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Identification of Suitable Sites for Plant Growth Using Multicriteria Technique and Physico-chemical Properties of Soils from Yerala River Catchment area, Western India

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ABSTRACT

The soil samples from the Yerala river basin situated in a semi-arid region have been analyzed for the various physico-chemical properties. The LULC map of the region was created to understand the distribution of land for various anthropogenic uses. Total 24 soil samples were analyzed using the standard techniques for the properties like pH, EC, sodium, potassium, and chloride. The pH of soil samples ranges from 7.6 to 8.65; electrical conductivity ranges from 0.13 to 0.38 mS/cm; sodium concentration varied from 6.0 to 33 meq/100g; potassium ranges from 0.6 to 3.5 meq/100g; and chloride values range between 10.63 and 24.85 mg/kg. These soil properties in the region were interpolated using a standard geostatistical tool Inverse Distance Weighted (IDW). The components such as elevation, slope, aspect, drainage density etc. unraveled the terrain features of the region. The study helped providing suitable locations for plant growth as well as the information and understanding of large-scale paddy cultivation in the study region. The good suitable class of agricultural land was calculated to be 229.56 sqkm (31.1%); very good suitable class covers 352.93 sq. km area (47.81%); and excellent suitable class is of 13.52 sq. km (1.83%). The region along with its good groundwater potential seems to be a favorable area for cultivation provided some organic/chemical treatments need to be carried out in the region to tackle the soil alkalinity and salinity issues.

KEYWORDS: *Soil, Rainfall, Elevation, Soil Physicochemical Parameters*

INTRODUCTION

The threefold objective set for watershed development program incorporates the enhancement of green cover along with soil and water conservation. However, the green growth in a region is governed by various factors such as soil, water availability, rainfall, land slope, land use pattern, etc. Soil is the support system for green growth and an inevitable part of the geologic cycle. This natural resource is currently threatened by uncontrolled erosion, soil pollution, reduction in fertility, moisture content, increasing salinity, etc. Hence, there is a hike in the analysis of physicochemical parameters of soil samples and interpretation for the effective management of this valuable natural resource (Zhang and Zhang, 2007). The data so generated aids in formulating the corrective measures for enhancing the nutrition value of the soil artificially by adding the necessary nutrients, fertilizers, and manures for plant growth and enhanced crop yields.

The soil profile is influenced by parent material, climate, topography, and the weathering process. The land is essentially for a country's wealth (Özkan et al., 2020). Soil is a natural resource with varying thicknesses depending on the parent rock's composition, texture, structure, color, chemical, biological, and physical properties. Soil characteristics differ from its parent rock due to the interactions between the lithosphere, hydrosphere, atmosphere, and biosphere (Özkan et al., 2020). The soil data is mostly used to understand soil fertility and for plant nutrition management. Soil analyses and its interpretation are crucial to determine and manage to provide nutrients through fertilizers and manures, to continuously keep agricultural soils fertile (Zhang and Zhang, 2007) such that the land remains capable of producing crops at a reasonable level(Zhang et al., 2006). The second stage is to analyze the data, and it leads to the next, i.e. third step, of suggesting addition of appropriate nutrients to maximize crop yields with minimal environmental damage. The biological, chemical and physical components of soil interact in complex way and sometimes it become difficult to determine a soil's productive capability. The overall nutrient in soil invariably exceeds the amount that is immediately available to plants. The changes in the quantity and availability of mineral nutrients is a function of fertilizers, manure, compost, mulch, lime or sulfur addition, as well as leaching, that changes the soil fertility all through the growing season. Soil analysis is also a tool to efficiently manage soil nutrients that includes phosphate (P), potassium (K), and magnesium (Mg) that are being retained by the soil and available to plants.

Aside from soil, plant development is hampered by a lack of land availability due to rising urbanization (Özkan, et al., 2020). In this process more and more land use types have been converting into the built-up area and thus becoming impervious. The efforts have been taken for preventing the random change in land use and the categorization of land capability has been put forth to promote the judicious use of land based on inherent characteristics (Sharma, 1981).

A holistic approach and a complete understanding of the significant aspects such as rainfall, drainage network, land slope, soil, land usage, and so on are required for the determination of suitable land for plantation. These attributes are integrated using a multi-criteria tool that helps in assigning the ranks and weights to each factor according to the degree of influence on plant growth. Thus, the integrated application of RS-GIS and multi-criteria tools in deciphering the suitable zones for green growth increases the accuracy of results.

The current project is primarily concerned with examining physico-chemical properties of soil from the Yerala River Basin in order to determine its current fertility status and to raise farmers' awareness regarding the comprehension of soil nutrient availability.

STUDY AREA

The Yerala River is a tributary of the Krishna River, located in Khatav tehsil, Satara district, Maharashtra, India creating a basinal area of 745.26km^2. This river begins in the northern portion of the basin at Mol and flows through Vaduj before meeting the Yerala dam in Yeralwadi in the south. The Yerala River flows in a northwest to southeast direction having dendritic, parallel, and rectangular drainage pattern.

The research area is covered in toposheets 47 K/1, 47 K/5, 47 K/6, and 47 K/10 from the Survey of India. It is located between the latitudes of 17°30′ 42″ and 17°52′55″ N and the longitudes of 74°14′8″ and 74°37′ 30″ E. (Figure 1). The Deccan basalt lava flows from the upper Cretaceous to lower Eocene in age are observed in the area. The upper part of the study area has vesicular basalt, while the lower part is covered by massive basalt (Figure 2). The Deccan trap in the area is formed of several lava flows, mainly aa-type. The middle portions of the flow are massive, hard, and dark grey. The lava flows are found to vary in thickness from around 5 meters to 20 meters .The topographic height varies between 1084 and 684 meters above sea level. According to the Maharashtra Agricultural Department's records, the climate in the research region is semiarid, with an average annual rainfall of 606 mm. Summer temperatures can reach 40°C, although the average annual temperature is at 24°C. The temperature dips to 10°C in the winter. River and rainwater that percolate down to the groundwater system are the main sources of groundwater recharge in the study area.

