Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN: 1671-5497
E-Publication: Online Open Access
Vol: 43 Issue: 06-2024
DOI: 10.5281/zenodo.12284768

ENVIRONMENTAL IMPACT ASSESSMENT OF THE GRANITE QUARRYING AND STONE PROCESSING INDUSTRY ON SOIL QUALITY: A CASE STUDY IN RAMANAGARA DISTRICT, KARNATAKA, INDIA

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Abstract

The granite quarrying and stone processing activities in the Ramanagara area have resulted in land degradation, ecological imbalance, increased soil pollution, loss of agricultural land and productivity, and physical and chemical soil contamination. This study examines the effects of local stone processing and granite quarrying operations on soil quality. The main objectives of the study are to determine the impacts of heavy metal concentration on the environment, examine the physico-chemical properties of the soil, and evaluate the consequences of granite quarrying and stone processing on the quality of the soil and associated parameters in the research region. At twelve (12) sites spanning residential neighborhoods, industrial zones, and granite quarries; the granite quarry and stone processing industry produces dimensioned stone, aggregates, dust, flying rock fragments (blasting material), chemicals (blasting explosives), and cracamite chemical powder, etc. All of these products are by-products of the quarrying activities spread throughout the surrounding areas. In order to ascertain the physicochemical properties of the soil and the quantity of heavy metals, core, auger, or well-drilled samples were extracted at a depth of 10 to 100 cm. Using conventional techniques; a range of physico-chemical analysis was performed on the gathered samples. The following were listed: temperature, pH, EC, nitrogen, potassium, phosphorus, zinc, copper, manganese, iron, and boron; organic carbon was also mentioned. Through laboratory analysis, the physical and chemical characteristics of the soil were evaluated in order to evaluate the quality of the soil in the research area. The primary conclusions showed that the significant damage caused to the soil by the granite quarrying and stone processing businesses has altered the quality of the soil in the Ramanagara district. The data indicates that, in comparison to the other research locations, the soil quality was found to be worse at a radius of 1 to 2 kilometers around quarry sites. Research utilizing positive correlation matrix analysis between the quarry locations showed how quarry operations negatively impact soil quality and contribute to a common source of pollution. The research strongly suggests that such soils should not be used for agricultural production until remediation methods like bioremediation, soil washing, thermal desorption, etc. are implemented in light of the findings. Researchers, academic institutions, businesses, government agencies, agricultural departments, and society at large will all find value in this study.

Keywords: Quarrying, Soil Quality, Soil Pollution, Heavy Metal.

1. INTRODUCTION

The operations of the granite quarrying and stone processing businesses will be greatly impacted by the geology and soil of the research region. Among other facets of people's lives, the granite business affects their socioeconomic status, health, and quality of life. The granite industry is currently one of the mining industry's fastest-growing segments due to the acceleration of technological advancement, urbanization, industrialization, modernization, and civilizational progress. The study's objective was to evaluate the possible effects on the soil environment that various stone-quarrying and stone-processing businesses in the Ramanagara district might have. The process of quarrying makes it possible to remove valuable minerals from the earth's crust. The globe is currently dealing with serious environmental issues as a result of the overexploitation of granite caused by human demand, need, and availability. The mining, quarrying, and stone-processing sectors negatively impact air, water, land, soil, noise, dust, and the biosphere, among other natural resources. For the past four or five centuries, we have been using natural resources excessively without thinking about the effects on the ecology, land degradation, soil erosion, human health, or the ozone layer or greenhouse effects. As a result, we are currently dealing with serious environmental issues like flooding, unusually cold weather, rising temperatures, forest fires, landslides, etc., (Warhate et al., 2006).

Open-pit, or open-cast, quarrying is the most widely used method of extracting natural resources. A few of the repercussions of these operations include topographical changes, land degradation, noise, air, dust and water pollution, drilling and blasting, ground vibration, soil erosion, health issues, biodiversity, decreases in native species, and socioeconomic effects (Venkatesha et al., 2015). This is happening because there are significant environmental concerns associated with reckless mineral exploitation. Due to resource exploitation and increased demand from people, businesses that quarry and process stone are facing challenges which further exacerbate environmental problems. To protect the environment, public health, socioeconomic position, and quality of life from the various types of pollution that the granite company produces, procedures, monitoring systems, and regulations have been put in place (Ghose, M.K., 2001). However, a variety of by-products are created during the quarrying and processing of rocks to remove them from the earth, posing a risk to the environment and public health. The mine's overburden, or waste rock, is piled high. Platforms are cut out of the quarry walls to provide access to progressively deeper goods as the upper-level material is depleted (Wong, 2015). Open-

ISSN: 1671-5497
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Vol: 43 Issue: 06-2024
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pit operations quarry 90% of the quarry output and generate a large amount of trash. In order to collect bulk minerals from alluvial deposits, an aqueous extraction technique known as placer or alluvial exploration uses water for the transportation, concentration, and excavation of minerals. Generally speaking, alluvial mines have relatively large volumes and inexpensive excavation. Aqueous extraction is the extraction technique used in solution mining to recover heavy minerals (Kalu et al., 2021).

The powerful explosives are employed in crushed stone quarrying, an open cast quarrying technique, to blast massive volumes of minerals into the air, where they are then crushed or filtered into minuscule bits. It is possible for aggregate mining in karst environments to alter environmentally delicate areas nearby, which could have a cascading effect on the ecosystem (Vandana et al., 2020). Drilling and blasting are two noisy operations associated with the quarrying industry. The earliest stages involve preparation, such as constructing a railroad track or road, mixing facilities, and mineral processing facilities. Usually, hydraulic excavators are used to remove the top layer of soil and other soft strata in order to expose the minerals that need to be gathered (Maletsika et al., 2015). In fact, mining will be a noisy activity, particularly if explosive techniques are used; result in dust pollution and ground vibration, damages the nearby buildings. Dust from quarry sites is a substantial source of contamination; even though granite quarries mostly produce acidic dust pollution quarries primarily produce alkaline (or active) dust. Decreased economic value, natural disasters, soil and water pollution, and biodiversity loss are all indirectly caused by quarrying (Okafor et al., 2023). The area surrounding the quarry has experienced uneven socioeconomic development; illegal stone extraction and transportation; socio-political unrest; agricultural land loss; decreased productivity; the creation of unproductive wastelands; building collapses or cracks; soil erosion; sedimentation; worker and machinery accidents; and serious health risks for the local population are among the other major issues (Wischmeier et al., 1978). Because of overexploitation and the increasing demand for finished and unfinished granite commodities in the building sector and other industries, granite quarrying is currently thought to be a hazardous practice for the environment, especially soil environment (Peter et al., 2018).

Soil erosion and sedimentation, instability of waste materials or quarry dump yards, potential destruction of fluvial terraces, depression of piezometric surface, altered groundwater infiltration(Figure 12) and flow direction changes, potential formation of periodically flooded areas that eroded the landscape and soil, permanent destruction of agricultural areas, potential changes to farming practices, and changes to the pedological characteristics of soil were among the main environmental effects of quarries. Among them are the risks associated with acid rain, desertification, oil and nuclear power plant leaks, climate change, water pollution, soil erosion, nutrient loss, acid rain, and the depletion of plant and animal resources (Chrysanthus C, 2016). When topsoil is removed during excavation, the amount of carbon dioxide and minerals present is reduced, and soil vegetation is killed or loss of vegetation. Compared to the un-compacted soil, the compacted soil had substantially reduced carbon content. CO_2 loss and crop growth may be adversely affected by exposure to temperature, humidity, and precipitation, among

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other environmental conditions (Dominguez-Haydar et al., 2019). These acts have had an adverse effect on the soil quality, which is the focus of this research investigation. Aim of the current study is: To determine the baseline soil parameters in the research area and to determine the potential impact on the soil's quality of the quarry operating areas and other areas. To test the soil quality in the study area.

2. STUDY AREA

The Ramanagara district was created on August 23, 2007, by dividing the erstwhile Bengaluru Rural District, which comprised the taluks of Ramanagara, Channapatna, Kanakapura, and Magadi. Its travel ranges are 102.25 kilometers north-south and 62.08 kilometers east-west (Bhat et al., 1994; Swamy, 1998). There are 823 communities spread across a geographic area of 3516 km^2 in the district. The district's whole area, or 699.46 km^2, is covered by forests to the extent of 17.21%. The state of Karnataka is home to the Indian city of Ramanagara shows **Figure 1**. The district capital is the town of Ramanagara, which is located about fifty miles southwest of Bangalore. The latitudes of the Ramanagara district are 12.720N to 77.270E. Contour lines indicate the district's most prominent low- and high-elevation sites, which are 289 and 1196 meters above mean sea level, respectively. Figure 1 shows that it is, on average, 742.50 meters above sea level. Bangalore Urban District shares boundaries with Tumakuru and Bangalore Rural districts to the north, Mandya District to the west, and the district to the northeast. The districts of Chamarajanagar are situated to the southeast and south of the state of Tamil Nadu.

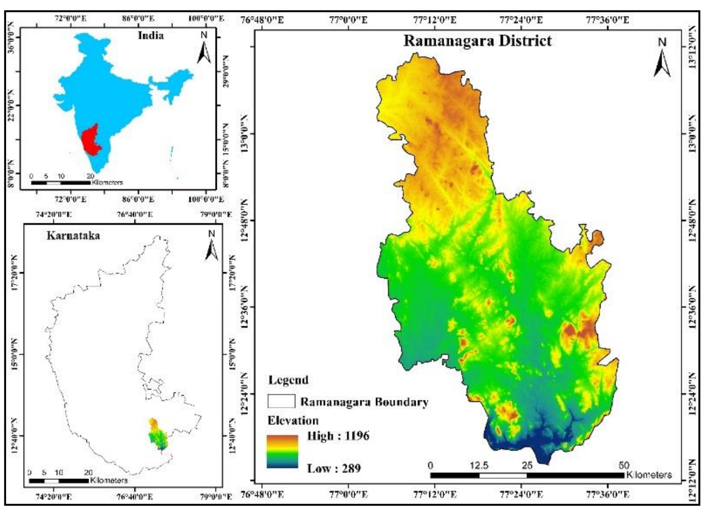

Figure 1: Study Area with Elevation Information

At the quarrying site, temperatures reached highs of 33°C and lows of 19°C during the research period. Throughout the trial, the average relative humidity ranged from 34% to 63%. An average of 931.58 mm of rain falls in the Ramanagara District per year. During the three-month trial, monthly wind speeds in the quarry zones varied from 4.9 m/s to 5.6 m/s. AERMET reformats meteorological data in order to make it ready for use as an input in the AERMOD model. The stone extraction and processing businesses will not alter the climate environment. Figure 1 shows the location map of the study area.

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3. MATERIAL AND METHODS:

3.1 Material:

Toposheet numbers from the Indian government's Survey of India (SOI) include D43R4_57G4, D43R8_57G8, D43X1_57H1, D43X2_57H2, D43X3_57H3, D43X5_57H5, D43X6_57H6, D43X7_57H7, D43X8_57H8, D43X9_57H9, D43X10_57H10, and D43X11_57H11. The morphological areas were extracted in this investigation using these toposheet numbers. The DEM Cartosat-1 and LISS satellite imagery (**Figure 6**) is utilized, among other things, by the ISRO Bhuvan website to create basic maps of elevation, lithology, soil; slope, geomorphology, and land use and land cover dataset to understand the local environment. The meteorological data sets were sourced from several government technical papers, fieldwork, Bhuvan-Indian soil datasets, the Karnataka State Pollution Control Board, the USDA soil survey, and the Indian Open Government Data (OGD) portal. The Department of Mines and Geology (DMG), the Agriculture Department, and the Ramanagara district mineral survey report were the three government agencies from which the reports and statistics regarding quarrying were obtained. **Table 1** displays these data sets.

Table1: Data sets used for the research work.

Data name	Resolution	Website
DEM	10m	Indian Geo platform(Bhuvan)
LISS 3	30m	Indian Geo platform(Bhuvan)
Landsat 8	30m	USGS
Toposheets	1:50000	SOI (survey of India)
Rainfall and temperature	0.5*0.5 km	IMD (India meteorological department)
Quarry and rocks	-	DMG (department of Mines and Geology)
Soil quality	-	Open governmental data (OGD) platform, India, USDA soil survey
Soil quality	-	Karnataka State Pollution Control Board, Handbook of Agriculture, ICAR, New Delhi
Soil quality and resources	-	Bhuvan-Indian soil dataset, Soil and Agriculture department of Karnataka etc.

3.2 Methodology

3.2.1 Important characteristics must be taken into consideration in the soil environment study

Numerous factors influence the soil study, like topography, geomorphology, bedrock and geological structure, parent material, slope direction, soil type (both physical and genetic), water balance, soil water management categories, soil texture, pH, depth of the column, groundwater compaction depth, and protected geological values. Three categories of factors can be identified that influence soil erosion and land sliding in most granite quarrying sites, like morphological factors (slope, aspect, curvature, plan curvature,

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profile curvature); geological factors (lithological formations of alluvium, granite, dyke rocks, andesite, clay stone, limestone, clay-limestone, conglomerate, gravel, sand distance to fault); soil types; and environmental factors (topographic wetness index, normalized difference vegetation index (NDVI) (**Figure 14**).

3.2.2 Creating the baseline soil quality dataset:

The primary feature classes in the baseline soil quality datasets are those pertaining to soil conditions that are often encountered in the quarrying concession region. Three main information sources form the basis of soil baseline research, like laboratory analysis, fieldwork, and desk studies. Measurements of the following common metrics should be included in baseline soil quality datasets like pH, mineral content, soil composition, and soil strength (resistance to crushing). A measurement of the bulk density, particle size, structure and texture, organic matter, and water content. Six feature classes are included in this dataset, like heavy metals (lead, copper, zinc, cadmium, mercury, and chromium), soil nutrients (potassium, calcium, magnesium, nitrogen, and phosphorus), dumping soil area, soil pH, cation exchange capacity, and soil sample points.

3.2.3 Collection of data with different sources

This investigation's primary and secondary sources served as its cornerstone. Field surveys and general observations were used to assess the effects of pollution on the local soil, soil erosion, land degradation, flora and wildlife, crops, ambient water and air quality, and the surrounding environment etc. This study only looks at the Ramanagara district in the Indian state of Karnataka, which is well-known for having abundant granite reserves and resources, different types of soil, water resources, biodiversity, and forest cover and a suitable environment for human settlement.

Using a systematic and objective selection process, a sample of the homes at the randomly selected quarry sites, residential areas and industrial areas; soil sample collection was created to create the sample households and surrounding environment. The sample consisted of only about a hundred adjacent towns or residences that are directly or indirectly influenced by quarrying operations. Field research and standardized questionnaires were used to collect data from families.

