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Assessment of soil properties and nitrogen status in western part of Yavatmal district in Vidarbha region

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Abstract

The present investigation was carried out to assess the soil chemical properties and nitrogen status in the western part of Yavatmal district in Vidarbha region. A total of 80 surface soil samples were collected from eight talukas, namely Ner, Darwha, Yavatmal, Digras, Arni, Pusad, Mahagaon and Umarched, at a depth of 0–15 cm. The collected soil samples were analysed for pH, electrical conductivity (EC), organic carbon (OC), calcium carbonate (CaCO_3), available nitrogen, ammoniacal nitrogen ($\text{NH}_4^+\text{-N}$) and nitrate nitrogen ($\text{NO}_3^-\text{-N}$) to evaluate the chemical characteristics and nitrogen status of the soils. The soil pH ranged from 7.23 to 8.10, with mean values of 7.48–7.76, indicating neutral to moderately alkaline soils. Soil EC showed low values, with mean values ranging from 0.21–0.32 dS m^{-1} , indicating non-saline conditions. Organic carbon ranged from 2.99–6.21 g kg^{-1} , with mean values of 4.30–4.84 g kg^{-1} , indicating low to medium status. Calcium carbonate ranged from 3.25–10.62%, with mean values of 8.11–9.43%, indicating calcareous soils. Available nitrogen ranged from 145.35–198.98 kg ha^{-1} , with mean values of 173.67–184.47 kg ha^{-1} , and was low in all samples. Ammoniacal nitrogen ranged from 13.60–26.80 mg kg^{-1} , with mean values of 19.28–23.17 mg kg^{-1} . Nitrate nitrogen ranged from 12.20–24.60 mg kg^{-1} , with mean values of 17.39–21.10 mg kg^{-1} , showing variation among the talukas. Overall the soils of the western part of Yavatmal district were characterized by neutral to moderately alkaline reaction, low electrical conductivity, low to medium organic carbon and moderate calcareousness. The low status of available nitrogen observed across the study area indicates the need for proper nitrogen management to maintain soil fertility and sustain crop productivity. The findings emphasize the importance of balanced fertilization, regular soil testing and incorporation of organic residues for improving nitrogen availability and maintaining the chemical fertility of soils in the region.

Keywords: Soil chemical properties, soil nitrogen status, available nitrogen, ammonical nitrogen, nitrate nitrogen, organic carbon, calcium carbonate, western yavatmal

Introduction

Soil is an important natural resource that plays a major role in agricultural production and crop productivity. Soil chemical properties such as pH, electrical conductivity, organic carbon, calcium carbonate and nitrogen status are important indicators of soil fertility and nutrient availability. Nitrogen is an essential nutrient for crop growth and occurs in soil in different forms, including available nitrogen, ammonical nitrogen ($\text{NH}_4^+\text{-N}$) and nitrate nitrogen ($\text{NO}_3^-\text{-N}$). Yavatmal district, situated in the Vidarbha region of Maharashtra, is one of the major agricultural and cotton-growing regions of the state. The district is predominantly characterized by black soils, with cotton, soybean, pigeon pea and other major crops widely cultivated. The western part of the district comprises deep, medium and shallow black soils (Vertisols) derived from Deccan Trap basalt, which are well suited for agricultural production. The western part of Yavatmal includes Ner, Darwha, Yavatmal, Digras, Arni, Pusad, Mahagaon and Umarched talukas. Assessment of soil chemical properties and nitrogen status in this region is important for understanding the existing soil fertility condition and supporting suitable nutrient management practices. Therefore, the present study was undertaken to assess the soil chemical properties and nitrogen status of agricultural soils in the western part of Yavatmal district.

Materials and Methods

Yavatmal is an important district of the Vidarbha region of Maharashtra, situated in the southeastern part of the state. Geographically, the district extends from 19°26' to 20°42' north latitudes and from 77°18' to 79°09' east longitudes and falls under Survey of India Toposheets 55-L, 55-P, 56-I and 56-M. It covers a geographical area of approximately 13,594 square kilometres. The district is bounded by Amravati District in the north, Wardha District in the northeast, Chandrapur District in the east, Nanded District in the southwest, and Adilabad District of Telangana State towards the south and southeast. The study was conducted in the western part of Yavatmal district of

Vidarbha region, Maharashtra, covering eight talukas viz., Ner, Darwha, Yavatmal, Digras, Arni, Pusad, Mahagaon and Umardhed. A total of 80 representative surface soil samples were collected from agricultural fields at a depth of 0–15 cm, with 10 samples from each taluka. The collected soil samples were properly labelled, air-dried, processed and analysed for important soil chemical properties. Soil pH, electrical conductivity (EC), organic carbon (OC), calcium carbonate (CaCO₃), available nitrogen, ammonical nitrogen (NH₄⁺-N) and nitrate nitrogen (NO₃⁻-N) were determined using standard laboratory procedures.