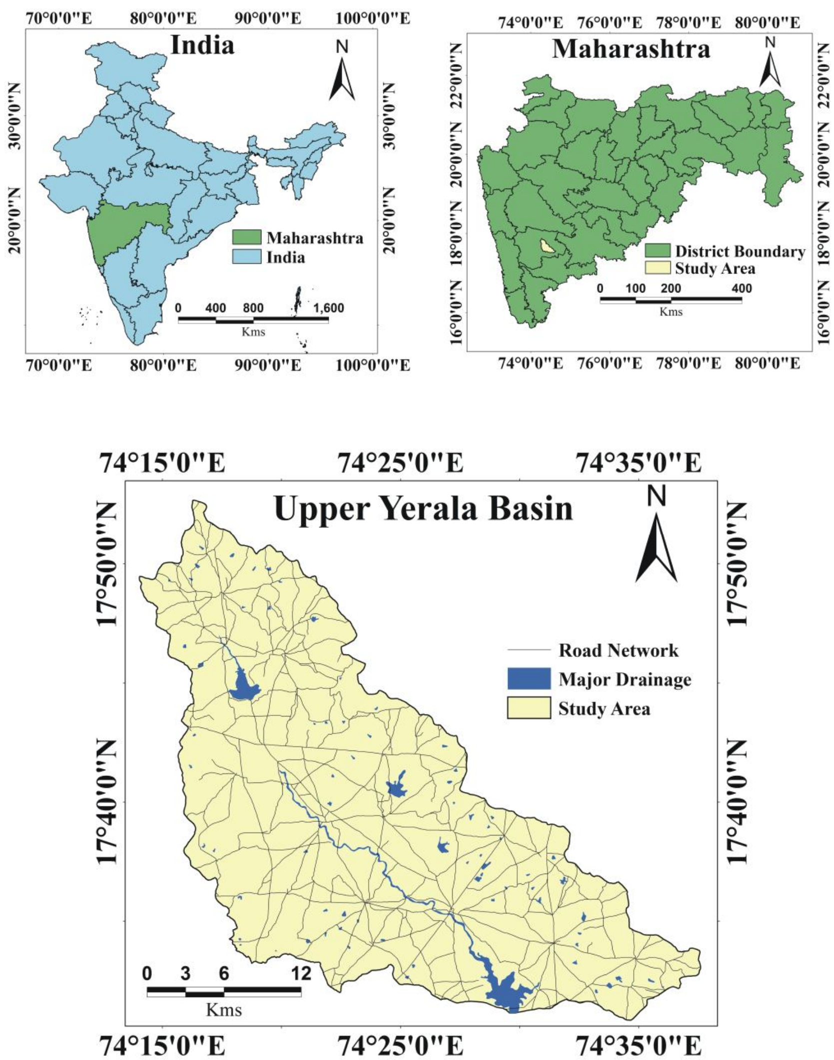

Figure 1: Location map of the Upper Yerala basin.

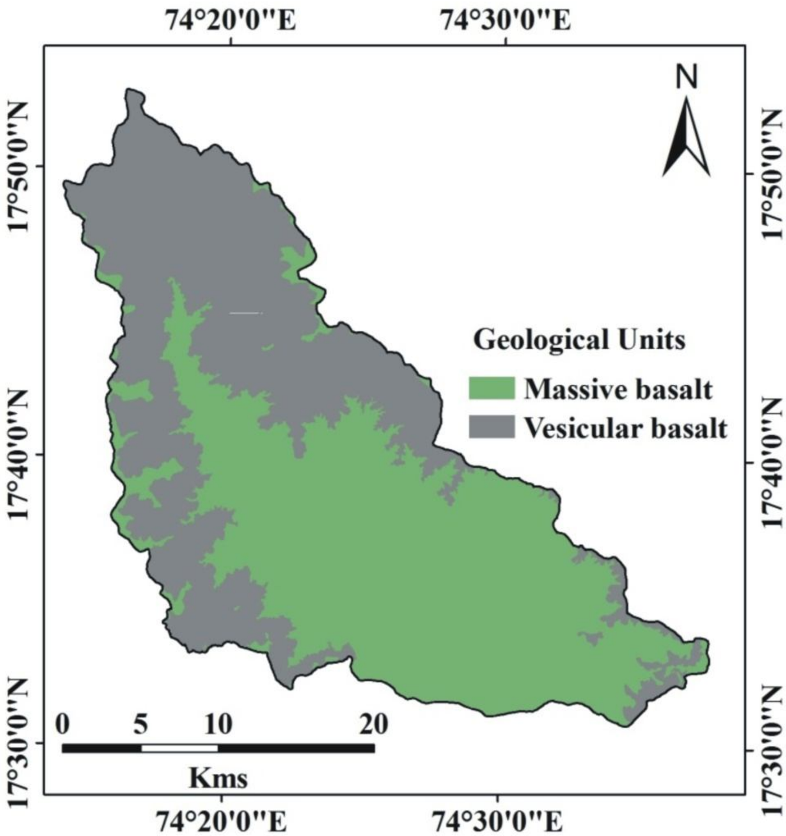

Figure 2: Geological map of Upper Yerala basin.

METHODOLOGY

Soil sample collection and analysis

In all 24 representative sites were selected for collection of soil samples from the upper Yerala basin and the samples were collected from plough layer (15 to 30 cm depth) in 2016 (post-monsoon season) using hand auger/soil auger. The samples were taken to the laboratory in polythene bags and air-dried under shade. The large clods were then pounded in a ceramic mortar by wooden mallet. These were then sieved (<2mm) and stored in clean polythene containers at 10°C before physicochemical analysis. Soil physicochemical parameters were measured that included pH, Electrical Conductivity (EC), Sodium (Na^+), Potassium (K^+), and Chloride (Cl^-) by standard procedure given by Jackson (1965, 1968, 1973, 1982), Black (1965a, b, 1968, 1982) and APHA (1998). The methodology is given briefly as follows:

1. pH and electrical conductivity (EC, dS/m) determination was done in supernatant solution of 1.5 soil/water ratio (w/v) by harnessing pH meter and conductivity meter (Jackson1965)
2. Exchangeable base cations like Ca^{2+}, Mg^{2+}, Na^+, and K^+ were extracted from sample. This was done by leaching the sample with 1N ammonium acetate at pH 7.0 (w/v) and kept overnight. Whatman filter paper no. 42 was used for filtering the overnight leached sample, which was increased to 100 ml by adding distilled water.
3. Calcium (Ca_2^+) and magnesium (Mg_2^+) were estimated by using ammonium acetate leachate (viz., filtrate) following EDTA titrimetric method (Jackson, 1973). Flame photometer was used to determine the quantity of potassium (K^+) and sodium (Na^+) (Chapman, 1965).

Thematic layers of influential elements for plant growth, such as slope, geomorphology, drainage density, soil type, LULC and rainfall, were generated using geospatial data obtained from various sources. The collected agricultural field soil samples were evaluated for five soil quality indicators to understand their spatial distribution (Table 1). Using ArcGIS software, all map layers were transformed to a raster format, projected to UTM Zone 43N, and then resample to the same cell size. Furthermore, the map layers were divided into five classes using the natural breaks approach (Jenks, 1967).