A research study report was created utilizing baseline data gathered at numerous places throughout one season (January 2024–March 2024) for the investigation in the Ramanagara district areas for collection of soil samples and field study. Table 2 displays the information. The potential harm brought about by the stone-processing and quarrying sectors was evaluated using these numbers. They provide advice on the appropriate course of action for the industry and the quarry site, as well as government agencies, management tools, and mitigation techniques. The results of the analysis report and study summary were carefully taken into account for this research endeavor. **Table 2** lists the data collection sources.

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Table 2: Parameter taken from different sources

Sl. No.	Attribute	Parameter	Source of Data
1	Climatology and Meteorology	Wind speed, Wind direction, Dry bulb temperature, Wet bulb temperature, Relative humidity, Rainfall, Solar radiation, Cloud cover and Environmental Lapse.	Field research, collecting data from a variety of locations, including industrial, residential, and quarry sites.
2	Geology, Rock and Soil	Geological history	Field research, primary and secondary sources, satellite photos, and various types of maps generated using Remote sensing technology and GIS software.
4	Soil Quality	Temperature, pH, EC, nitrogen, potassium, phosphorus, zinc, copper, manganese, iron, and boron; organic carbon etc.	Primary data, mapping, field research Monitored Data (12 locations)

3.2.4 Spatial analysis of soil quality impact assessment

Due to the possibility of extensive soil contamination from the quarrying sites, which could have an impact on neighboring agricultural operations, spatial analysis of soil erosion risk mapping offers a visual help for identifying problematic regions for soil erosion. Contamination of soil can result from hazardous substance spills and leaks as well as from contaminated windblown dust deposition. Reliable data on the spatial distribution of soil qualities that influence landscape processes and services is necessary for sustainable land management. Several maps and datasets were created for this study project in order to better comprehend the Ramanagara district's environment. The biggest risk to the assessment of soil quality at granite quarrying sites is typically caused by high concentrations of lead, radionuclides, and arsenic in windblown dust. Quantitative assessments of how the deposition of polluted windblown dust could affect neighboring agricultural activities and raise soil pollutant levels should be included in spatial impact analysis.

3.2.5 The database required for the spatial analysis:

The following information should be extracted from the baseline spatial database and utilized to create the GIS-based landslide susceptibility impact study maps: This information includes soil sample locations, dumping soil area, pH, cation exchange capacity, and soil nutrients (potassium, calcium, magnesium, nitrogen, and phosphorus) in addition to heavy metals such as lead, copper, zinc, cadmium, mercury, and chromium. The topography, parent material, climate, soil properties, and other natural elements are a few examples of structural factors that influence how electrical conductivity (EC), pH, and organic carbon (OC) are distributed spatially in soil.

3.2.6 The methodology of spatial analysis:

Using GIS software, a georeferenced spatial data analysis should be carried out to determine how land use in the granite quarrying concession area affects soil quality. To

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examine the data for spatial variability, a combination of traditional analytical techniques and geostatistical techniques should be applied. A technique for analyzing variability and spatial distribution that originated in classical statistics is called the geostatistical method. The soil's pH, organic carbon (OC), phosphorus (P), potassium (K), and electric conductivity (EC) should all be evaluated using standard analytical methods. Due to research work limitations, only basic maps have been generated in the study area for soil erosion risk mapping. One should use classical ordinary kriging (OK) interpolation to predict the values of the unsampled locations, also known as un-measured sites, and to visually represent soil attributes. Baseline soil quality maps of the following should be produced by spatial analysis of baseline landslide susceptibility impact assessment results, like the spatial distribution of soil properties of EC, pH, K, P, and OC. Maps show the spatial variability of the soil's pH, EC, K, and P, as well as maps showing the spatial correlation of these variables.

3.2. Choosing sites for sampling within the study area

The topography of the study area, climate data, rocks and soil types and distribution in the study area, concentration of quarry sites, residential and industrial areas, human settlements, health status, resource availability, accessibility of the monitoring site, representativeness of the region for establishing baseline status, and representativeness concerning likely impact areas were all taken into consideration when selecting the monitoring sites for soil quality examination. The research area's sample collecting locations and protocols for various environmental situations are listed in **Table 3 and Figure 2.**

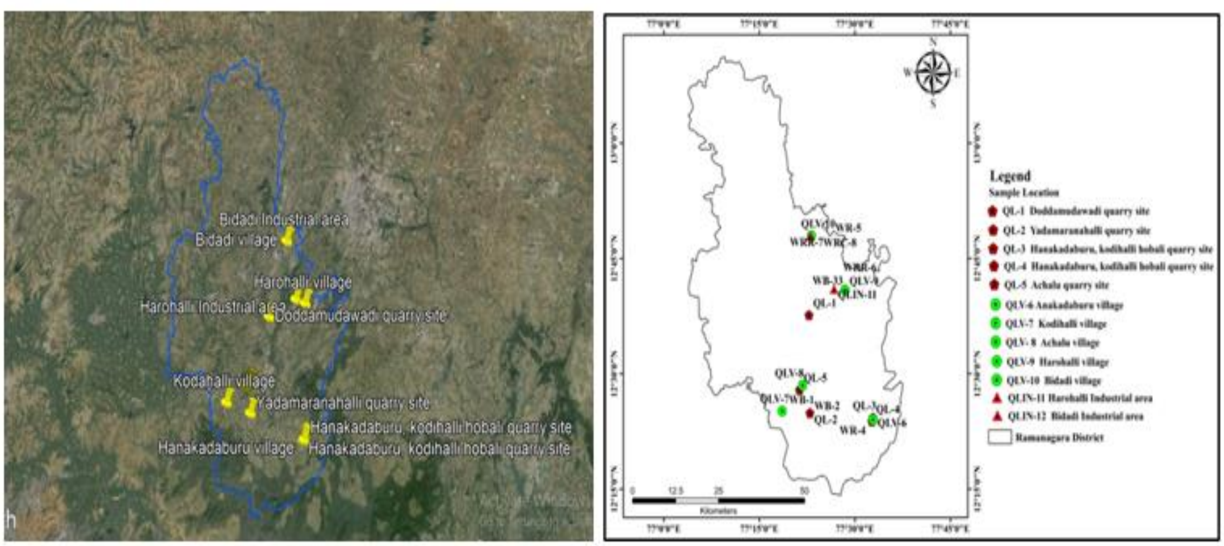

Figure 2. Location Map of Study Area

Table 3: Soil quality monitoring location and specimen gatherings from various environments setting in the study area.

Location Code	Sample code	Locations	Latitude	Longitude	Distance (km) from Ramanagara town	Azimuth Directions	Environmental setting
QL 1	SS 1	Doddamudawadi quarry site	12°37'38.08" N	77°22'47.27" E	15.74	SE	Commercial
QL 2	SS 2	Yadamaranahalli quarry site	12°24'54.09"N	77°22'56.53"E	35.54	S	Commercial
QL 3	SS 3	Hanakadaburu, kodihalli hobali quarry site	12°24'17.24"N	77°32'50.28"E	45.4	SE	Commercial
QL 4	SS 4	Hanakadaburu, kodihalli hobali quarry site	12°23'49.59"N	77°32'39.51"E	46.58	SE	Commercial
QL 5	SS 5	Achalu quarry site	12°27'55.43"N	77°21'18.06"E	30.37	S	Commercial
QLV 6	SS 6	Hanakadaburu village	12°24'1.12"N	77°32'51.18"E	46.5	SE	Residential
QLV 7	SS 7	Kodahalli village	12°25'9.41"N	77°18'34.70"E	33.66	SW	Residential
QLV 8	SS 8	Achalu village	12°28'30.11"N	77°21'47.08" E	28.55	S	Residential
QLV 9	SS 9	Harohalli village	12°40'53.59"N	77°28'26.33"E	21.3	SE	Residential
QLV 10	SS 10	Bidadi village	12°47'56.48"N	77°23'9.77"E	15.67	NE	Residential
QLIN 11	SS 11	Harohalli Industrial area	12°41'0.05"N	77°26'43.60"E	18.27	SE	Industrial
QLIN 12	SS 12	Bidadi industrial area	12°47'54.84"N	77°23'0.33"E	14.51	NE	Industrial

3.2.10 Method of soil sample collection and preparation

Using the grid approach, soil samples were taken from ten different places throughout the quarry area, both at the surface (0–30 cm) and subsurface (30–100 cm). The quarry area was divided into 10 equal sections, or grids, for the purpose of the grid system. Five sites in each grid system were systematically sampled using a calibrated stainless steel auger, then combined and subsampled to provide a representative sample. The samples were gathered, labeled appropriately, maintained, and kept in storage. The soil samples from the quarry region were designated as SS1, SS2, SS3, SS4, SS5, SS6, SS7, SS8, SS9, SS10, SS11 and SS12. After soil samples were obtained from a variety of locations, such as granite quarries, homes, and surrounding industrial areas, the samples were delivered to a laboratory for analysis in order to determine the physicochemical properties of the soil. While core samples were used to determine the physical properties of the soil (total porosity, bulk density, mean weight diameter, and aggregate stability of the soil level analyzed), auger samples were used to determine the composition of the soil (pH, sulfate, nitrate, calcium, sodium, potassium, magnesium, and total amount of nitrogen) as well as heavy metals (zinc, lead, iron, and cadmium). The samples were allowed to air dry before being filtered using a 2 mm screens to achieve a final size of 2 mm. The soil samples were then weighed and stored in a cool, dust-free area so that they could be accurately analyzed using recognized standard processes.

3.2.11 Soil quality monitoring programme and parameter

In order to assess the environmental variables, monitoring of the site and its environs, particularly the land environment, such as soil erosion and soil quality, will be carried out during the first, second, and third phases of quarrying activities. An overview of the monitoring program is given in **Table 4, 5** and **6**, which also includes the parameters to

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ISSN: 1671-5497
E-Publication: Online Open Access
Vol: 43 Issue: 06-2024
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be monitored, sample frequency, and the regions, numbers, and placements of monitoring stations.

Table 4: Environmental attributes

Sl. No.	Attribute	Parameter	Source of Data collection and Remark
1	Climatology and Meteorology	Wind speed, wind direction, Dry bulb temperature, wet bulb temperature, relative humidity, Rainfall, solar radiation, cloud cover, and environmental lapse	Indian Meteorological Department- and site-specific data at the quarry site.
2	Geology	Geological history	Field survey and secondary sources
3	Land Use	Trend of land use change for different categories	Secondary data or satellite imagery, topo sheet, etc.
4	Ambient Air Quality	PM_{10}, PM_{25}, SO_2, NOx, Pb, CO, O_3, C_6H_6, As, Ni, NH_3, and Free Silica etc.	Present research work not measured the air quality, but considered only impact on soil environment
5	Ambient Noise Quality	Noise levels in dB (A)	Present research work not measured the noise quality, but considered only impact on soil environment
7	Water Quality	Physical and chemical parameters	Present research work not measured the water quality, but considered only impact on soil environment
8	Soil	Soil types and samples were analyzed for physical and chemical Parameters.	Analysis of soil samples at 12 locations
9	Ecology	Existing terrestrial flora and fauna within the study area	Field survey, present research work not measured the ecology quality, but considered only impact on soil environment
10	Socio economic Aspects	Socioeconomic characteristics of the affected area	Based on a field survey and data collected from primary source.

Table 5: Frequency and monitoring methodology

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
Meteorology				
Wind speed, wind direction, Dry bulb temperature, wet bulb temperature, Relative humidity, Rainfall, solar radiation, cloud cover, and Environmental Laps	Selected locations	Continuous for 3 Months	Weather monitors with the database	As per meteorological department standards Primary or secondary data
Land Environment: Soil quality				
Parameter for soil quality: pH, texture, electrical conductivity, organic matter, nitrogen, phosphate, sodium, calcium, potassium and Magnesium etc.	Requisite soil samples were collected as per BIS specification within quarry influence area	Once in Season	Collected and analyzed as per soil analysis reference book, M.L. Jackson	Field survey, primary data, Satellite images/toposheet, RS and GIS software tools

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3.2.12 Determination of physicochemical parameters;

3.2.12.1 Determination of soil pH:

The acidity or alkalinity of the soil is determined by the pH of the soil. Using a pH meter, each soil sample's pH was measured in compliance with ASTM D4972. In a 100 ml beaker, 10 g of a 2 mm sieved and air-dried soil sample were weighed. To 20 milliliters of the distilled water was added. Using a glass rod, the suspension was swirled many times during a 30-minute period. It was determined what pH the soil in the beaker had. The sample was suspended in distilled water at a ratio of 1:1, and the pH was measured by putting the pH meter's probe into this suspension.

3.2.12.2 Determination of Exchangeable Cations (Ca_2+, Mg_2+, Na+, K+):

The exchangeable cations in the soil samples, such as K, Na, and Mg, were identified in the manner mentioned. A 2 mm sieve was used to filter 5 g of air-dried dirt before it was placed in a centrifugal tube. This was mixed with 3 milliliters of NH4O AC and shaken for two hours on a mechanical shaker. It was then run through a centrifuge that was spinning at 2000 revolutions per minute. After the clear supernatant was poured into a 100 ml volumetric flask, the residue was mixed with another 30 ml of NH_4O AC solution, shaken for half an hour, and then centrifuged. After transferring the supernatant into the identical volumetric flask, the procedure was repeated and the flask was filled to the brim with NH_4O AC solution. Magnesium (Mg_2+) was measured using an atomic spectrophotometer, while Ca_2+ and K+ were extracted from the supernatant using a flame photometer.

Table 6: Environmental monitoring programme in different phase of quarrying activities

Sl. No	Area of Monitoring	Number of Sampling Stations	Frequency of Sampling	Parameters to be Analyzed
1st phase : Development phase of quarry operation				
1.	Meteorology	One at site	Hourly and daily basis.	Wind speed and direction, Temperature, relative humidity, atmospheric pressure, and rainfall.
2	Soil	Three locations within the site	Once a month	Physicochemical properties, Nutrients, heavy metals
2nd phase: Quarry operation				
Sl. No	**Area of Monitoring**	**Number of Sampling Stations**	**Frequency of Sampling**	**Parameters to be Analyzed**
1.	Meteorology	One at site	Hourly and daily basis.	Wind speed and direction, Temperature, relative humidity, atmospheric pressure, and rainfall.
10.	Soil	Three locations (two within and one outside project site.	Quarterly	Physicochemical properties, nutrients, and heavy metals
2	Ambient Air Quality	2 stations (in downwind)	Twice a week: 24 hourly period	PM_{10}, $PM_{2.5}$, SO_2, CO and NOx etc.