Table 1: Sites of sampling

Sample No.	Farmer name	Taluka	Village name	Latitude	Longitude
S ₁	Sunil Narayan Kambale	Ner	Pandhari	20.508474	77.729448
S ₂	Prashant Shrikurshn Kambale	Ner	Pandhari	20.521239	77.730446
S ₃	Rajeshwar Rameshwar Jadhao	Ner	Takali	20.521441	77.969908
S ₄	Suresh Uttamchand Khabiya	Ner	Manikwada	20.532292	77.936132
S ₅	Vaishali Suresh Meshram	Ner	Loni	20.528563	77.857283
S ₆	Vinod Duryodhan Gaynar	Ner	Pathrad	20.548077	77.896684
S ₇	Priti Nadkshor Ghawade	Ner	Bramhamanwada	20.516491	77.947552
S ₈	Vimal Shrikrusna Bodade	Ner	Loni	20.504821	77.967024
S ₉	Satish Madhuka Tupatkar	Ner	Pimapari	20.52847	77.857319
S ₁₀	Ratan Saklal Chavhan	Ner	Walki	20.573137	77.87298
S ₁₁	Sanjay Zingaji Rathod	Darwha	Sangavi	20.421802	77.596134
S ₁₂	Savita Ashokrao khade	Darwha	Dolhari	20.402054	77.798521
S ₁₃	Shirish Baban Chaudhari	Darwha	Sangavi	20.422402	77.604928
S ₁₄	Arpita Sandip Patil	Darwha	Daheli	20.26139261	77.85174371
S ₁₅	Ashok Chanpat Thakare	Darwha	Both	20.325871	77.4528014
S ₁₆	Sudarshan Namdev Borchate	Darwha	Kumbharkinhi	20.296465	77.665722
S ₁₇	Raju Parshram Mirase	Darwha	Chopadi	20.297585	77.716752
S ₁₈	Amol Govindrao Khond	Darwha	Mangkinhi	20.300945	77.660019
S ₁₉	Rajendra Vishwnath Gawande	Darwha	Talegaon	20.367288	77.732069
S ₂₀	Devanand Prabhakar Kurale	Darwha	Nakhegaon	20.415641	77.730754
S ₂₁	Rajesh Narayan Rathod	Yavatmal	Wagada	20.099619	78.465946
S ₂₂	Anil Pralhad Jadhav	Yavatma	Pangari	20.102565	78.079805
S ₂₃	Dinesh Natthu Jadhav	Yavatma	Asola	20.499475	77.977622
S ₂₄	Nitin Vasanta Jadhav	Yavatma	Hiwari	20.102565	78.079805
S ₂₅	Pankaj Nilkantha Wasrikar	Yavatma	Manpur	20.313681	78.043314
S ₂₆	Janardhan Nimji Yerkade	Yavatma	Chinchghat	20.312084	78.24014
S ₂₇	Sanjay Sawairam Jadhav	Yavatma	Madkona	20.409621	78.221681
S ₂₈	Asha Vinod Giri	Yavatma	Pimpari	20.393296	78.022011
S ₂₉	Manda Dadarao Madavi	Yavatma	Ghatana	20.240695	78.120841
S ₃₀	Haribhau Laxman Landne	Yavatma	Rui	20.161388	78.055984
S ₃₁	Uttam Lakshman Hatkar	Digras	Vitoli	20.048456	77.753569
S ₃₂	Shantabai Bhimrao Rathol	Digras	Chinchapatra	20.04459	77.782386
S ₃₃	Yogiraj Dinkar Gavande	Digras	Nimba	20.062092	77.739469
S ₃₄	Sanjay Subhash Thakre	Digras	Vasantnagar	20.020057	77.765214
S ₃₅	Mersiha Bhuvan Jadhav	Digras	Mandwa	20.152091	77.693736
S ₃₆	Raju M. Gavande	Digras	Vitoli	20.060984	77.748544
S ₃₇	Shankar Kishan Gavande	Digras	Sevanagar	20.080129	77.679384
S ₃₈	Vinod Ra.Gavande	Digras	Isapur	20.092735	77.702272
S ₃₉	Aashish Gavande	Digras	Isapur	20.092735	77.693754
S ₄₀	Devrao Ki.Gavande	Digras	Kolura	20.061804	77.712125
S ₄₁	Dnyaneshwar Sheshrao Pawar	Arni	Anjargoan	20.040231	77.990716
S ₄₂	Madhukar Narayan Pawar	Arni	Kinhi	20.121689	77.971881
S ₄₃	Vijay V.Rathol	Arni	Gavana	20.139334	77.981997
S ₄₄	Aananta Aade	Arni	Javala	20.136143	77.964764
S ₄₅	Kusumabai Aade	Arni	Javala	20.136382	77.95724
S ₄₆	Nursiha Jadhav	Arni	Gavana	20.142178	77.971154
S ₄₇	Vijay Mohan Jadhav	Arni	Kinhi	20.122966	77.967862
S ₄₈	Asubhash U. Jadhav	Arni	Kinhi	20.119442	77.972514
S ₄₉	Cintaman Jadhav	Arni	Pandhurna	20.138646	78.230299
S ₅₀	Suresh Jadhav	Arni	Pandhurna	20.148461	78.246883
S ₅₁	Parvati Bai	Pusad	Bori (khu)	19.870067	77.547606