Table 1: Analysis of soil physicochemical parameters

Sr. No.	Location	pH	EC mS/cm	Na (mg/kg)	K (mg/kg)	Chloride (mg/Kg)
1	Pusegaon	8.65	0.2	25	3	17.7
2	Pedgaon	8.13	0.19	17	1.8	10.65
3	Khatav	8.2	0.15	10	1.1	10.63
4	Darajai	8.01	0.13	12	1.3	14.2
5	Bombale	7.84	0.21	20	2.1	10.66
6	Umbarde	8.19	0.19	33	3.5	21.3
7	Palasgaon	8.12	0.17	18	1.9	14.2
8	Vaduj	7.82	0.33	14	1.5	14.2
9	Rajapur	7.89	0.3	23	2.5	14.2
10	Khatgun	8.04	0.21	6	0.6	14.5
11	Nidhal	8.05	0.19	9	1.0	14.7
12	Enkul	7.93	0.26	15	1.6	14.2
13	Vadkhal	8.12	0.17	21	2.3	14.9
14	Daruj	8.12	0.2	24	2.6	21.3
15	Bhandewadi	8.27	0.13	12	1.3	17.75
16	Ner	7.6	0.25	11	1.2	17.75
17	Banpuri	7.73	0.38	23	2.5	17.75
18	Fadatarwadi	8.23	0.25	25	2.6	17.75
19	Jamb	8.25	0.23	25	2.4	17.75
20	Visapur	8.24	0.25	26	2.5	17.75
21	Kumathe	7.27	0.30	25	2.4	24.85
22	Tadavale	7.26	0.30	26	2.5	21.3
23	Yeralwadi	7.27	0.32	24	2.5	17.75
24	Vetane	8.20	0.32	25	2.4	21.3

For the impact assessment of all influential themes, Analytical Hierarchical Process (AHP) was employed to design the diagonal matrix (Saaty, 1980). This method helps organize the multi-parametric options in a hierarchical pattern and supports opting for the best decision. This method involves a pair wise comparison matrix where the weights of individual parameters are determined by considering the relative importance of all the other parameters (Saaty, 2008). The normalized primary eigenvector, which contains the weight of each factor, has been generated in this study, and the reliability of the comparison was verified using consistency ratio (CR) which is a kind of acceptability test for the various components factor weights. To accept the allocated weights, CR must be less than 10%; otherwise, the pair comparison matrix has to be redesigned. CR is computed using the following equation:

$$Consistancy\ Ratio = CI/\mathrm{RI} \qquad (1)$$

Where *RI* is the average of the resulting consistency index depending on the order of the matrix and *CI* is the consistency index and can be expressed as:

$$CI = (\lambda max - n) / (n - 1) \quad (2)$$

Where λmax is the largest or principal eigen value of the matrix and can be easily calculated from the matrix and n is the order of the matrix.

RESULTS AND DISCUSSION

Geomorphology

Many geomorphological features are found in the study area. The study area is a highly dissected region with thin soil cover. Weathered units are observed at Mol, Diskal, Rajapur, Lalgun, Budh, and Fadtarwadi. One can find mesa type residual hills, moderately dissected plateau with exposed rock cover, and thin soil cover along a major part of the study area. The massive residual hills comprise the run-off zone and are present in the northern, eastern, and western regions of the study area. The flood plains found in the southern region of the study area have a thick soil cover (Figure 3).

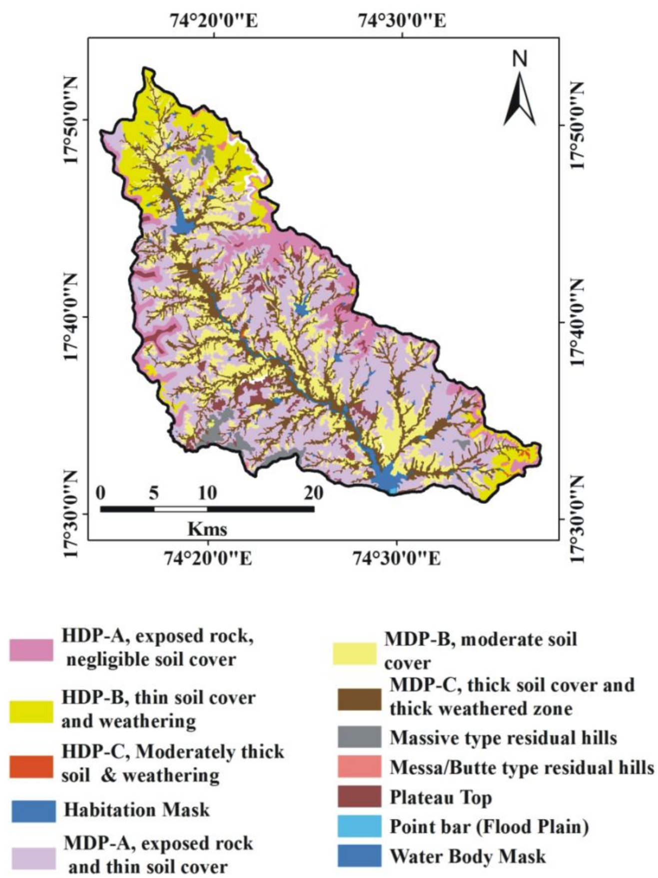

Figure 3: Geomorphological map of Upper Yerala basin.

Rainfall (Rf)

The high rainfall has been observed in the upper part of the study area compared to the central as well as lower regions. 885.5 to 1007 mm rainfall occurs at Pusegaon, Ner, Fadatarwadi; 789 to 885 mmat Rajapur, Vadkhal, Bhandewadi, Visapur, and Vetane; 688 to 788 mm rainfall occurs, Khatav, Darajai, Khatgun, Nidhal, Daruj, Jamb, Tadavale; 514 to 687mm rainfall occurs at Pedgaon, Bombale, Umbarde, Vaduj, and Kumathe; and 601 to 687 mm rainfall occurs at Palasgaon, Enkul, Banpuri, and Yeralwadi. This indicates a significant relationship between climate and vegetation cover in the study area (Figure 4).

