburgi	Jevargi	2.4599	0.4038	0.0000	0.1727	0.5765	0.1940	1.9730	23.44	Safe
124	Kalburgi	Kalagi	1.1758	0.1831	0.0000	0.0891	0.2722	0.0930	0.8997	23.15	Safe
125	Kalburgi	Kamalapura	1.4285	0.3081	0.0006	0.1043	0.4131	0.1090	1.0108	28.92	Safe
126	Kalburgi	Sedam	2.2425	0.2933	0.0060	0.1896	0.4890	0.1986	1.7445	21.8	Safe
127	Kalburgi	Shahbadha	0.3688	0.0823	0.0000	0.1037	0.1859	0.1199	0.2037	50.41	Safe
128	Kalburgi	Yadrami	1.2945	0.1627	0.0000	0.0550	0.2177	0.0574	1.0744	16.82	Safe
129	Kodagu	Kushalanagara	1.7457	0.6595	0.0005	0.0589	0.7189	0.0604	1.0253	41.18	Safe
130	Kodagu	Madikeri	2.0015	0.5996	0.0645	0.0649	0.7289	0.0746	1.2628	36.42	Safe
131	Kodagu	Ponnampete	3.4071	0.9459	0.0002	0.0697	1.0158	0.0705	2.3906	29.81	Safe
132	Kodagu	Somavarapete	1.4180	0.5367	0.0113	0.0628	0.6108	0.0643	0.8058	43.07	Safe
133	Kodagu	VIRAJPET	1.0261	0.3195	0.0059	0.0671	0.3924	0.0680	0.6327	38.25	Safe
134	Kolara	BANGARPET	1.6809	2.4801	0.0000	0.1963	2.6764	0.2031	0.0000	159.22	Over Exploited
135	Kolara	K.G.F	1.2842	2.1532	0.0006	0.2520	2.4058	0.2621	0.0000	187.35	Over Exploited

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136	Kolara	Kolar	3.0091	4.9520	0.0096	0.3751	5.3367	0.3994	0.0000	177.35	Over Exploited
137	Kolara	Malur	1.8666	2.8479	0.0103	0.2123	3.0704	0.2342	0.0000	164.49	Over Exploited
138	Kolara	Mulabagilu	3.8278	9.0424	0.0016	0.2320	9.2761	0.2490	0.0000	242.33	Over Exploited
139	Kolara	Srinivaspura	1.9833	1.8975	0.0006	0.1630	2.0611	0.1699	0.0000	103.92	Over Exploited
140	Koppal	Gangavathi	4.6881	0.7364	0.0000	0.1047	0.8411	0.1124	3.8393	17.94	Safe
141	Koppal	Kanakagiri	2.4434	1.7601	0.0001	0.0692	1.8294	0.0710	0.6689	74.87	Semi Critical
142	Koppal	Karatagi	3.1867	0.3760	0.0000	0.0968	0.4728	0.1003	2.7104	14.84	Safe
143	Koppal	koppal	4.5060	2.7150	0.0072	0.2699	2.9921	0.3038	1.4800	66.4	Safe
144	Koppal	Kukanuru	1.8878	1.7664	0.0106	0.0837	1.8607	0.0864	0.0244	98.56	Critical
145	Koppal	Kushtagi	4.1765	2.4727	0.0000	0.2216	2.6944	0.2413	1.4625	64.51	Safe
146	Koppal	Yelburga	2.1012	1.6227	0.0000	0.1125	1.7352	0.1183	0.3602	82.58	Semi Critical
147	Mandya	Krishnarajpet	2.6252	1.0405	0.0028	0.1990	1.2422	0.2039	1.3781	47.32	Safe
148	Mandya	Maddur	3.4597	1.4652	0.0106	0.2237	1.6995	0.2292	1.7547	49.12	Safe
149	Mandya	Malavalli	4.9824	3.7129	0.0035	0.2147	3.9312	0.2200	1.5157	78.9	Semi Critical
150	Mandya	Mandya	4.0354	1.9569	0.0064	0.3243	2.2877	0.3323	1.7397	56.69	Safe
151	Mandya	Nagamangala	3.3532	2.1661	0.0003	0.1420	2.3085	0.1455	1.1740	68.84	Safe
152	Mandya	Pandavpura	2.2534	1.3928	0.0000	0.1388	1.5315	0.1422	0.8797	67.96	Safe
153	Mandya	Srirangapatna	2.1039	1.0566	0.0000	0.1372	1.1938	0.1406	1.0956	56.74	Safe
154	Mysuru	Heggadadevanakote	2.7071	1.2434	0.0018	0.1004	1.3456	0.1014	1.3605	49.71	Safe
155	Mysuru	Hunsur	2.7078	1.4826	0.0014	0.1722	1.6562	0.1795	1.0443	61.16	Safe
156	Mysuru	K.R.Nagar	2.2393	1.2059	0.0002	0.0560	1.2621	0.0570	0.9763	56.36	Safe
157	Mysuru	Mysuru	2.0836	0.9037	0.0060	0.7455	1.6553	0.8277	0.3461	79.44	Semi Critical
158	Mysuru	Nanjangud	2.7257	1.5960	0.0018	0.0446	1.6425	0.0459	1.0819	60.26	Safe
159	Mysuru	Piriyapatna	2.6334	1.5930	0.0003	0.1495	1.7429	0.1545	0.8856	66.18	Safe
160	Mysuru	Saraguru	1.2757	0.3861	0.0000	0.0291	0.4152	0.0294	0.8602	32.55	Safe
161	Mysuru	T.Narasipura	2.8009	1.7066	0.0017	0.0919	1.8002	0.0985	0.9941	64.27	Safe
162	Raichur	Devdurga	2.4968	0.9314	0.0000	0.1800	1.1114	0.2151	1.3503	44.51	Safe
163	Raichur	Lingasugur	1.8466	1.0099	0.0000	0.1575	1.1675	0.1648	0.6719	63.22	Safe
164	Raichur	Manvi	3.7308	0.8218	0.0000	0.0969	0.9187	0.1157	2.8854	24.62	Safe

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165	Raichur	Maski	2.7244	1.1412	0.0163	0.0865	1.2440	0.0905	1.4764	45.66	Safe
166	Raichur	Raichur	3.2256	1.8847	0.0041	0.2612	2.1499	0.2930	1.0439	66.65	Safe
167	Raichur	Sindhanur	5.5771	1.1159	0.0023	0.2407	1.3589	0.2738	4.2499	24.37	Safe
168	Raichur	Sirivara	3.7219	2.8244	0.0000	0.0634	2.8878	0.0757	1.4867	77.59	Semi Critical
169	Ramanagara	Channapatna	2.3710	1.7897	0.0001	0.2355	2.0253	0.2417	0.3395	85.42	Semi Critical
170	Ramanagara	Harohalli	2.2053	2.5269	0.1672	0.1212	2.8153	0.1329	0.0000	127.66	Over Exploited
171	Ramanagara	Kanakpura	4.3998	3.3017	0.0003	0.2323	3.5344	0.2543	0.8529	80.33	Semi Critical
172	Ramanagara	Magadi	2.2535	2.1191	0.0019	0.2029	2.3239	0.2243	0.0000	103.13	Over Exploited
173	Ramanagara	Ramanagar	2.8680	2.5353	0.0216	0.2960	2.8529	0.3293	0.0925	99.47	Critical
174	Shivamogga	Bhadravathi	3.8545	1.7840	0.0023	0.1507	1.9370	0.1544	1.9138	50.25	Safe
175	Shivamogga	Hosanagar	4.7364	0.9995	0.0000	0.0885	1.0880	0.0898	3.6472	22.97	Safe
176	Shivamogga	Sagara	6.0353	1.6485	0.0012	0.1065	1.7562	0.1077	4.2778	29.1	Safe
177	Shivamogga	Shikaripura	3.9801	2.5209	0.0009	0.1503	2.6722	0.1571	1.3012	67.14	Safe
178	Shivamogga	Shimoga	3.7577	1.7796	0.0865	0.1992	2.0653	0.2085	1.6831	54.96	Safe
179	Shivamogga	Soraba	5.1722	2.6215	0.0000	0.1661	2.7876	0.1746	2.3761	53.9	Safe
180	Shivamogga	Thirthahalli	4.4588	1.3358	0.0000	0.0782	1.4140	0.0791	3.0440	31.71	Safe
181	Tumakuru	Chiknayakanahalli	2.1248	2.1685	0.0004	0.1720	2.3408	0.1827	0.0000	110.17	Over Exploited
182	Tumakuru	Gubbi	3.3159	1.5118	0.0002	0.2089	1.7209	0.2199	1.8443	51.9	Safe
183	Tumakuru	Koratagere	1.7089	1.5291	0.0001	0.1340	1.6632	0.1414	0.0383	97.33	Critical
184	Tumakuru	Kunigal	3.0836	1.8194	0.0023	0.1831	2.0048	0.1945	1.1405	65.02	Safe
185	Tumakuru	Madhugiri	2.7977	3.0302	0.0001	0.2141	3.2444	0.2260	0.0000	115.97	Over Exploited
186	Tumakuru	Pavagada	2.3171	1.6625	0.0007	0.1951	1.8582	0.2054	0.4485	80.2	Semi Critical
187	Tumakuru	Sira	2.8771	3.3395	0.0040	0.2484	3.5919	0.2611	0.0000	124.85	Over Exploited
188	Tumakuru	Tiptur	1.7634	2.1721	0.0025	0.1806	2.3552	0.1919	0.2608	133.56	Over Exploited
189	Tumakuru	Tumkur	3.4235	3.5340	0.0079	0.4849	4.0269	0.5173	0.6715	117.62	Over Exploited
190	Tumakuru	Turuvekere	2.1653	1.2496	0.0026	0.1370	1.3893	0.1456	0.7675	64.16	Safe
191	Udupi	Bramhavara	2.2628	0.9034	0.0010	0.1543	1.0588	0.1590	1.1993	46.79	Safe
192	Udupi	Bynduru	1.8733	0.5662	0.0003	0.1109	0.6773	0.1142	1.1926	36.16	Safe
193	Udupi	Hebri	1.5274	0.7972	0.0001	0.0414	0.8387	0.0426	0.6875	54.91	Safe

Sl. No	District	Assessment Unit Name	Annual Extractable Ground Water Resource (TMC)	Irrigation Use (TMC)	Industrial Use (TMC)	Domestic Use (TMC)	Total Extraction (TMC)	Annual GW Allocation for Domestic Use as on 2025 (TMC)	Net Ground Water Availability for future use (TMC)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/ Semi Critical/ Safe)
194	Udupi	Kapu	1.1422	0.2476	0.0001	0.1197	0.3675	0.1234	0.7711	32.17	Safe
195	Udupi	Karkala	3.3372	0.8586	0.0031	0.0800	0.9416	0.0824	2.3932	28.22	Safe
196	Udupi	Kundapur	4.0201	0.9602	0.0057	0.1163	1.0822	0.1199	2.9344	26.92	Safe
197	Udupi	Udupi	1.6319	0.4542	0.0024	0.1125	0.5691	0.1159	1.0594	34.87	Safe
198	Uttara Kannada	Ankola	2.2081	1.2810	0.0012	0.0805	1.3627	0.0827	0.8430	61.72	Safe
199	Uttara Kannada	Bhatkal	1.0141	0.2820	0.0025	0.1211	0.4056	0.1246	0.6050	40	Safe
200	Uttara Kannada	Dandelli	0.7568	0.0363	0.0001	0.0497	0.0861	0.0511	0.6693	11.37	Safe
201	Uttara Kannada	Haliyal	1.7652	0.9613	0.0001	0.0788	1.0402	0.0811	0.7227	58.93	Safe
202	Uttara Kannada	Honnavar	2.0023	0.6282	0.0008	0.1246	0.7536	0.1282	1.2451	37.64	Safe
203	Uttara Kannada	Joida	3.6220	0.5367	0.0000	0.0433	0.5800	0.0446	3.0408	16.01	Safe
204	Uttara Kannada	Karwar	2.1307	1.2631	0.0018	0.1164	1.3812	0.1197	0.7462	64.82	Safe
205	Uttara Kannada	Kumta	1.8024	0.2975	0.0018	0.1157	0.4149	0.1189	1.3842	23.02	Safe
206	Uttara Kannada	Mundgod	2.0616	0.5080	0.0000	0.0884	0.5965	0.0910	1.4627	28.93	Safe
207	Uttara Kannada	Siddapur	2.9073	0.6183	0.0005	0.0730	0.6917	0.0750	2.2135	23.79	Safe
208	Uttara Kannada	Sirsi	3.9775	0.9448	0.0021	0.1401	1.0870	0.1441	2.8865	27.33	Safe
209	Uttara Kannada	Yellapur	4.6078	0.9660	0.0004	0.0655	1.0319	0.0674	3.5740	22.39	Safe
210	Vijayanagara	Hadagali	2.7147	2.1275	0.0005	0.1370	2.2651	0.1463	1.0280	83.44	Semi Critical
211	Vijayanagara	Hagaribommanahalli	1.8037	1.9750	0.0017	0.1208	2.0975	0.1304	0.0073	116.29	Over Exploited
212	Vijayanagara	Harapanahalli	2.7742	2.9195	0.0016	0.2015	3.1226	0.2116	0.0000	112.56	Over Exploited
213	Vijayanagara	Hospet	1.7861	0.9782	0.0033	0.0979	1.0794	0.1092	0.6954	60.43	Safe
214	Vijayanagara	Kotturu	0.9022	0.9775	0.0000	0.0623	1.0399	0.0652	0.0000	115.26	Over Exploited
215	Vijayanagara	Kudligi	2.0116	1.0421	0.0007	0.1504	1.1933	0.1590	0.8097	59.32	Safe
216	Vijayapura	Alamela	1.7164	0.7437	0.0003	0.0974	0.8414	0.1030	0.9412	49.02	Safe
217	Vijayapura	Babaleshwara	2.0429	0.5564	0.0042	0.1035	0.6641	0.1095	1.3728	32.51	Safe
218	Vijayapura	Basavan Bagewadi	1.2538	0.8840	0.0000	0.1371	1.0211	0.1450	0.5021	81.44	Semi Critical
219	Vijayapura	Bijapur	1.7416	0.8125	0.0003	0.3748	1.1877	0.3964	0.7011	68.19	Safe
220	Vijayapura	Chadachana	1.7232	1.3385	0.0000	0.0978	1.4363	0.1034	0.3940	83.35	Semi Critical
221	Vijayapura	Devara Hipparagi	1.0741	0.4559	0.0000	0.0867	0.5426	0.0917	0.5864	50.52	Safe
222	Vijayapura	Indi	4.1557	2.3755	0.0006	0.2405	2.6167	0.2544	1.6750	62.97	Safe

Sl. No	District	Assessment Unit Name	Annual Extractable Ground Water Resource (TMC)	Irrigation Use (TMC)	Industrial Use (TMC)	Domestic Use (TMC)	Total Extraction (TMC)	Annual GW Allocation for Domestic Use as on 2025 (TMC)	Net Ground Water Availability for future use (TMC)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/ Semi Critical/ Safe)
223	Vijayapura	Kolhara	0.8806	0.5713	0.0000	0.0655	0.6368	0.0693	0.3133	72.32	Semi Critical
224	Vijayapura	Muddebihal	1.4417	0.6275	0.0000	0.1440	0.7716	0.1523	0.8035	53.52	Safe
225	Vijayapura	Nidagundi	1.0964	0.9329	0.0000	0.0700	1.0029	0.0740	0.4420	91.47	Critical
226	Vijayapura	Sindagi	1.5684	0.6309	0.0000	0.1245	0.7554	0.1316	0.9232	48.16	Safe
227	Vijayapura	Talikote	1.0861	0.4535	0.0000	0.1061	0.5596	0.1123	0.6164	51.52	Safe
228	Vijayapura	Tikota	1.6561	1.3466	0.0000	0.1008	1.4475	0.1066	0.2559	87.4	Semi Critical
229	Yadgir	Gurumithakala	1.7895	1.4634	0.0010	0.1088	1.5732	0.1212	0.2040	87.91	Semi Critical
230	Yadgir	Hunisigi	2.2777	0.5485	0.0000	0.0931	0.6416	0.0985	1.6307	28.17	Safe
231	Yadgir	Shahapur	2.7059	0.5711	0.0901	0.1500	0.8111	0.1593	1.8855	29.97	Safe
232	Yadgir	Shorapur	2.9109	0.4629	0.0058	0.1706	0.6394	0.1854	2.2568	21.96	Safe
233	Yadgir	Vadagera	2.2655	0.3934	0.0006	0.0731	0.4671	0.0813	1.7901	20.62	Safe
234	Yadgir	Yadgir	3.2485	2.0593	0.1848	0.1556	2.3997	0.1733	0.8312	73.87	Semi Critical
		Total	**566.5848**	**353.3743**	**4.4367**	**38.4120**	**396.2230**	**41.4610**	**224.0390**	**17134.73**	

ANNEXURE- VI: DISTRICT WISE GROUND WATER RESOURCE ASSESSMENT OF KARNATAKA -GWRA 2022

Sl. No.	District	Annual Ground water Recharge (ham)	Annual Extractable Ground Water Resource (ham)	Annual Ground Water Extraction for Domestic Use (ham)	Annual Ground Water Extraction for Industrial Use (ham)	Annual Ground Water Extractionfor Irrigation Use (ham)	Total Annual Ground Water Extraction for all uses (ham)	Stage of Ground Water Extraction (%)	Allocation of Ground Water Resource for Domestic Utilisation for projected year 2025 (ham)	Net Annual Ground Water Availability for Future Use (ham)
1	Bagalkot	69481.84	62603.33	4341.51	28.29	48128.09	52497.89	83.86	4601.51	19587.32
2	Ballari	54259.93	48833.94	1901.23	370.43	13813.00	16084.66	32.94	2108.96	32755.75
3	Belagavi	131883.12	120261.73	11400.43	532.84	64409.15	76342.47	63.48	13217.96	48185.44
4	Bengaluru (Rural)	21631.46	19468.31	2370.77	779.89	25567.50	28718.14	147.51	2572.12	0.00
5	Bengaluru (Urban)	23436.90	21218.36	3486.32	7825.80	20607.30	31919.40	150.43	3659.66	0.00
6	Bidar	36464.56	32818.08	4291.20	49.30	15451.96	19792.45	60.31	4487.09	13090.40
7	Chamarajanagara	37770.62	34753.15	2622.74	0.00	33874.78	36497.51	105.02	3173.32	2697.38
8	Chikkaballapura	36120.19	32508.16	2959.38	95.52	44523.62	47578.52	146.36	3150.21	0.00
9	Chikkamagaluru	58188.56	52774.35	2446.21	0.15	30795.46	33241.82	62.99	2625.54	23839.70
10	Chitradurga	43084.56	38776.10	3827.57	77.43	50626.11	54531.13	140.63	4073.87	1696.01
11	DakshinaKannada	70148.75	64194.29	5062.72	40.16	23217.05	28319.93	44.12	5501.60	35435.48
12	Davanagere	57270.62	51543.56	3589.92	228.05	46059.55	49877.52	96.77	3732.26	14745.93
13	Dharwad	32301.32	29162.43	2967.56	68.86	14554.25	17590.68	60.32	3099.47	11439.85
14	Gadag	30328.98	27296.11	649.95	26.52	23143.30	23819.77	87.26	733.62	6265.61
15	Hassan	81133.91	73137.08	3014.68	42.97	47882.71	50940.36	69.65	3142.70	26078.22
16	Haveri	53797.77	48417.98	1908.91	73.02	31582.72	33564.62	69.32	2184.68	16345.36
17	Kalburgi	69992.08	63667.13	7031.39	45.00	19401.89	26478.31	41.59	7653.22	37036.50
18	Kodagu	30199.70	27179.71	915.53	233.15	8668.35	9817.03	36.12	956.23	17321.98
19	Kolara	42953.37	38658.02	4051.17	64.61	66184.83	70300.60	181.85	4297.60	0.00

Sl. No.	District	Annual Ground water Recharge (ham)	Annual Extractable Ground Water Resource (ham)	Annual Ground Water Extraction for Domestic Use (ham)	Annual Ground Water Extraction for Industrial Use (ham)	Annual Ground Water Extractionfor Irrigation Use (ham)	Total Annual Ground Water Extraction for all uses (ham)	Stage of Ground Water Extraction (%)	Allocation of Ground Water Resource for Domestic Utilisation for projected year 2025 (ham)	Net Annual Ground Water Availability for Future Use (ham)
20	Koppal	72065.40	65099.83	2713.89	50.76	32420.93	35185.58	54.05	2926.84	29862.17
21	Mandya	71194.93	64599.53	3906.96	66.85	36219.99	40193.83	62.22	4003.43	27007.40
22	Mysuru	59979.58	54293.59	3934.15	37.37	28649.29	32620.84	60.08	4230.42	21376.48
23	Raichur	73207.10	66043.99	3075.74	64.08	27550.24	30690.07	46.47	3478.95	37277.80
24	Ramanagara	44355.00	39919.51	3080.53	541.08	34752.43	38374.02	96.13	3348.15	3638.53
25	Shivamogga	99809.92	90599.76	2660.77	257.25	35933.72	38851.74	42.88	2749.97	51658.82
26	Tumakuru	80096.42	72426.91	6111.28	59.09	62344.17	68514.54	94.60	6472.48	14643.80
27	Udupi	49695.47	44725.92	2081.47	35.92	13556.32	15673.71	35.04	2144.62	28989.06
28	Uttara Kannada	90448.16	81710.58	3106.64	31.91	23568.76	26707.26	32.69	3194.97	54914.98
29	Vijayanagara	37559.07	33958.93	2180.17	22.31	28373.26	30575.74	90.04	2326.63	7193.59
30	Vijayapura	67218.49	60703.25	4952.40	15.51	33213.72	38181.59	62.90	5237.48	26976.99
31	Yadgir	47817.45	43035.73	2127.37	799.32	15570.05	18496.74	42.98	2318.99	24347.37
	Total	**1773895.23**	**1604389.35**	**108770.56**	**12563.44**	**1000644.50**	**1121978.47**	**69.93**	**117404.55**	**634407.92**