S ₅₂	Sanjay B.Tudav	Pusad	Borgadi	19.877278	77.570497
S ₅₃	Vishvanath P. Mukhare	Pusad	Mandava	19.848279	77.536084
S ₅₄	Bhaskar Kapate	Pusad	Sandava	19.820356	77.504758
S ₅₅	Aakash S. Mukhare	Pusad	Bori(machchhindar)	19.86513	77.559121
S ₅₆	Prabhakar V.Mukhare	Pusad	Bori(machchhindar)	19.860443	77.563098
S ₅₇	Sunanda R. Vivekar	Pusad	Borgadi	19.875598	77.561302
S ₅₈	Bandu V. Kulat	Pusad	Kakaddati	19.882834	77.551476
S ₅₉	Surendra Dhonke	Pusad	Kakaddati	19.885552	77.556346
S ₆₀	Savita S.Aade	Pusad	Bori (khu)	19.874579	77.554236
S ₆₁	Tarachan laximan chavhan	Mahagaon	sevanagar	19.799538	77.833472
S ₆₂	Govindrao Namdevrao Kare	Mahagaon	Bham	19.762863	77.818298
S ₆₃	Pandit Damodar Jadhav	Mahagaon	Rahur	19.717311	77.907855
S ₆₄	Pawan Raosaheb Chaudhary	Mahagaon	Sirphuli	19.853028	77.75583
S ₆₅	Bharat Suryabhan Chavhan	Mahagaon	Aamni	19.784873	77.754121
S ₆₆	Pawan Marotrao Kare	Mahagaon	Kasarbehal	19.787606	77.842695
S ₆₇	Bhimrao Vinayak Chavhan	Mahagaon	Sevanagar	19.805465	77.848236
S ₆₈	Dipak Govind Jadhav	Mahagaon	Fhulsavangi	19.726876	77.862569
S ₆₉	Devanand Tukaram Jadhav	Mahagaon	Anatwadi	19.832949	77.837626
S ₇₀	Munna Kisan Rathod	Mahagaon	Hiwara sangam	19.844993	77.867045
S ₇₁	Aniket G.Dhopte	Umarkhed	Vidul	19.562275	77.757904
S ₇₂	Kedarnath Wankhele	Umarkhed	Sukali	19.642602	77.681315
S ₇₃	Laximan Pawar	Umarkhed	Churmura	19.628853	77.736125
S ₇₄	Mangal Rathod	Umarkhed	Dhanora	19.559565	77.592022
S ₇₅	Chakradhar Shinde	Umarkhed	Marlegoan	19.550194	77.681371
S ₇₆	Yogesh Wankhele	Umarkhed	Sukali	19.646262	77.68929
S ₇₇	Devanand Kakale	Umarkhed	Marsul	19.649983	77.659809
S ₇₈	Sachin Deshmukh	Umarkhed	Marsul	19.648546	77.667532
S ₇₉	Mahesh Bichhevar	Umarkhed	Vidul	19.555633	77.743009
S ₈₀	Rahun Rathod	Umarkhed	Dhanora	19.565692	77.579678

Soil pH and electrical conductivity were determined in a 1:2.5 soil-water suspension following Jackson (1973) [7]. Organic carbon was determined by the modified Walkley and Black method, while calcium carbonate was determined by the rapid titration method of Piper (1966) [9]. Available nitrogen was

estimated by the alkaline permanganate method of Subbiah and Asija (1956) [11]. Soil ammonical nitrogen ($\text{NH}_4^+\text{-N}$) and nitrate nitrogen ($\text{NO}_3^-\text{-N}$) were determined by the MgO -Devarda alloy steam distillation method described by Bremner (1965) [5].

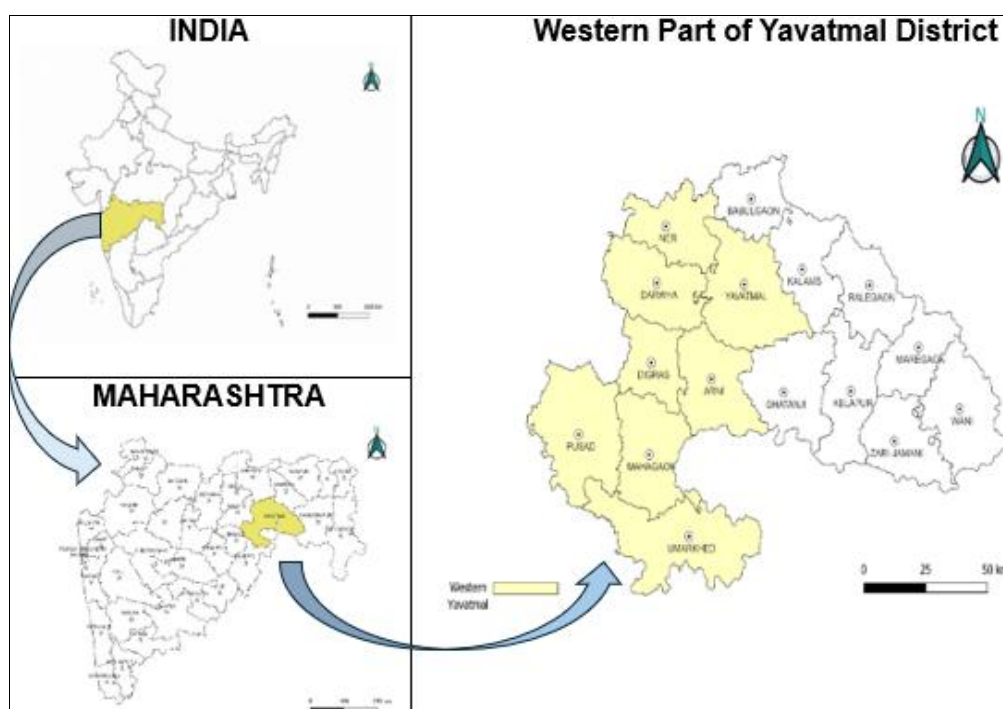


Fig 1: Geographical location of the study area

Results and Discussion

Soil properties

The soil chemical properties of the 80 surface soil samples collected from eight talukas of western Yavatmal district

showed considerable variation across the study area. Soil pH ranged from 7.23 to 8.10, indicating a neutral to moderately alkaline reaction. The mean pH values ranged from 7.48 in Arni to 7.76 in Umarkhed, with the highest pH of 8.10 recorded in

Yavatmal taluka and the lowest value of 7.23 in Ner taluka and map of soil pH depicted in Fig.4. The neutral to moderately alkaline reaction observed in the present study was comparable with the findings of Bhokare and Wankhade (2024) ^[3] in Digras and Bhokare *et al.* (2024) ^[4] in Mahagaon, while Dorlikar and Thengare (2025) ^[6] also reported slightly alkaline soils. Electrical conductivity remained low throughout the study area, with mean values ranging from 0.21 to 0.32 dS m⁻¹ and individual values varying from 0.14 to 0.43 dS m⁻¹ and map of soil EC depicted in Fig.5. The low EC values indicated low soluble salt concentration and non-saline conditions, suggesting that salinity was not a major limitation in the studied soils. Organic carbon content varied from 2.99 to 6.21 g kg⁻¹, while the mean values among the talukas ranged from 4.30 to 4.84 g kg⁻¹. Based on the soil-test classification, 22 samples were low, 56 were medium and 2 sample was moderately high in organic carbon, indicating predominantly low to medium organic carbon status and status of organic carbon depicted in Fig. 2. Map of organic carbon depicted in Fig.6