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3.	Noise	2 (two within plant premises and two outside plant premises)	Once every season	Ambient equivalent continuous sound pressure levels (Leq) at day and Night time.
4	Exhaust from the DG set	Stack of the DG set	Quarterly	PM_{10}, $PM_{2.5}$, SO_2, NOx and CO
5	Vehicular Emissions	Parking area	Periodic monitoring of vehicles	Air emissions and noise, PCU
6	Solid waste or hazardous waste	Check conformance to HWM rules.	Quantity and quality monitoring	Physical state, paint filter liquid test (PFLT), loss on drying (LOD), and loss on ignition Calorific Value.
8	Terrestrial Ecology	Within 10km, around the project	Once in three. Years	Symptoms of injuries on plants
9	Surface and ground water quality	Two Locations within the Project Site	Yearly Once	As per ISO 10500 Standard parameters
3rd phase: Closure phase				
10.	Soil	Three locations (two within and one outside project site.	Yearly	Physicochemical properties, nutrients, and heavy metals
Other parameters – All the above parameters yearly once				

The results of the analysis report and study summary, which were carefully taken into account for this research work.

3.2.12.3 Particle size analysis:

The examination of soil particle size was conducted using the Buoyoucos hydrometer method. A 250 mm beaker was filled to the brim with 50 g of 2 mm oven-dried dirt. After adding 100 milliliters of Calgon and letting it soak for half an hour, the mixture was moved to a dispersion cup.

A mechanical stirrer was then used to mix the mixture for approximately three minutes. Later, while the hydrometer was in suspension, the soil suspension was quantitatively transferred to a sedimentation cylinder and filled to the mark with distilled water. To fully mix the contents, the plunger was inserted and moved up and down. Strong upward plunger strokes toward the bottom and plunger spinning when the disk was slightly above the sediment were used to loosen the sediment. Two or three strokes would conclude the stirring.

The stirring was completed at a time that was noted. When foam formed on the suspension's surface, a drop of amyl alcohol was added. After gently lowering the hydrometer into the suspension, the measurement was made after 40 seconds (i.e., R40 seconds). After taking the hydrometer out of the suspension, a thermometer was used to measure the suspension's temperature.

After mixing the suspension once more, the 40-second reading was recorded until it was confirmed that the result was accurate. A second hydrometer reading (i.e., R2 hours) was obtained two hours following the last suspension mixing procedure.

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN: 1671-5497
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DOI: 10.5281/zenodo.12284768

Equations (1) to (3) were used to determine the proportions of sand, silt, and clay.

% Silt + % Clay = ($R40_{sec}$ - R_a + R_c /W_t x 100 ------------------ (1)

% Clay = (R_{2hrs} - R_b) / Wt x 100 ---------------------- (2)

Where, Ra is 40 secs blank hydrometer reading Rb is 2 hrs blank hydrometer reading Rc is 40 secs correction factor (temperature × 0.360) Rd is 2hrs correction factor (temperature × 0.360) and Wt.is Weight of Soil.

% (sand + silt + clay) = 100 -------- (3)

3.2.12.4 Determination of total organic matter:

To quantify the amount of decomposable organic matter in the soil, the Walkey and Black method was used. The soil samples used in this analysis were ground into a fine powder, and 1 g of the sample was added to the 250-ml conical flask after being weighed twice. Afterward, 10 ml of $K_2Cr_2O_7$ was added. After quickly adding 20 ml of concentrated H_2SO_4, the soil gently shook the flask to combine the reagent and the soil, and then aggressively swirled for a minute. After that, the flask was turned one more and let to stand on an asbestos sheet for half an hour.

Thirty minutes later, 100 milliliters of distilled water was added. A ferroin indicator was added in 3–4 drops, and 0.5 M iron (II) ammonium sulfate was used to titrate the mixture. At this stage, drop by drop of ferrous sulfate was added till the color quickly turned from green to a brownish red. A soil-free blank titration was conducted. The iron (II) solution was used to titrate the excess $K_2Cr_2O_7$ after the carbon was oxidized by $K_2Cr_2O_7$.

Equation 4 can be used to determine the proportion of carbon in organic materials.

% Soil Organic Carbon = (Me .$K_2Cr_2O_7$ −Me .$FeSO_4$) × 0.003 × 100 × F Wt ---------- (4)

Where, Me. $K_2Cr_2O_7$ is titrate value

Me is the Mille-equivalent (used for normality) Me.$FeSO_4$ is the titrate value of sodium solution F is the Correction factor, and Wt. is the Weight of air-dried sample Normality $FeSO_4$ is 0.003 %.

Total Organic Matter = % soil organic carbon × 1.729

Where, 1.729 is constant.

3.2.12.5 Determination of nitrogen content of the soil:

The macro-Kjeldahl method was used to calculate total nitrogen. After being pulverized to fit through a 0.5-mm sieve, the soil sample was weighed into a 500 ml dry macro-Kjeldahl flask. After adding 20 milliliters of distilled water and giving it a few minutes of swirling, the mixture was let to stand for half an hour. 30 milliliters of concentrated H_2SO_4 were poured onto the mercury catalyst tablet, along with 10 grams of K_2SO_4. The digesting stand was heated to a low temperature until the water was gone and nothing stopped happening. After raising the heat to the point where the digestion stopped, the mixture was cooked for five hours. After the digest had cooled, 100 milliliters of distilled

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water was added. The sand particles in the original digesting flask were kept, and it was then moved into a larger macro-Kjeldahl flask. After that, the sand residue was cleaned four times with 500 ml of distilled water, with an aliquot being added to the 750 ml flask after each wash.

A 500 ml Erlenmeyer flask was filled to the brim with 50 ml of H_3BO_3 indicator solution, and it was set beneath the distillation apparatus' condenser. After that, the 750-ml Kjeldahl flask was fastened to the distillation apparatus, and the funnel stopcocks were opened to allow 150 ml of NaOH to pass through the flask. After that, distillation was started, and 150 milliliters of distillate were gathered. By titrating with 0.01N standard HCL, the ammonium nitrogen content of the distillate was ascertained. The endpoint was indicated by a color change from green to pink.

Calculation method:

Digestion: $H_2SO_4 + 2NH_3 \longrightarrow (NH_4)2SO_4$

Nitrogen converted to ammonia and reacted with H_2SO_4 to form $(NH_4)2SO_4$

Distillation: $(NH_4)2SO_4 + 2NaOH_2 \longrightarrow Na_2SO_4 + NH_3 + 2H_2O$

% N = MassofN/Wt x 100 --------------------- (5)

% N = M×T×0.014 ×V1/ V2 ×Wt × 100 ------------------------ (6)

3.2.12.6 Determination of total phosphorus in soil:

In order to begin, 2 g of finely milled dirt must be placed into a 25 ml conical flask. Add 30 milliliters of $HClO_4$. It was broken down until the solution looked clear on a hot plate in a fume cupboard at 1300 °C.

The temperature was raised as needed. White $HClO_4$ vapors occurred when digestion was finished, and the soil residue turned white. To prevent an explosion, it wasn't heated to a dry temperature. $HClO_4$ was added as needed.

The flask was taken out and allowed to go to room temperature. After adding and filtering 50 ml of distilled water into a 100 ml standard flask. Phosphorus concentration was measured after the volume was increased to 100 milliliters. For the additional samples, the same protocol was used.

3.2.13 Soil Quality Index

The soil quality index (SQ index) for a quarry site was determined by averaging specific soil quality indicator features in a single integrator using an inductive additive approach based on normalizing summation.

SQ index = Σ (X Xmax-1) n-1

Where, X is the value of any particular soil property, X max is highest value of that particular soil property, and N is the total number of soil properties used in the calculation. SQ index ranges from > 0 to <1.00

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4. RESULTS AND DISCUSSION

4.1 The granite quarry's geological context within the research area

The rocks of the district are said to have originated from the following groups: the Sargur group, the Charnockite group, the Peninsular Gneissic Complex (PGC), the Closepet granite, and the basic and more recent intrusives (Bhat et al., 1994). The Charnockite group's representative is Charnockite. The Sargur group comprises microscopic bands of banded magnetite present in migmatite, amphibolite, and quartzite, as well as lenses found in gneisses. Granites, gneisses, and migmatite make up the PGC, which is situated east and west of the Closepet granite. PGC is reportedly being turned into charcoal in the district, according to local sources. The Near-N-S trending intrusive masses that comprise the Closepet granite are situated within the gneisses, between 15 and 20 kilometers wide and 50 km long (Syed Abrar et al., 2000; Swamy, 1998). Closepet's granite exhibits a range of compositions, including migmatite, quartzite, amphibolites, and gneiss enclaves. The most common intrusives are gabbro, norite, pyroxenite, and gabbro. Dolerite is the most common of the fundamental dikes, according to Swamy (1998), Paranthaman et al. (1995). There are three main sections of the district's NNW-SSE lineaments (**Figure 5**). These lineaments range in length from 45 to 70 kilometers.

The primary land uses in the regions covered by quarry leases include planned land, hills, vegetation, various rock formations, and soil cover or overburden. The geological setting of the granite quarry region is influenced by various factors such as the granite quarry's location, the kind and quantity of deposit formation, the materials' quality, and their absence of inherent defects. Brownish-red soil capping at the foot of the quarry lease area covers most of the hill's eastern, western, and north-western sections. The middle ridge's dirt has an average thickness of less than 0.5 meters and is only present in the spaces between the stones. The Ramanagara District's rock types and lithostratigraphy are displayed in **Table 7**. Sand mining and defined, and unspecified minor mineral licenses were conducted in Kanakapura, Ramanagara, Channapatna, and Magadi Taluk in addition to taluk-specific quarrying activities for dimensional stone, construction stone, brick earth, crushers, and stone cutting facilities in this district.

Table 7: Rock types and lithostratigraphy found in the Ramanagara District.

- Soil Clover –	
I. **Younger intrusive** (More recent invasion)	Extremely potassic rocks; dolerite/gabber/diorite/norite dykes; felsite/felsite porphyry dykes; coarse-grained pink/grey porphyritic granite.
II. **Closepet granite (2400–2100 Ma)**	Pink/grey porphyritic granite with coarse grain; pink granites (less mafic); grey granites; pink hornblende granite; pink equigranular/porphyrite migmatites.
III. **Peninsular Gneissic Complex (3000 Ma)**	Grey migmatites, biotite gneiss, leucogneiss and homophonous gneiss, charnockite and migmatite.
IV. **Sargur group (> 3000 Ma)**	Garnet-sillimanite gneiss, quartzite (fuchsite and BMQ), meta-ultramafites, amphibolites (both massive and schistose), and banded magnetite quartzite.
----Not visible is the base. ----	

ISSN: 1671-5497
E-Publication: Online Open Access
Vol: 43 Issue: 06-2024
DOI: 10.5281/zenodo.12284768

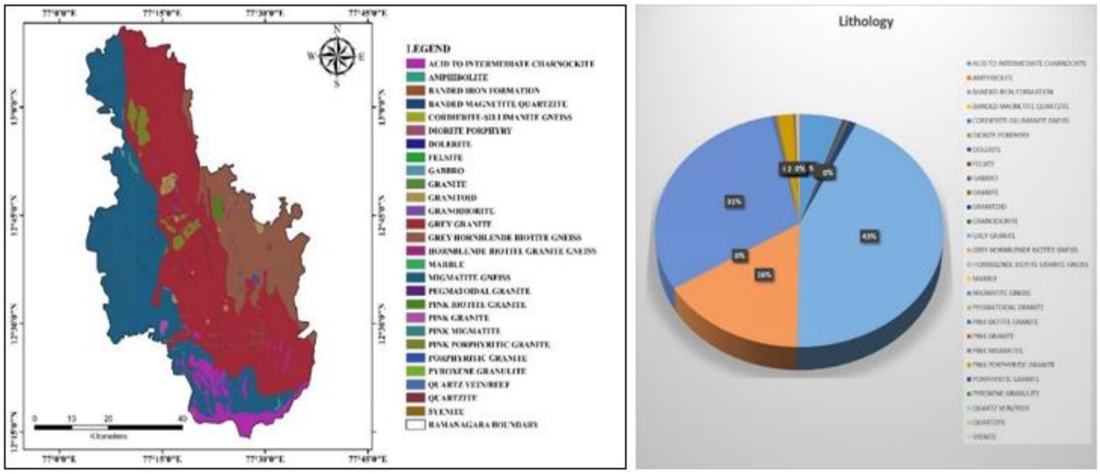

Figure 3: Lithology map of study area and percentage of area covered

It also has more crushing plants per square mile than other districts, and it was home to several granite quarries and crushing industries forty to fifty years ago. The environment is contaminated by quarrying and stone-cutting operations due to noise, dust, water, and other pollutants. The associated radioactivity varies with the surrounding environment due to dust emissions from the quarrying and crushing processes. Seismic Zone IV, commonly known as the high damage risk zone, is where the research area is situated. There is a very significant possibility for earthquake shocks of magnitude five or six in Seismic Zone III. **Figure 3** depicts the lithology and percentage of area covered in Ramanagara district. In this area, migmatite gneiss and gray granite are the two main lithologies. The region spans 1552 km^2–1080 km^2. **Table 8** displays the percentage of rocks covered in the Ramanagara district.