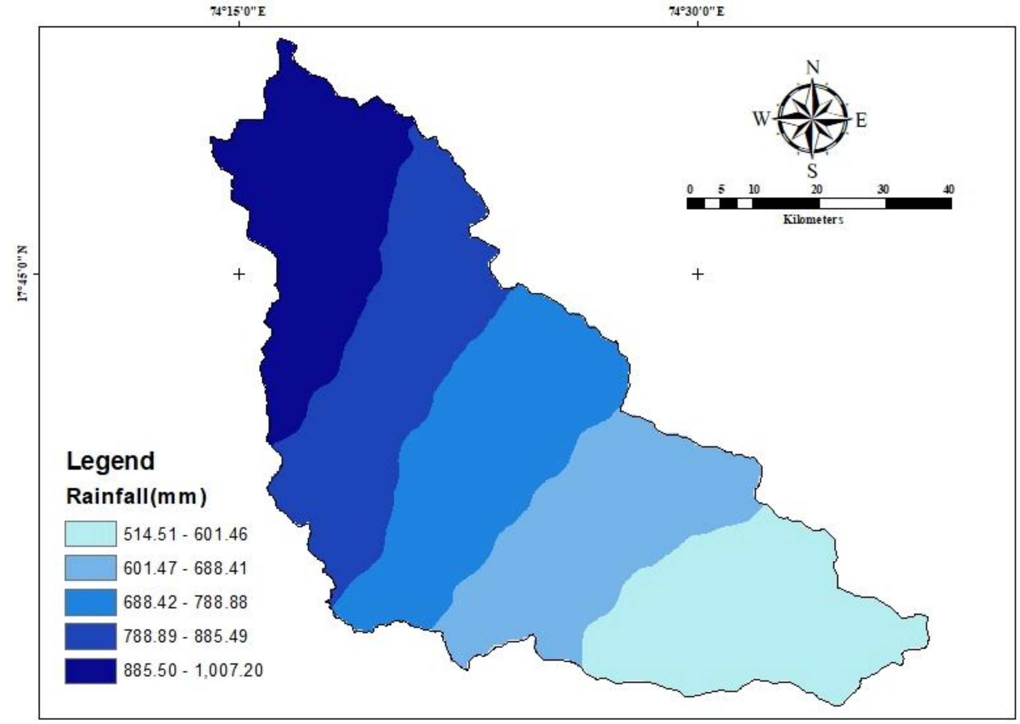

Figure 4: Rainfall distribution map of Upper Yerala basin.

Land use Land cover (LULC)

The pattern of land use and land cover aids in understanding the presence of groundwater as well as water percolation. Remote sensing and GIS techniques give dependable, accurate baseline data for land use/land cover mapping. Reduced runoff along forested areas and increased runoff along barren rocky, settlements, and wet agriculture areas are the effects of LULC. Settlements are generally considered to be the least suited for groundwater recharge, while dense plant cover (forest) is seen to be extremely suitable. The comprehension of LULC is important in planning measures to effectively manage land, environment and to chart out mitigation strategies. Land use is an anthropogenic characteristic that cannot be captured with plain photography (Lo, 1986). Land cover, on the other hand, refers to natural vegetation and man-made structures that cover the land surface (Burley, 1961). The LULC change studies are used to comprehend, 1) where the changes are occurring, 2) what type of land cover changes are occurring, 3) what sort of modifications occurred, 4) the rate and extent of land use changes, and 5) the proximal sources of change and their driving force (Loveland and Acevedo, 2006). The LULC map of the study area reveals most of the region is covered with agricultural land, followed by patches of built-up area. Forest cover is primarily seen along the western margin of the basin, with watershed and water bodies (Figure 5).

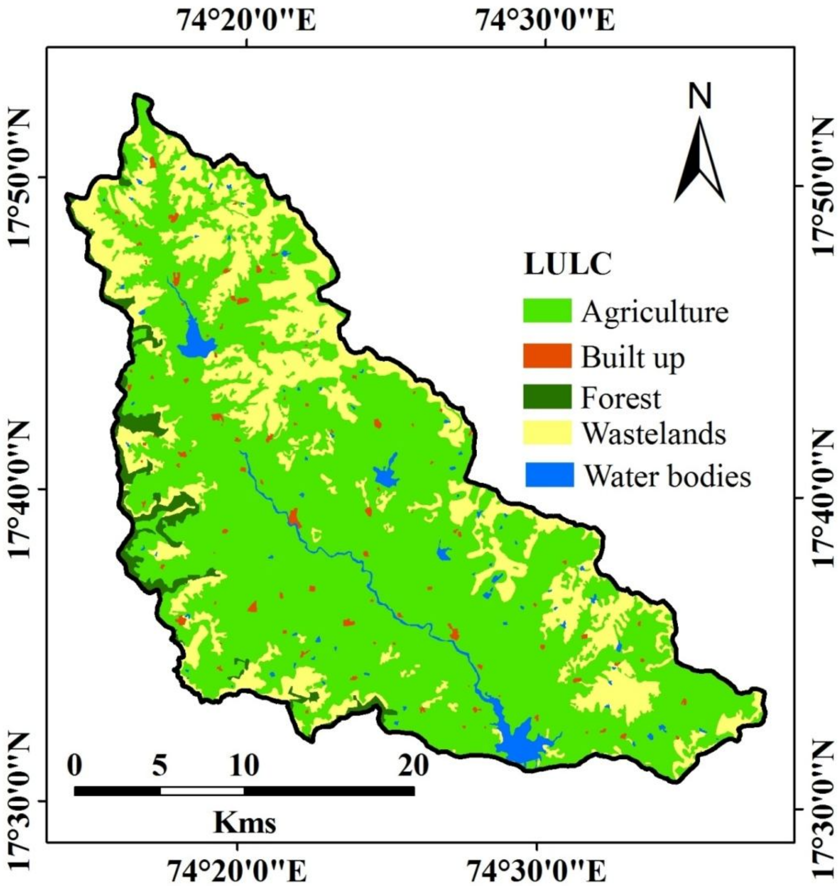

Figure 5: Land use landcover map of Upper Yerala basin.

The agriculture distribution of crops is quite varied, though it is mainly paddy, with secondary plantations like wheat, jowar and maize (Kharif and Rabi). Pulses like tur, dal, moong and some others are also grown. One can also find vegetables like onion, brinjal, potatoes, and tomatoes growing in the study area.

Drainage Density (Dd)

The drainage density, when is compared to surface runoff, it represents the rate at which precipitation infiltrates down through the soil. Low-drainage-density areas allow for greater infiltration and less surface runoff. As a result, low-drainage-density locations are ideal for groundwater recharging (Dinesh et al., 2007; Mangesh et al., 2012).