The observed variation in organic carbon may be associated with differences in crop residues, organic matter addition and farm management practices. Similar low to moderate organic carbon status was reported by Bhagat *et al.* (2024) ^[1], Bhokare and Wankhade (2024) ^[3] in soils of Yavatmal district. Calcium carbonate content ranged from 3.25 to 10.62 per cent, with mean values ranging from 8.11 to 9.43 per cent among the talukas. Out of the 80 soil samples, 15 were slightly calcareous and 65 were calcareous, while none was highly calcareous and status of calcium carbonate depicted in Fig. 3. Map of calcium carbonate depicted in Fig.7 The variation in CaCO₃ content may be related to differences in parent material, climatic conditions and soil drainage. Similar findings were reported by Wankhade (2015) ^[13], who recorded CaCO₃ values ranging from 5.14 to 15.32 per cent in soils of the Digras region of Yavatmal district. Overall, the soils of western Yavatmal were characterized by neutral to moderately alkaline reaction, low electrical conductivity, low to medium organic carbon and predominantly calcareous conditions.

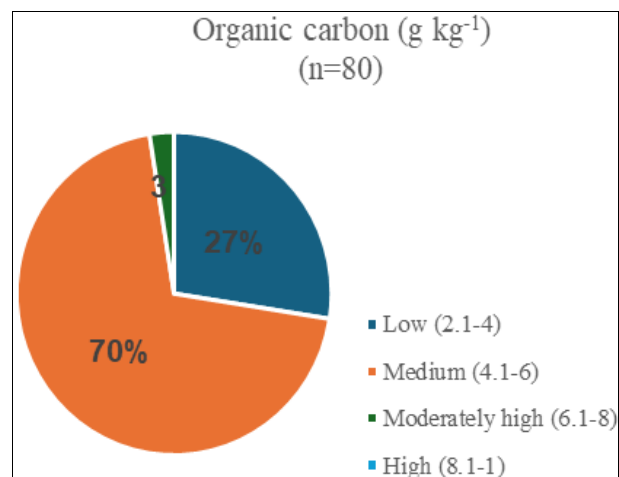


Fig 2: Status of organic carbon in soils of eight taluka in western part of Yavatmal district

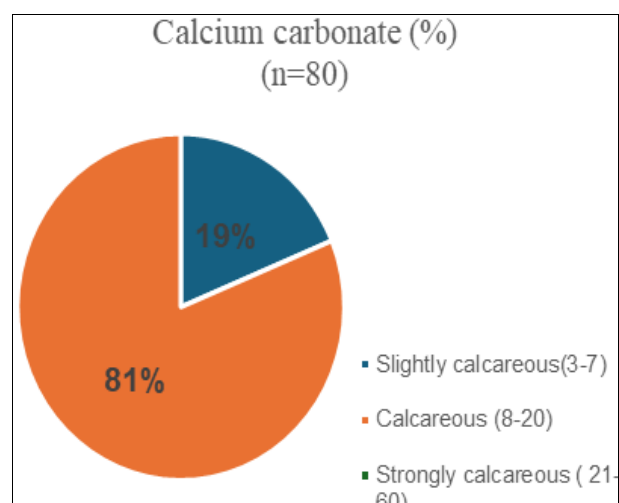


Fig 3: Status of calcium carbonate in soils of eight taluka in western part of Yavatmal district

Table 2: Soil properties in western part of the Yavatmal district

Soil sample	pH	E.C. (dSm ⁻¹)	O.C. (g kg ⁻¹)	CaCO ₃ (%)
S ₁	7.53	0.23	4.70	8.25
S ₂	7.51	0.21	4.49	8.50
S ₃	7.78	0.28	5.72	9.37
S ₄	7.37	0.18	3.40	9.25
S ₅	7.44	0.23	4.85	8.75
S ₆	7.23	0.14	4.31	8.50
S ₇	7.36	0.16	3.66	9.12
S ₈	7.65	0.22	5.36	7.87
S ₉	7.68	0.27	4.48	8.37
S ₁₀	7.31	0.17	3.01	8.50
S ₁₁	7.97	0.28	3.75	8.25
S ₁₂	7.66	0.22	4.18	6.75
S ₁₃	7.84	0.21	5.67	7.75
S ₁₄	7.64	0.26	4.55	8.62
S ₁₅	7.85	0.24	2.99	8.37
S ₁₆	7.51	0.21	3.91	9.87
S ₁₇	7.58	0.27	5.27	9.37
S ₁₈	7.69	0.21	3.21	8.62
S ₁₉	7.26	0.19	3.97	8.37
S ₂₀	7.58	0.21	5.48	9.87
S ₂₁	8.10	0.22	3.61	7.87
S ₂₂	7.41	0.26	4.87	9.25