Table 8: The rocks covered in the study area

Sl. No	Lithologic units	Area in sq. Km	Sl. No	Lithologic units	Area in sq. Km
1	Acid to intermediate charnockite	173.60	15	Hornblende biotite granite gneiss	0.69
2	Amphibolite	3.12	16	Marble	0.59
3	Banded iron formation	4.24	17	Migmatite gneiss	1080.64
4	Banded magnetite quartzite	1.20	18	Pegmatoidal granite	3.37
5	Cordierite-sillimanite gneiss	0.30	19	Pink biotite granite	12.03
6	Diorite porphyry	0.96	20	Pink granite	8.07
7	Dolerite	12.40	21	Pink migmatite	6.92
8	Felsite	3.26	22	Pink porphyritic granite	66.46
9	Gabbro	12.82	23	Porphyritic granite	4.66
10	Granite	0.54	24	Pyroxene granulite	2.00
11	Granitoid	29.36	25	Quartz vein/reef	0.23
12	Granodiorite	3.23	26	Quartzite	16.19
13	Grey granite	1522.90	27	Syenite	0.57
14	Grey hornblende biotite gneiss	545.83			
Total areas in Sq. Km 3516.21					

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4.2 Soil environment in the study area

The word "soil," which comes from the Latin word "solum," refers to loose inorganic particulate matter that is produced when rocks and minerals break down due to the influence of chemical, mechanical, or natural forces that sustain plant life. He goes on to describe "transported or sedimentary soils" as soils that have been transformed into sediments by forces such as wind, water, and gravity, whereas "residual soils" are generated by the weathering of rocks that are still in their original location. Rock weathering produces highly porous materials called soils. Different soil types are produced by varying lithologies. The natural body known as soil is made up of layers that are mostly made up of minerals. These minerals have different properties from their parent materials, such as texture, structure, consistency, color, and chemical and biological makeup. The topography of the soils, the plant and animal life they sustain, and the length of time they have been exposed to these factors all have an impact on the evolution of the soil. Residual soil is soil that has formed directly from the bedrock underneath it. It is transported soil if the soil was formed from material that was carried there by erosion. The five main elements that affect soil formation are terrain, time, living creatures, climate, and parent material**.** The soils are categorized into nine classes of bare soil and five classes of soil covered in vegetation under Alfisols, Entisols, and Inceptisols. These soil assemblages are called rocks, and each of their constituent minerals has spectral composites made up of different elements joined by different bands in varying proportions. The soil qualities determine the quantity of recharge, storage, and outflow of groundwater as well as the degree of groundwater contamination. The visual interpretation technique is crucial for identifying and charting the soil from the range of properties that make up the soil, such as moisture, texture, color, and structure, as well as the soil-forming conditions that are reflected in the imagery and include landform, drainage, vegetation, hydrogeology, and parent material**.**

Lateritic soil and red loamy soil are the two broad groups into which district soils are divided. Sand and red loamy soils are most commonly found on hills and sloping land slopes in granite and gneissic terrain. The soils are light-textured, naturally strongly leached, and have a high penetration rate. Soils can be classified into five categories, like clay, black cotton soil, red loam, sandy loam, and clayey loams. Red loamy soils are usually found at higher elevations, while black cotton soils are always found in valley locations. Different types of soil can be found at intermediate elevations. The laterite soils of the peninsular gneissic region create a plain with gently sloping topography on undulating terrain. The rain-fed cultivation of oilseeds, jawar, ragi, and groundnuts is supported by these soils (Hema et al., 2012). There are substantial stretches of red loam in the district. They originate from igneous rocks, primarily granites and gneisses. The red soils are characterized by their light texture, porous and friable nature, absence of lime kankar, and free carbonates. The texture of the soil varies from gravely sandy loam to clay loam. The clay portions of the red soil include large amounts of kaolinite minerals. In addition, ragi, paddy, legumes, oilseeds, vegetables, and fruit crops are grown on these soils. Lateritic soils, red gravelly sandy loams, and red loams are the three types of soil found in the district. The district contains isolated areas of black soil, while the

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downstream section of the tanks and the tank beds in every taluk have gray alluvium soil with small particles**.**

The district's soils are deficient in plant nutrients. There are a few acidic soils in the district as well. Its depth varies from a few inches to several feet. This type of well-drained soil is found in the Kanakapura Taluk. Red loamy soil is a brilliant red to pale red soil. Red gravelly sandy loams are shallow-diving and usually found beneath rock strata. Gravel and pebbles are attached to coarse soil particles. This type of soil has sufficient drainage and is found in various places in the taluks of Magadi, Kanakapura, and Ramanagara. Red sandy loams, a type of soil with good drainage and a high percentage of sand and coarse particles, are also found in the area. It is located in the Ramanagara and Channapatna taluks. An analysis of the soil was carried out utilizing IS 2720 protocols. All the types of soil are listed in **Table 9** and **Figure 4.**

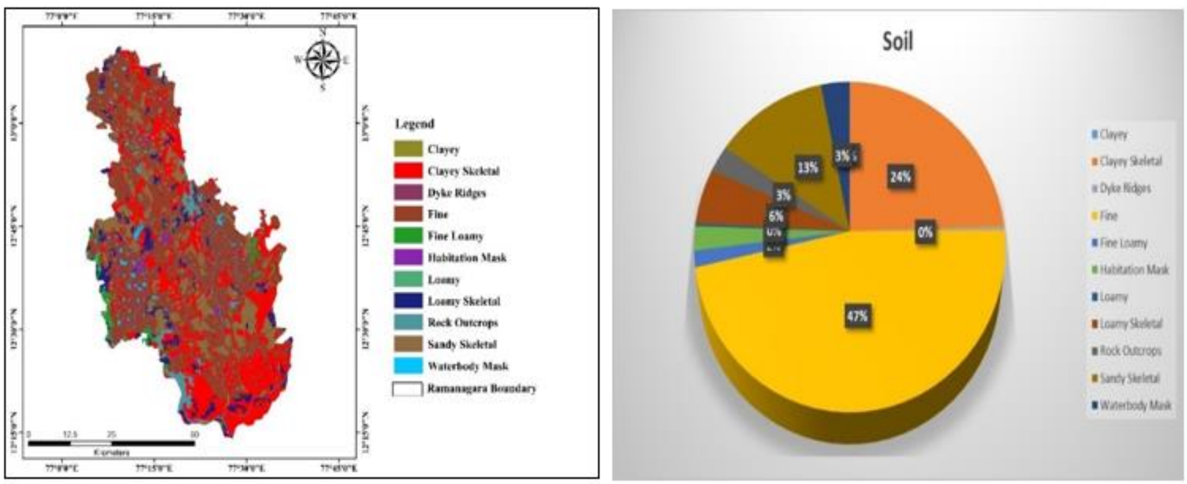

Figure 4: Soil map of the study area and percentage of soil covered in the study area and Quantities of sand, silt, and clay

Table 9: Type of soils and its distribution percentage in the study area

Soil Texture	Area in Sq. Km
Clayey	2.38
Clayey Skeletal	859.70
Dyke Ridges	17.09
Fine	1634.47
Fine Loamy	54.79
Habitation Mask	81.91
Loamy	12.23
Loamy Skeletal	192.06
Rock Outcrops	98.34
Sandy Skeletal	445.70
Water body Mask	117.54
Total Area	**3516.21**

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4.3 Classification of soils:

A classification scheme built around the soil body itself. This system is extremely intricate and comprehensive. Its many soil-forming processes are what give it its complexity. Included are the following factors: time, ground slope, creatures, parent material, and climate. A column of soil that extends from the ground's surface to the parent material is known as a soil ped, or solum. Horizons, or soil layers, form as a result of the physical and chemical weathering that occurs as the soil ages. The soil's "order" varies with increasing depth and degree of weathering, as the following illustration and **Table 10** shows the initial parent and weathering-based groupings of the soil into ten orders.

Table 10: Ten soil orders within the "Seventh Approximation"

Name of soil order	Characteristics of soil
Entisol	Minimal horizon distinction throughout all climates in alluvium, frozen ground, dry sand, etc.
Vertisol	Rich in clay soils that, when wet, hydrate, expand, and break. Primarily in arid to sub-humid climates.
Inceptisol	Soils that have barely developed at the horizon. Soils on newly formed volcanic deposits, in tundra regions, in recently deglaciated places, etc.
Aridisol	Accumulations of carbonate, gypsum, salt, or dry soils are frequent.
Mollisol	The thick, black, soft surface layer of temperate grassland soils is enriched with organic matter.
Spodosol	Humid forest soils, found largely beneath conifers, typically contain an ashy-gray leached A horizon in addition to a distinctive B horizon that is high in iron or organic matter.
Alfisol	Clay-enriched B Horizon, young soils commonly under deciduous forests.
Ultisol	Old land surfaces with humid to tropical soils that are deeply
Oxisol	Lateritic, bauxite, and tropical and subtropical soils. Ancient, severely worn soils that are almost horizon less.
Histosol	Bog soils, organic soils, peat and muck. No climatic distinctions.

4.4 Soil types in the study area

The Channapatna, Kanakapura, Magadi and Ramanagara taluks are the primary locations of red sandy soil due to their undulating land slopes. Their soil composition ranges from loam to sandy loam on the surface to sandy clay loam to clayey soils in the subsurface strata. They have a dark brown tint. Soil is an open system that is difficult to classify over an extended period of time. Granitic gneiss, granites, and acidic rocks are the sources of these soils. Their nature ranges from neutral to alkaline. Red loamy soils are typically found on granite and granite gneisses with hilly to undulating land slopes. Because of this, classifying soil can be challenging over time, necessitating the development of a shared conceptual framework. These soils are found on pediments that slope slightly. It is mostly covered in the taluks of Magadi, Kanakapura, portions of Channapatna and Ramanagara taluks**.** Before acknowledging soil as a natural resource that sustains and nourishes people, let's take a moment to learn about geology. The Ramanagara district has lateritic soils, red gravelly sandy loams, and red loams. There are isolated spots of black soil in the district, and all the taluks have alluvium soil in gray with fine particles in the downstream section of the tanks and on tank beds. There are not

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many plant nutrients in the district's soils. The district also contains a small amount of acidic soil. It ranges in depth from a few inches to many feet. This kind of soil is found in the Kanakapura taluk and has good drainage. The bright red to pale red soil is red loamy soil. Red gravelly sandy loams are typically found beneath rock strata and have a short depth. Coarse soil particles are connected to pebbles and gravel. This kind of soil is present in several areas of the taluks of Magadi, Kanakapura, and Ramanagara and has adequate drainage. The territory also contains red sandy loams, a kind of soil with good drainage and a large proportion of sand and coarse particles. It can be found in the taluks of Channapatna and Ramanagara.

4.5 Soil erosion in the study area:

In the Ramanagara district, the exploration and quarrying of granite have severely eroded the soil and harmed the ecology. The environmental effects of the granite quarrying and stone processing businesses are often unknown to the majority of farmers who till the land. They don't know which methods can stop soil erosion and are the most environmentally friendly. In places where quarries are located, the primary exogenetic processes that cause soil erosion are soil erosion, land degradation, water erosion, wind erosion, man-induced erosion, etc. The majority of soil loss in the region is a result of surface, channel, and splash erosion caused by water. The main cause of man-induced erosion in the study area is the various quarrying activities that increase erosion. Large-scale heaping of overburden rock mass and the excavation of open-pit quarrying have altered or destroyed topography and soil cover. The quarrying sites have seen widespread deforestation, which has exposed the soil to additional erosion.

4.6 Top soil management:

The area of the low-lying quarry lease has very thin topsoil. There isn't any topsoil produced; whatever is taken out during area clearance or excavation will be temporarily heaped and put to use in afforestation efforts. Soil and shattered stones make up the overburden. This is good news for farmers.

4.7 Physiography and topography in the study area

Plateaus, rocky uplands, undulating hills and flat ground, and hills with a level peak are the principal physiographic features. The Deccan Plateau, the coastal plains, and the islands are the three separate macro-regions that make up the physiographic division of Karnataka State within the Indian Union. In addition, the physiographic characteristics of each area have been used to divide the state into four micro-regions. The micro-regions are the Karnataka Coast, the Central Karnataka Plateau, the Southern Karnataka Plateau, and the Northern Karnataka Plateau. The state of Karnataka's southeast is where Ramanagara is situated. The district of Ramanagara is located on the Deccan Plateau in southeast Karnataka state, between latitudes 12°24' and 13°09' in the north and longitudes 77°06' and 77°34' in the east.

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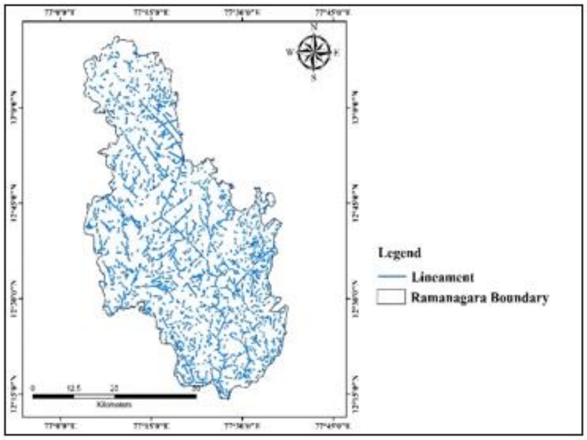

Figure 5: Lineament map of the study area

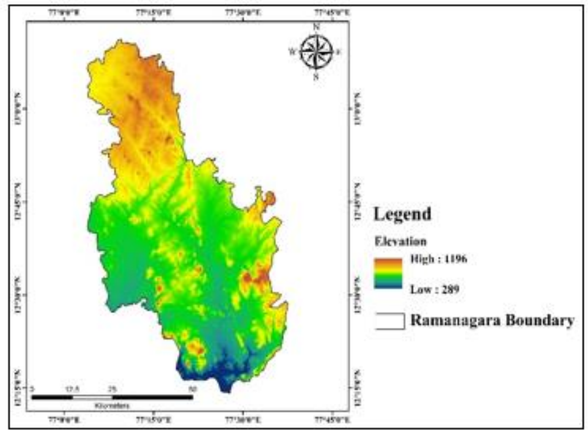

Figure 6: DEM map of the study area.

The open landscape in the district's east, north, and center is made up of vast stretches of undulating plains. Uplands are covered with low scrub jungle, whereas low-lying parts are used for agriculture and have tanks sprinkled along waterways. The terrain in the west is rugged and broken, with rocky outcrops and fast-moving streams with sandy bottoms strewn throughout hills and valleys. The area is heavily forested, and as the hills from the south approach, it drops into the Cauvery River. A range of close-grained granite hills that stretches from Nijagal in the north to Kanakapura in the south is a prominent geographical feature. The slopes are dotted with stones and are mostly covered in scrub trees. Occasionally, the granite hills rise sharply to form distinct landmarks. The valleys between these hills are full of fertile land and full of water. There are numerous tanks on the low-lying plains. There are no lakes in the district that are found naturally. Larger lakes like Madhure, Doddaballapura, and Hoskote are used to temporarily store rainwater for agricultural purposes. The most famous of the hills are Shivaganga Betta (1380 m), Bilikal Betta, Mudavadi Betta, and Narasimhadevara Betta **Figure 7**.

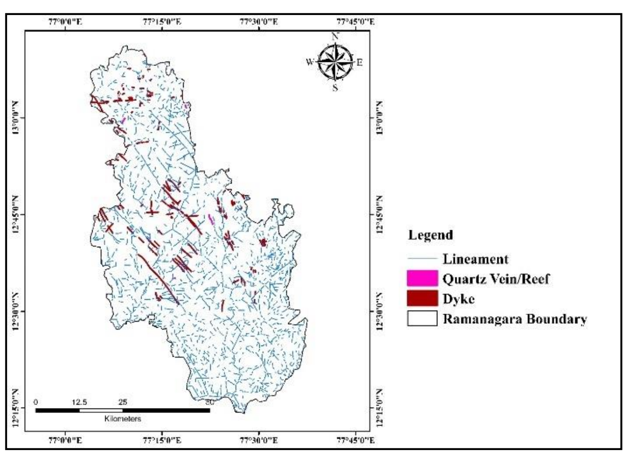

Figure 7: Structural map of the study area

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Ramanagara, Kanakapura, Devanahalli, and Nelamangala combine to create captivating scenes. Located about 5 km north of Ramanagara, Ramagiri Betta is a picturesque hill on the left bank of the Arkavathi River. Sivagiri is a large fortified rock located near Ramanagara on the right bank of the Arkavathi. The valley of Arkavathi, which empties into the district of Doddaballapura taluk and flows south, is formed by this district. It creates numerous lakes at Doddaballapura and Hesaraghatta as it runs through the eastern taluk of Nelamangala. It then runs east of Sawanadurga and through the Taluk of Magadi. Between Shivagiri and Ramagiri, the river passes through the Channapatna taluk and enters Kanakapura before joining the Cauvery River, which likewise flows south. The western portion includes a small fraction of the Shimsa River basin, while the eastern portion includes the upper Pinakini River basin. Similar to Arkavathi, the Pinakini River begins in the Nandi Hills and drains into the Hoskote tank after running through Hoskote and Devanahalli. In addition, the Kanva, Kumudavati, Vrishabhavathi, and Suvarnamukhi are minor rivers in this area. Dams have been built over them at Kanva, Manchanabele, and Thippagondanahalli. The districts of Tamil Nadu that border the tract are Kolar to the northeast, Mandya to the southwest, Chamarajanagar to the south, and Salem to the southeast. From Kanakapura to Magadi, the western part of the district is traversed by the Closepet Granite group. Near Thalaghatapura, there are strings of dark hornblende granulite and pale green pyroxene rocks. Hoskote and Doddaballapura are potential locations for the mineral kaoline. Graphite is found in the vicinity of Chikbanavar and Gollahalli. Good slabs and sized stones are being produced by the genetic exposures in the district. At higher elevations, the soil is reddish-gray and gravelly; the majority of the district has loamy soil, especially in the valleys. This soil is ideal for most agricultural and horticultural crops.