ANNEXURE- VIA: DISTRICT WISE GROUND WATER RESOURCE ASSESSMENT OF KARNATAKA - GWRA 2022 in TMC

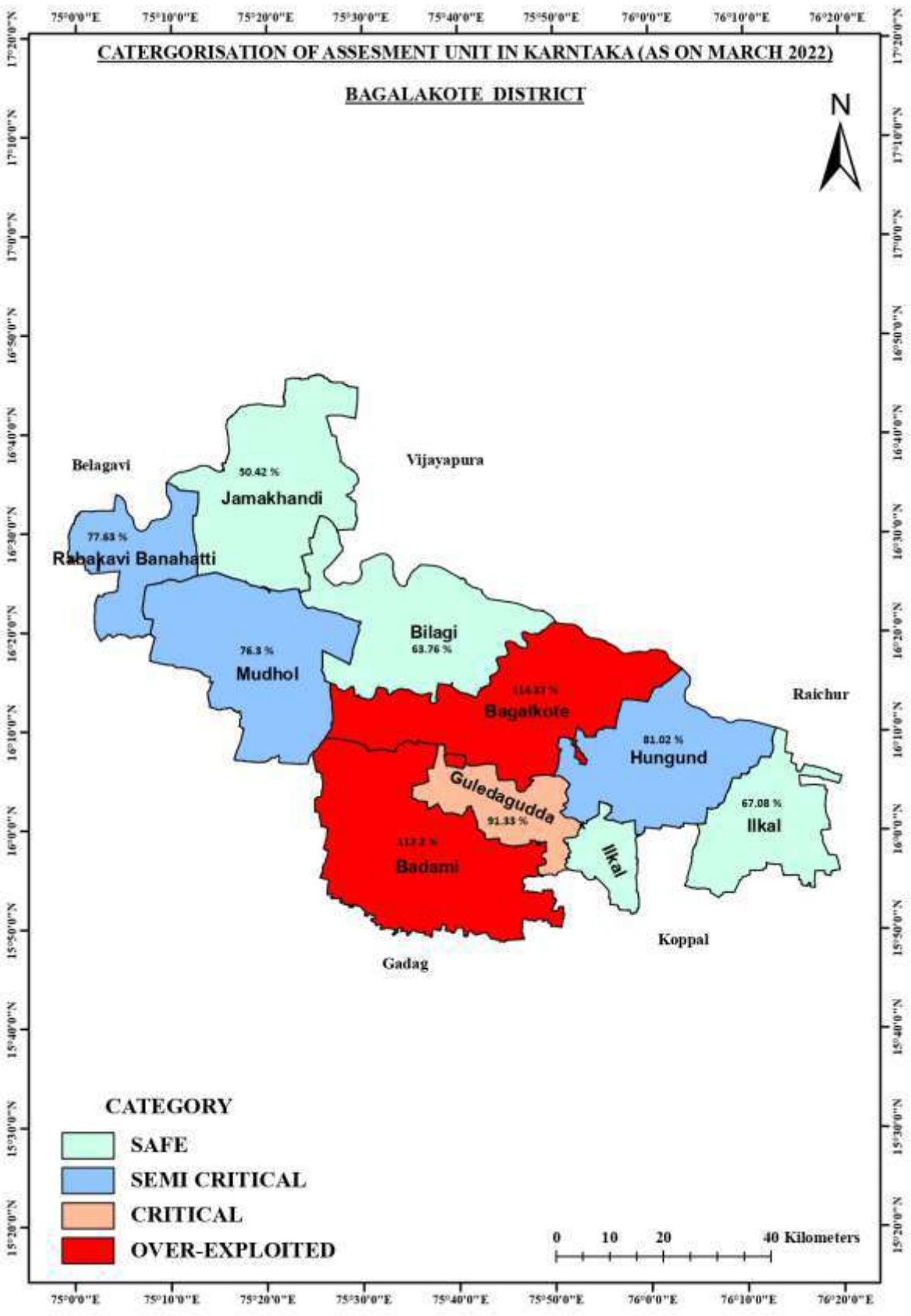
Sl. No.	District	Annual Ground water Recharge (TMC)	Annual Extractable Ground Water Resource (TMC)	Annual Ground Water Extraction for Domestic Use (TMC)	Annual Ground Water Extraction for Industrial Use (TMC)	Annual Ground Water Extraction for Irrigation Use (TMC)	Total Annual Ground Water Extraction for all uses (TMC)	Stage of Ground Water Extraction (%)	Allocation of Ground Water Resource for Domestic Utilisation for projected year 2025 (TMC)	Net Annual Ground Water Availability for Future Use (TMC)
1	Bagalkot	24.5373	22.1082	1.5332	0.0100	16.9963	18.5395	83.86	1.6250	6.9172
2	Ballari	19.1617	17.2455	0.6714	0.1308	4.8780	5.6802	32.94	0.7448	11.5676
3	Belagavi	46.5741	42.4700	4.0260	0.1882	22.7459	26.9601	63.48	4.6679	17.0165
4	Bengaluru (Rural)	7.6391	6.8752	0.8372	0.2754	9.0291	10.1417	147.51	0.9083	0.0000
5	Bengaluru(Urban)	8.2767	7.4932	1.2312	2.7637	7.2774	11.2722	150.43	1.2924	0.0000
6	Bidar	12.8773	11.5896	1.5154	0.0174	5.4568	6.9896	60.31	1.5846	4.6228
7	Chamarajanagara	13.3386	12.2730	0.9262	0.0000	11.9628	12.8890	105.02	1.1206	0.9526
8	Chikkaballapura	12.7557	11.4801	1.0451	0.0337	15.7234	16.8022	146.36	1.1125	0.0000
9	Chikkamagaluru	20.5491	18.6371	0.8639	0.0001	10.8753	11.7392	62.99	0.9272	8.4189
10	Chitradurga	15.2152	13.6937	1.3517	0.0273	17.8784	19.2575	140.63	1.4387	0.5989
11	DakshinaKannada	24.7728	22.6700	1.7879	0.0142	8.1990	10.0011	44.12	1.9429	12.5139
12	Davanagere	20.2249	18.2024	1.2678	0.0805	16.2658	17.6141	96.77	1.3180	5.2075
13	Dharwad	11.4071	10.2986	1.0480	0.0243	5.1398	6.2121	60.32	1.0946	4.0399
14	Gadag	10.7106	9.6395	0.2295	0.0094	8.1730	8.4119	87.26	0.2591	2.2127

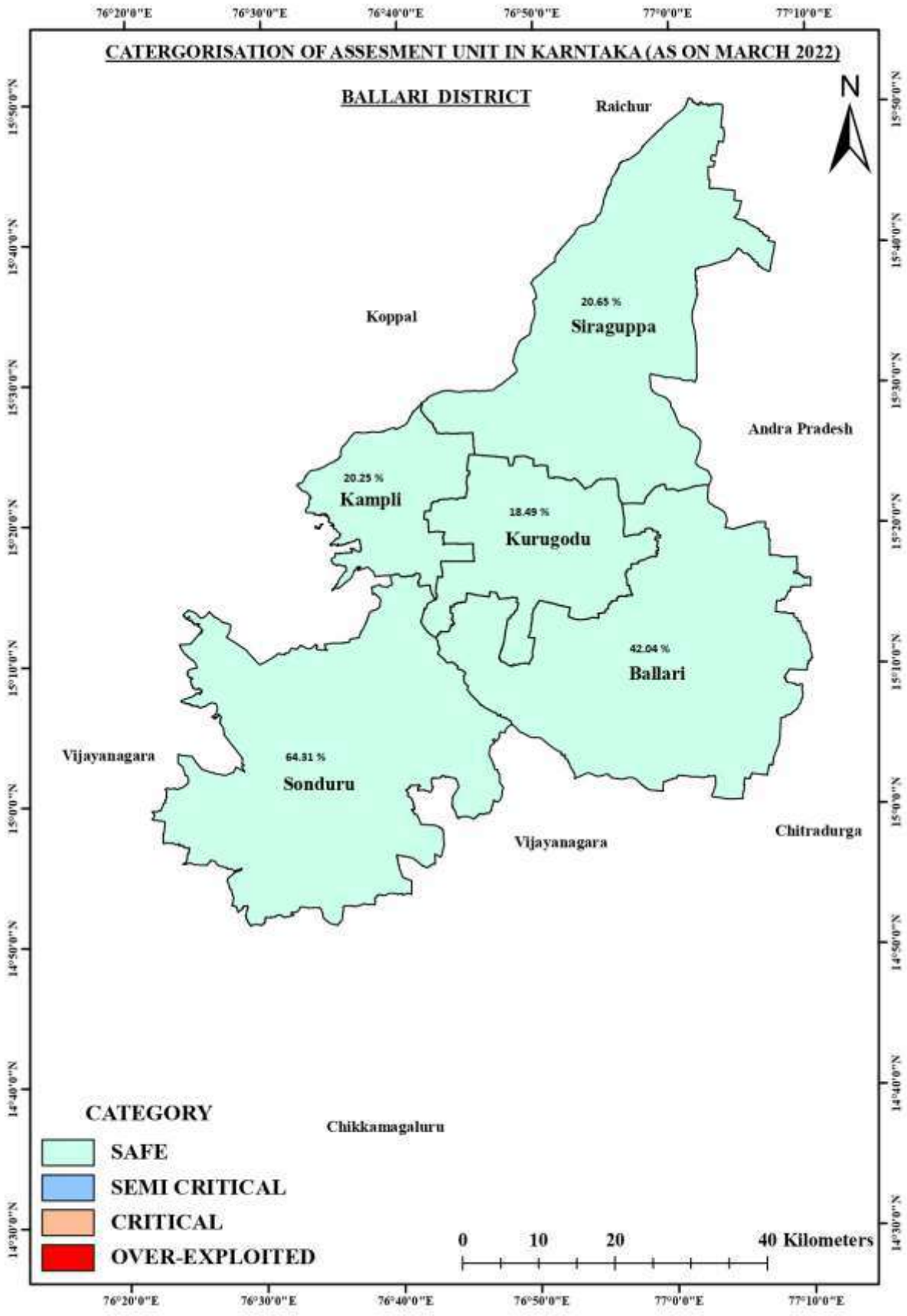
Sl. No.	District	Annual Ground water Recharge (TMC)	Annual Extractable Ground Water Resource (TMC)	Annual Ground Water Extraction for Domestic Use (TMC)	Annual Ground Water Extraction for Industrial Use (TMC)	Annual Ground Water Extraction for Irrigation Use (TMC)	Total Annual Ground Water Extraction for all uses (TMC)	Stage of Ground Water Extraction (%)	Allocation of Ground Water Resource for Domestic Utilisation for projected year 2025 (TMC)	Net Annual Ground Water Availability for Future Use (TMC)
15	Hassan	28.6522	25.8281	1.0646	0.0152	16.9096	17.9894	69.65	1.1098	9.2094
16	Haveri	18.9985	17.0986	0.6741	0.0258	11.1533	11.8532	69.32	0.7715	5.7723
17	Kalburgi	24.7175	22.4838	2.4831	0.0159	6.8517	9.3507	41.59	2.7027	13.0793
18	Kodagu	10.6649	9.5984	0.3233	0.0823	3.0612	3.4669	36.12	0.3377	6.1172
19	Kolara	15.1688	13.6520	1.4307	0.0228	23.3730	24.8264	181.85	1.5177	0.0000
20	Koppal	25.4497	22.9898	0.9584	0.0179	11.4493	12.4257	54.05	1.0336	10.5457
21	Mandya	25.1423	22.8131	1.3797	0.0236	12.7910	14.1943	62.22	1.4138	9.5376
22	Mysuru	21.1816	19.1736	1.3893	0.0132	10.1174	11.5199	60.08	1.4940	7.5490
23	Raichur	25.8528	23.3232	1.0862	0.0226	9.7293	10.8381	46.47	1.2286	13.1645
24	Ramanagara	15.6638	14.0974	1.0879	0.1911	12.2727	13.5517	96.13	1.1824	1.2849
25	Shivamogga	35.2475	31.9950	0.9396	0.0908	12.6899	13.7204	42.88	0.9711	18.2431
26	Tumakuru	28.2858	25.5773	2.1582	0.0209	22.0166	24.1957	94.6	2.2857	5.1714
27	Udupi	17.5498	15.7948	0.7351	0.0127	4.7874	5.5351	35.04	0.7574	10.2374
28	Uttara Kannada	31.9415	28.8558	1.0971	0.0113	8.3232	9.4316	32.69	1.1283	19.3930
29	Vijayanagara	13.2639	11.9925	0.7699	0.0079	10.0199	10.7977	90.04	0.8216	2.5404
30	Vijayapura	23.7380	21.4372	1.7489	0.0055	11.7293	13.4837	62.9	1.8496	9.5268
31	Yadgir	16.8866	15.1979	0.7513	0.2823	5.4985	6.5321	42.98	0.8189	8.5982
	Total	**626.4452**	**566.5848**	**38.4120**	**4.4367**	**353.3743**	**396.2230**	**69.93**	**41.4610**	**224.0390**

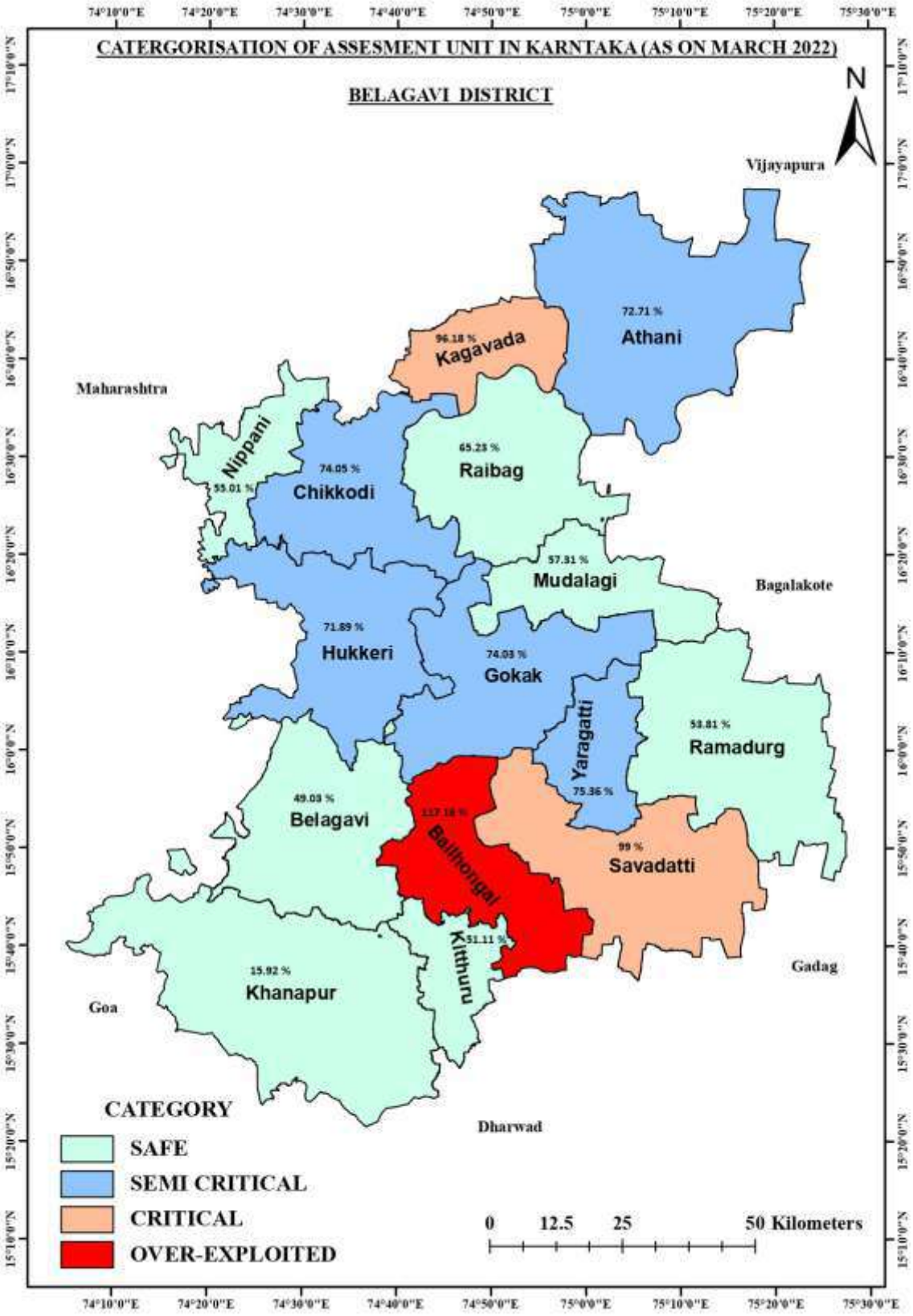
ANNEXURE-VII: SUMMARY OF DISTRICT WISE CATEGORIZATION OF ASSESSMENT UNITS (TALUKS) KARNATAKA -GWRA 2022

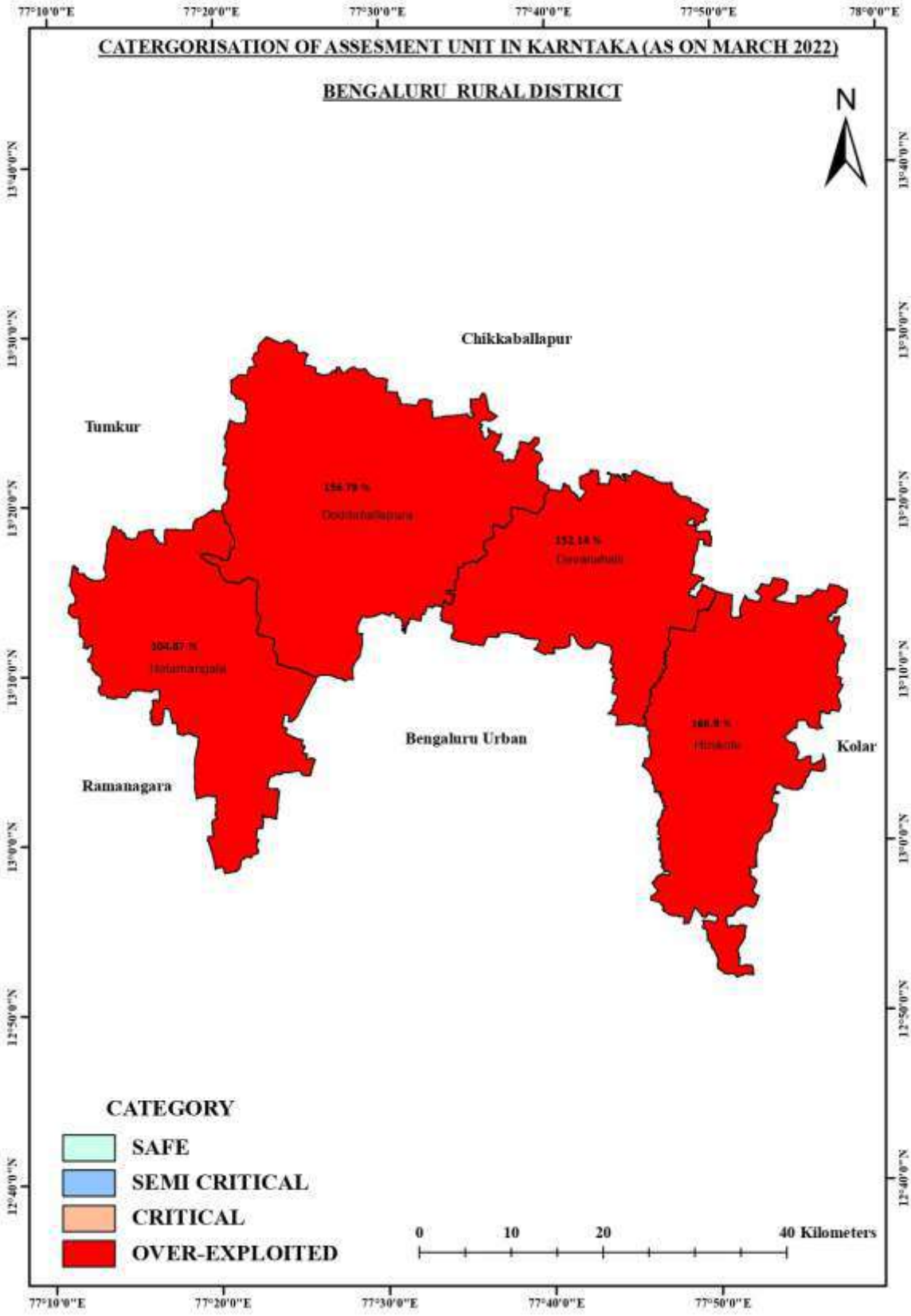
Sl. No.	Name of District	Total No. of Assessed Units	Safe		Semi-Critical		Critical		Over-Exploited	
			No	%	No.	%	No.	%	No.	%
1	Bagalkot	9	3	33.33	3	33.33	1	11.11	2	22.22
2	Ballari	5	5	100.00		0.00		0.00		0.00
3	Belagavi	15	7	46.67	5	33.33	2	13.33	1	6.67
4	Bengaluru (Rural)	4		0.00		0.00		0.00	4	100.00
5	Bengaluru (Urban)	6		0.00		0.00		0.00	6	100.00
6	Bidar	8	6	75.00	2	25.00		0.00		0.00
7	Chamarajanagara	5		0.00	2	40.00	1	20.00	2	40.00
8	Chikkaballapura	6		0.00		0.00		0.00	6	100.00
9	Chikkamagaluru	9	7	77.78		0.00		0.00	2	22.22
10	Chitradurga	6	1	16.67		0.00		0.00	5	83.33
11	Dakshina Kannada	7	7	100.00		0.00		0.00		0.00
12	Davanagere	6	2	33.33	1	16.67	1	16.67	2	33.33
13	Dharwad	8	8	100.00		0.00		0.00		0.00
14	Gadag	7	2	28.57	3	42.86		0.00	2	28.57
15	Hassan	8	6	75.00		0.00	1	12.50	1	12.50
16	Haveri	8	4	50.00	3	37.50	1	12.50		0.00
17	Kalburgi	11	10	90.91	1	9.09		0.00		0.00
18	Kodagu	5	5	100.00		0.00		0.00		0.00
19	Kolara	6		0.00		0.00		0.00	6	100.00
20	Koppal	7	4	57.14	2	28.57	1	14.29		0.00
21	Mandya	7	6	85.71	1	14.29		0.00		0.00
22	Mysuru	8	7	87.50	1	12.50		0.00		0.00
23	Raichur	7	6	85.71	1	14.29		0.00		0.00
24	Ramanagara	5		0.00	2	40.00	1	20.00	2	40.00
25	Shivamogga	7	7	100.00		0.00		0.00		0.00
26	Tumakuru	10	3	30.00	1	10.00	1	10.00	5	50.00