S ₂₃	7.98	0.31	4.42	8.12
S ₂₄	7.42	0.28	3.41	9.25
S ₂₅	7.59	0.31	4.57	7.25
S ₂₆	7.72	0.43	5.67	7.38
S ₂₇	7.96	0.29	5.52	8.38
S ₂₈	7.58	0.36	4.01	8.38
S ₂₉	7.81	0.32	4.97	7.63
S ₃₀	7.65	0.37	4.82	7.86
S ₃₁	7.58	0.24	4.27	9.75
S ₃₂	7.64	0.21	5.11	8.62
S ₃₃	7.78	0.23	4.12	7.25
S ₃₄	7.91	0.25	5.47	8.37
S ₃₅	7.48	0.21	5.17	8.12
S ₃₆	7.62	0.22	5.87	9.75
S ₃₇	7.88	0.19	4.72	7.12
S ₃₈	7.43	0.26	5.22	8.50
S ₃₉	7.73	0.17	3.81	7.87
S ₄₀	7.68	0.23	4.61	8.25
S ₄₁	7.46	0.29	4.82	8.00
S ₄₂	7.51	0.28	5.43	8.25
S ₄₃	7.38	0.18	3.86	8.75
S ₄₄	7.69	0.24	4.76	8.50
S ₄₅	7.54	0.26	4.36	9.37
S ₄₆	7.42	0.19	3.71	7.62
S ₄₇	7.36	0.22	3.81	9.50
S ₄₈	7.55	0.23	5.46	9.20
S ₄₉	7.49	0.21	6.21	3.25
S ₅₀	7.42	0.25	5.52	8.62
S ₅₁	7.67	0.22	5.37	7.37
S ₅₂	7.74	0.16	3.72	8.50
S ₅₃	7.73	0.18	4.42	8.20
S ₅₄	7.88	0.21	5.81	9.87
S ₅₅	7.68	0.23	4.97	8.50
S ₅₆	7.62	0.19	5.72	8.62
S ₅₇	7.69	0.27	5.16	8.25
S ₅₈	7.93	0.21	4.17	9.75
S ₅₉	7.55	0.36	5.01	8.62
S ₆₀	7.72	0.24	3.27	8.75
S ₆₁	7.46	0.23	5.16	9.62
S ₆₂	7.52	0.21	4.21	8.75
S ₆₃	7.68	0.23	3.82	10.37
S ₆₄	7.72	0.19	3.17	10.12
S ₆₅	7.93	0.22	4.42	8.50
S ₆₆	7.69	0.31	5.37	9.37
S ₆₇	7.78	0.18	5.46	9.00
S ₆₈	7.63	0.21	3.52	8.87
S ₆₉	7.99	0.23	4.21	9.12
S ₇₀	7.57	0.27	5.92	10.62
S ₇₁	7.62	0.26	5.27	8.12
S ₇₂	7.77	0.29	4.42	8.75
S ₇₃	7.92	0.32	4.97	9.62
S ₇₄	7.64	0.31	6.72	8.12
S ₇₅	7.68	0.25	4.21	9.25
S ₇₆	7.78	0.24	4.67	8.75
S ₇₇	7.78	0.31	5.67	7.87
S ₇₈	7.79	0.32	5.11	9.37
S ₇₉	7.92	0.26	3.42	8.25
S ₈₀	7.67	0.23	3.71	8.12
Mean	7.65	0.24	4.63	8.57
Range	7.23-8.10	0.14-0.43	2.99-6.72	3.25-10.62
C.V.	2.43	21.67	18.00	11.45