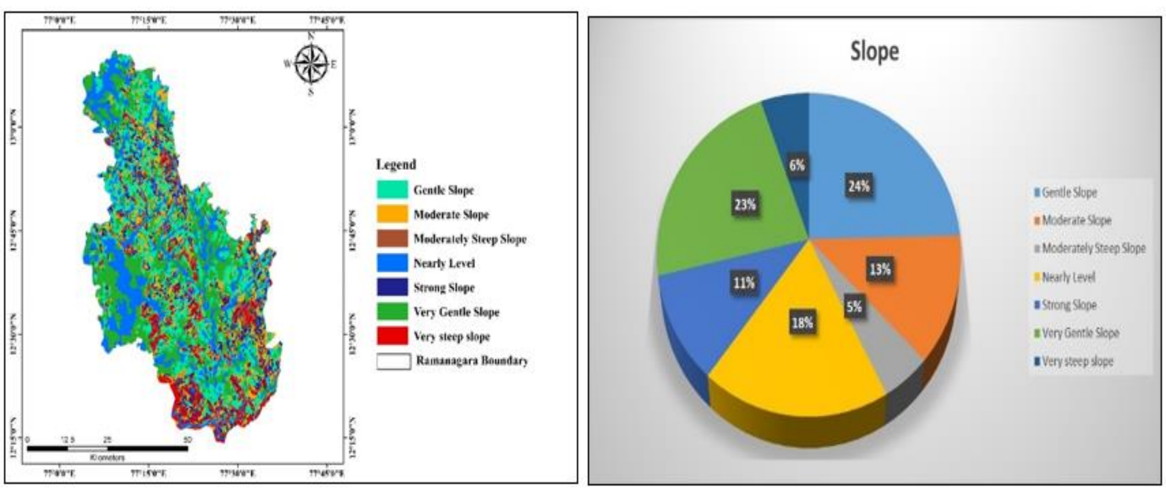

Figure 8: Slope map and percentage covered of the study area

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN: 1671-5497
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Table 11: Slope, elevation difference and percentage of distribution in the study area

Slope	Area in Sq km
Gentle Slope	861.838
Moderate Slope	449.451
Moderately Steep Slope	172.709
Nearly Level	645.58
Strong Slope	378.805
Very Gentle Slope	811.585
Very steep slope	196.243
Total Area	3516.21

In other words, relief is the height difference, measured in feet or meters, between the high and low points of a landscape. Relief is typically defined as the form of the terrain, including its height and steepness. The main methods used by topographic maps to depict the relief of the land include contour lines and patterns, layer colors, landform shading, and spot heights. Contours are the lines that join areas of the earth's surface that have the same height or elevation **Figure 9**. The contour line as a function of two variables along a curve with a constant value. The district is roughly 600–700 meters above sea level. A large portion of Kanakapura and Channapatna are included in this elevation group. Generally speaking, the Magadi region is 800–900 meters above sea level. While some parts of the taluk are 600–700 meters high, other parts of Ramanagara are 700–800 meters high. The highest points, which ranged in elevation from 900 to 1200 meters, were found in a few locations within the Kanakapura and Magadi taluks **Figure 8 and Table 11**.

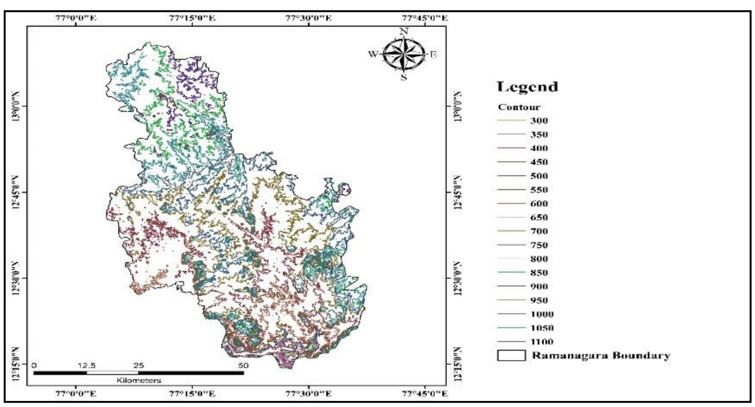

Figure 9: Contour map of the study area

4.8 Geomorphology in the study area

The region under study is a granitic nation with notable topographic highs surrounded by gneissic penguins. What makes these granitic hills so distinctive is their wild terrain, with steep slopes and dome-shaped tops that form an endless network of ridges throughout this region **Figure 10 and Table 12**. The slopes of these hills are steep and bare, with very little vegetation on them. Nevertheless, the lower foot slopes of these robust hills that encircle Savandurga are thick with vegetation. On the other hand, there are

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sporadically minor to significant undulations in the mature gneissic plain that covers these rugged hills. The drainage traveling SSE-ly follows the overall Darwarian tendency, while the drainage perpendicular to them follows the major joint pattern. The northern portion of the region is located south and west of Kanakapura and has an undulating topography with a sequence of hills that slope NNW-SSE. Most of the active quarries are located in this region. To the south of Doddaalahalli, the terrain is rugged and rugged, with big hills mostly covered in reserve forests. The important hill points are 1011 (Vammalaggabetta), 1125 (Devarabetta), 1100 (Shivadappanabetta), 906 (Devaragudda hill), 1057 (Bhimanakandi betta), and 1070 (Kabbal Durga). Part of the reserve forest lies in the northeast, where there are large hills and rugged terrain. In this region, the noteworthy hillocks include 1146 (Kumarabhadraswami), 1171 (Rangaswamibetta), and 861 (Durgatkallu). The region's notable state reserve woodlands are Bilikal State Forest, Bantanal Forest, Muguru Forest, Basavanabetta Forest, Chilandvadi Forest, and Muguru Forest. The northern part of the region has high hills such as Byradevara Betta (923), Pichankere Betta (989), and Doddamudavadi Betta (953), which are at higher levels. Three further high peaks, Gangadharam Gudda (893), Marasandra betta (808), and Bilikal betta, are located in the southeast corner.

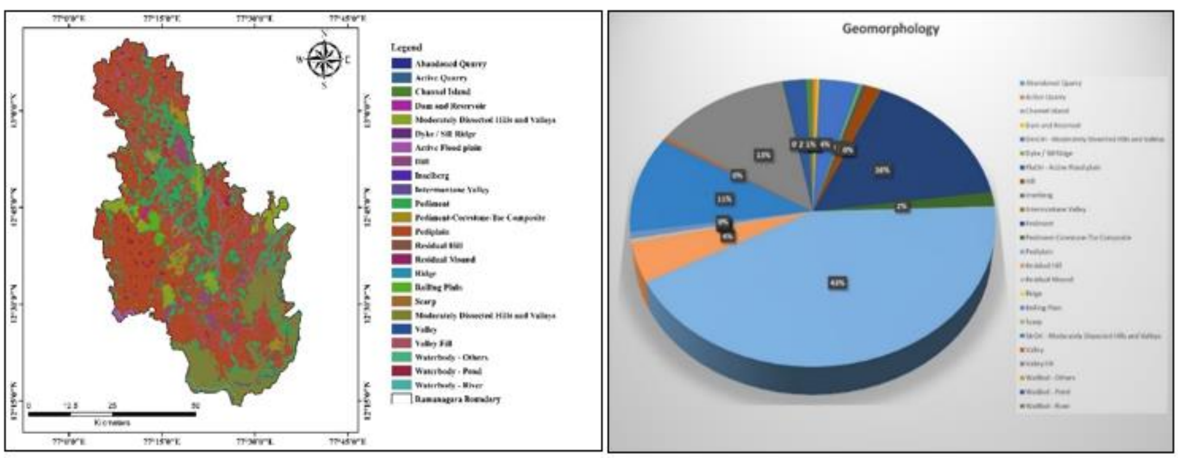

Figure 10: Geomorphology and percentage covered of the study area

The northern portion of the region is located south and west of Kanakapura and has an undulating topography with a sequence of hills that slope NNW-SSE. Most of the active quarries are located in this region. To the south of Dodda Alahalli, the terrain is rugged and rugged, with big hills mostly covered in reserve forests. The important hill points are 1011 (Vammalaggabetta), 1125 (Devarabetta), 1100 (Shivadappanabetta), 906 (Devaragudda hill), 1057 (Bhimanakandi betta), and 1070 (Kabbal Durga). Part of the reserve forest lies in the northeast, where there are large hills and rugged terrain. In this region, the noteworthy hillocks include 1146 (Kumarabhadraswami), 1171 (Rangaswamibetta), and 861 (Durgatkallu). The region's notable state reserve woodlands are Bilikal State Forest, Bantanal Forest, Muguru Forest, Basavanabetta Forest, Chilandvadi Forest, and Muguru Forest.

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Table 12: Geomorphological feature and distribution in the study area

GEOMORPHOLOGY	Area in Sq. Km
Abandoned Quarry	2.03
Active Quarry	13.12
Channel Island	1.11
Dam and Reservoir	8.98
DenOri - Moderately Dissected Hills and Valleys	133.91
Dyke / Sill Ridge	16.14
FluOri - Active Flood plain	10.74
Hill	51.50
Inselberg	1.39
Intermontane Valley	2.87
Pediment	569.34
Pediment-Corestone-Tor Composite	56.51
Pediplain	1497.77
Residual Hill	160.06
Residual Mound	10.18
Ridge	3.64
Rolling Plain	24.27
Scarp	1.25
StrOri - Moderately Dissected Hills and Valleys	381.04
Valley	12.64
Valley Fill	451.58
WatBod – Others	3.10
WatBod – Pond	80.95
WatBod – River	22.69
Total area	3516.21

4.9 Drainage system with description of main rivers in the study area

A large portion of the Ramanagara district is contained in the Arkavati valley; small areas of land in the eastern and western sections are accounted for by the basins of the Dakshina Pinakini and the Shimsha, respectively; the eastern boundary of the cuavery system is formed by this watershed; along this watershed, there is a broken chain of rocky hills that stretches from the western part of Nelamangala Taluk through the taluks of Kanakapura, Magadi, Ramanagara, and Channapatna; west of this undulating region, the Shimsha River drains the land.

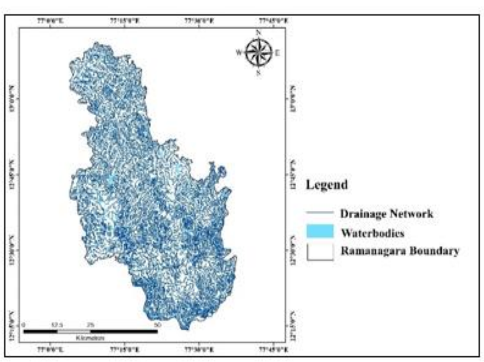

Figure 11: Drainage map of the study area

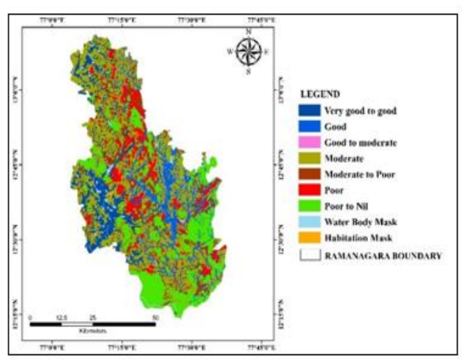

Figure 12: Groundwater prospect map of the study area.

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4.9.1 Drainage pattern

The whole of the Ramanagara district is included in the Cauvery basin. The two principal tributaries of the Cauvery River that drain the district are the Arkavathi and Shimsha rivers **Figure 11**. The Arkavathi basin is primarily composed of four watersheds, 4B3B5, 6, 7, and 8, whereas the Shimsha River is composed of three watersheds, 4B3C1, 2, and 5. The rivers and streams that feed into the various tanks strewn around the area originate from small watersheds. The drainage pattern in the area can be classified as semi-dendritic to dendritic. A map of the district's drainage system provided in the Figure.11 and Ground water prospect map of the study area provided in the Figure.12.

4.11 Forestry

The total area of forest in the district is 69,946 hectares. Trees and plants abound, especially in the gullies that divide the heights. The hills of Channapatna Taluk are accompanied by fewer trees. Sandalwood forests in the taluks of Magadi, Kanakapura, and Channapatna. Furthermore, because agriculture is less profitable, farmers are shifting their focus to cultivating casuarinas and eucalyptus plantations. The state woodlands in the district have deteriorated to around half of what they were originally. There have been significant afforestation operations in certain areas. Net Area Sown: 47.54%, or 169203 hectares. There are 175539 hectares of arable land **Figure 13**.