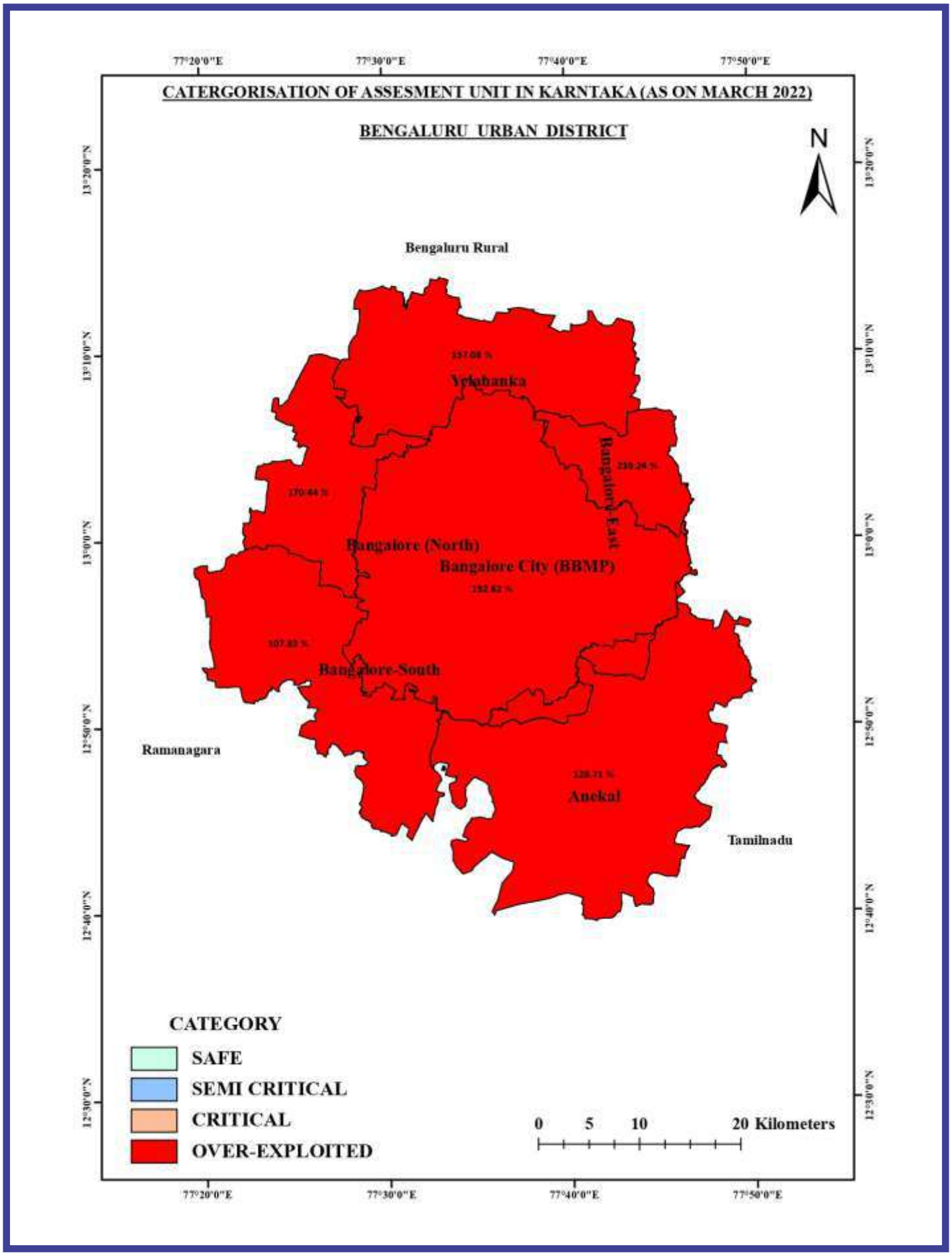
Sl. No.	Name of District	Total No. of Assessed Units	Safe		Semi-Critical		Critical		Over-Exploited	
			No	%	No.	%	No.	%	No.	%
27	Udupi	7	7	100.00		0.00		0.00		0.00
28	Uttara Kannada	12	12	100.00		0.00		0.00		0.00
29	Vijayanagara	6	2	33.33	1	16.67		0.00	3	50.00
30	Vijayapura	13	8	61.54	4	30.77	1	7.69		0.00
31	Yadgir	6	4	66.67	2	33.33		0.00		0.00
32	**Total**	**234**	**139**	**59.40**	**35**	**14.96**	**11**	**4.70**	**49**	**20.94**

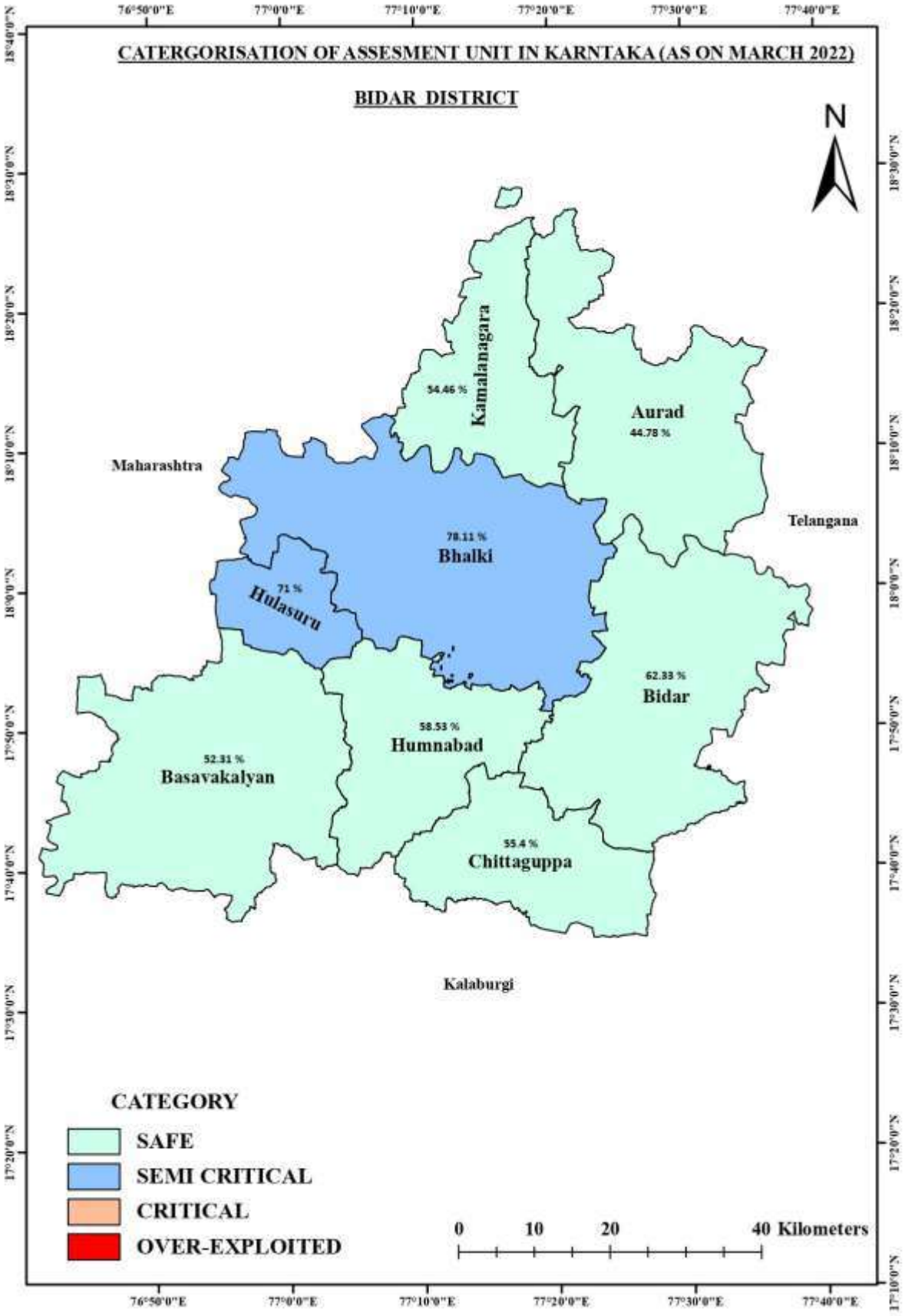

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
BAGALAKOTE DISTRICT
N
Belagavi
Vijayapura
Raichur
Koppal
Gadag
50.42 %
Jamakhandi
77.63 %
Rabakavi Banahatti
Bilagi
63.76 %
76.3 %
Mudhol
114.37 %
Bagalkote
81.02 %
Hungund
Guledagudda
91.33 %
112.2 %
Badami
Ilkal
67.08 %
Ilkal
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers

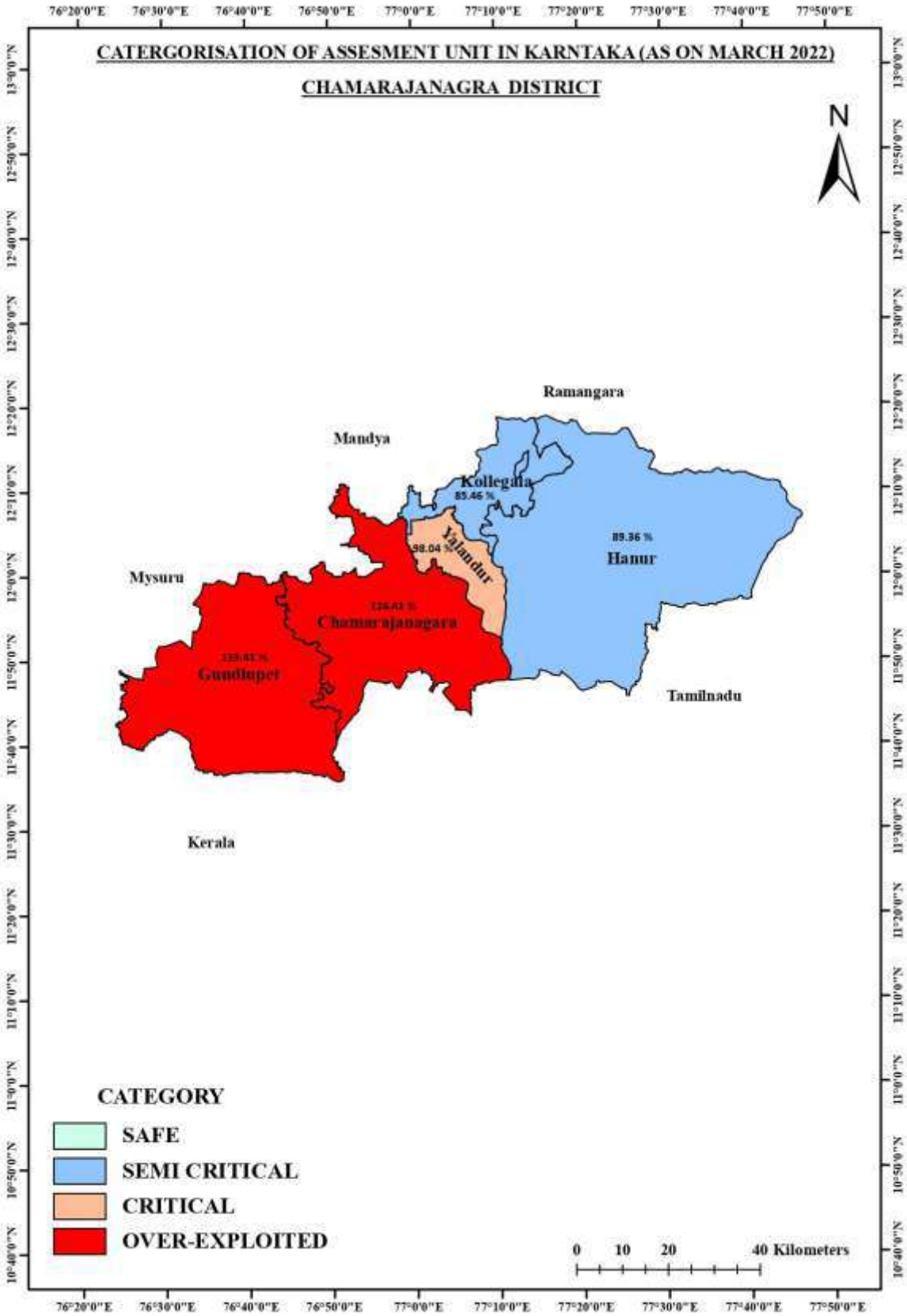

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
BALLARI DISTRICT
N
Raichur
Koppal
20.65 %
Siraguppa
Andra Pradesh
20.25 %
Kampli
18.49 %
Kurugodu
42.04 %
Ballari
Vijayanagara
64.31 %
Sonduru
Vijayanagara
Chitradurga
Chikkamagaluru
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers
76°20'0"E
76°30'0"E
76°40'0"E
76°50'0"E
77°0'0"E
77°10'0"E

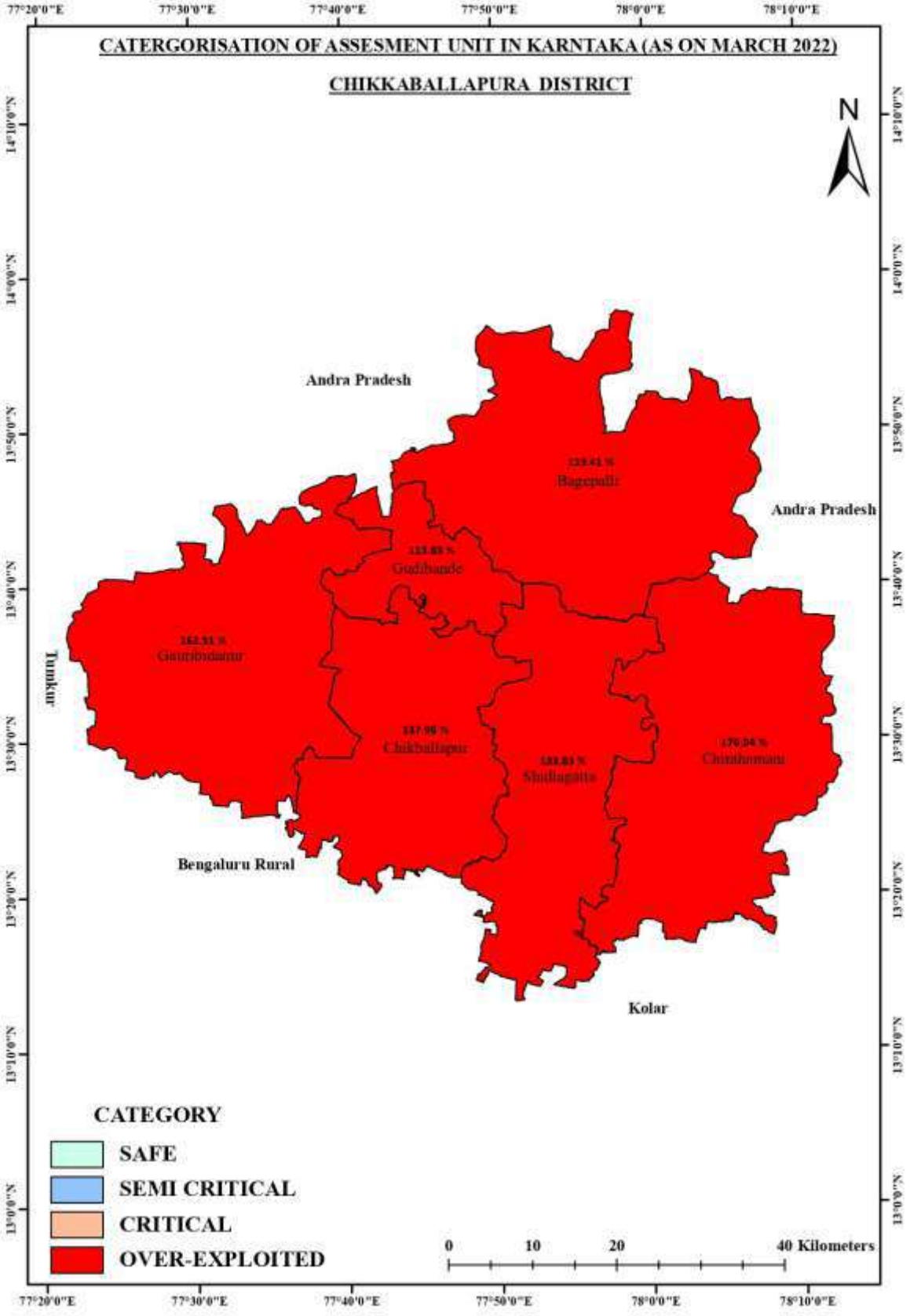

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
BELAGAVI DISTRICT
N
Vijayapura
Maharashtra
Bagalakote
Gadag
Dharwad
Goa
Athani
72.71 %
Kagavada
96.18 %
Nippani
55.01 %
Chikkodi
74.05 %
Raibag
65.23 %
Mudalagi
57.31 %
Hukkeri
71.89 %
Gokak
74.03 %
Yaragatti
75.36 %
Ramadurg
53.81 %
Belagavi
49.03 %
Bailhongal
117.18 %
Savadatti
99 %
Kitthuru
51.11 %
Khanapur
15.92 %
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 12.5 25 50 Kilometers
74°10'0"E
74°20'0"E
74°30'0"E
74°40'0"E
74°50'0"E
75°0'0"E
75°10'0"E
75°20'0"E
75°30'0"E