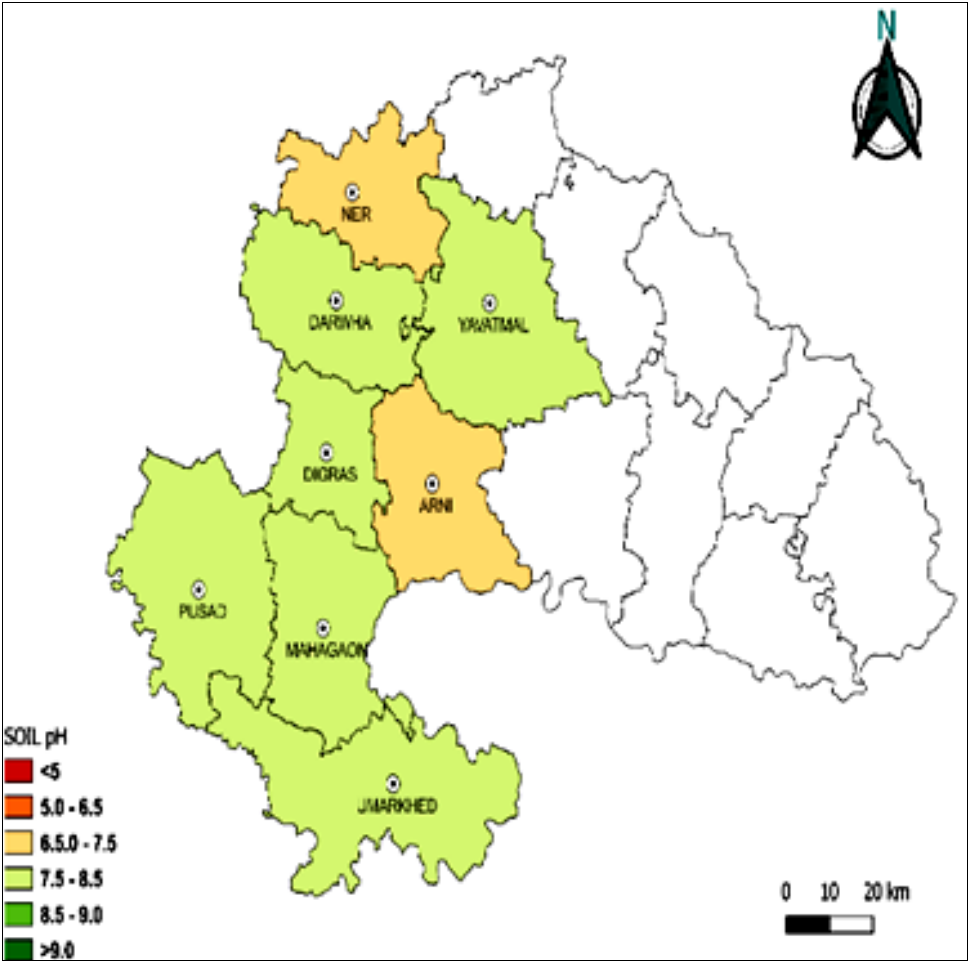


Fig 4: Map of soil pH in the western part of Yavatmal district

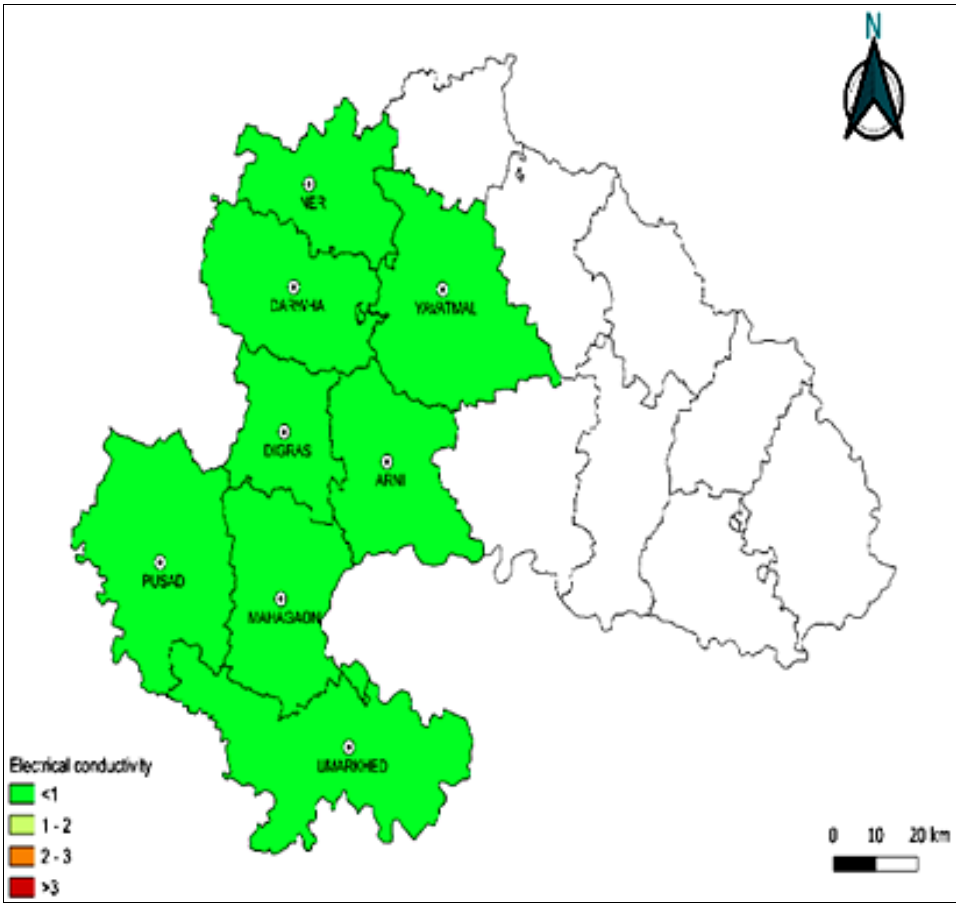


Fig 5: Map of EC (dSm⁻¹) in soils of western part of Yavatmal district

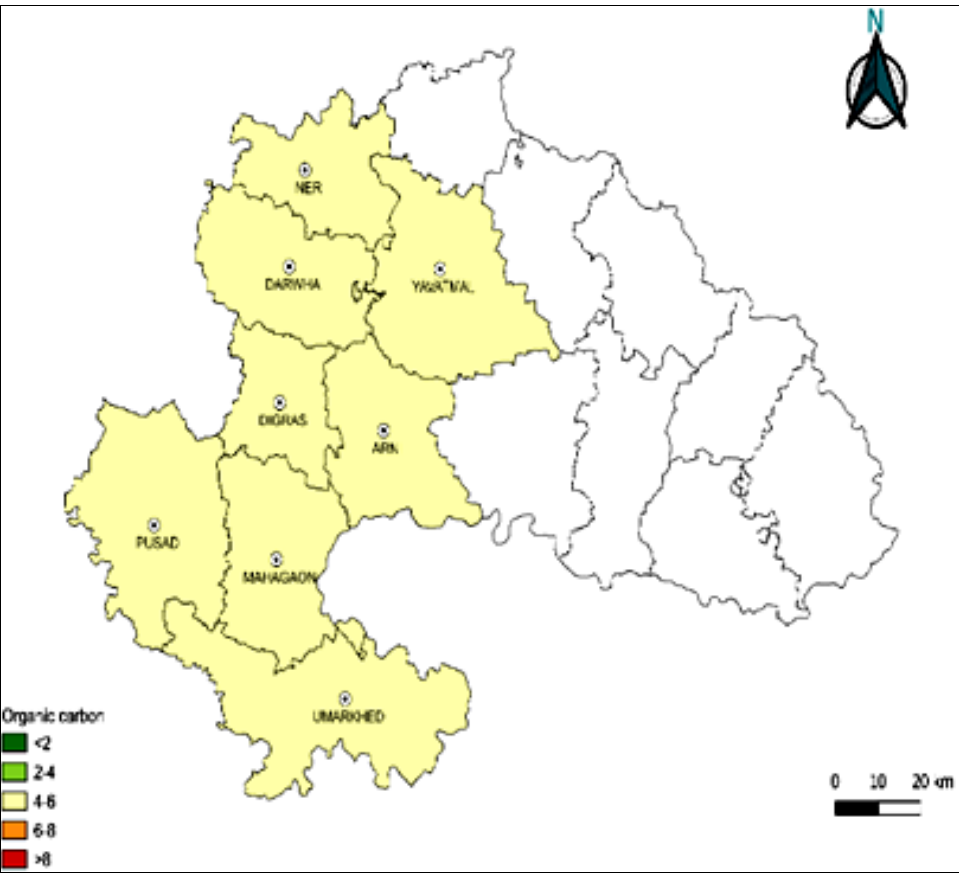


Fig 6: Map of OC (g kg⁻¹) in soils of western part of Yavatmal district

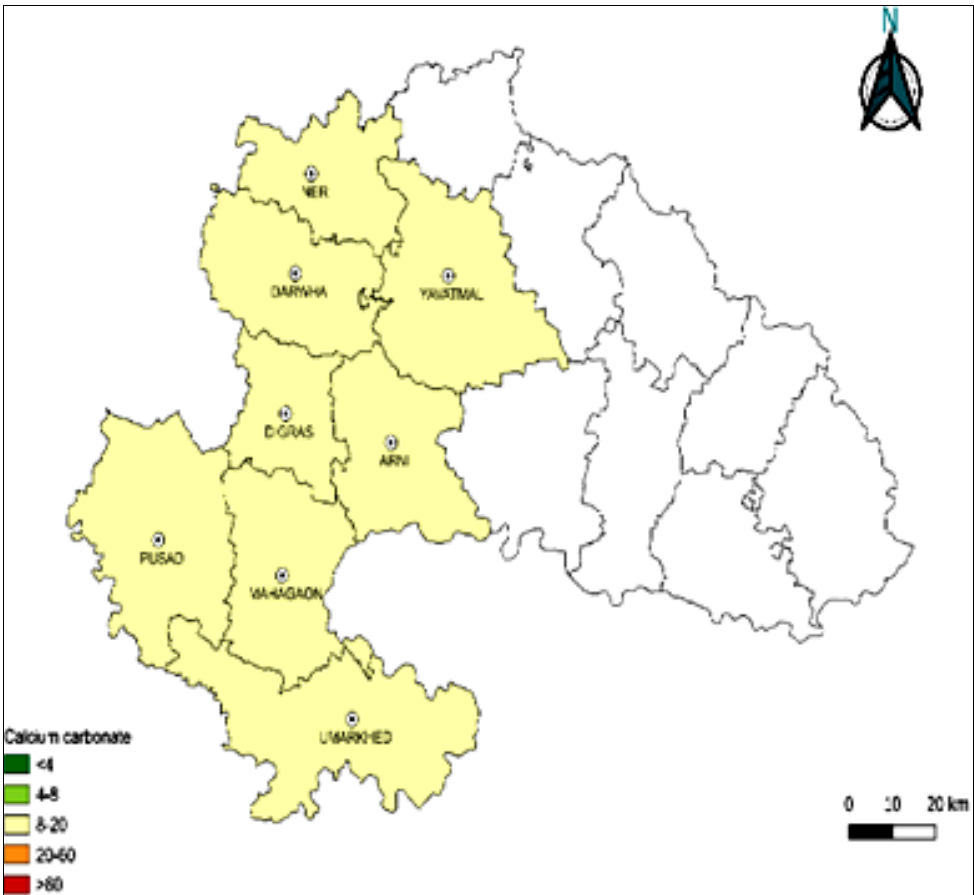


Fig 7: Map of CaCO₃ (%) in soils of western part of Yavatmal district

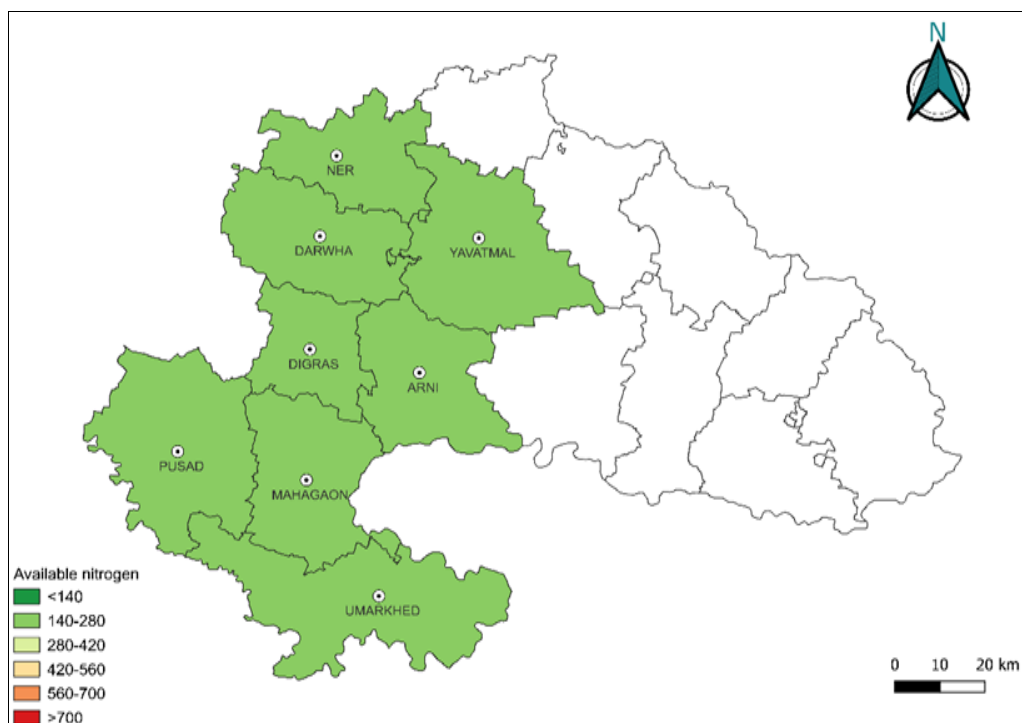


Fig 8: Map of available nitrogen (kg ha^{-1}) in soils of western part of Yavatmal district

3.3 Ammonical ($\text{NH}_4^+\text{-N}$)

The ammonical nitrogen ($\text{NH}_4^+\text{-N}$) content in the soils of western Yavatmal ranged from 13.60 to 26.80 mg kg^{-1} , indicating considerable variation among the soil samples. The mean $\text{NH}_4^+\text{-N}$ content across the eight talukas ranged from 19.28 to 23.17 mg kg^{-1} . The highest mean $\text{NH}_4^+\text{-N}$ content was recorded in Yavatmal taluka (23.17 mg kg^{-1}), whereas the lowest mean was observed in Mahagaon taluka (19.28 mg kg^{-1}). Among the individual soil samples, the maximum $\text{NH}_4^+\text{-N}$ content of 26.80 mg kg^{-1} was recorded in Isapur village of Digras taluka, while the minimum value of 13.60 mg kg^{-1} was recorded in Sirphulli village of Mahagaon taluka and status of ammonical nitrogen depicted in Fig.9. The observed variation in ammonical nitrogen may be associated with differences in organic matter decomposition, fertilizer application, crop

residues and soil management practices.

