I would like to dedicate this thesis to my family who has supported and encouraged me throughout this endeavour: thank you for your love and support throughout my entire life and helping me to realize who I am today!

CERTIFICATE

It is certified that the work contained in the thesis titled *"Impact Assessment of Coal Mining on Ground and Surface Water in Korba Coalfield Region, Chhattisgarh, India"* by **VIJAYENDRA PRATAP DHEERAJ** has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

It is further certified that the student has fulfilled all the requirements of Comprehensive Examination, Candidacy and SOTA for the award of Ph.D. Degree.

Dr Chandra Shekhar Singh
(Supervisor)
Senior Scientific Officer
Department of Mining Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi 221005
India

Dr. C. S. Singh
Senior Scientific Officer
Department of Mining Engineering
Indian Institute of Technology (BHU)
Varanasi-221005, U.P.

DECLARATION BY THE CANDIDATE

I, *VIJAYENDRA PRATAP DHEERAJ*, certify that the work embodied in this thesis is my own bonafide work and carried out by me under the supervision of ***Dr Chandra Shekhar Singh*** from ***July-2019 to May-2024,*** at the ***Department of Mining Engineering,*** Indian Institute of Technology (BHU), Varanasi. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma.

I declare that I have faithfully acknowledged and given credits to the research workers wherever their works have been cited in my work in this thesis. I further declare that I have not will fully copied any other's work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports dissertations, thesis, etc., or available at websites and have not included them in this thesis and have not cited as my own work.

Date: 23.04.2024

Place: Varanasi

(Vijayendra Pratap Dheeraj)

CERTIFICATE BY THE SUPERVISOR

It is certified that the above statement made by the student is correct to the best of my knowledge.

Dr Chandra Shekhar Singh
(Supervisor)
Department of Mining Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi-221005
India

Dr. C. S. Singh
Senior Scientific Officer
Department of Mining Engineering
Indian Institute of Technology (BHU)
Varanasi-221005, U.P.

Prof. Suprakash Gupta
(Head of Department)
Department of Mining Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi-221005
India

विभागाध्यक्ष/HEAD
खनन अभियांत्रिकी विभाग
Deptt. of Mining Engg.
भारतीय प्रौद्योगिकी संस्थान (काशी हिन्दू विश्वविद्यालय)
Indian Institute of Technology (Banaras Hindu University)
वाराणसी-221005/Varanasi-221005

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Name of the Student: **Vijayendra Pratap Dheeraj**

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Date: 23.04.2024

Place: Varanasi

(Vijayendra Pratap Dheeraj)

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(VIJAYENDRA PRATAP DHEERAJ)

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Abbreviations:	**Details**
CGWB	Central Ground Water Board
BCM	Billion Cubic Meter
MCM	Million Cubic Meter
CIL	Coal India Limited
PSU	Public Sector Undertaking
SECL	South Eastern Coalfield Limited
MW	Mega Watt
CMPDI	Central Mine Planning and Design Institute
CMPDIL	Central Mine Planning and Design Institute Limited
EQWI	Effluent Water Quality Indices
USSL	United States Salinity Laboratory Staff
TDS	Total Dissolved Solid
TSS	Total Suspended Solid
EPA	Environment Protection Agency
GIS	Geographical Information System
LULC	Land Use Land Cover
kcal/kg	Kilo Calory per Kilogram

SPM	Suspended Particulates Matter
CMRI	Central Mining Research Institute
PM	Particulate Matter
CWI	Coal Workers Pneumoconiosis
TB	Tuberculosis
AMD	Acid Mine Drainage
LST	Land Surface Temperature
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Water Index
KCF	Korba Coalfield
HPI	Heavy Metal Pollution Index
HEI	Heavy Metal Evaluation Index
C_d	Degree of Contamination
SAR	Sodium Absorption Ratio
%Na	Percent Sodium
PI	Permeability Index
KI	Kelly's Index
MH	Magnesium Hazard
WQI	Water Quality Index
Mbgl	Metres Below Ground Level