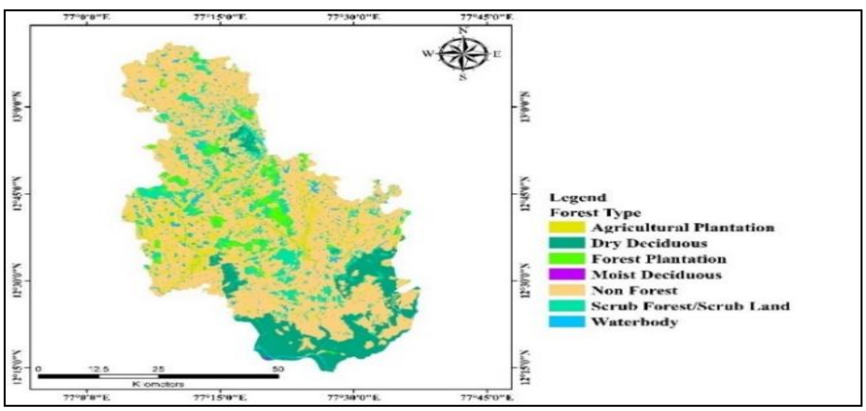

Figure 13: Forest type map of the study area

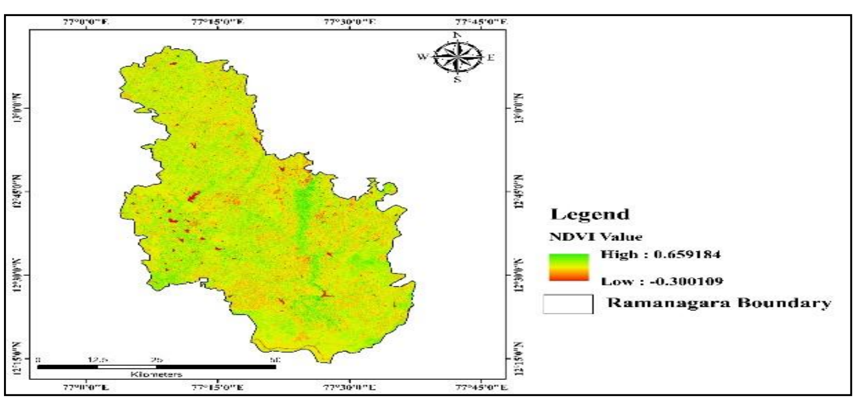

Figure 14: NDVI map of the study area

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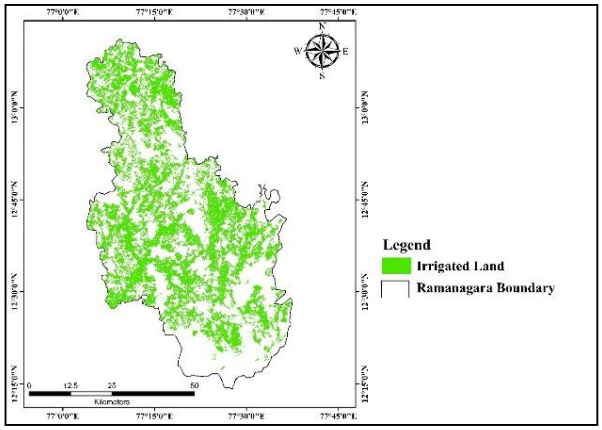

Figure 15: Irrigated land map of the study area

4.13 Cropping pattern

The district's main industry is agriculture. The Census of India 2011 only shows that the district is dominated by agriculture, with 39.16 percent of cultivators and 19.28 percent of agricultural laborers **Table 13**.

Table 13: Area, production, and average yield of principal crops for 2009–10 under all seasons

Crops	Area in hectare	Production in tonnes	Yield i n Kgs per hectare	Area in hectare	Production in tonnes	Yield i n Kgs per hectare	Area in hectare	Production in tonnes	Yield in Kgs per hectare
Paddy	7534	34059	4759	780	1945	2625	8314	36004	4558
Rice	7534	22718	3174	780	1297	1751	8314	24015	3041
Jawar	0	0	0	0	0	0	0	0	0
Bajra	0	0	0	0	0	0	0	0	0
Maize	1600	6256	4116	393	1530	4098	1993	7786	4112
Ragi	719	1669	2443	76053	137781	1907	76772	139450	1912
Wheat	0	0	0	0	0	0	0	0	0
Total cereals and Millets	-	-	-	-	-	-	87237	171293	2067
Total Pulses	-	-	-	-	-	-	19584	13317	716

4.14 Irrigation and Irrigation project

There aren't any noteworthy irrigation projects in the district. The Kanva Reservoir Project and the Byramangala Reservoir Project are two medium-irrigation projects located in this region. The Byramangala Reservoir Project is located in Bidadi Hobli, Ramanagara taluk, on the river Vrishabhavathi, a tributary of the Arkavathi River. Its command area is 1949 hectares, and its principal crops are sugarcane and paddy. Situated on the Kanva River in Channapatna Taluk, the Kanva Reservoir Project occupies a command area of 2076 hectares. A total of 4025 hectares of irrigation potential has therefore been developed by

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the present medium-irrigation projects. Three further irrigation projects, with proposed command areas of 4380 ha, 3846 ha, and 4957 ha, respectively, are currently under development in addition to these two medium-sized projects. The Manchanabele Reservoir Project, the Arkavathi Reservoir Project, and the Iggalur Anecut Project are these projects. The 178 km-long canals provided irrigation to a net area of 2346 hectares in 2008–09. 808 tanks had supplied water to a net area of 2993 ha, while 38059 tube wells had irrigated 36808 ha. Of the 169203 ha of net area sown, 42598 hectares (25.17%) were under irrigation. The net area irrigated by taluk, source, and area is displayed in Table 1. The data indicates that 36808 ha (86.4%) are irrigated by groundwater sources, such as bore wells, while only 5520 ha (12.95%) are irrigated by surface water sources, such as lift irrigation systems and canal tanks. The main source of irrigation water is bore wells because no region is irrigated by dug wells **Figure 15 and Table 14**.

Table 14: Taluk wise source wise net area irrigated in Ramanagara district (2008-09)

Sl. No	Taluk	Net area irrigated (ha)						
		Canals	Tanks	Lift irrigation	Dug wells	Bore Wells	Other sources	Total
1	Channapatna	107	72	103	---	11866	---	12148
2	Kanakapura	2000	828	63	---	13387	135	16413
3	Magadi	36	8	15	---	6434	--	6493
4	Ramanagara	203	2085	---	---	5121	135	7544
Total		**2346**	**2993**	**181**	**---**	**36808**	**270**	**42598**

4.16 Mineral resources in Ramanagara district

The Ramanagara district has little mineral resources. The district is home to several significant mineral resources, including clays, quartz, garnet, limestone, ocher, and stones for construction and ornamentation. The Ramanagara taluk contains Chinese clay resources, which are essential for high-tension insulators and other ceramic items. Amphibole asbestos is found in the Ramanagara taluk's Bidadi. Also, the district contains quartz resources on hillocks close to Bannikuppe in the Ramanagara taluk and Kolar in the Magadi taluk. Furthermore, the district has various locations where one can see rock crystals. Other instances of using garnet have been reported in the vicinity. It is in the Kanakapura Taluk, close to Salhunse and Maralavadi. There are reports of limestone in the same taluk. Some of the micaceous gneisses and quartzite bands in Valgerehalli and other locations southeast of Channapatna contain garnets. There are many different types of building stones in the area, including granite and granitic gneisses with different compositions, structures, and hues. There is also pink granite with a uniform texture and fine grains near the taluks of Channapatna and Magadi. Porphyritic types are also found in the granitic exposures in the district and near Ramanagara. These types provide beautiful stones with good architecture. These types have rough pink feldspar crystals that may or may not contain tiny bits of green minerals like epidote and chlorite **Table 15**.

Table 15: Mineral Resources of Ramanagara District

Taluk wise mineral resources of the Ramanagara district				
Sl. No	**Taluk**	**Major mineral**	**Minor mineral**	**Remarks**
1	Magadi	Quartz	Building stone, Ornamental stone	Building stone is abundantly available
2	Ramanagara	-	Building stone, Ornamental stone, Ordinary clay	Building stone is abundantly available
3	Channapatna	Corundum, quartz	Building stone, Ornamental stone	Building stone is abundantly available
4	Kanakapura	Corundum, quartz	Building stone, Ornamental stone and dyke rocks	Building stone is abundantly available

Table 16: The following are examples of quarrying activities in the Ramanagara district areas leased by the government as on 2022 - 2023.

Sl. No	Taluk	Building stone	Ornamental or dimension stone	Brick earth	Crusher Units	M-sand units
1	Ramanagara	38	02	-	29	08
2	Kanakapura	25	52	-	03	02
3	Magadi	19	04	O2	10	02
4	Channapatna	-	02	-	-	-
	Total	82	60	02	42	12

4.17 Environment impact identification and evaluation:

The nature of the impact (positive, negative, direct, or indirect); intensity (low, moderate, or high); duration (temporary or permanent); and geographical extent (local, isolated, or regional) are the four fundamental factors that are used to assess the overall significance of impacts. These components serve as the framework for the assessment method. The plan is put into action after the identified implications have been examined and evaluated in the context of the available data. The overall relevance or importance (low, moderate, or high, negative or positive) of any effect that has been found can be determined using these criteria. The approach places a strong emphasis on observation and crucial mitigating measures to stop or minimize impacts. Moreover, it makes it possible to determine suitable thresholds even in cases where an assessment is based solely on a value judgment rather than missing numerical data.

Examine the various granite processing facilities, crusher units, sandstone quarrying locations, and quarry sites during the fieldwork investigation. In order to obtain more information about the environmental effects of granite stone quarrying—a topic that is thoroughly examined in this study area—a marketing survey should also be given to the local population. In order to determine the current state of several environmental variables, including the soil environment and atmospheric conditions, baseline environmental studies were conducted in the Ramanagara district of Karnataka state, India. Nevertheless, there has been little research done on ambient air quality, ambient noise, hydrogeological conditions, health, the ecological and socioeconomic environment, etc. The crops grown locally, the makeup of the soil, the patterns of the climate, etc., all influence how agricultural land is used.

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The specific land use (commercial or residential), the infrastructure services that are accessible, the characteristics of neighborhood development, and—most crucially and particularly for the research region—the status and condition of the environment all influence the value of urban land.

Quarrying is one of the most important known human-caused land degradation contributors. This is corroborated by the fact that the natural environment, which is often in its pristine state, becomes unstable when quarrying begins. The first step in the quarrying process involves removing the natural vegetation, which provides a home for a range of creatures. This initial stage is not so severe when compared to the next great instability of the physical environment brought on by excavation exposing the target granite rock.

The topsoil is then dumped or emptied far from the quarry site, adding to the instability of the surrounding environment. Active quarrying is when land degradation is at its worst. Severe degradation is taking place inside the quarry itself as vast volumes of the soil material that makes up the hard granite rock are crushed into ballast and brought to the surface. This has left behind of human origin holes that expose the underlying rock layers of the towering cliffs.

During the quarry's closure period, degradation of the land was also seen. There is no evidence that steps have been undertaken to entirely repair the quarries within the research area. After they run out, the quarries are leased to construction companies so that they can get rid of the unwanted red soil that is present all across the Ramanagara district. The deposition of waste soils just speeds up land degradation in the absence of a specified end state. Since it has the highest concentration of organic matter, the topsoil is inherently the most permeable.

This characteristic increases the soil's permeability and capillarity at the top strata of the soil structure. The fine quarry dust on the surface counteracts this feature by keeping a large amount of water from seeping to the lower surfaces of the ground when more water flows off the surface. This has an adverse effect on aquatic biodiversity because it impacts groundwater recharge, induces groundwater withdrawal, and diverts surface water. As a result, above-ground and underground hydrologic systems dry up.

Lack of either of these keeps plants from producing food, which stops growth even in the presence of rich soils and water. This action of dust prevents plants from growing. This problem isn't fixed until the rainy season arrives, when the dust is completely blown off the surface or swept away by high winds. Dust particles that settle on various plant parts, especially the leaf surface, after varying lengths of time in the air have an effect on the local flora. The magnitude of the impact depends on how much dust collects on the surface. More dust is blown and deposited in the surrounding area during hot and windy days. The natural vegetation and agricultural crops are seriously harmed by the thick layers of quarry dust. Many examples of sick plants, stunted development, reduced leaf area, low chlorophyll content, and low crop output that are found in the vicinity of active quarries are caused by quarry dust deposition.

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A set of safety precautions and rules outlined by the Mine Act of 1952, the MMR of 1961, the Mines Standards of 1955, and the policies and instructions of the Karnataka State Pollution Control Board must be followed by all quarrying operations and processing facilities. When using the open-cast quarrying method to extract granite for decorative or dimensional stone, there are multiple steps required. These consist of overburden removal, drilling, area clearing, moving, dressing, bench formation, excavation, secondary drilling and blasting, primary and secondary block separation, loading, transporting, and processing raw materials, quality control, and stockyard management. Operating restrictions apply to the quarrying of building stones.

4.18 The Ramanagara district's granite quarrying operation techniques:

In the Ramanagara district region, opencast extraction and processing methods are used for the majority of stone quarrying, stone cutting, and stone processing operations. During open-cast quarrying, substantial overburden like organic plant cover and topsoil must be removed to reach the mineral reserves. Granite is extracted via open-cast quarrying for decorative or dimensional stone.

This entails several procedures, such as clearing the area, moving, cutting, and splitting the rough blocks; dressing the rough blocks; bench formation; excavation; primary and secondary drilling, blasting, and splitting; loading waste or well-dressed materials; transportation; processing raw materials; quality control; shifting; managing stockyards; and recycling waste materials as brick materials (Rajan Babu et al., 2003). Stone quarrying, sand mining, and stone crusher construction are subject to additional operational limitations. The negative impact these behaviors have on the ecology has been demonstrated**.** Quarrying operations are divided into several stages, each of which affects the environment.

Prospecting and deposit exploration, the construction and preparation of quarries, the use of materials from the quarries, and the processing of the minerals gathered at the various installations to produce goods that could be sold are typical tasks associated with these phases (Chandrashekar et al., 1992). The following Ramanagara district areas are leased by the government for quarrying as of 2022–2023, **Table 16**, even though open-cast quarrying activities carry significantly more environmental dangers. Quarry rock ranks third and fourth globally in terms of both volume and value of non-fuel mineral commodities. But the quarry's operations damage the surrounding area and those who live or work, thereby degrading the state of the land and increasing noise, air, and water pollution (Luis M. O. Sousa et al., 2005).

The results demonstrate that the dust created during the process is carried by the atmosphere, ends up in the water bodies by contaminating them, and travels great distances to reach people in the vicinity of the quarrying and crusher sites. Depending on the quarry's capacity, the following equipment (minimum) is employed each shift to assist with the semi-mechanized quarry operation: The equipment required to run a quarry varies depending on production capacity, as **Table 17** illustrates.

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Table 17: The list of machinery required for quarry operation depends on the capacity of production.

Sl. No.	Type	No's.	Size/ capacity	Make	Motive Power
01	Compressor	02	440 cfm	Atlas Copco	Diesel/Electricity/DG
02	Jack Hammer	10	33mm dia.	Atlas Copco	-
03	Hydraulic Rock Breaker/Excavator	02	1.2 cu.m	SANY – SY210C-9	Diesel
04	Tipper	02	20 tons	TATA	Diesel
05	Water tanker	01	5000 liter	Mahindra	Diesel
06	Tractor	01	04 tons	Mahindra	Diesel
07	JCB	01		JCB	Diesel
08	Diamond Wire saw machine	02	40 and 60 hp.	-	Electricity
09	Quarry core drilling machine	01	-	-	Diesel/Electricity/DG
10	Diesel Generator	-	02	Cummins 320 KVA and 26 KVA	Diesel/Electricity
11	Accessories		All size drilling rods and other machine spare parts	-	-

4.18.1 Positive impact of granite quarrying and stone processing activities on environment:

Quarrying is often believed to be essential to human life. This is because it has contributed to the growth and development of every country, region, and sub-region. This makes it easier to build concrete structures and expands the state's network of roads and bridges, both of which significantly improve the economics of the nation. It also created both direct and indirect jobs, which made it easier for individuals to find work and support themselves. According to the study, quarrying was a particularly sustainable business since it provided people with economic power and maintained their standard of living. This suggests that quarrying is a significant source of income for the local population, in addition to agriculture. The dimension stone mining and processing sector has made building materials and dimensioned stone easily accessible in the Ramanagara district area. It also generates employment for both residents and visitors. The mining and processing of stones has provided substantial financial benefits to state and municipal governments.