Various environmental variables and drainage densities have been related to one another (Sreedevi et. al., 2009). Tucker and Brass (1998) established a positive correlation between Dd and rainfall parameters. According to Gardiner (1995), greater Dd is usually seen in impermeable rocks. Dd has an inverse relation to the hydraulic conductivity beneath soil. Low Dd occurs where the terrain is highly resistant having permeable subsoil material, and where there is thick vegetative cover and low relief. Gregory and Walling, (1968) reviewed drainage density is often used in consonance with the catchment characteristics pertaining to soil type or basin shape. They also revealed Dd is also used as an estimate to understand the input or output of the basin, which can be used to know the past to decipher future changes.

Low Dd is observed at Pusegaon, Khatav, Bombale, Palasgaon, Rajapur, Khatgun, Nidhal, Vadkhal, Daruj, Banpuri, Jamb, Visapur, Kumathe and Yeralwadi (Figure 6). In comparison to a high drainage density region, a low drainage density region allows for more infiltration resulting in good soil moisture content. Moderate Dd has been observed at Pedgaon, Vaduj, Enkul, and Vetane. The high Dd found in Darjai, Bhandewadi, Fadatarwadi, and Tadavale reveal these places favor fast surface run-off, and hence indicate low groundwater recharge potential (Figure 6).

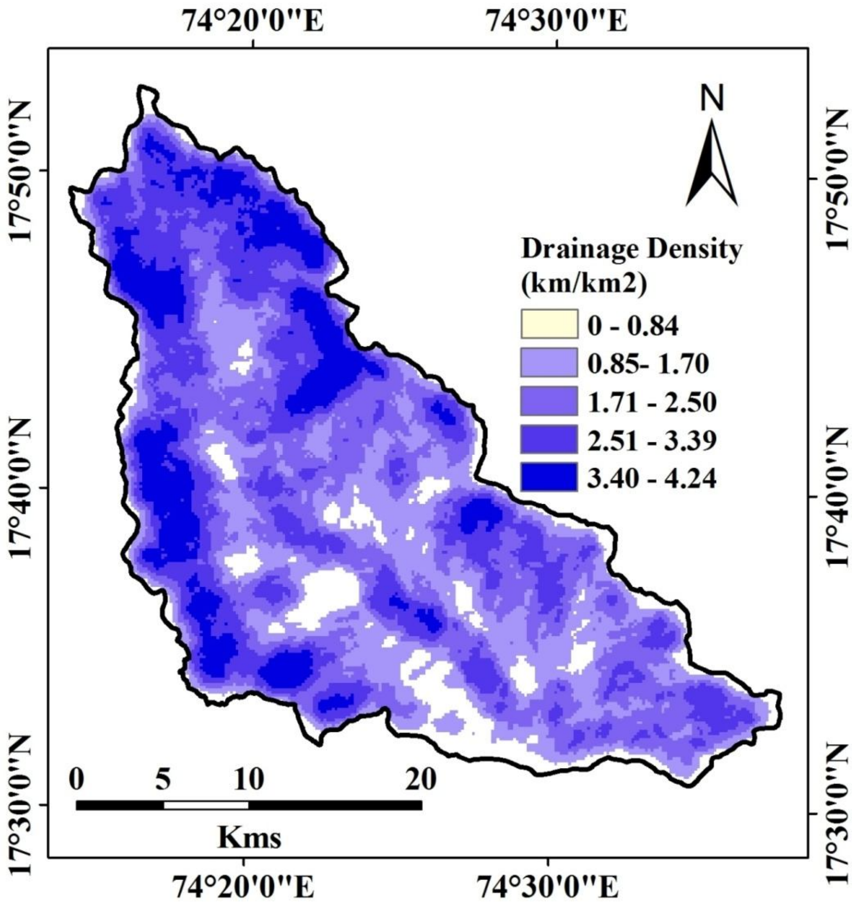

Figure 6: Drainage density map of Upper Yerala basin.

Slope (S)

The topographic slope allows for speedy run-off, low recharge, and movement of surface water. Elevation, slope, and aspect are some of the important elements of topography and are related to the development of soil (Platter, 2013). The slope gradient is an important topographic feature that influences drainage, runoff, and soil erosion, as well as physiochemical qualities (Farmanullah, 2013). Soil loss would generally be expected to increase as the slope gradient increases, due to an increase in surface runoff velocity and a decrease in infiltration rate (Luk et al., 1993; Zhang and Hosoyamada, 1996). Slope gradients have a significant influence on soil qualities, as indicated in the distribution of soils along with slope locations, (Amuyou and Kotingo 2015). The effect of topography on soil genesis and development was studied by Change and Lal (1997) and Nejad and Nejad (1997), who found that slope gradient, had a direct and indirect effect on soil physicochemical parameters. Variations in various soil parameters could be connected to slope gradient (Gessler et al., 2000). The recharging of groundwater is greater in flat areas and less in steep, high-slope areas. Because of the virtually level terrain and relatively high infiltration rate, locations with a 1 to 3 percent slope fall into the 'very good' groundwater recharge potential category. This category encompasses the majority of the research area, because of the slightly undulating topography and lower runoff, regions with a 3 to 5% slope. Hence, these places in the study area can be categorized as suitable groundwater storage zones. Areas with a slope of 5 to 10% have relatively significant runoff and limited infiltration and are thus classified as moderate. Because of the higher slope and runoff, the 10–15 percent and >15 percent slope classifications are classified poor and very poor, respectively (Figure7).