KR	Kelly’s Ratio
PTEs	Potentially Toxic Trace Elements
WHO	World Health Organization
BIS	Bureau of Indian Standards
LISS	Linear Imaging Self Scanner Sensor
TM	Thematic Mapper
°C	Degree Centigrade
%	Percent
Km	Kilo Meter
SOI	Geological Survey of India
MTPA	Million Tonnes Per Annual
USGS	United States Geological Survey
OCP	Opencast Project
DEM	Digital Elevation Map
SRTM	Shuttle Radar Topography Mission
NRSC	National Remote Sensing Centre
FAO-UN	Food and Agriculture Organization of the United Nations
GPS	Global Positioning System
CIF	Central Instrument Facility
µm/cm	Micron Meter per centimetre
EC	Electrical Conductivity

SLC	Scan-Line Corrector
OLI	Operational Land Imager
EDTA	Ethylene Diamine Tetra Acid
CCME	Canadian Council of Ministers of the Environment
Meq/L	MilliQ Per Litre
mg/l	Milligram per Litre
MSL	Mean Sea Level
IDW	Inverse Distance Weighting
FCC	False Colour Composite
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
KML	Keyhole Markup Language
IS	Indian Standard
APHA	American Public Health Association
UTM	Universal Transverse Mercator
NIR	Near Infra-Red
IC	Ion-Chromatography
ICP	Inductively Coupled Plasma
IMD	India Meteorological Department
DW	Dug Well
BW	Bore Well
HP	Hand Pump
SW	Surface Water
GW	Ground Water
R^2	Correlation coefficient

Preface

Coal mines are situated in close proximity to significant water bodies that receive effluents from mining activities, particularly during the monsoon season. Water is extensively utilised for a diverse range of purposes, encompassing drinking, residential, commercial, and agricultural irrigation, among others. Therefore, while planning for development projects, it is essential to have better information about the water quality resources available in the selected area. The anticipated causes contributing to a decline in water quality encompass population expansion, urbanisation, industrial activities, and technological advancements in mining projects.

Therefore, an effort has been made in this study to assess the possible effects of coal mining operations on local surface and groundwater quality, heavy metal analysis found in groundwater, land use/land cover change analysis, and correlation analysis between land surface temperature (LST) with normalized difference vegetation index (NDVI) and normalized difference water index (NDWI) in Korba coalfield region, Chhattisgarh.

The six chapters that comprise this thesis explain various aspects of the ongoing research. A quick outline of each chapter is provided below.

- **Chapter 1** includes an overview of the consequences of the mine on the surroundings, including information on ground and surface water quality, heavy metals in the groundwater, changes in LULC, and changes in LST, NDVI and NDWI, etc. The objectives of the research are also briefly discussed in this chapter.
- **Chapter 2** Comprises a massive overview of previous studies relevant to this research activity.

- **Chapter 3** provides a brief overview of the study area under consideration, covering administrative data, physiography, topology and contour, geology, geomorphology, drainage patterns, hydrogeological features, lineament, soil, slope, and flora-fauna.
- **Chapter 4** includes the different methodologies employed in this research work, which include water sampling, physicochemical analysis, statistical data validation methods, heavy metal pollution indices, land use/land cover change analysis with their accuracy assessment of the study region, and LST with NDVI and NDWI variations and their correlation.
- **Chapter 5** summarises the outcomes of each specified objective mentioned in this research endeavour, which normally involves evaluations of several physicochemical parameters and heavy metals found in water samples obtained during both pre and post monsoon season. The spatial distribution maps for each parameter were generated using the ArcGIS software. A few multivariate statistical methods have been utilized to validate the results. Furthermore, this study further includes an analysis of changes in the region over a 21-year period, specifically focusing on land use and land cover changes. This analysis was integrated with an accuracy evaluation to ensure the reliability of the findings. This study utilises satellite data to analyse the temporal variations of LST, NDVI, and NDWI over a span of 21 years. The primary objective is to examine the correlation pattern between these indices in this area. Furthermore, this chapter includes an analysis and interpretation of the results related to each objective that was examined in the study.
- **Chapter 6** discuss the research conclusions and makes recommendations for future work.