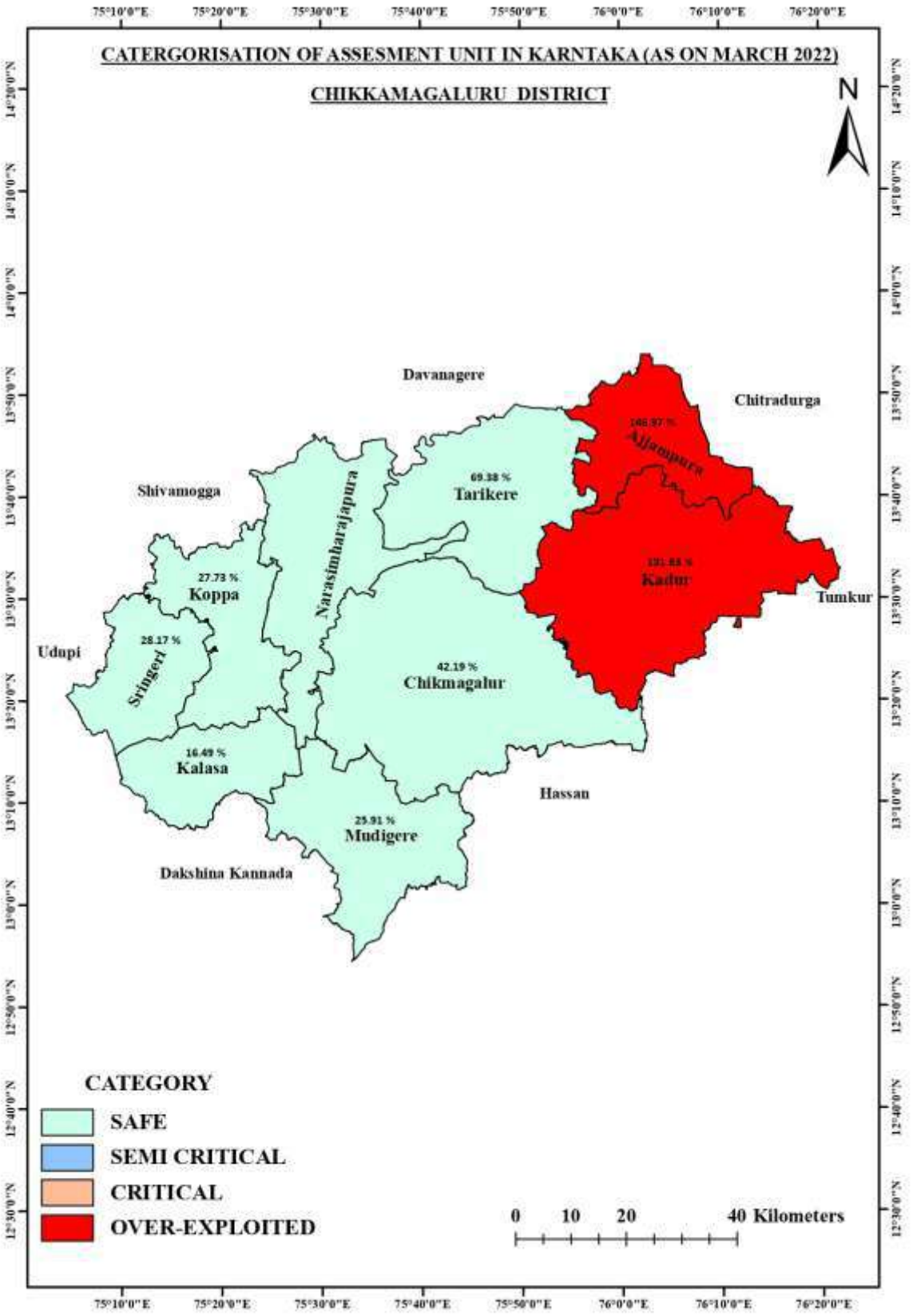

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
BENGALURU RURAL DISTRICT
N
Chikkaballapur
Tumkur
Bengaluru Urban
Kolar
Ramanagara
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers

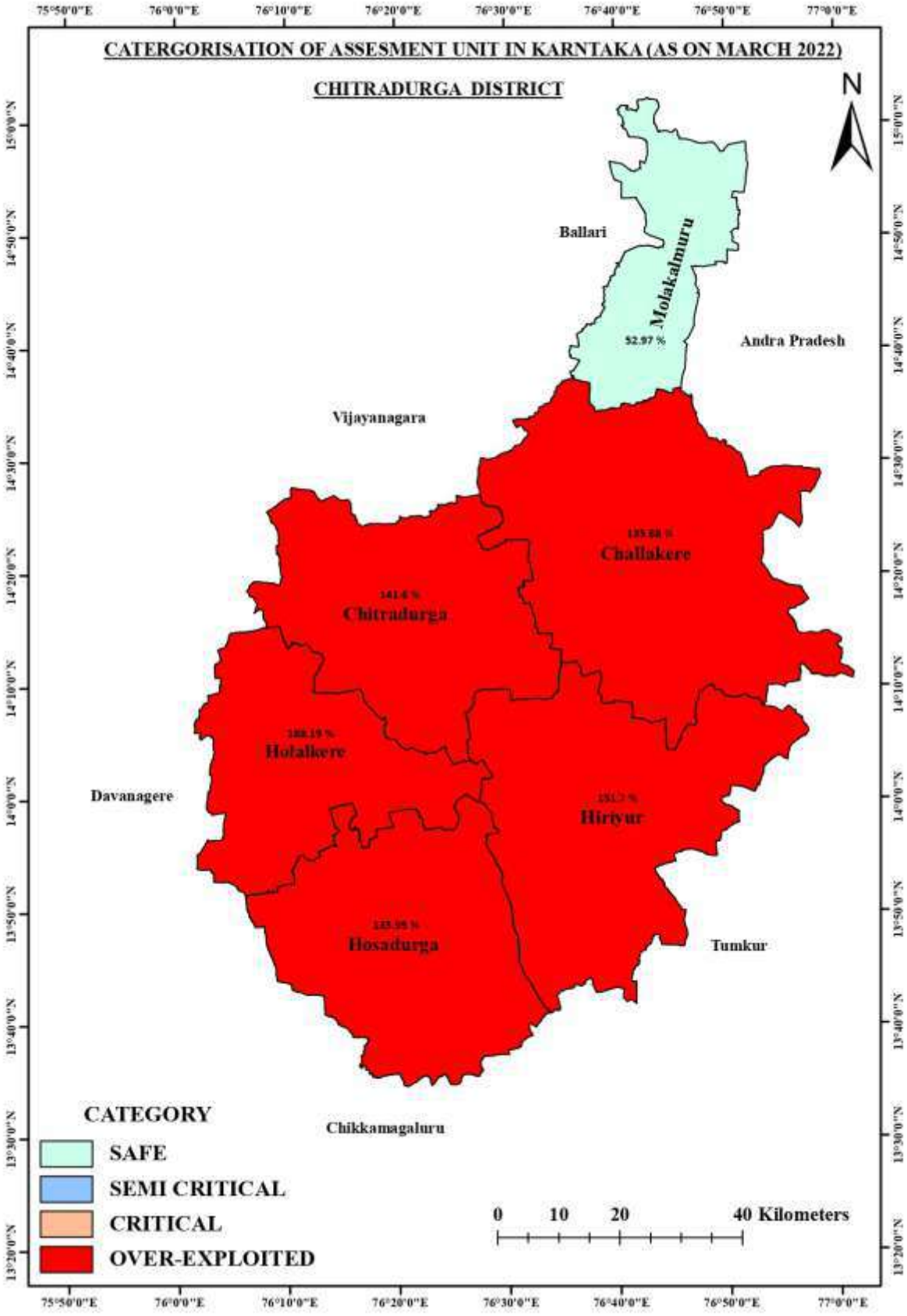

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
BENGALURU URBAN DISTRICT
N
77°20'0"E
77°30'0"E
77°40'0"E
77°50'0"E
13°20'0"N
13°10'0"N
13°0'0"N
12°50'0"N
12°40'0"N
12°30'0"N
Bengaluru Rural
Yelahanka
Bangalore East
Bangalore (North)
Bangalore City (BBMP)
Bangalore-South
Anekal
Ramanagara
Tamilnadu
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 5 10 20 Kilometers

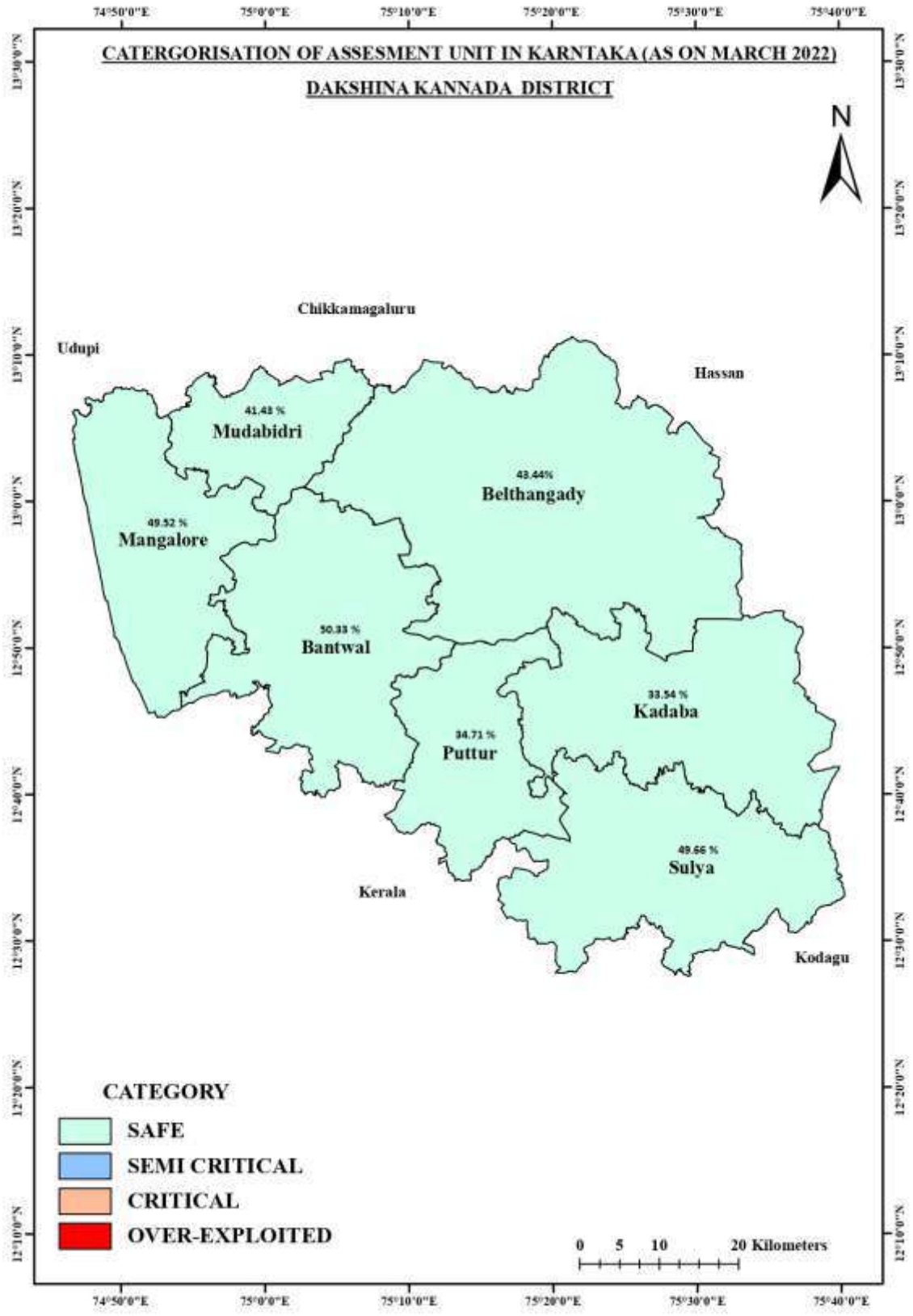

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
BIDAR DISTRICT
N
76°50'0"E
77°0'0"E
77°10'0"E
77°20'0"E
77°30'0"E
77°40'0"E
18°40'0"N
18°30'0"N
18°20'0"N
18°10'0"N
18°0'0"N
17°50'0"N
17°40'0"N
17°30'0"N
17°20'0"N
17°10'0"N
Kamalanagara
54.46 %
Aurad
44.78 %
Maharashtra
Telangana
Bhalki
78.11 %
Hulasuru
71 %
Bidar
62.33 %
Humnabad
58.53 %
Basavakalyan
52.31 %
Chittaguppa
55.4 %
Kalaburgi
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers

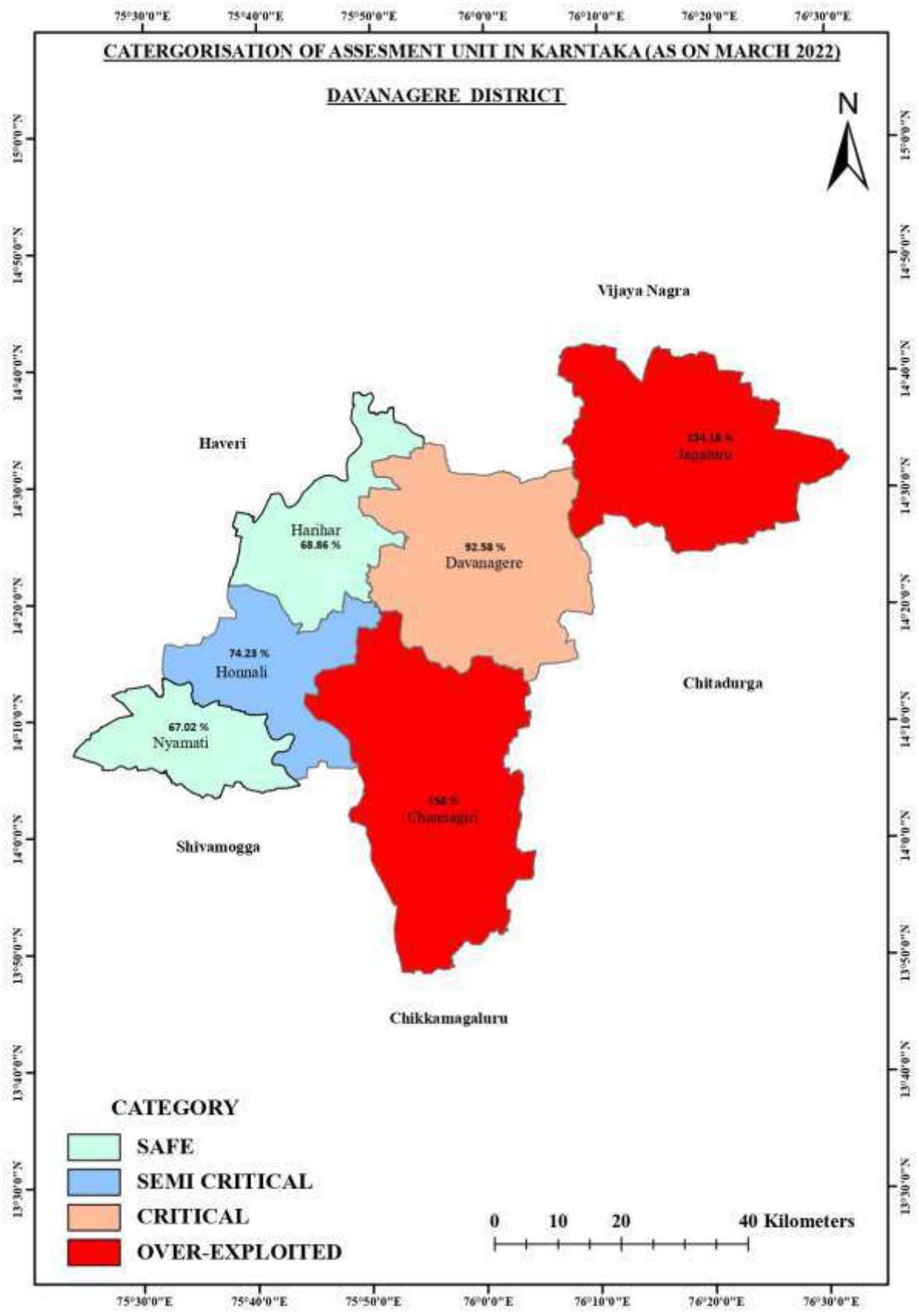

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
CHAMARAJANAGRA DISTRICT
N
Ramangara
Mandya
Kollegala
85.46 %
Yalandur
98.04 %
89.36 %
Hanur
Mysuru
Chamarajanagara
Gundlupet
Tamilnadu
Kerala
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers
76°20'0"E
76°30'0"E
76°40'0"E
76°50'0"E
77°0'0"E
77°10'0"E
77°20'0"E
77°30'0"E
77°40'0"E
77°50'0"E

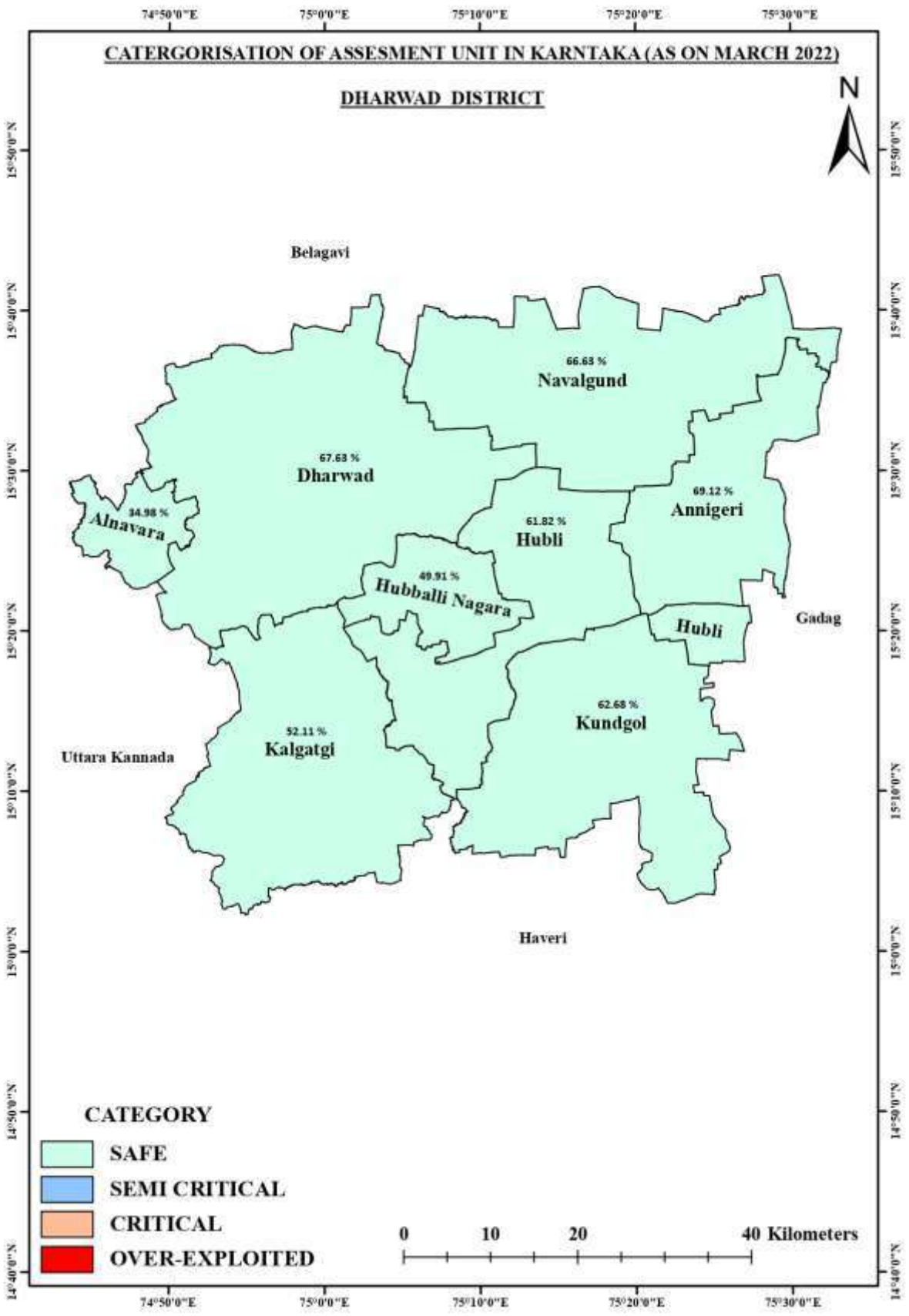

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
CHIKKABALLAPURA DISTRICT
N
77°20'0"E
77°30'0"E
77°40'0"E
77°50'0"E
78°0'0"E
78°10'0"E
14°10'0"N
14°0'0"N
13°50'0"N
13°40'0"N
13°30'0"N
13°20'0"N
13°10'0"N
13°0'0"N
Andra Pradesh
Andra Pradesh
Tumkur
Bengaluru Rural
Kolar
Bagepalli
Gudibande
Gauribidanur
Chikballapur
Shidlaghatta
Chinthamani
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers