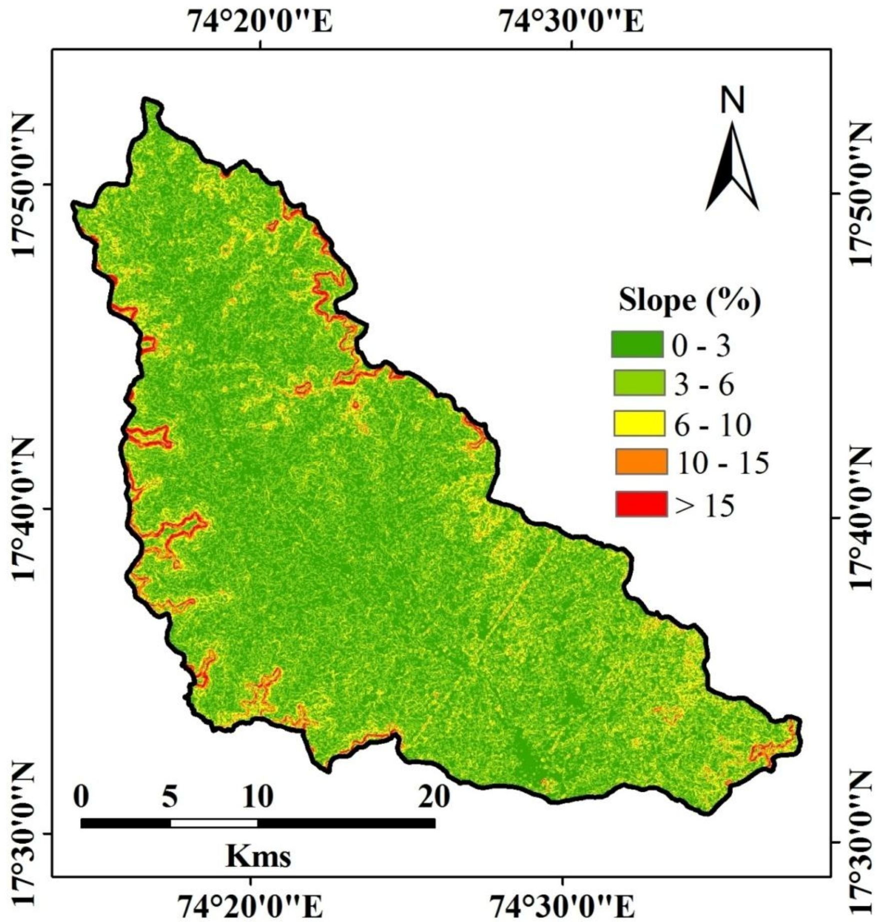

Figure 7: Slope map of the Upper Yerala basin.

Soil pH

It measures hydrogen ion concentration in the soil to indicate its acidic and alkaline character. Soil pH is a significant parameter to identify soils chemical nature (Shalini et al., 2003), since it impacts soil biogeochemical activities. By increasing the dissociation of acid functional groups in clays, soil pH aids in solubility of organic matter and weakens the bonds between organic elements and clays (Anderson et al., 2000; Curtin et al., 1998). Soil acidity (pH) from 5.5 to 7.5 has no direct effect on crop growth, but it affects the availability of other nutrients (Kamble et al., 2013). The pH of study area soil samples range from 7.6 to 8.65, indicating they are alkaline. The Tadavale sample has the lowest pH of 7.26 and Pusegaon sample has highest pH of 8.65 (Table 1). The substantial number of exchangeable anions leaching could explain the alkaline character of the soil samples. All of the soil samples had a slightly alkaline pH (Figure 8).

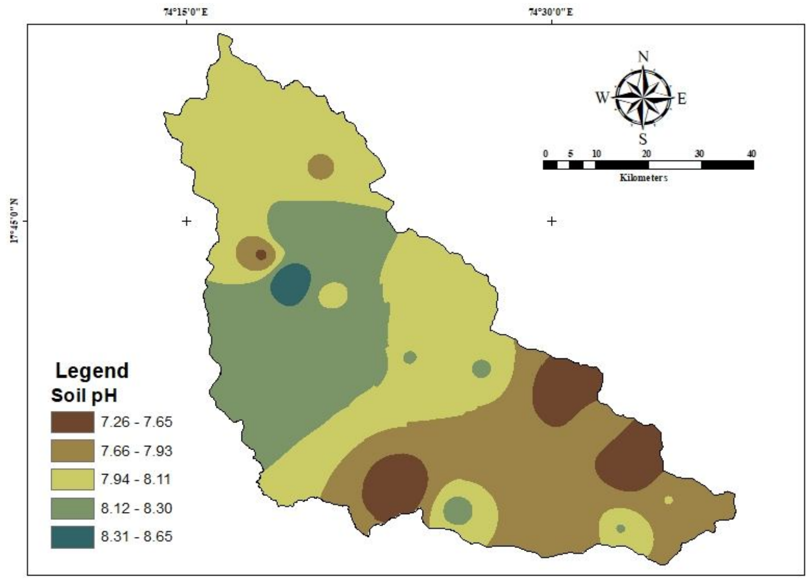

Figure 8: Soil Ph map of Upper Yerala river basin.

Electrical Conductivity (Salinity)

Electrical conductivity reveals current carrying capacity and delineates presence of soluble salts in the soil, indicating soil salinity. Salinity increases with EC value and a number of factors influence soil conductivity (Kamble et al., 2014). High conductivities are generally associated with clay-rich soils, whereas low conductivities correlate with sandy and gravelly soils. The shape and physical qualities of the particles also contribute to soil conductivity. A salt-infested soil having anion or cations of soluble salt adversely affects growth of crops in areas of meager precipitation, because there is insufficient rainfall to flush them out. The sodic and saline soils are widespread in arid and semi-arid regions, irrigation command areas, regions with poor drainage, and locations where poor-quality water is utilized for irrigation. The EC measurements ranged from 0.13 to 0.38 mS/cm. The lowest values were found at Bhandewadi, while the highest values at Banpuri (Figure 9).

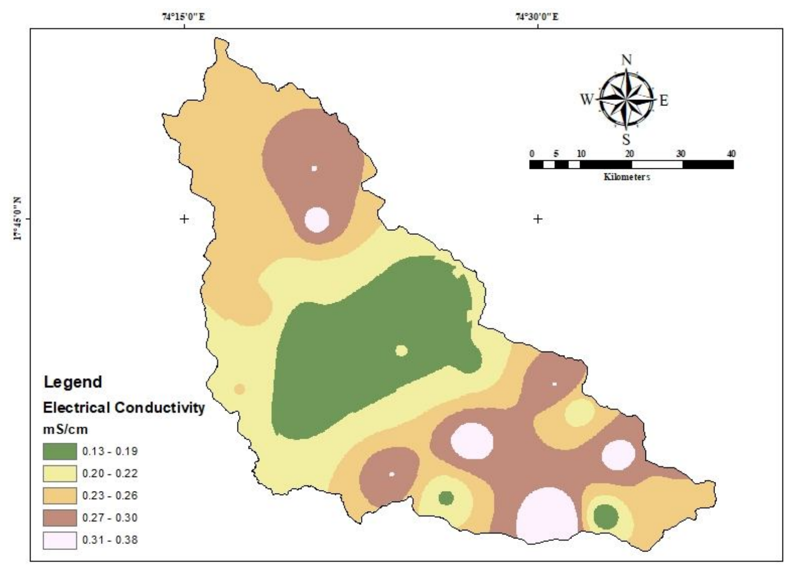

Figure 9: Electrical conductivity of soil map of the Upper Yerala river basin.

Exchangeable Sodium

The exchangeable sodium concentration in the study area varied from 6.0 to 33 (expressed as Na, meq/100g). The minimum value of 6.0 meq/100g is observed at Khatgun, while the maximum value of 33meq/100g was observed at Umbarde. The spread of exchangeable sodium is similar to that of the EC, as well as to the exchangeable potassium. The central regions of the study area are seen to show low concentration of sodium compared to the upper as well lower regions (Figure 10).