4.18.2 Negative impact of granite quarrying and stone processing activities on environment

The various difficulties and problems related to the stone quarrying and stone processing sectors have an effect on both locals and workers. Emissions and the production of dust, water, and air are a few of these issues. Emissions of ionizing radiation, soil erosion, biodiversity loss and ecosystem degradation, dust and noise pollution, health. The study's findings demonstrate how much dust and soil are created during the various phases of the quarrying process, which include drilling, crushing and blasting stone, loading, and transferring the final goods and the people's socioeconomic status. The study's findings demonstrate the amount of soil and dust that are introduced at several points during the quarrying process, such as drilling, stone crushing and blasting, loading, and product transportation. The larger dust particles settle close to one another, while the thinner ones

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spread out widely, depending on the direction and speed of the wind. It is well known that workers in quarries disregard safety and health regulations. Wearing safety equipment such as dust masks, goggles, gloves, helmets, and suitably protective clothes is something that people frequently neglect to do. They consequently come into contact with very little dirt and dust particles. As a result, it negatively impacts their health. Dust exposure can cause a wide range of health issues, such as lung infections, skin and eye infections, respiratory and pulmonary illnesses, skin diseases, and lung collapse. The quarry workers in the Ramanagara district discovered that respiratory issues were caused by their lack of protective gear as well as the dirt and dust from the quarries. Among these were dyspnea, coughing, wheezing, and chest pain.

Because quarrying typically leaves behind very unsightly scars, it is seen to have a negative impact on the landscape. The study discovered that quarrying changed the geomorphology and turned productive land into wasteland because of the unsightly "pit heaps." The findings of the field surveys also demonstrated that the industry was primarily responsible for habitat loss, sedimentation, dust emissions, and quarry abandonment prior to the landscapes being restored in compliance with the environmental, health, and social impact assessments. These results indicate that places that were productive in the past have become unproductive, which is upsetting the ecosystem as a whole. Thus, deforestation and land degradation have an effect on biodiversity. Due to their role as mosquito habitats and rain-retaining materials, open quarries and deforestation have been associated with an increase in non-communicable diseases including malaria. This also affects the cost of buying and selling real estate. There is also a connection between acid rain and quarrying. The study claimed that quarrying was the cause of acid rain, which is known to harm plants, exacerbate air pollution, and sicken people and animals. The act of quarrying carries several health concerns. An investigation revealed a link between fractures and the vibrations brought on by quarrying. Building collapses could result from this; there would be fatalities and injuries. Furthermore, quarrying has an effect on biodiversity. This is because of the dust that the quarries throw into the atmosphere.

Gravel dust is one of the main contributors to air pollution and is associated with several leaf diseases, including abscission (early leaf fall), partial leaf death, epinasty (leaf bending downward from faster growth on the upper surface), and chlorosis (leaf yellowing from less chlorophyll). The investigation found that dust was impeding photosynthesis and decreasing agricultural yield in the vicinity of the quarries as a result of all these plant-related issues. The quantity of dust in the atmosphere was the reason for this. The research indicates that quarrying degrades the local community's land, reduces plant cover, and pollutes the air. In addition, a sizable portion of quarry sites have been abandoned, endangering the health of the local populace, aggravating socioeconomic conditions, and increasing the crime rate.

Among the most significant issues facing the quarrying sector are those of noise, air, water, and dust pollution; other issues include soil erosion and land degradation. Human health is in danger due to the high noise levels produced by blasting, crushing, the machinery employed, and the trucks required to transport the finished goods. The amount of noise that cattle produce affects their growth, development, and productivity. The

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disruption may have an effect on the reproductive systems of other living things. The main consequences of stone quarrying are dust pollution, which is harmful to both people and plants, contaminated water, abandoned land, ionizing radiation, loss of biodiversity (particularly when bushes are cut down to start quarrying), and other issues. Among the most significant problems facing the granite business right now are soil erosion, land degradation, and water pollution. Pollution of surface and groundwater poses a threat to human health and negatively impacts the socioeconomic standing of the locals living around the quarry. The survey indicates that the Ramanagara district's high groundwater nitrate levels may put locals at risk for health issues. Numerous infrastructure facilities are needed for the primary processes of granite mining and processing, as well as for pollution control and environmental preservation. It is necessary to carry out significant mitigation measures in a suitable way prior to, during, and following quarry operations. These measures include planting along the road, the safety zone, the service building, and the fence surrounding the quarry area to reduce dust and erosion in exposed places. They also make use of automatic sprinkler systems and water tankers. The quarry decommissioning plan calls for planting saplings of native plants, utilizing water tankers and automatic sprinklers, contouring the area around service buildings, contouring the safety zone, and contouring overburden dumps to reduce erosion.

4. 19 Analysis of the ambient soil quality in the research area:

The investigation of the physico-chemical characteristics of soil quality is conducted using the standard technique in one to two kilometers of agricultural and open land, as well as in the vicinity of residential and industrial zones. Twelve soil samples were taken from different locations for evaluation, and the results demonstrated that the CPCB, USDA soil survey, and standard soil classification as per ICAR criteria for acceptable levels of soil quality were met by the soil quality parameters. This implies that land can be used for agricultural purposes without risk, because the granite business only generates dust and small amounts of explosive chemicals that are harmful to people's health and welfare. The enclosed test findings concern the surrounding ambient soil quality of the quarry. The observed data was used in their computation for each site. **Table 18** provides a summary of the ambient soil quality test results.

4.19.1 The parameters for soil quality observation and results:

Analyzing the properties of the soil is crucial since it directly affects production, agricultural practices, and the growth of plants. Within the research region, soil samples were collected at twelve (12) separate places. The soil is usually tinted reddish-brown. Samples of soil always contain stones and rock powder. The dust (granite powder), chemicals (blasting explosives), blasted materials (fly rocks), and activity by-products (aggregates) are all found in the immediate vicinity of the quarry sites. The semiarid terrain and various explosives used in the quarry sites are the reasons behind the pH level instability. There is no denying that a significant portion of the pH change can be attributed to the leachate from the quarry dumpsites. Remarkably, the H+ and OH-ions emitted by the residues also play a role in the pH level shift, suggesting a range that is moderate to ideal for plant growth **Table 18 and Figure 16.**

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Table 18: Study area location soil quality monitoring and analysing results.

Study area location soil quality analysing results with fertility rating in the study area													
Sl. No	**Parameters**	**SS1**	**SS2**	**SS3**	**SS4**	**SS5**	**SS6**	**SS7**	**SS8**	**SS9**	**SS10**	**SS11**	**SS12**
1	pH: 1:5 (Soil Suspension)	6.78	6.51	7.22	6.94	6.71	7.03	6.88	7.39	6.26	6.73	7.54	7.69
2	Bulk Density, g/cc	1.41	1.39	1.45	1.38	1.42	1.35	1.39	1.36	1.43	1.38	1.43	1.44
3	Electrical conductivity, mS/cm	0.086	0.071	0.0142	0.114	0.158	0.094	0.073	0.236	0.113	0.152	0.174	0.089
4	Total Nitrogen as N, kg/ha	153	138	173	163	184	213	146	171	191	171	152	168
5	Available Phosphorous as P, kg/ha	31.5	22.8	28.4	27.5	32.7	27.1	22.8	34.7	31.7	19.8	39.1	36.8
6	Available Potassium as K, kg/ha	238	198	352	219	284	315	218	305	274	256	324	338
7	Exchangeable Calcium as Ca, m.eq/100g	12.8	12.2	13.3	11.7	12.6	14.8	13.1	15.2	13.1	12.5	13.6	13.3
8	Exchangeable Magnesium as Mg, m.eq/100g	3.16	3.98	4.22	3.83	3.59	3.74	3.88	4.71	3.14	3.74	4.16	3.85
9	Exchangeable sodium, such as Na, m.eq/100g	0.93	0.84	1.37	1.2	1.14	1.58	1.54	1.43	0.96	1.25	1.16	1.27
10	Zinc (mg/l)	0.9	0.8	1.4	1.1	0.9	1.3	0.8	0.9	1.4	1.5	1.2	1.1
11	Copper (mg/l)	0.5	0.7	0.9	1.2	0.8	0.6	0.9	1.1	0.9	0.7	1.1	1.3
12	Manganese (mg/l)	1.3	0.7	1.3	0.9	1.4	0.8	1.9	1.2	1.6	0.9	1.3	1.8
13	Iron (mg/l)	1.8	2.5	2.7	1.9	3.5	2.9	2.7	1.4	3.6	2.6	1.8	2.7
14	Boron(mg/l)	0.4	0.7	0.5	0.8	0.9	1.1	0.8	0.5	0.7	1.1	0.9	0.8
15	Organic matter (%)	0.84	0.93	0.98	1.03	1.15	1.18	0.97	1.19	0.81	1.14	1.24	1.28
16	Texture Classification	Loam	Loam	Loam	Loam	Loam	Clay Loam	Loam	Clay Loam	Clay Loam	Clay Loam	Loam	Loam
17	Sand (%)	37.3	38.2	40.4	39.5	39.6	33.8	41.2	38.3	36.2	41.8	43.5	35.2
18	Clay (%)	24.9	25.7	24.8	26.1	25.6	37.1	27.4	37.1	34.8	26.3	25.3	26.3
19	Silt (%)	28.6	36.1	34.8	30.4	31.7	29.1	31.8	27.7	31.6	28.7	31.9	35.1

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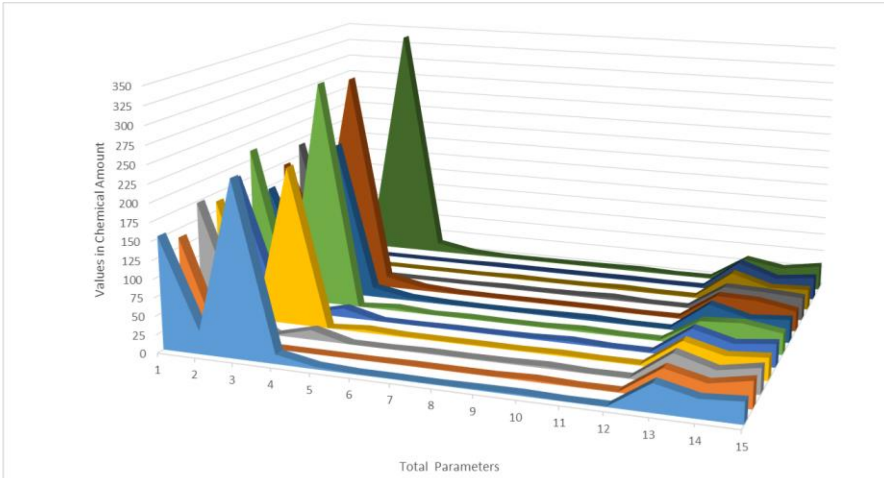

Figure 16: Soil Quality Chart

The variation in EC can be attributed to leachate explosive components that accumulated on the surface of the soil as a result of quarry activities. The five quarry locations' soil tests show that the amount of organic carbon rises with distance. The low organic carbon content could be caused by the presence of quarry dust close to the quarry sites through aerial deposition. With increasing distance, the quantity of dust generated by crushing and quarrying operations gradually decreases. Near the quarry region, the nitrogen level was low due to significant dust buildup in the fields and the low organic carbon content. The rise in available nitrogen away from the quarry sites may be explained by the nitrogen and ammonia that bacteria produce in the soil as a result of their activities on organic matter. The main cause of the high phosphorus level is partly weathered rock-derived calcium phosphate. The low phosphorus concentration around the quarry sites is caused by low levels of organic carbon and a significant dust buildup in the agricultural areas. The high quantity of easily available potassium may be due to the presence of primary minerals such as mica and potassium feldspar. Because of hydration, potassium (K), a mobile element, is removed from the mixture as dissolved salt during the chemical reaction. The decreased available potassium values can be attributed to the addition of quarry dust in the area surrounding the crushing and quarrying operations (Dominguez-Haydar et al., 2019).

The elevated zinc concentration could be the result of dust collection. If there are no large metal smelting operations nearby, the primary source of zinc on urban streets is probably the breakdown of car tire rubber. Sewage sludge soils contain higher amounts of zinc, and adding phosphate, ammonium nitrate, and nitrate fertilizers to the soil increases the concentration of zinc. Leaching from sandy, extremely acidic soils that decompose during soil formation is the main factor causing differences in soil boron contents. Boron is found in the micronutrients borate and borosilicate. Evaluating soil qualities is essential since vegetation development, agricultural methods, and productivity are all directly impacted by soil fertility and quality. Twelve (12) locations within the study area were used to collect soil samples.

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Evidence from observations has demonstrated that

- The pH values, which show moderate and optimal plant growth qualities, vary from 6.26 to 7.69.
- In most areas, the soil sample's texture is primarily loam, with other areas having clay loam.
- The ranges of the characteristics of the sand, silt, and clay were determined to be 35.2 to 43.5; 28.6 to 36.1, and 24.8 to 37.1, respectively.
- The soil has a conductivity ranging from 0.071 mS/cm to 0.236 mS/cm.
- In the area, the value of the phosphorus content varies from 19.8 kg/ha to 39.1 kg/ha, while the available nitrogen content ranges from 138 kg/ha to 213 kg/ha. This suggests that there are extremely high levels of phosphate and nitrogen in the soil.
- The range of 198 kg/ha to 352 kg/ha in the potassium content shows that the soils have medium potassium values.
- The range of 0.8 mg/l to 1.5 mg/l in the zinc content; 0.5 mg/l to 1.3 mg/l in copper content; 0.7 mg/l to 1.9 mg/l in manganese content; 1.4 mg/l to 3.6 mg/l in iron content and 0.4 mg/l to 1.1 mg/l in boron content shows that the soils have medium values.
- It was discovered that the organic matter ranged from 0.81% to 1.28%.

Based on the aforementioned data, it was determined that the research area's soil exhibits moderate fertility and is perfect for plant growth.

5. DISCUSSION

5.1 Quarrying impact on soil quality and health in the study area

One of the negative effects of quarrying is the excavation and blasting of rocks at granite quarrying sites, which not only alters the characteristics and ruins the structure of the soil but also creates other environmental issues. The population in the vicinity of the quarry was asked to rate their perceptions of how quarry operations affected the quality of the soil using a four-likert scale agreement level. Positive (+) frequencies of agree and strongly agree were used to scale and group the agreement level, whereas negative (-) frequencies of disagree and strongly disagree where information was obtained for field investigation from a variety of places in and around residential areas, industrial regions, and quarrying areas using the standard questionnaires. Quarries and the stone-processing industry's primary problems with the soil environment are air, dust, and water pollution. One way that quarry dust might contaminate a body of water is by dissolving in it and changing its chemical composition. In addition, these activities interfere with the regular flow of surface water and groundwater, which results in lost agricultural productivity, among other negative effects. They also disturb recharge processes and may reduce the quantity and quality of drinking water available to wildlife and neighboring communities.