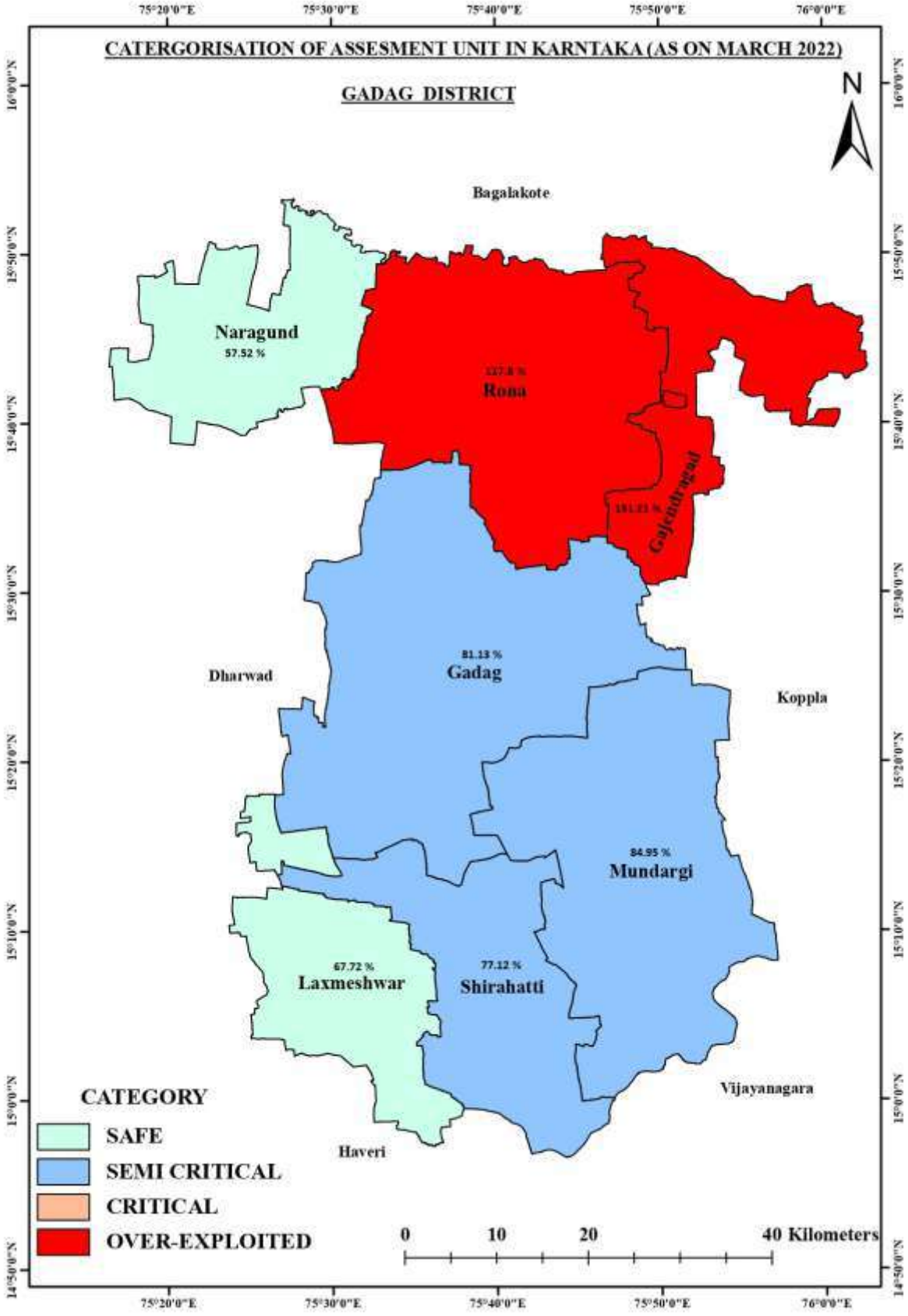

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
CHIKKAMAGALURU DISTRICT
N
Davanagere
Chitradurga
Shivamogga
Tumkur
Udupi
Hassan
Dakshina Kannada
146.97 %
Ajjampura
69.38 %
Tarikere
131.44 %
Kadur
27.73 %
Koppa
28.17 %
Sringeri
Narasimharajapura
42.19 %
Chikmagalur
16.49 %
Kalasa
25.91 %
Mudigere
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers

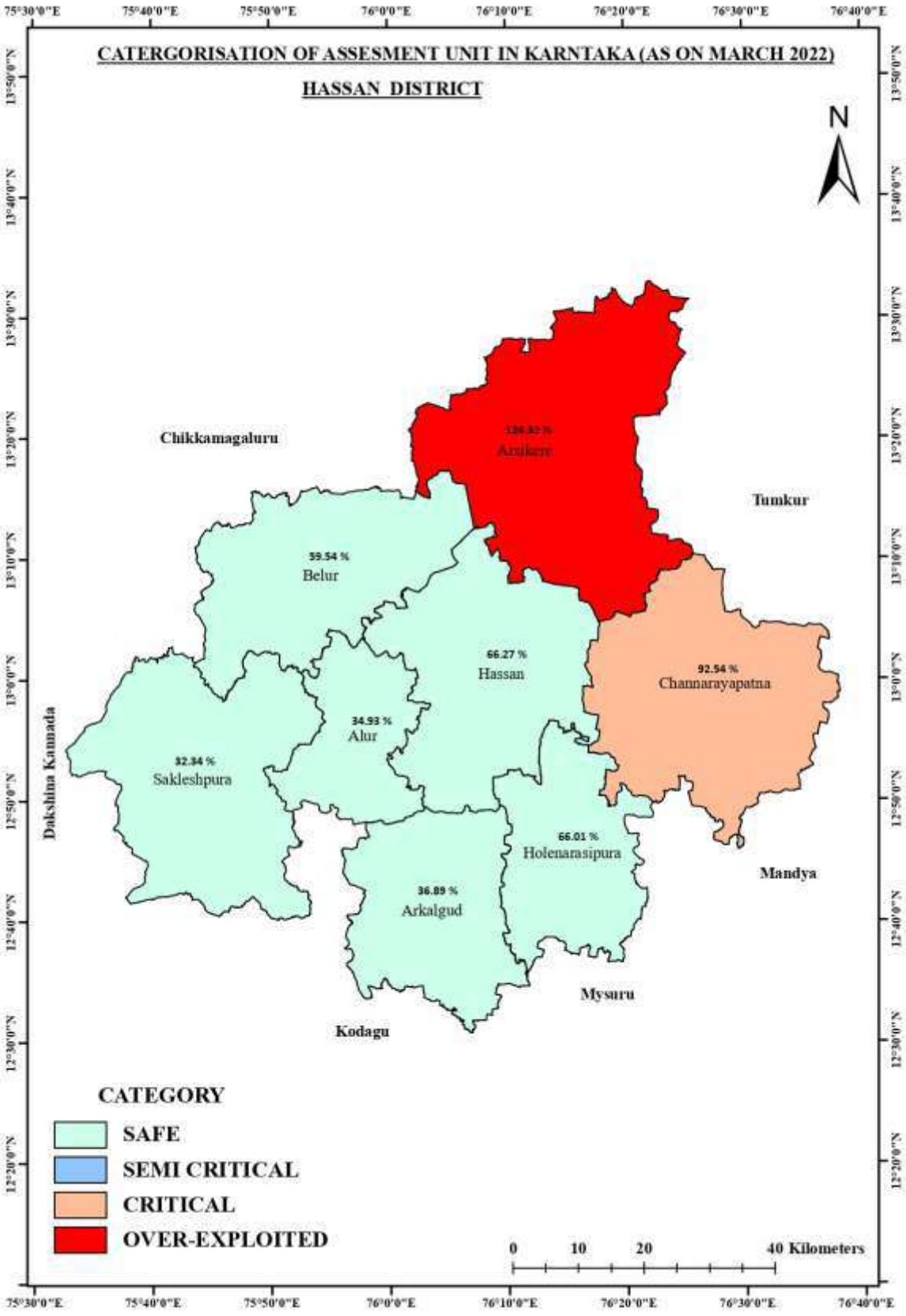

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
CHITRADURGA DISTRICT
N
Molakalmuru
52.97 %
Ballari
Andra Pradesh
Vijayanagara
Challakere
Chitradurga
Holalkere
Hiriyur
Davanagere
Hosadurga
Tumkur
Chikkamagaluru
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers
75°50'0"E
76°0'0"E
76°10'0"E
76°20'0"E
76°30'0"E
76°40'0"E
76°50'0"E
77°0'0"E

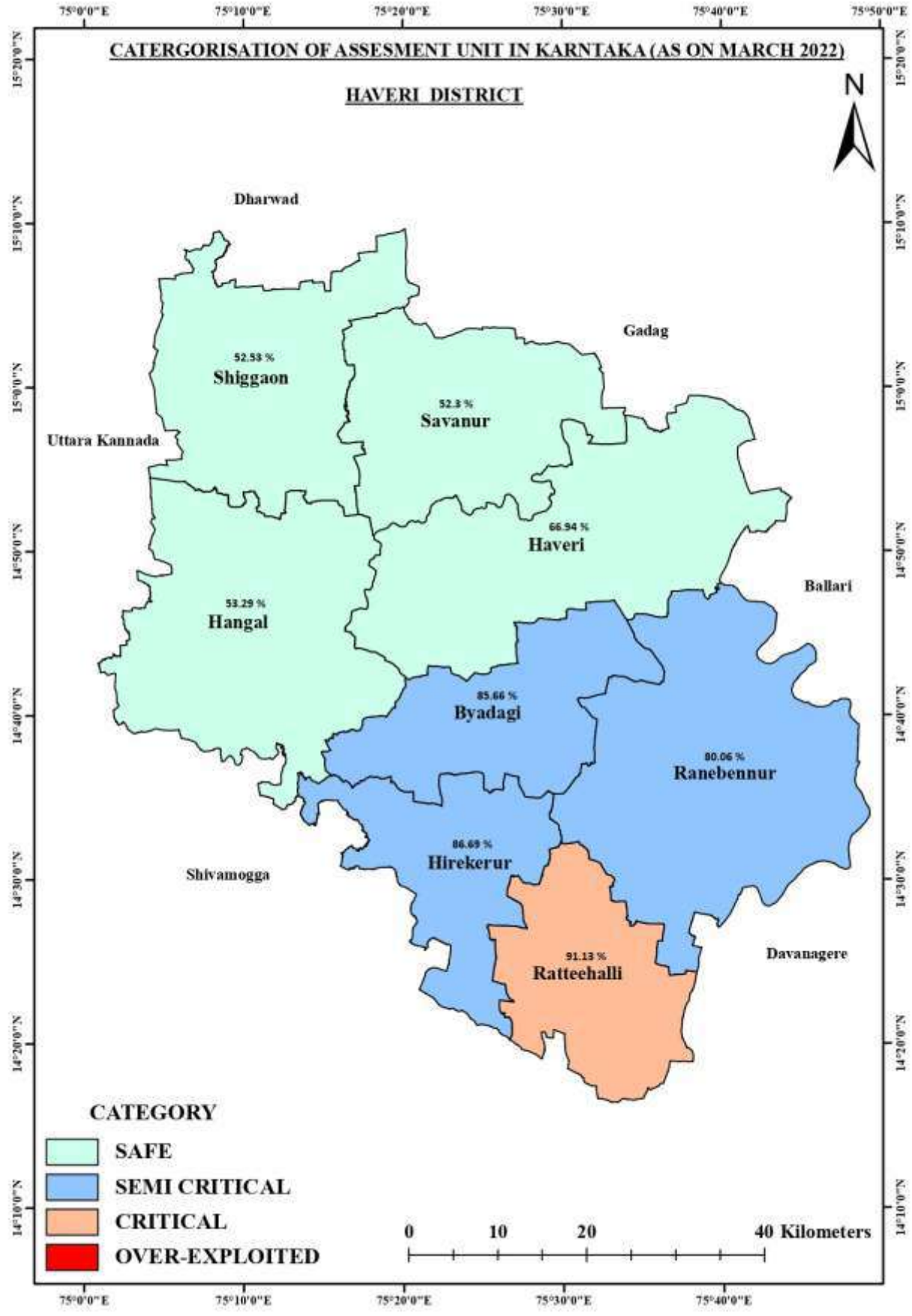

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
DAKSHINA KANNADA DISTRICT
N
74°50'0"E
75°0'0"E
75°10'0"E
75°20'0"E
75°30'0"E
75°40'0"E
13°30'0"N
13°20'0"N
13°10'0"N
13°0'0"N
12°50'0"N
12°40'0"N
12°30'0"N
12°20'0"N
12°10'0"N
Chikkamagaluru
Udupi
Hassan
41.48 %
Mudabidri
43.44%
Belthangady
49.52 %
Mangalore
50.33 %
Bantwal
33.54 %
Kadaba
34.71 %
Puttur
49.66 %
Sulya
Kerala
Kodagu
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 5 10 20 Kilometers

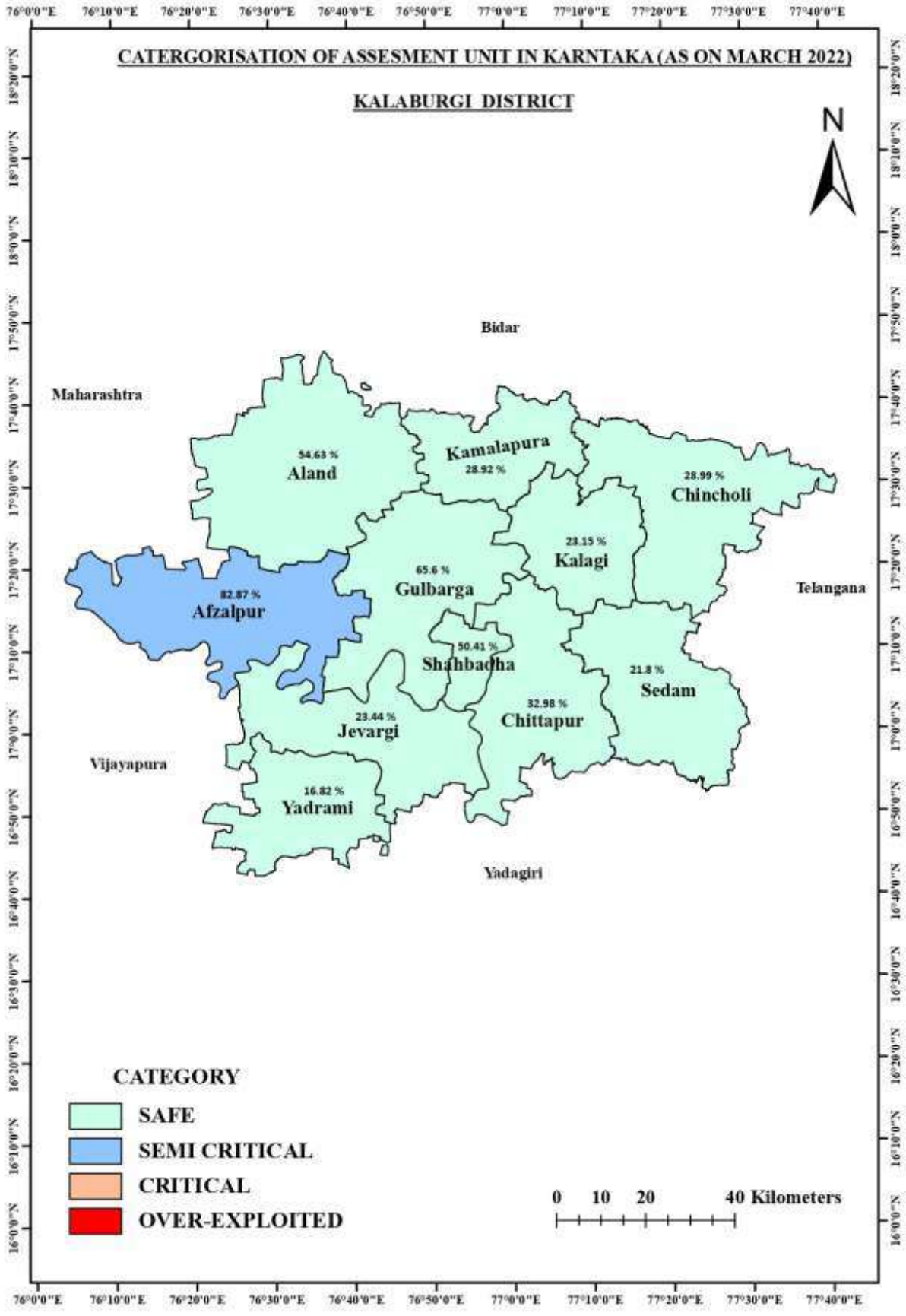

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
DAVANAGERE DISTRICT
N
75°30'0"E
75°40'0"E
75°50'0"E
76°0'0"E
76°10'0"E
76°20'0"E
76°30'0"E
Vijaya Nagra
Haveri
134.18 %
Jagaluru
Harihar
68.86 %
92.58 %
Davanagere
74.23 %
Honnali
Chitadurga
67.02 %
Nyamati
Channagiri
Shivamogga
Chikkamagaluru
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers

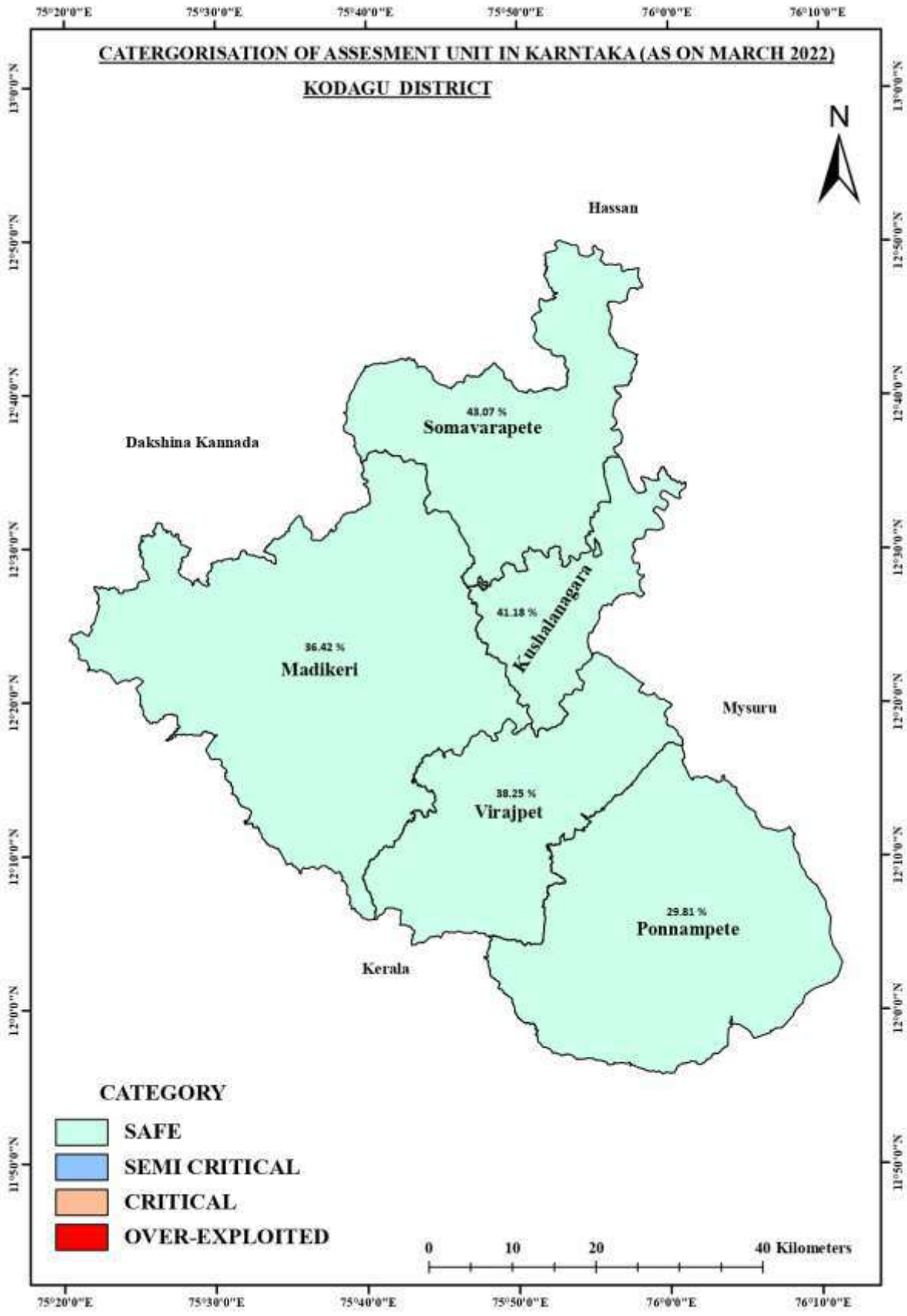

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
DHARWAD DISTRICT
N
74°50'0"E
75°0'0"E
75°10'0"E
75°20'0"E
75°30'0"E
15°50'0"N
15°40'0"N
15°30'0"N
15°20'0"N
15°10'0"N
15°0'0"N
14°50'0"N
Belagavi
66.63 %
Navalgund
67.63 %
Dharwad
34.98 %
Alnavara
61.82 %
Hubli
69.12 %
Annigeri
49.91 %
Hubballi Nagara
Hubli
Gadag
62.68 %
Kundgol
52.11 %
Kalgatgi
Uttara Kannada
Haveri
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers