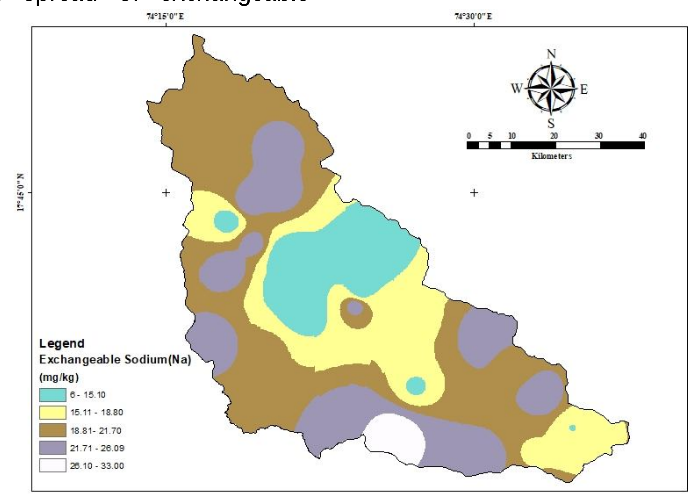

Figure 10: Exchangeable sodium of soil map of Upper Yerala river basin.

Exchangeable Potassium

Potassium (K) is the third most important element for plants, and is important for water balance and osmosis (Singh and Tripathi, 1993). In-plant cells, it is the most abundant metal cation (2 to 3 percent by dry weight). Its levels ranged from 0.6 to 3.5 meq/100g in the Yerala basin, with a minimum of 0.6 meq/100g in the Khatgun sample and a maximum of 3.5 meq/100g in the Umbarde sample (Figure 11). K^+ elimination by crops is substantial under normal field conditions with adequate fertilizer delivery; often three to four times that of phosphorus and equivalent to that of nitrogen.The excess K^+ adsorbed does not affect the crop yield, and is referred to as 'luxury consumption. The term 'necessary potassium' refers to the amount of this element required for optimal yields.

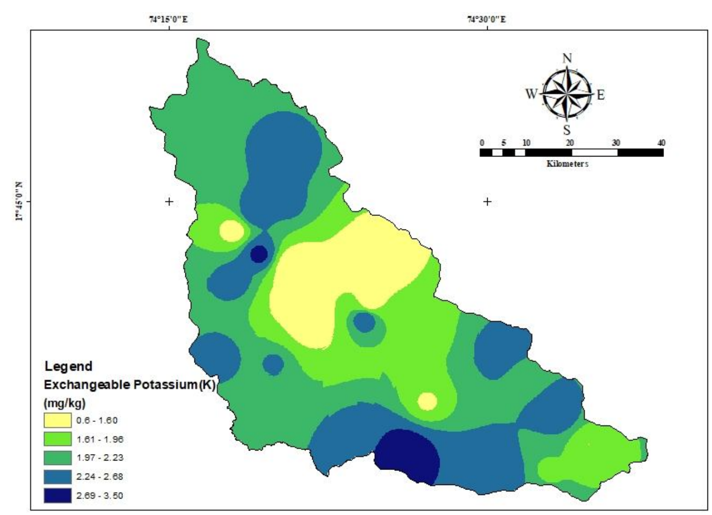

Figure 11: Exchangeable potassium of soil map of Upper Yerala river basin.

Exchangeable Chloride

The chloride values range between 10.63 to 24.85 mg/kg. The minimum value was recorded at Khatav while the maximum was recorded at Kumthe (Figure 12).

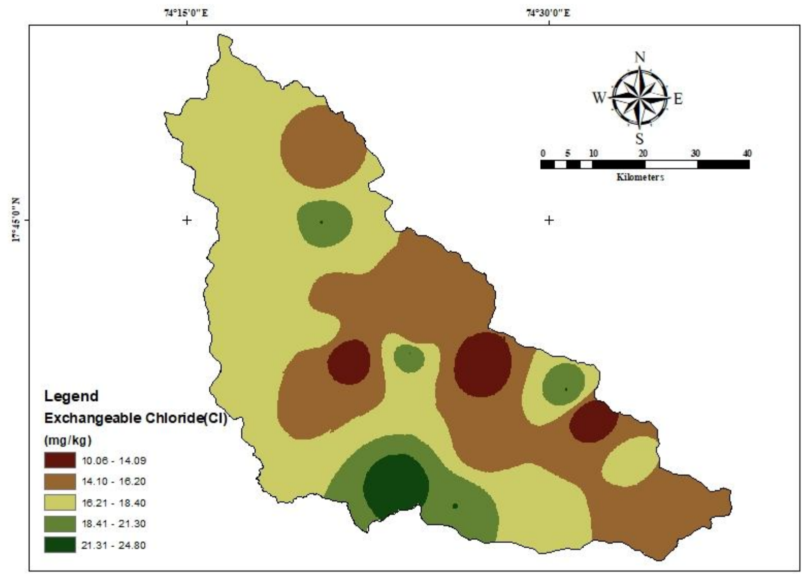

Figure 12: Exchangeable chloride of soil map of Upper Yerala river basin.

Soil site suitability analysis

Soil site suitability analysis undertaken for the Yerala River basin revealed the not suitable class is 12.31 sqkm (1.67%); moderate suitable class is 129.85 sqkm (17.59%); good suitable class was inferred to be 229.56 sqkm (31.1%); very good suitable class is 352.93 sqkm (47.81%); and excellent suitable class is to the tune of 13.52 sqkm (1.83%) (Table 4 and Figure 13).

Table 2: Pair-wise comparative matrix for ten influential parameters of suitability analysis.

Parameters	Slope	Geom	LULC	Drainage Density	pH	EC mS/cm	Na (mg/kg)	Chloride (mg/Kg)	Slope	Rainfall
Slope	1.00	0.50	1.00	0.50	0.25	1.00	0.33	0.20	2.00	3.00
Geomorphology	2.00	1.00	1.00	4.00	1.00	0.33	0.50	2.00	0.33	1.00
LULC	1.00	1.00	1.00	5.00	0.33	1.00	3.00	1.00	1.00	0.33
Drainage Density	2.00	0.25	0.20	1.00	0.20	1.00	0.33	2.00	0.50	1.00
pH	4.00	1.00	3.00	5.00	1.00	2.00	1.00	0.50	0.33	1.00
EC mS/cm	1.00	3.00	1.00	1.00	0.50	1.00	0.33	0.50	2.00	0.50
Na (mg/kg)	3.00	2.00	0.33	3.00	1.00	3.00	1.00	1.00	1.00	1.00
K (mg/kg)	5.00	0.50	1.00	0.50	2.00	2.00	1.00	1.00	1.00	1.00
Chloride (mg/Kg)	0.50	3.00	1.00	2.00	3.00	0.50	1.00	1.00	1.00	2.00
Rainfall	0.33	1.00	3.00	1.00	1.00	2.00	1.00	1.00	0.50	1.00

Table 3: Weights and ranks assigned to the factors and sub-feature class.