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Silt from quarry drainage may enter nearby streams that are not part of the quarrying region. If soil erosion and household wastewater are dumped into the surface water stream, it may get contaminated. Because dirt and stones don't contain any hazardous compounds, they won't change the groundwater table even if they contaminate the soil, dust, air, and water. Surface and subterranean rivers, as well as the amount and quality of soil, have all been adversely affected by quarrying operations. The physicochemical qualities of water and soil are harmed by the precipitation of dust particles produced by the crushing and quarrying equipment or by the surface runoff of contaminated water from the quarrying sites (Abdul-Kareen et al., 2020) Furthermore, soil, air, dust, surface water, and groundwater are all negatively impacted by explosive waste from rock quarries. The loss of topsoil and the disposal of trash have changed surface features that have an effect on the water cycle. These alterations have affected not just the soil's quality but also the quantity and direction of water flowing at the surface (Tamma Rao et al., 2012). Diseases including cholera, polio, typhoid, dysentery, and diarrhea can spread due to poor sanitation and contaminated soil and water. Furthermore, biodiversity and habitats are disappearing. The various difficulties and problems related to stone quarrying have an effect on both locals and workers. Emissions and the production of soil, dust, water, and air are a few of these issues. Ionizing radiation emissions, land degradation and abandonment, loss of agricultural production, loss of biodiversity, and ecosystems (Asubiojo et al., 1991)

The study’s findings demonstrate the amount of dust generated at each stage of the quarrying process, from loading and drilling to stone crushing and blasting to product transportation. Depending on the wind's direction and speed, the larger dust particles settle close to one another, while the thinner ones spread out widely around nearby plants and bodies of water. The amount, duration, and quantity of particulate matter (PM) that is released into the atmosphere are all dependent on its size (Ogbonna et al., 2018 & 2020). The sizes are separated into $PM_{2.5}$ (equal to or less than 2.5 micrometers) and PM_{10} (equal to or less than 10 micrometers) particles based on their aerodynamic diameter. These diameters are smaller than the 50–70 µm range that characterizes human hair. Depending on its size, scattered particulate matter might result in a number of problems. According to Akanwa et al. (2016), dust covers on plant surfaces, for instance, can reduce light, which is necessary for photosynthesis. They can also cause visual problems near quarries and crushers. Particles can cause respiratory illnesses in animals. Finally, they can cause ocular diseases in both humans and animals. It is well known that workers in quarries disregard safety and health regulations. It is common for people to overlook the use of safety gear, including helmets, dust masks, and properly fitting clothing. They thus come into contact with tiny dust particles. As a result, it negatively impacts their health. Dust exposure has been linked to a number of health issues, such as lung infections, skin and eye infections, respiratory and pulmonary illnesses, and lung collapse.

The dust from the quarries and the quarry workers' lack of protective gear were identified to be the primary causes of respiratory issues in the Ramanagara district. Dyspnea, coughing, wheezing, asthma, migraines, eye and chest pain, heart problems, mental stress, throat infections, allergies, and skin diseases were among the symptoms reported

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prior to and during the quarry operation. Based on the previously given facts—that is, that dust affects health, rain-covered roofs are dirty, and that dust, water, and air are irritating—the impact of quarrying on human health is examined. The results demonstrated that all respondents (100%) thought that the main causes of annoyance and health hazards were dirt, air, dust, noise, and water. Dust almost always contaminates rainwater that falls from roofs. All the respondents also mentioned that noise, dust, water, flooding, and soil erosion could make their on-going health issues worse. The various diseases and health problems that occur, particularly for the populations near crushers, are clear indicators of the harmful effects of processing and quarrying stone.Their opinions vary according to how quarrying affects various areas. According to the locals' assessment, the nearby village's granite quarrying and stone-crushing operations caused 86% of the soil's fertility to be degraded, 79% of the soil's structure to be destroyed or altered, 92% of the debris dumped from crushed rocks, and 65% of the soil to leach. Furthermore, 87% of the sample reported that quarry operations frequently cause several soil cracks and the loss of agricultural land. The earth vibrates a few meters distant from the site, causing cracks and fractures in the adjacent building. This usually happens when rocks and chemical explosives are being blasted. In addition, it was shown that quarry operations have accelerated soil water erosion in the Ramanagara district community by up to 78%. This occurrence carries a high risk of triggering landslides.

5.2 Soil pollution control and mitigation measures:

The quantity of rainfall that spills over from the pits and landfills will be controlled by the streams surrounded by garland. At the foot of the dump slopes, a retaining wall will be constructed to prevent silt from entering the river. We'll measure the salinity of the quarry runoff water and administer the appropriate treatment if needed. Pure water can only enter via channels of divergence. Garland drains are being built to divert surface runoff from the quarrying area to the settling pit. Gully plugs and check dams should be built where they are needed to stop the flow from impacted areas. Domestic sewage from the site office will be emptied into a septic tank following soak pits.

After the mine closes, the pit is utilized as a rainwater reservoir. Routine observation of the nearby municipalities' mines and groundwater supplies. Surface water pollution can be decreased by constructing appropriately sized ring drains around the quarry area and setting up dumps to keep precipitation out of the active quarry sites. In order to reduce dust and construct greenbelts in the water-fed tank of the quarry, rainwater collected by the area's natural slope during the monsoon season is used.

The purpose of the dump tops' inner slopes is to regulate water flow and prevent erosion washouts. To prevent erosion, vegetation such as grass, shrubs, mulch, and other plants will be placed on the tops of the landfills and the slopes of populated areas. Material will be applied on the loose open-pit benches at the quarry to prevent debris from washing off the dumps and sliding off the benches. Fences with the right-sized buds will also be built at the top of the dumps.

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This will reduce the likelihood that the quarry's rainfall will clog the channels and drains that carry it; the settling pits and baffles are intended to collect any suspended objects that may be in the water. The chosen species of shrubs and grasses will next be planted to stabilize the designated slopes.

To find out if the quarry water contains any unwanted materials, testing will be done on a regular basis. The appropriate action will be taken if any elements are discovered to be present in excess of the CPCB-mandated limits. A new alignment that is appropriate for the area's upstream drainage slope has been recommended by the analysis. This alignment will allow for easy water entry into the diversion channel and final water discharge into the original stream. Surface runoff volume won't decrease. The canteen's and the restrooms' domestic waste will be dumped into septic tanks, and nearby bore wells and open wells will be routinely tested for water quality and level. During the monsoon season, the area's natural slope collects rainwater, which is then sent into the mine's water-fed tank to help with dust control and the growth of greenbelts. There will be inner slopes on the dump tops to control water flow and prevent erosion washouts. To redirect rainfall away from active quarry regions, garland drains of the appropriate size will be constructed around mining activities and landfills. To stop erosion, vegetation such as plants, mulch, and grass should be placed on the slopes and dump tops of the active regions.

6. CONCLUSIONS

The study examines the effects of quarrying on the physico-chemical properties and heavy metal levels of the soil in the district of Ramanagara. Findings indicate that quarrying activities have negatively impacted the quality of the soil, rendering parts of the area unsuitable for agricultural development. However, statistical studies back up the claim that quarrying seriously degrades soil quality. The current study indicates that the practices of quarrying and crushing are causing the features of soil fertility to deteriorate. The broken rock debris and spent explosives that have been deposited in the vicinity are having an effect on the organic carbon and nitrogen content of the soils in the nearby agricultural areas.

Rainwater runoff from landfills and other sources degrades the fertility of the soil in the nearby agricultural areas. The soil quality values show a steady increase with increasing distance from the quarrying and crushing operations. Both fine and coarse sand are being added in substantial amounts to the soil. After the mining of gravel, large, damp pits are often left behind. These holes could become vital habitat for aquatic and wetland animals if they are kept up properly. The study's findings also show that the removal of stones has reduced crop yields, the amount of available chemical nutrients in the soil, water penetration, the number of microorganisms, and the ability of organic matter in soil particles to bind together to form stable aggregates. Moreover, studies on the relationship between soil physicochemical properties and heavy metals revealed a common source for both traits. Furthermore, it is suggested that such soils not be used for agricultural production until remediation methods such soil cleaning, bioremediation, and thermal desorption are put into practice.

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DOI: 10.5281/zenodo.12284768

Reference

1) Abdul-Kareen AW, McRae SG (2020) the effects on the topsoil of long-term storage in stockpiles. A contribution of acacia species to plant and soil. J Geosci 21:357–363. https://doi.org/10.3390/resources6040064

2) Akanwa, A., Onwuemesi, F., & Chukwurah, G. (2016). Effects of open cast quarrying technique on vegetation cover and the environment in south-eastern Nigeria. American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS), 21(1), 227-240.

3) Asubiojo, O.I., P.O Aina and A.F. Oluwole (1991). Effect of cement production on the elemental composition of soil in the neighbouhood of two cement factories. Water Air Soil pollution, 57-58, and 819-828.

4) Bhat. S. K and Suresh Babu. V, (1994), Survey for ornamental stones with special reference to pink granite in parts of Kanakapura taluk, Bangalore district, Department of Mines and Geology, Karnataka, 1994.

5) Chandrashekar.H, Venugopal.T.N, 1992, Characters of Ornamental Stones and their influence on Quarrying Techniques, DMG, Karnataka.

6) Chrysanthus C, (2016), evaluating baseline data for trace elements, pH, organic matter content and bulk density in agricultural soils in Nigeria. Wat Air Soil Poll 86:13–34. https://doi.org/10.1007/BF00279143

7) Dominguez-Haydar, Y., Velasquez, E., Carmona, J., Lavelle, P., Chavez, L.F., and Jiménez, J.J. (2019). Evaluation of reclamation success in an open-pit coal mine using integrated soil physical, chemical and biological quality indicators. Ecol. Indic. 103, 182–193.

8) Ghose, M.K., (2001), Management of topsoil for geo- environmental reclamation of coal mining areas. Environmental Geology, 40, 2001, pp 1405-1410

9) Hema, H. C., & Govindaiah, S. (2012). Morphometric analysis using remote sensing and GIS techniques in the subwatersheds of Kanakapura watershed, Arkavathi river basin, Ramanagar district, Karnataka, India. Environ Geochem, 15(2), 47-56.

10) Kalu, I. E., & Ogbonna, N. J. (2021). Investigation of environmental effect of stone quarrying activities on soil and water in Akpoha and Ishiagu communities of Ebonyi state, Nigeria. International Journal of Construction Management, 21(12), 1185-1199.

11) Luis M. O. Sousa et.al, (2005), Influence of micro fractures and porosity on the physic-mechanical properties and weathering of ornamental granites, Elsevier, Engineering Geology 77 (2005) 153-168.

12) Maletsika, P. A., Nanos, G. D., & Stavroulakis, G. G. (2015). Peach leaf responses to soil and cement dust pollution. Environmental Science and Pollution Research International, 22(20), 15952.

13) Ogbonna, P. C., Kalu, E. N., & Nwankwo, O. U. (2018). Determination of heavy metals in sawdust particles, distribution in soil and accumulation in plants at Ahiaeke timber market in Umuahia, Nigeria. Nigerian Journal of Environmental Sciences and Technology, 2(2), 160.

14) Ogbonna, P. C., Ukpai, N. P., & Ubuoh, E. A. (2020). Assessment of particulate matter (PM2. 5, PM10) in air, elemental composition of granite and weather parameters at a quarry site in Ngwogwo, Ebonyi State, Nigeria. Nigerian J Environ Sci Techn, 4(1), 182-196.

15) Okafor, O. C., Njoku, C., & Akwuebu, A. N. (2023). Environmental impact of quarrying on air quality in Ebonyi state, Nigeria. Environmental Sciences Europe, 35(1), 98.

16) Peter, C., Alozie, M. C., & Azubuine, C. E. (2018). Stone Quarrying Impact on Air Soil Water in Ebonyi State, Nigeria J Pollut Eff Cont 6: 225. doi: 10.4172/2375-4397.1000225 Page 2 of 4 Volume 6• Issue 2• 1000225 J

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E-Publication: Online Open Access
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DOI: 10.5281/zenodo.12284768

17) Rajan Babu. A., Behera P.K., & Gupta R.N (2003), Eco-friendly stone quarrying-some Issues, Seminar on safe & Environmental friendly quarrying, Mining Engineers Association of India, Bangalore

18) Swamy M.M., (1998), A report on regional assessment and inventory of the resources of dimensional stones, commercial granites, and ornamental stones of closepet granites in parts of Kanakapura, Ramanagaram, and Magadi taluks, Bangalore rural districts, Karnataka, GSI, Southern Region (field season 1994–95), Bangalore.

19) Syed Abrar, Mulgundmuth S.F., and Badami R.B.,(2000) Assessment of Ornamental Stones in Ramanagaram Taluk, Bangalore District, Department of Mines and Geology, Bangalore (Field season 1992–93), 2000.

20) Tamma Rao G., Gurunadha Rao V. V. S., SarmaRatnakar Dhakate V. S.,Surinaidu L., Mahesh J., Ramesh G., (2012), Hydrogeochemical parameters for assessment of groundwater quality in a river sub-basin, International Journal of Environmental Science and Technology,vol9,2,DOI 10.1007/s13762-012-0024-z,http://link.springer.com/article/10.1007/s13762-012-0024-z

21) Vandana, M., John, S. E., Maya, K., & Padmalal, D. (2020). Environmental impact of quarrying of building stones and laterite blocks: a comparative study of two river basins in Southern Western Ghats, India. Environmental Earth Sciences, 79, 1-15.

22) Venkatesha, G., Kumar, C., & Gowda, P. R. (2015), Assessment and spatial distribution of groundwater quality in Bidadi industrial area, Ramanagara district, Karnataka, using water quality index (WQI) and GIS.

23) Wangela, S. W. (2019). Effects of Dimension Stone Quarrying Activities in Ndarugo Area of Kiambu County, Kenya (Doctoral dissertation, University of Nairobi).

24) Warhate, S.R., Yenkie, M.K.N., Chaudhari, M. D and Pokale, W. K. (2006), Impacts of Mining Activities on Water and Soil. Journal of Environ. Science & Engg. 48(2): 81-90.

25) Wischmeier, W.H.; Smith, D.D. (1978), Predicting Rainfall Erosion Losses: A Guide to Conservation Planning with Universal Soil Loss Equation (USLE); Agriculture Handbook; Department of Agriculture: Washington, DC, USA, 1978.

26) Wong MH (2015) Ecology restoration of mine degraded soils, with emphasis on metal contaminated soils. Chemosphere J 50:775– 780.