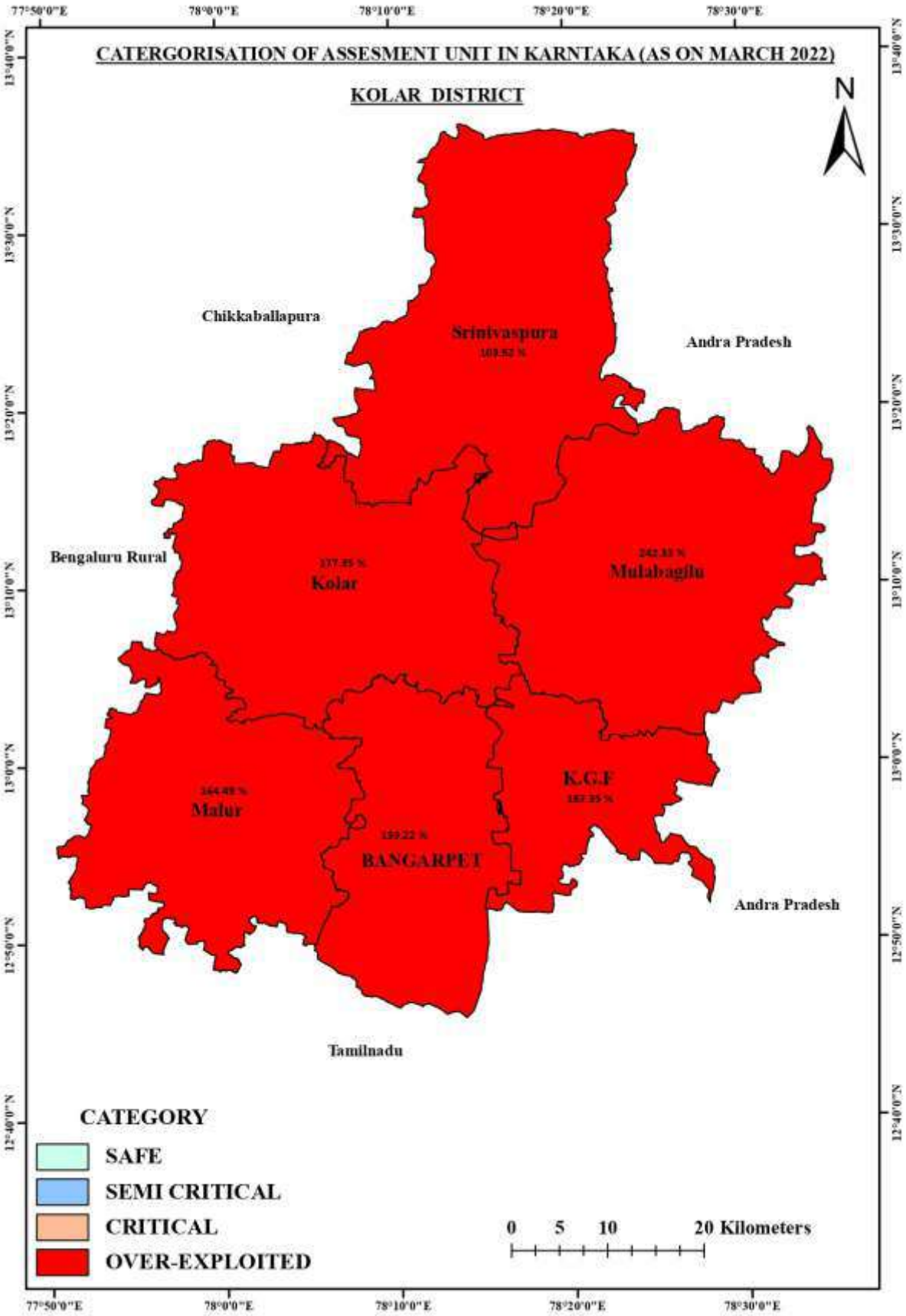

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
GADAG DISTRICT
N
Bagalakote
Naragund
57.52 %
Rona
Gajendragad
81.13 %
Gadag
Dharwad
Koppla
84.95 %
Mundargi
67.72 %
Laxmeshwar
77.12 %
Shirahatti
Vijayanagara
Haveri
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers
75°20'0"E
75°30'0"E
75°40'0"E
75°50'0"E
76°0'0"E
16°0'0"N
15°50'0"N
15°40'0"N
15°30'0"N
15°20'0"N
15°10'0"N
15°0'0"N
14°50'0"N

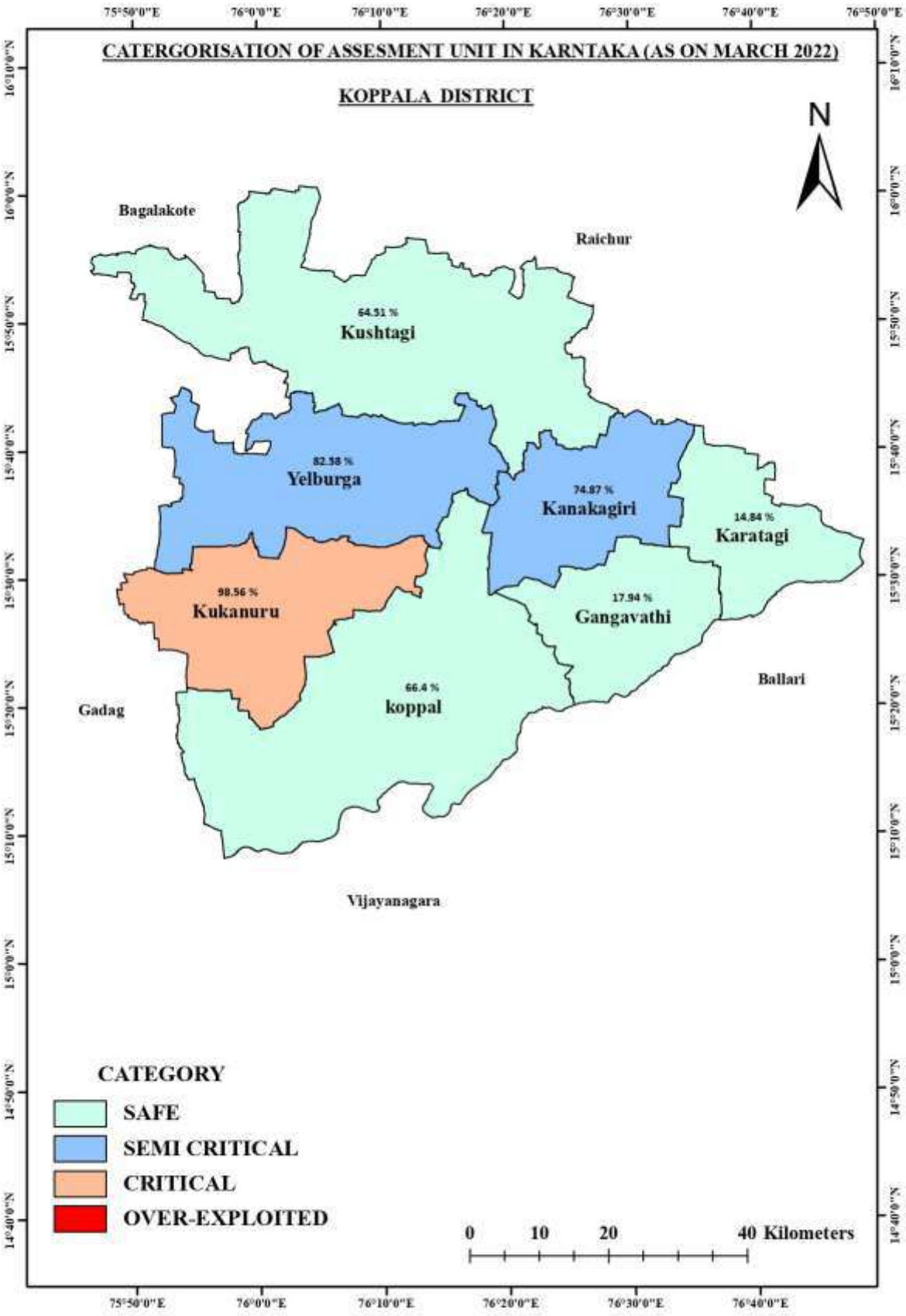

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
HASSAN DISTRICT
N
Chikkamagaluru
Tumkur
Dakshina Kannada
Kodagu
Mysuru
Mandya
Arsikere
59.54 %
Belur
66.27 %
Hassan
92.54 %
Channarayapatna
34.93 %
Alur
32.34 %
Sakleshpura
66.01 %
Holenarasipura
36.89 %
Arkalgud
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers

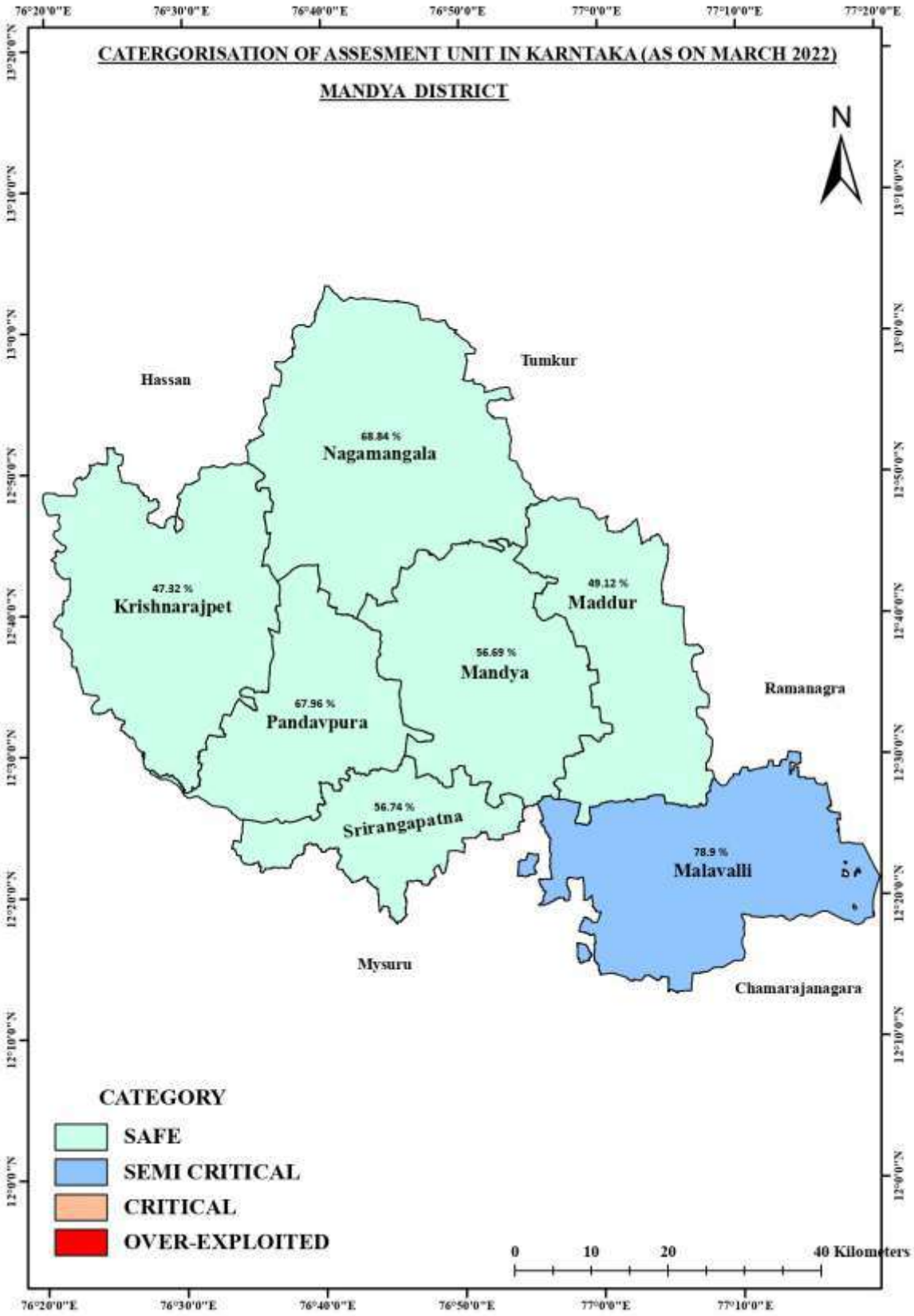

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
HAVERI DISTRICT
N
Dharwad
Gadag
Uttara Kannada
Ballari
Shivamogga
Davanagere
52.58 %
Shiggaon
52.3 %
Savanur
66.94 %
Haveri
53.29 %
Hangal
85.66 %
Byadagi
80.06 %
Ranebennur
86.69 %
Hirekerur
91.13 %
Ratteehalli
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers

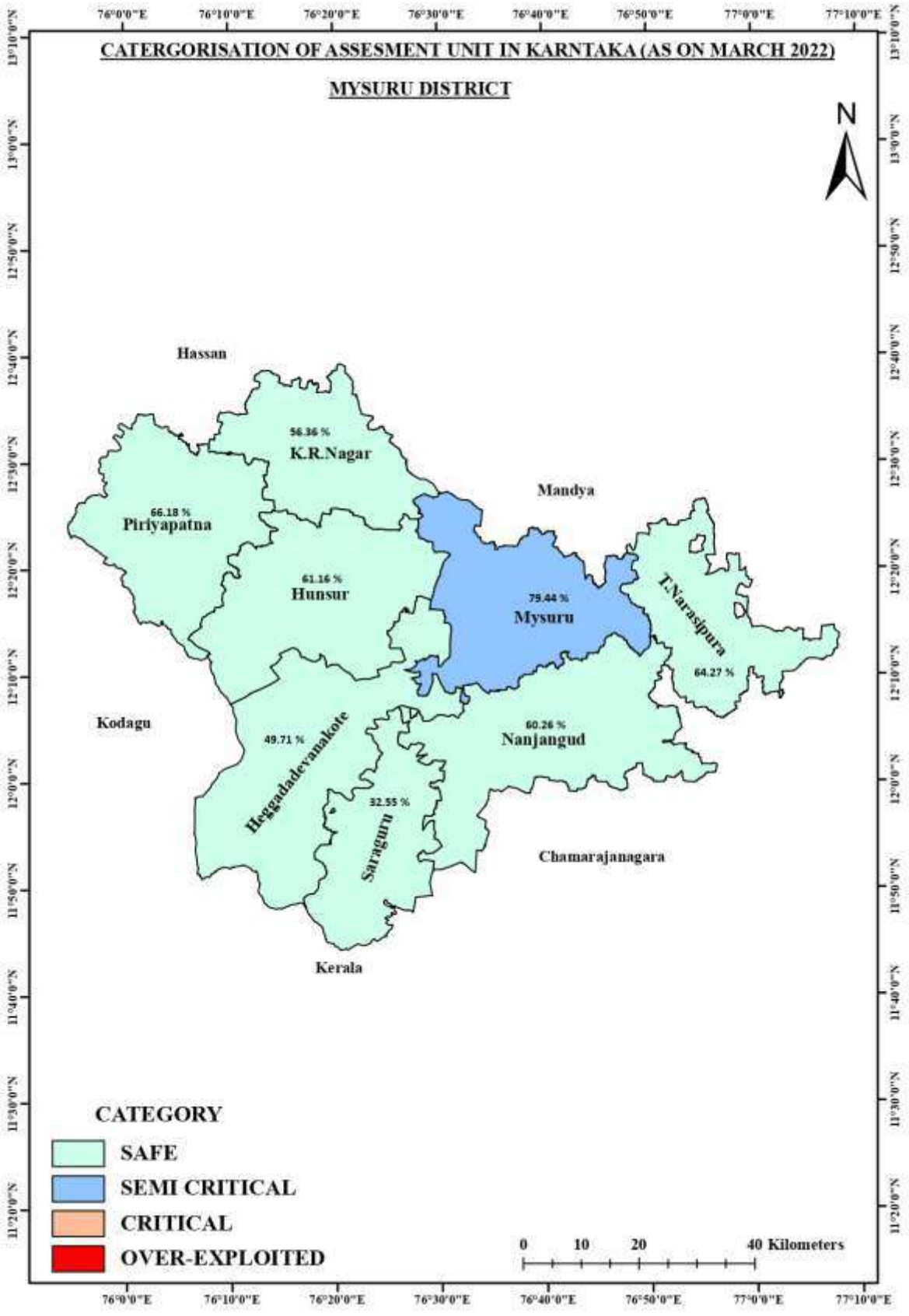

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
KALABURGI DISTRICT
N
Bidar
Maharashtra
Telangana
Vijayapura
Yadagiri
54.63 %
Aland
Kamalapura
28.92 %
28.99 %
Chincholi
23.15 %
Kalagi
65.6 %
Gulbarga
82.87 %
Afzalpur
50.41 %
Shahbadha
21.8 %
Sedam
32.98 %
Chittapur
23.44 %
Jevargi
16.82 %
Yadrami
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers

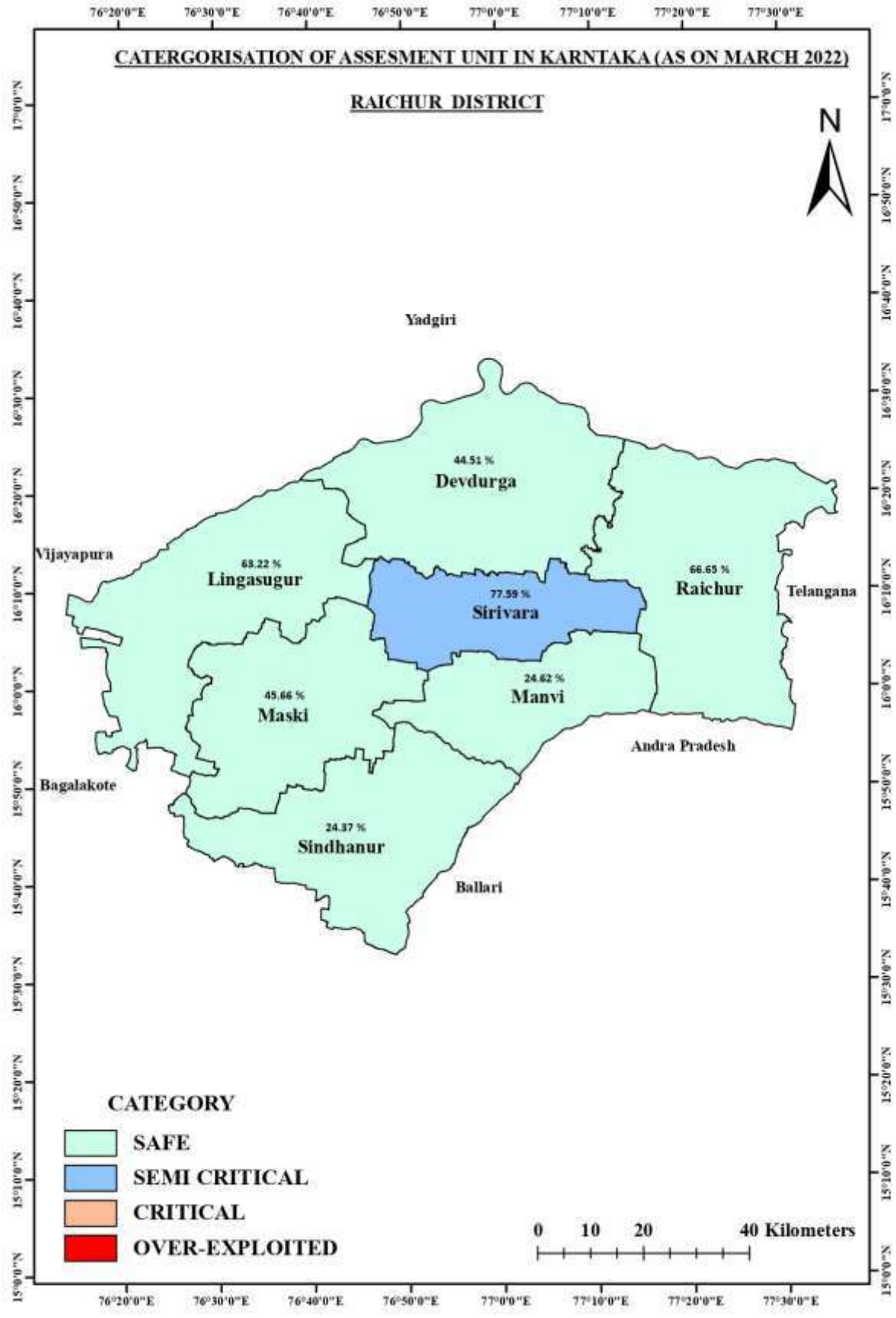

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
KODAGU DISTRICT
N
Hassan
43.07 %
Somavarapete
Dakshina Kannada
41.18 %
Kushalanagara
36.42 %
Madikeri
Mysuru
38.25 %
Virajpet
29.81 %
Ponnampete
Kerala
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers
75°20'0"E
75°30'0"E
75°40'0"E
75°50'0"E
76°0'0"E
76°10'0"E
13°0'0"N
12°50'0"N
12°40'0"N
12°30'0"N
12°20'0"N
12°10'0"N
12°0'0"N
11°50'0"N