Classes	Subclasses	Rank	Weight
Slope	Gentle(0 - 2.21)	5	
(degree)	Moderate(2.22 - 5.17)	4	
	Moderate strong(5.18 - 9.98)	3	7.57
	Strong(9.99 - 17.19)	2	
	Steep (17.20 - 47.14)	1	
Geomorphology	Point bar (Flood Plain)	2	
	Water Body Mask	0	
	MDP-C, With thick soil cover and thick weathered zone	4	
	Messa/Butte type residual hills	3	7.49
	Plateau Top	1	
	MDP-B, With moderate soil cover	1	
	MDP-A, With exposed rock and thin soil cover	3	
	Habitation Mask	2	
	HDP-C, Moderately thick soil cover and moderate weathering	2	
	Massive type residual hills	1	
	outer fringe of Upper plateau (Denudational Slopes)	4	
	HDP-A, With exposed rock, negligible soil cover	5	
	HDP-B, With thin soil cover and weathering	4	
LULC	Forest	3	
	Build-up Region	1	
	Waterbody	4	8.55
	Wasteland	2	
	Agricultural Land	5	
Drainage Density	Very High0.08 - 0.81)	1	
(km/sq.km)	High(0.82 - 1.24)	2	
	Moderate (1.25 - 1.62)	3	7.68
	Low (1.63 - 2.08)	4	
	Very Low(2.09 - 3.37)	5	
pH	Very High(7.26 - 7.65)	5	
	High(7.66 - 7.92)	4	
	Moderate (7.93 - 8.11)	3	17.47
	Low (8.12 - 8.30)	2	
	Very Low(8.31 - 8.65)	1	
EC mS/cm	Very High(0.13 - 0.19)	5	
	High(0.20 - 0.22)	4	
	Moderate (0.23 - 0.26)	3	9.47
	Low (0.27 - 0.29)	2	
	Very Low(0.30 - 0.38)	1	
Na (mg/kg)	Very High(6.00 - 15.11)	5	
	High(15.12 - 18.81)	4	
	Moderate (18.82 - 21.67)	3	15.13
	Low (21.68 - 26.01)	2	
	Very Low(26.02 - 33.00)	1	
K (mg/kg)	Very High(0.6 - 1.6)	5	

	High(1.61 - 1.96)	4	
	Moderate (1.97 - 2.23)	3	10.84
	Low (2.24 - 2.68)	2	
	Very Low(2.69 - 3.5)	1	
Chloride (mg/ Kg)	Very High(10.63 - 13.97)	5	
	High(13.98- 16.20)	4	
	Moderate (16.21 - 18.43)	3	21.34
	Low (18.44 - 21.28)	2	
	Very Low (21.29 - 24.85)	1	
Rainfall (mm)	Very High(514.51 - 601.46)	5	
	High(601.47 - 688.41)	4	
	Moderate (688.42 - 788.88)	3	11.23
	Low (788.89 - 885.49)	2	
	Very Low(885.50- 1,007.20)	1	

Table 4: Site Suitability analysis

Sr. No	Class	Area (sq.km)	Area (%)
1	Not Suitable	12.3147	1.67
2	Moderate	129.8538	17.59
3	Good	229.5648	31.1
4	Very Good	352.9395	47.81
5	Excellent	13.5288	1.83

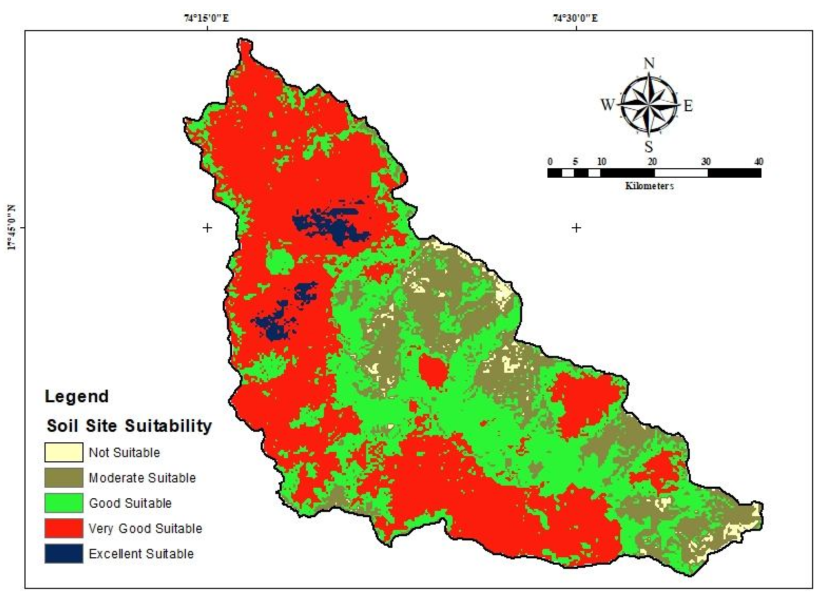

Figure 13: Soil Site Suitability map of Upper Yerala river basin.

CONCLUSION

A land suitability study has been undertaken for the catchment of the Yerala River basin for enhancing the green cover vis-à-vis conservation of soil and water. The thematic layers of relevant factors such as drainage density, rainfall, land slope, geomorphology, and land use pattern along the physicochemical parameters of soil were generated using RS-GIS techniques. The suitable weights and ranks were allocated to the parameters and sub-feature classes were derived using multi-criteria AHP technique. The integrated suitability map reveals 47.81% area is highly suitable for plantation. Paddy was found to be the single most dominant crop in the region under very good suitability. The pH of the soil is mostly neutral and can be interpreted as slightly alkaline in some parts of the study area. The electrical conductivity is relatively higher in the region and is shown to greatly influence the distribution of both exchangeable sodium and potassium in the region. The concentration of chlorine in the region is not directly dependent on any other parameters. Thus, it could be interpreted that the appropriate treatments are required in the areas of poor plant growth. All in all the soil in study area is quite suitable for agriculture-related activities. The findings of this study would be shared with the local administrators, farmers, and developers for the sustainable development of the area.

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