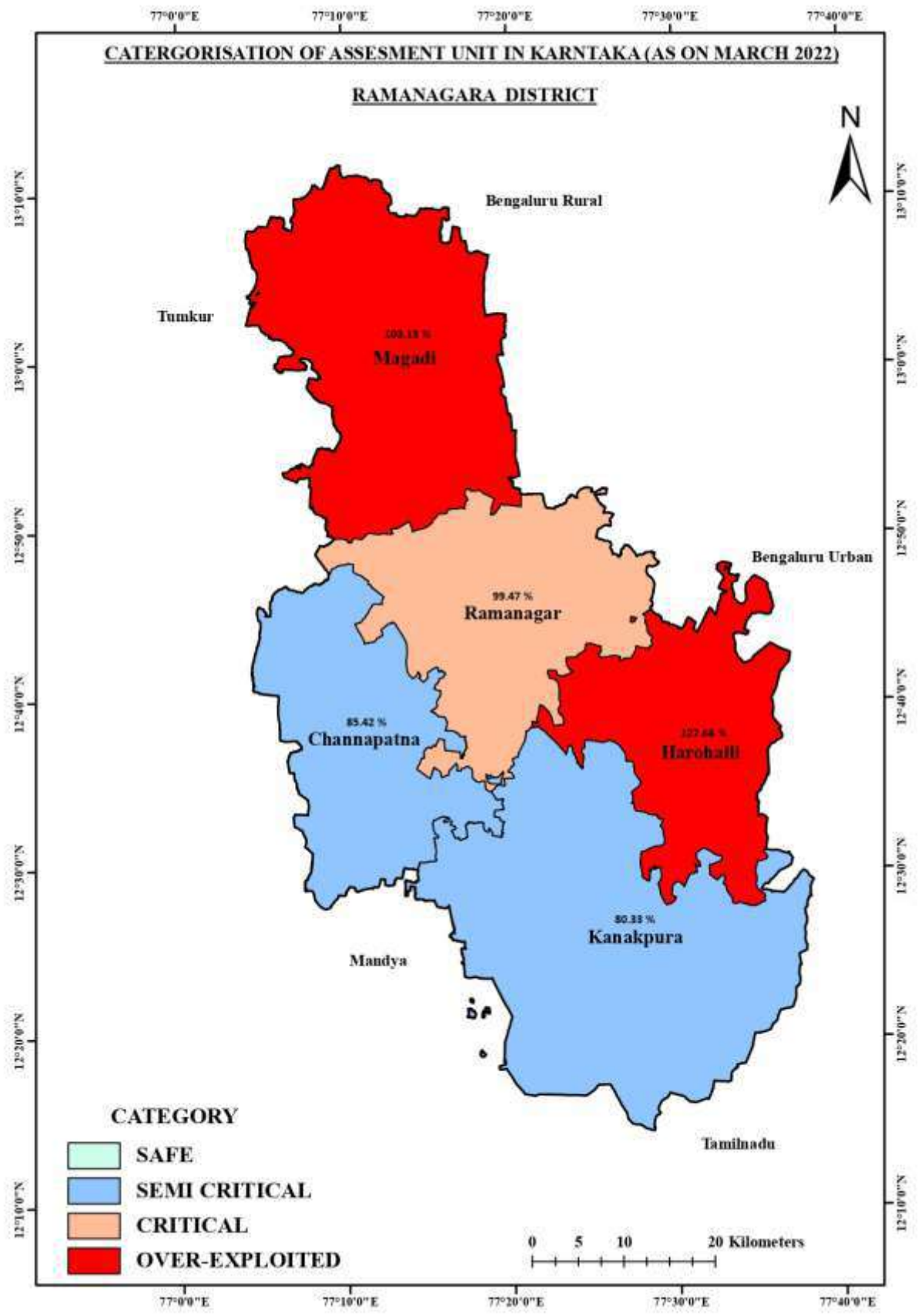

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
KOLAR DISTRICT
N
Chikkaballapura
Srinivaspura
Andra Pradesh
Bengaluru Rural
Kolar
Mulabagilu
K.G.F
Malur
BANGARPET
Andra Pradesh
Tamilnadu
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 5 10 20 Kilometers
77°50'0"E
78°0'0"E
78°10'0"E
78°20'0"E
78°30'0"E
13°40'0"N
13°30'0"N
13°20'0"N
13°10'0"N
13°0'0"N
12°50'0"N
12°40'0"N

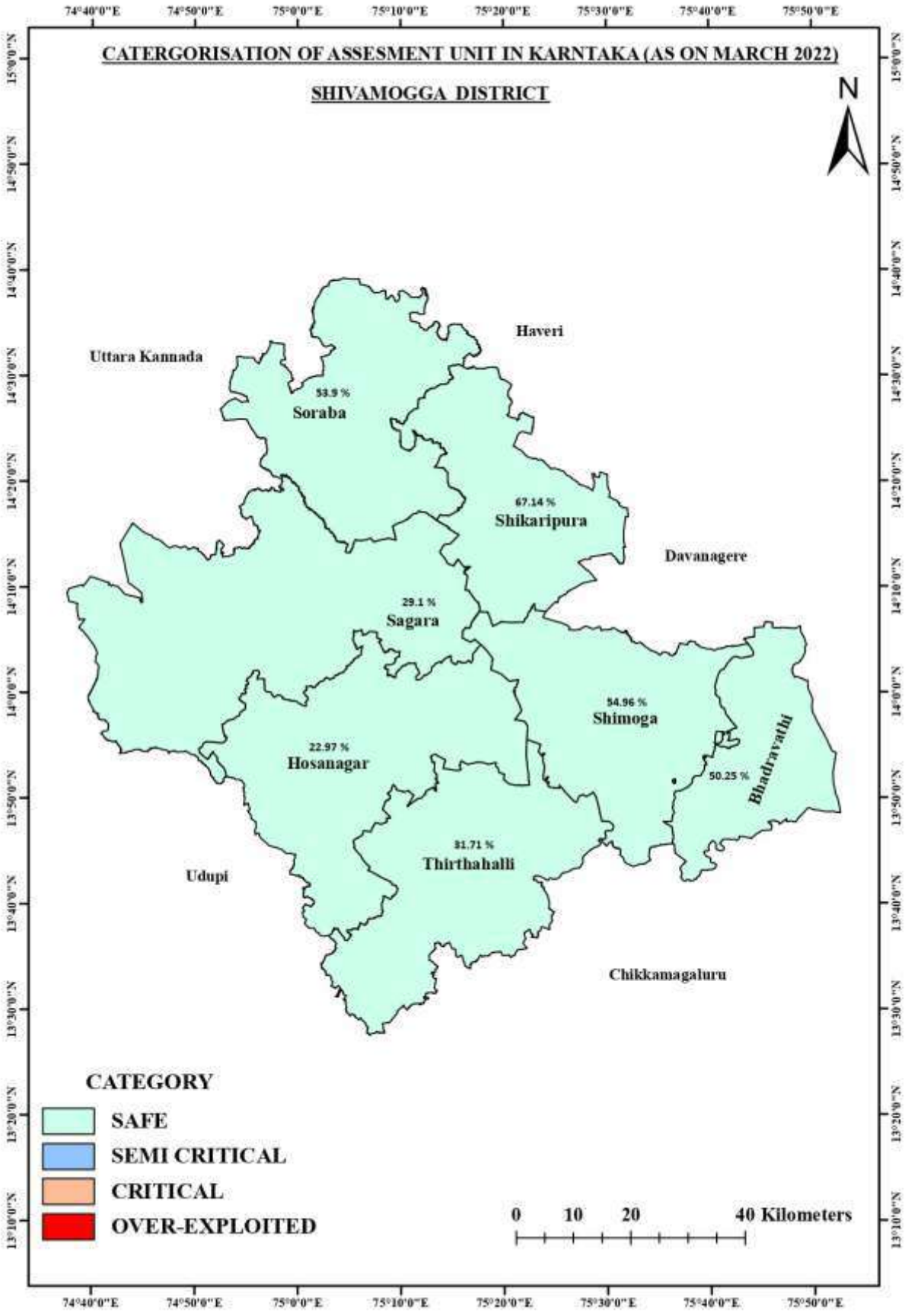

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
KOPPALA DISTRICT
N
Bagalakote
Raichur
64.51 %
Kushtagi
82.58 %
Yelburga
74.87 %
Kanakagiri
14.84 %
Karatagi
98.56 %
Kukanuru
17.94 %
Gangavathi
66.4 %
koppal
Gadag
Ballari
Vijayanagara
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers
75°50'0"E
76°0'0"E
76°10'0"E
76°20'0"E
76°30'0"E
76°40'0"E
76°50'0"E

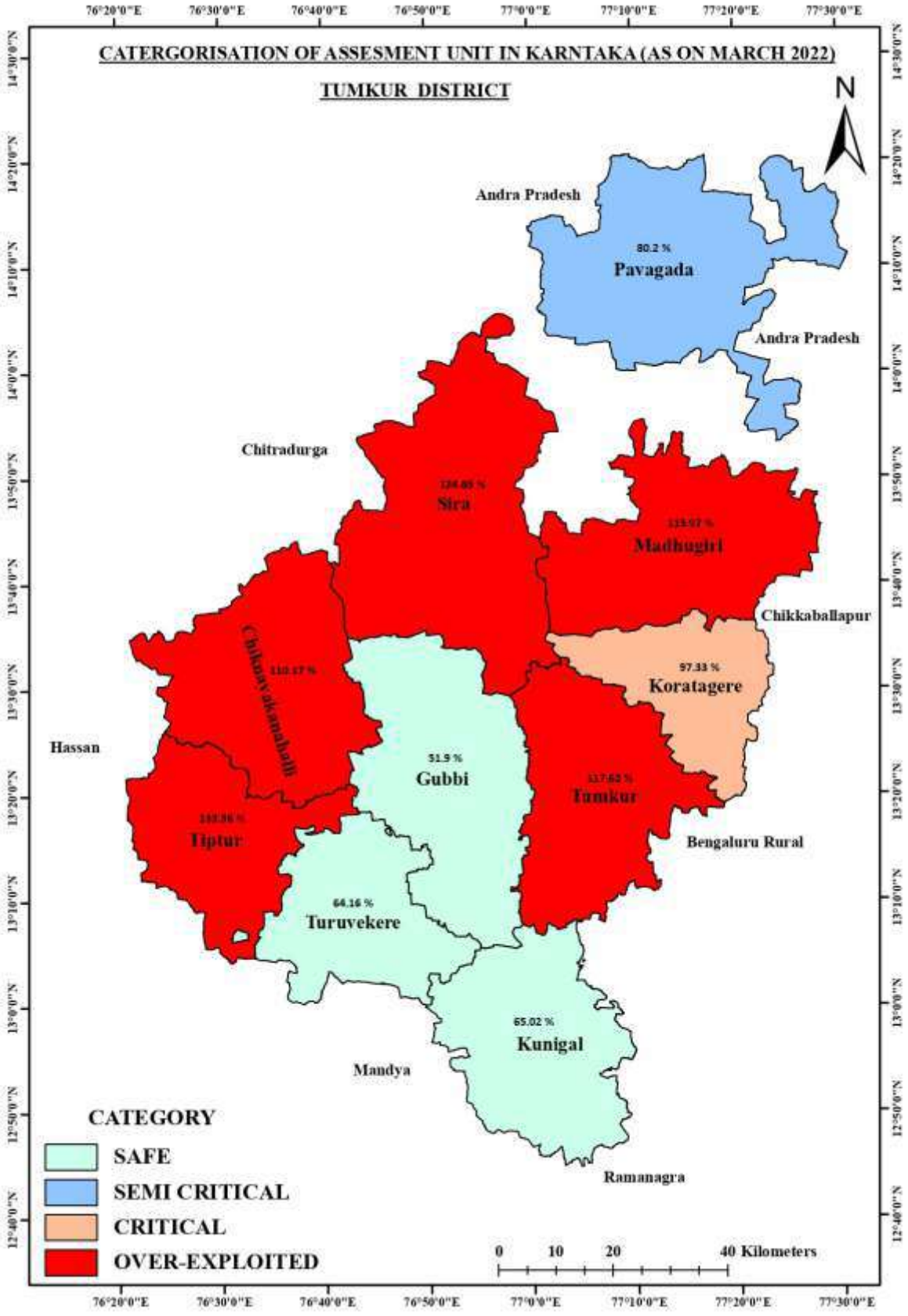

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
MANDYA DISTRICT
N
Hassan
Tumkur
68.84 %
Nagamangala
47.32 %
Krishnarajpet
49.12 %
Maddur
56.69 %
Mandya
67.96 %
Pandavpura
56.74 %
Srirangapatna
78.9 %
Malavalli
Ramanagra
Mysuru
Chamarajanagara
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers

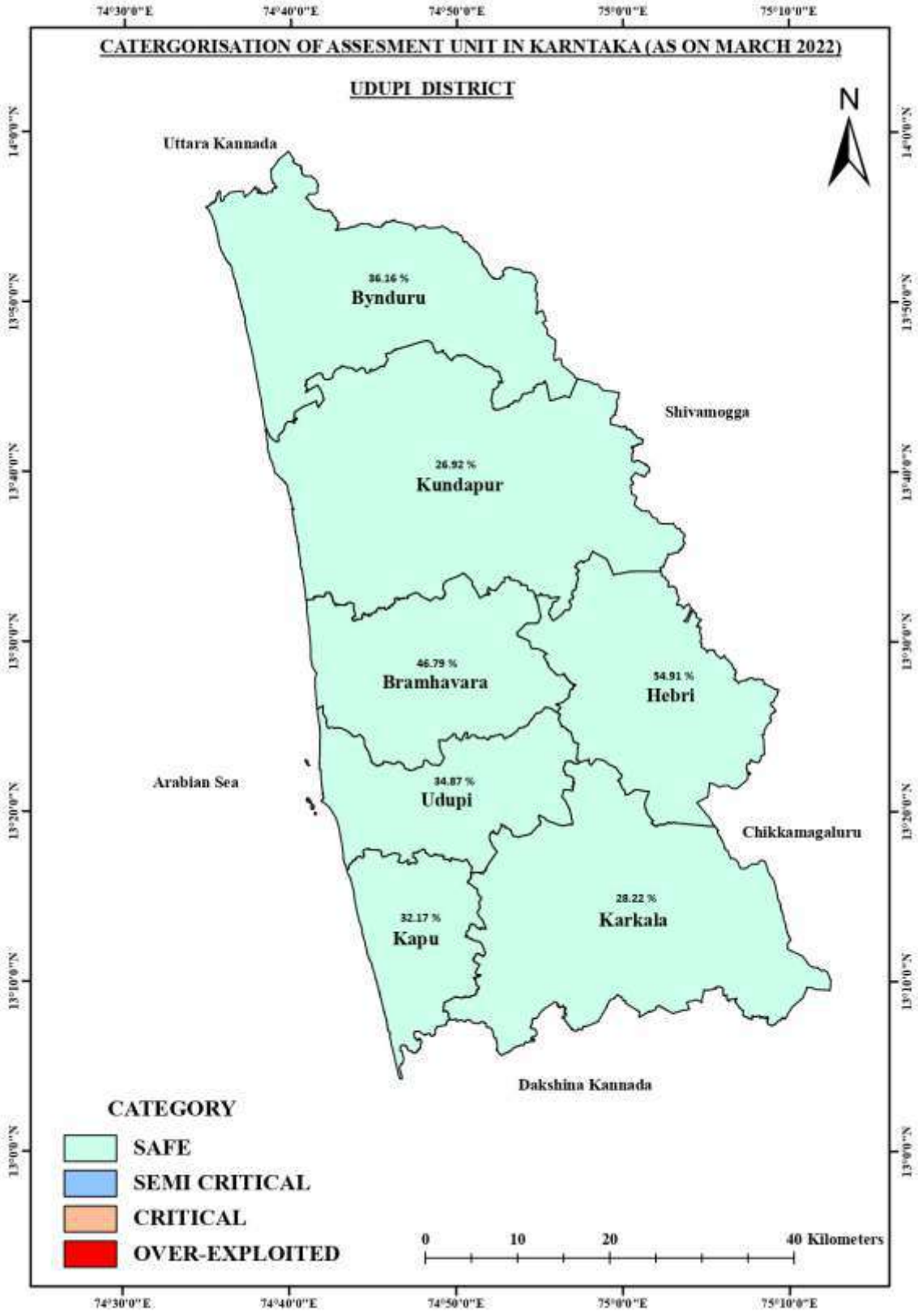

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
MYSURU DISTRICT
N
76°0'0"E
76°10'0"E
76°20'0"E
76°30'0"E
76°40'0"E
76°50'0"E
77°0'0"E
77°10'0"E
Hassan
56.36 %
K.R.Nagar
Mandya
66.18 %
Piriyapatna
61.16 %
Hunsur
79.44 %
Mysuru
T.Narasipura
64.27 %
Kodagu
49.71 %
Heggadadevanakote
60.26 %
Nanjangud
32.55 %
Saraguru
Chamarajanagara
Kerala
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers

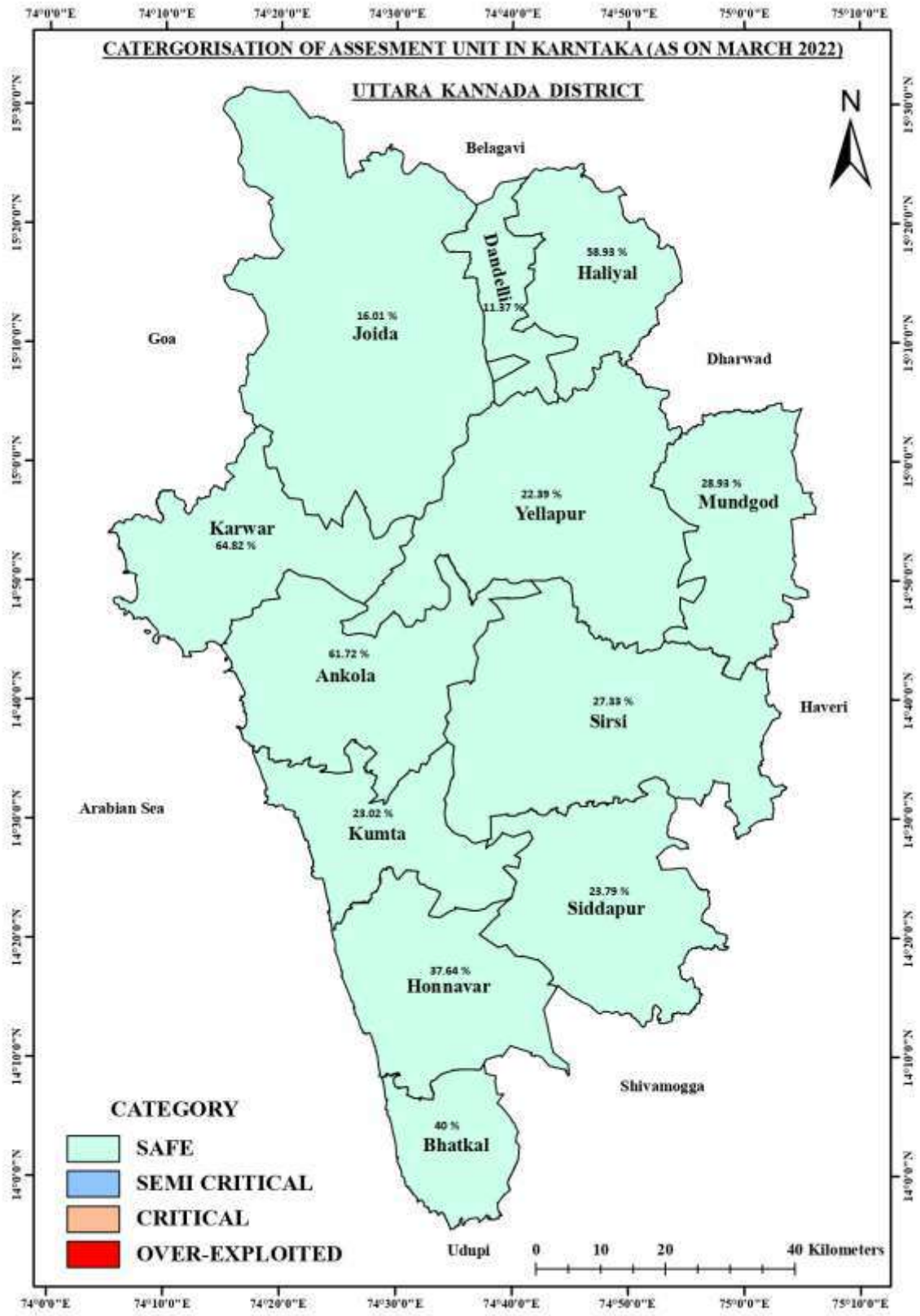

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
RAICHUR DISTRICT
N
Yadgiri
44.51 %
Devdurga
Vijayapura
68.22 %
Lingasugur
77.59 %
Sirivara
66.65 %
Raichur
Telangana
45.66 %
Maski
24.62 %
Manvi
Andra Pradesh
Bagalakote
24.37 %
Sindhanur
Ballari
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers
76°20'0"E
76°30'0"E
76°40'0"E
76°50'0"E
77°0'0"E
77°10'0"E
77°20'0"E
77°30'0"E

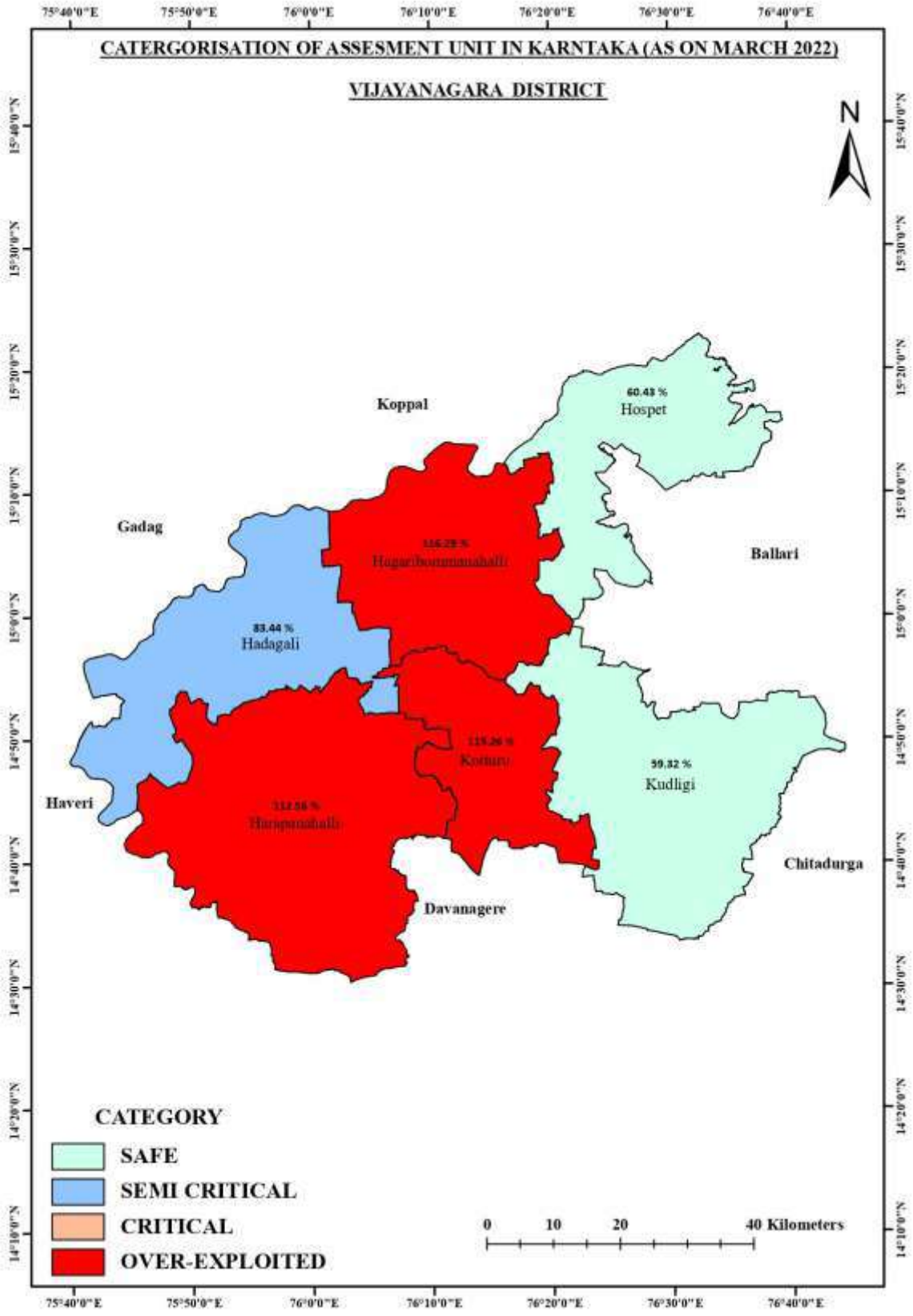

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
RAMANAGARA DISTRICT
N
Bengaluru Rural
Tumkur
108.18 %
Magadi
99.47 %
Ramanagar
Bengaluru Urban
85.42 %
Channapatna
127.64 %
Harohalli
80.33 %
Kanakpura
Mandya
Tamilnadu
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 5 10 20 Kilometers
77°0'0"E
77°10'0"E
77°20'0"E
77°30'0"E
77°40'0"E
13°10'0"N
13°0'0"N
12°50'0"N
12°40'0"N
12°30'0"N
12°20'0"N
12°10'0"N

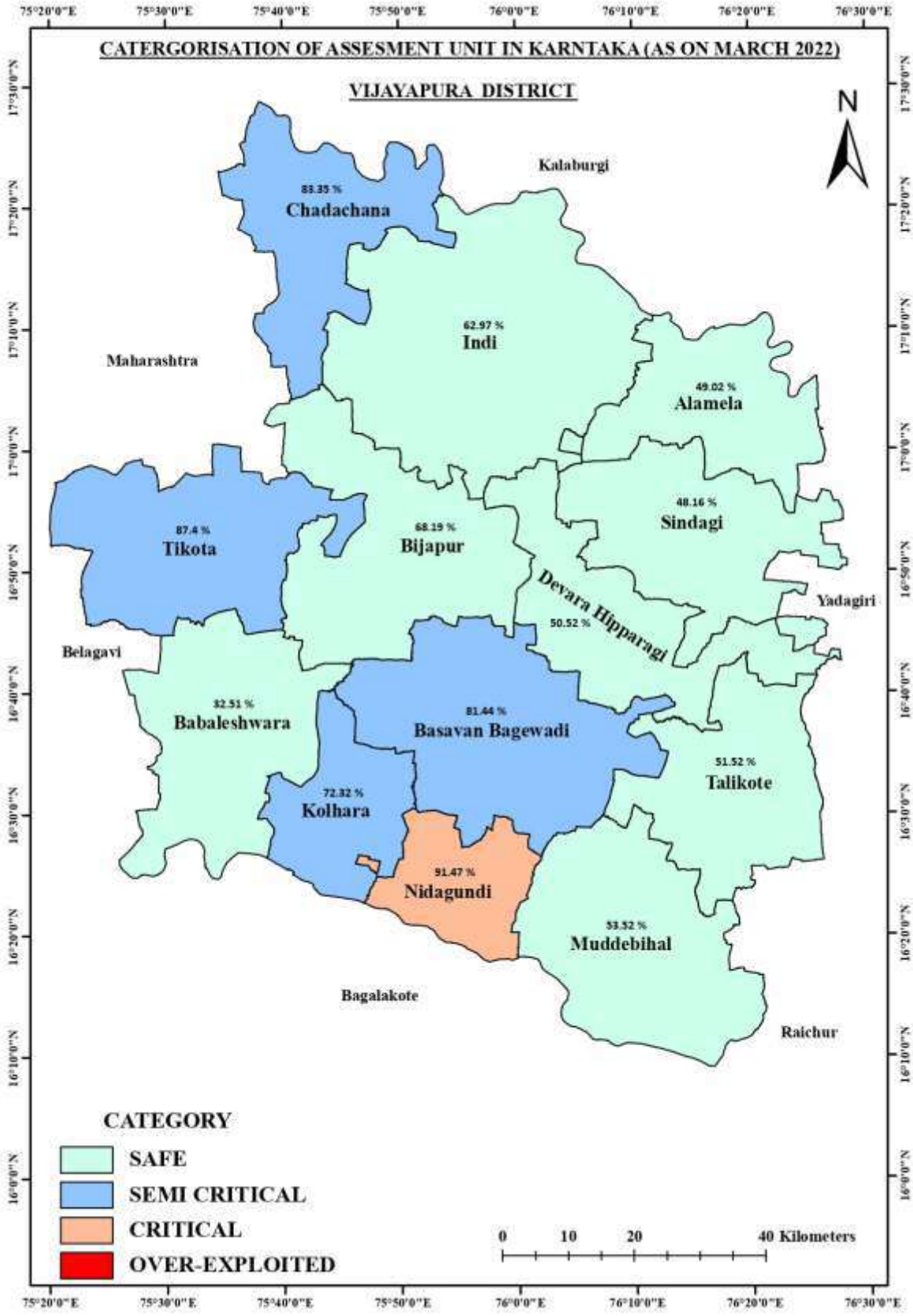

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
SHIVAMOGGA DISTRICT
N
74°40'0"E
74°50'0"E
75°0'0"E
75°10'0"E
75°20'0"E
75°30'0"E
75°40'0"E
75°50'0"E
Haveri
Uttara Kannada
53.9 %
Soraba
67.14 %
Shikaripura
Davanagere
29.1 %
Sagara
54.96 %
Shimoga
22.97 %
Hosanagar
50.25 %
Bhadravathi
81.71 %
Thirthahalli
Udupi
Chikkamagaluru
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers

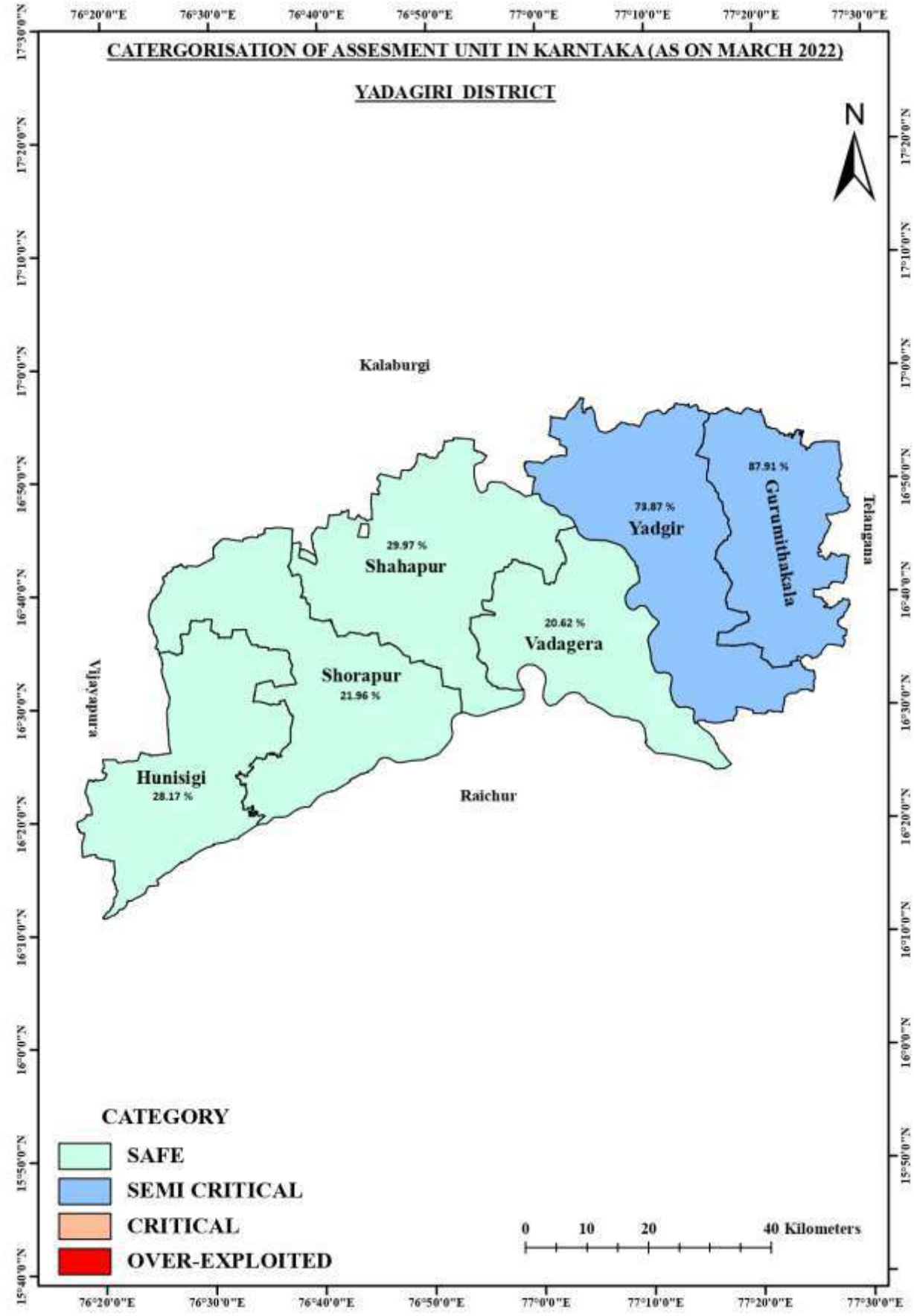

CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
TUMKUR DISTRICT
N
Andra Pradesh
80.2 %
Pavagada
Andra Pradesh
Chitradurga
Sira
Madhugiri
Chikkaballapur
97.33 %
Koratagere
Chikkanayakanahalli
Hassan
51.9 %
Gubbi
Tumkur
Tiptur
Bengaluru Rural
66.16 %
Turuvekere
65.02 %
Kunigal
Mandya
Ramanagra
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers
76°20'0"E
76°30'0"E
76°40'0"E
76°50'0"E
77°0'0"E
77°10'0"E
77°20'0"E
77°30'0"E


CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
UDUPI DISTRICT
N
74°30'0"E
74°40'0"E
74°50'0"E
75°0'0"E
75°10'0"E
Uttara Kannada
36.16 %
Bynduru
Shivamogga
26.92 %
Kundapur
46.79 %
Bramhavara
54.91 %
Hebri
Arabian Sea
34.87 %
Udupi
Chikkamagaluru
28.22 %
Karkala
32.17 %
Kapu
Dakshina Kannada
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers


CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
UTTARA KANNADA DISTRICT
N
Belagavi
Dandelli
11.37 %
58.93 %
Haliyal
16.01 %
Joida
Goa
Dharwad
28.93 %
Mundgod
22.39 %
Yellapur
Karwar
64.82 %
61.72 %
Ankola
27.33 %
Sirsi
Haveri
Arabian Sea
23.02 %
Kumta
23.79 %
Siddapur
37.64 %
Honnavar
Shivamogga
40 %
Bhatkal
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
Udupi
0
10
20
40 Kilometers
74°0'0"E
74°10'0"E
74°20'0"E
74°30'0"E
74°40'0"E
74°50'0"E
75°0'0"E
75°10'0"E


CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
VIJAYANAGARA DISTRICT
N
75°40'0"E
75°50'0"E
76°0'0"E
76°10'0"E
76°20'0"E
76°30'0"E
76°40'0"E
Koppal
Gadag
Haveri
Davanagere
Ballari
Chitadurga
60.48 %
Hospet
83.44 %
Hadagali
Kudligi
99.82 %
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0
10
20
40 Kilometers


CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
VIJAYAPURA DISTRICT
N
Kalaburgi
Maharashtra
Belagavi
Bagalakote
Raichur
Yadagiri
Devara Hipparagi
88.35 %
Chadachana
62.97 %
Indi
49.02 %
Alamela
87.4 %
Tikota
68.19 %
Bijapur
48.16 %
Sindagi
50.52 %
82.51 %
Babaleshwara
81.44 %
Basavan Bagewadi
51.52 %
Talikote
72.32 %
Kolhara
91.47 %
Nidagundi
53.52 %
Muddebihal
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers
75°20'0"E
75°30'0"E
75°40'0"E
75°50'0"E
76°0'0"E
76°10'0"E
76°20'0"E
76°30'0"E


CATERGORISATION OF ASSESMENT UNIT IN KARNTAKA (AS ON MARCH 2022)
YADAGIRI DISTRICT
N
Kalaburgi
Telangana
Vijayapura
Raichur
Yadgir
78.87 %
Gurumithakala
87.91 %
Shahapur
29.97 %
Vadagera
20.62 %
Shorapur
21.96 %
Hunisigi
28.17 %
CATEGORY
SAFE
SEMI CRITICAL
CRITICAL
OVER-EXPLOITED
0 10 20 40 Kilometers
76°20'0"E
76°30'0"E
76°40'0"E
76°50'0"E
77°0'0"E
77°10'0"E
77°20'0"E
77°30'0"E
17°30'0"N
17°20'0"N
17°10'0"N
17°0'0"N
16°50'0"N
16°40'0"N
16°30'0"N
16°20'0"N
16°10'0"N
16°0'0"N
15°50'0"N
15°40'0"N

CONTRIBUTORS PAGE

Sl. No.	District	Officers Name	Designation
Central Groundwater Board, SWR, Bengaluru			
1.	Bengaluru	Shri N. Jyothi Kumar	Regional Director
2.	Bengaluru	Ms. D. Dhyamalar	Scientist-E
3.	Bengaluru	Shri Rahul R Shende	Scientist-C
4.	Bengaluru	Dr. Lubna Kouser	Scientist-C
5.	Bengaluru	Shri Abdul Razik	Asst. Hydrogeologist
Groundwater Directorate, Government of Karnataka, Bengaluru			
6.	Bengaluru	Sri. B.G. Ramachandraiah	Director
7.	Bengaluru	Sri. G. Jayanna	Deputy Director
8.	Bengaluru	Smt. Jagadeshwari .M	Senior Geologist
9.	Bengaluru	Sri. Nagaraja .H.M	Senior Geologist
District Groundwater Office, Groundwater Directorate			
10.	Bengaluru Urban	Smt. T. Ambika	Deputy Director
11.	Bengaluru Rural	Smt. Janaki. P	Deputy Director
12.	Bellary and Koppal	Sri. Arun .D.E	Senior Geologist
13.	Belagavi and Dharwad	Dr. Mallikarjuna B Baligar	Senior Geologist
14.	Bagalakote and Vijayapura	Sri. Mahesh B. Birajanavara	Senior Geologist
15.	Bidar and Kalaburagi	Sri. Mujibur Rehaman .R	Senior Geologist
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18.	Chitradurga	Sri. Basanth.V	Senior Geologist
19.	Chamarajanagara	Smt. Dhanalakshmi. R	Senior Geologist
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21.	Gadag and Haveri	Sri Santhosh Pyatiganer	Senior Geologist
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23.	Uttara Kannada and Udupi	Dr. M. Dinakar Shetty	Senior Geologist
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26.	Mandya	Smt. S.R. Rajashree	Senior Geologist
27.	Dakshina Kannada	Sri. Sheik Davood	Senior Geologist
28.	Raichur and Yadagiri	Sri. Krishna S.M.	Senior Geologist
29.	Ramanagara	Dr. Prasanna Kumar	Senior Geologist
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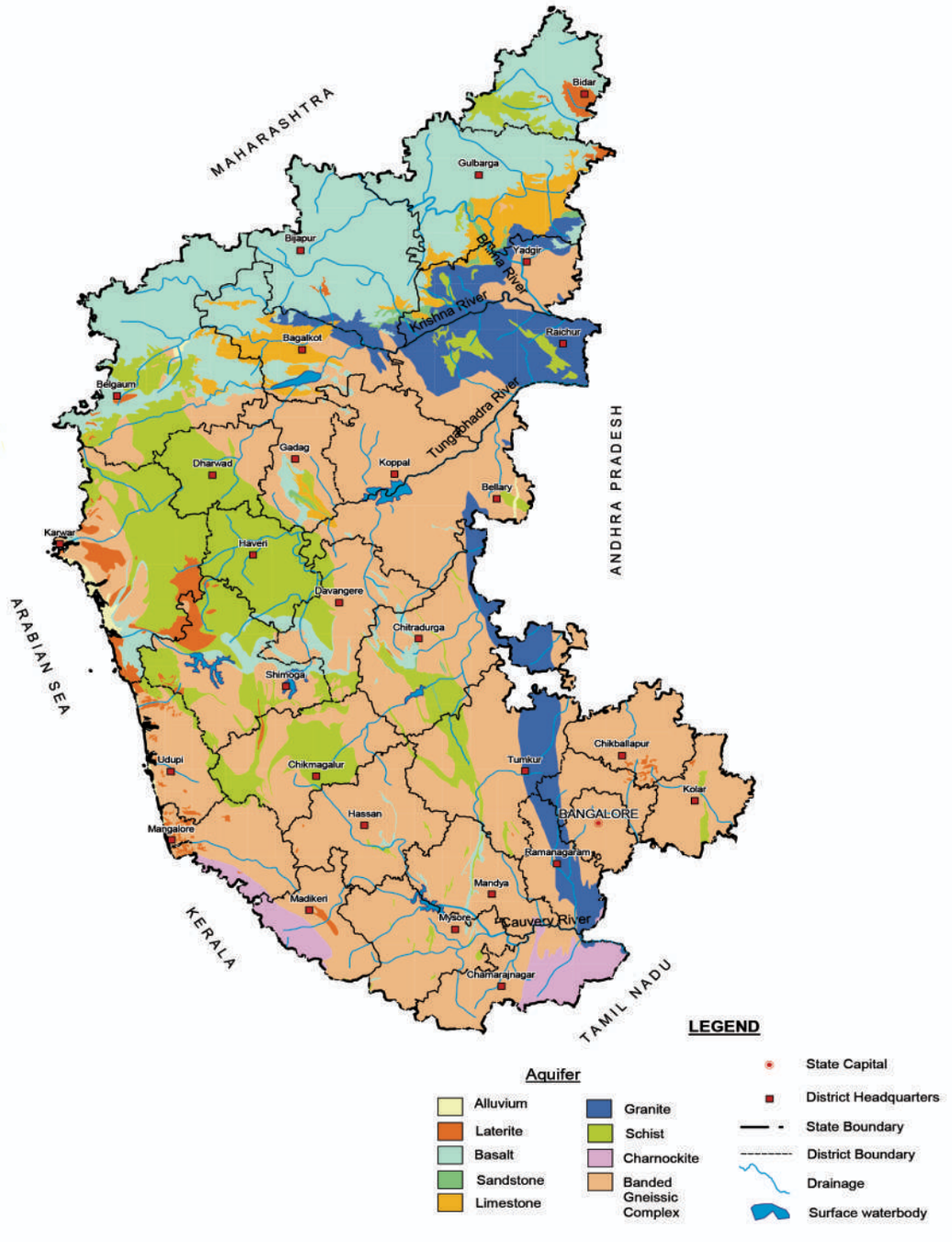
31.	Tumakuru	Smt. Nagaveni .K.S.	Senior Geologist
32.	Bengaluru Urban	Smt. Chayapattar	Senior Geologist
33.	Bengaluru Rural	Smt. Pallavi .N	Senior Geologist
34.	Bengaluru Rural	Sri. T. Venkatesh	Geologist
35.	Mysuru	Smt. Shobharani .P.S	Senior Geologist

Groundwater Directorate Head Office and All District out source Geologist and Data Entry Operators.

PRINCIPAL AQUIFER SYSTEMS

0 50 100
kilometres



LEGEND

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Limestone
- Granite
- Schist
- Charnockite
- Banded Gneissic Complex

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Drainage
- Surface waterbody

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