3.4 Nitrate nitrogen ($\text{NO}_3^-\text{-N}$)

The nitrate nitrogen ($\text{NO}_3^-\text{-N}$) content in the soils of western Yavatmal varied from 12.20 to 24.60 mg kg^{-1} , showing considerable variation among the soil samples. The mean $\text{NO}_3^-\text{-N}$ content ranged from 17.39 to 21.10 mg kg^{-1} across the eight talukas. The highest mean $\text{NO}_3^-\text{-N}$ content was recorded in Yavatmal taluka (21.10 mg kg^{-1}), whereas the lowest mean was observed in Mahagaon taluka (17.39 mg kg^{-1}). Considering the individual observations, the maximum $\text{NO}_3^-\text{-N}$ content of 24.60 mg kg^{-1} was recorded in Bori (Machchhindar) village of Pusad taluka, while the minimum value of 12.20 mg kg^{-1} was recorded in Kinhi village of Arni taluka and status of nitrate nitrogen depicted in Fig.10.

Table 3: Nitrogen status in soils of western part of the Yavatmal district

Soil sample	Available nitrogen (Kg ha^{-1})	NH_4^+ (mg Kg^{-1})	NO_3^- (mg Kg^{-1})
S ₁	190.43	22.50	20.70
S ₂	185.61	20.60	19.40
S ₃	196.70	23.40	21.20
S ₄	156.80	16.70	13.40
S ₅	190.07	22.40	19.10
S ₆	181.89	19.90	17.60
S ₇	165.98	17.20	15.80
S ₈	198.44	24.40	22.60
S ₉	170.26	18.20	16.50
S ₁₀	150.53	17.80	15.20
S ₁₁	170.98	22.40	19.30
S ₁₂	180.72	23.70	21.20
S ₁₃	197.25	25.40	23.10
S ₁₄	190.62	21.80	18.60
S ₁₅	165.43	19.50	17.40
S ₁₆	170.53	20.90	19.20
S ₁₇	196.26	24.40	23.60
S ₁₈	159.34	18.50	16.50
S ₁₉	161.89	19.80	17.80
S ₂₀	192.26	21.20	18.40

S ₂₁	175.62	22.80	21.40
S ₂₂	195.98	24.20	22.70
S ₂₃	185.17	22.60	19.60
S ₂₄	160.80	19.50	17.40
S ₂₅	180.98	21.60	20.80
S ₂₆	194.07	26.20	24.40
S ₂₇	189.89	24.40	22.80
S ₂₈	175.26	21.70	19.50
S ₂₉	196.44	25.80	22.10
S ₃₀	190.53	22.90	20.30
S ₃₁	178.62	19.70	18.30
S ₃₂	196.81	24.40	22.70
S ₃₃	173.62	19.80	17.40
S ₃₄	182.54	22.50	20.10
S ₃₅	191.81	23.60	22.50
S ₃₆	188.35	23.20	21.20
S ₃₇	187.17	21.40	19.60
S ₃₈	194.44	26.80	24.40
S ₃₉	165.26	17.60	15.80
S ₄₀	185.35	23.50	21.60
S ₄₁	185.53	21.40	18.30
S ₄₂	188.17	22.90	20.40
S ₄₃	173.07	19.50	17.70
S ₄₄	170.26	18.20	16.80
S ₄₅	178.98	20.40	19.60
S ₄₆	166.80	16.60	14.10
S ₄₇	160.07	15.80	12.20
S ₄₈	184.71	21.20	19.80
S ₄₉	198.98	25.50	23.70
S ₅₀	190.17	23.80	21.60
S ₅₁	186.72	21.80	19.40
S ₅₂	165.62	19.50	18.10
S ₅₃	174.35	20.40	16.50
S ₅₄	181.26	22.60	21.40
S ₅₅	196.17	25.80	24.60
S ₅₆	188.81	21.70	19.30
S ₅₇	192.99	23.60	22.80
S ₅₈	168.54	18.20	16.20
S ₅₉	192.71	24.80	23.30
S ₆₀	148.35	16.60	14.80
S ₆₁	182.26	21.80	19.30
S ₆₂	164.53	17.60	15.20
S ₆₃	158.71	15.20	13.40
S ₆₄	145.35	13.60	12.70
S ₆₅	177.98	19.40	18.20
S ₆₆	189.34	23.20	21.40
S ₆₇	188.53	22.80	19.80
S ₆₈	159.17	16.20	14.20
S ₆₉	176.80	18.40	17.60
S ₇₀	194.07	24.60	22.10
S ₇₁	180.53	20.70	19.50
S ₇₂	176.80	23.20	21.60
S ₇₃	188.98	24.40	22.80
S ₇₄	186.71	24.50	23.30
S ₇₅	163.07	19.60	17.20
S ₇₆	175.53	21.80	19.40
S ₇₇	192.62	25.20	23.70
S ₇₈	175.34	21.50	18.40
S ₇₉	160.26	18.40	16.60
S ₈₀	166.80	18.60	16.10
Mean	179.45	21.32	19.30
Range	145.35-198.98	13.60-26.80	12.20-24.60
C.V.	7.47	13.59	15.56

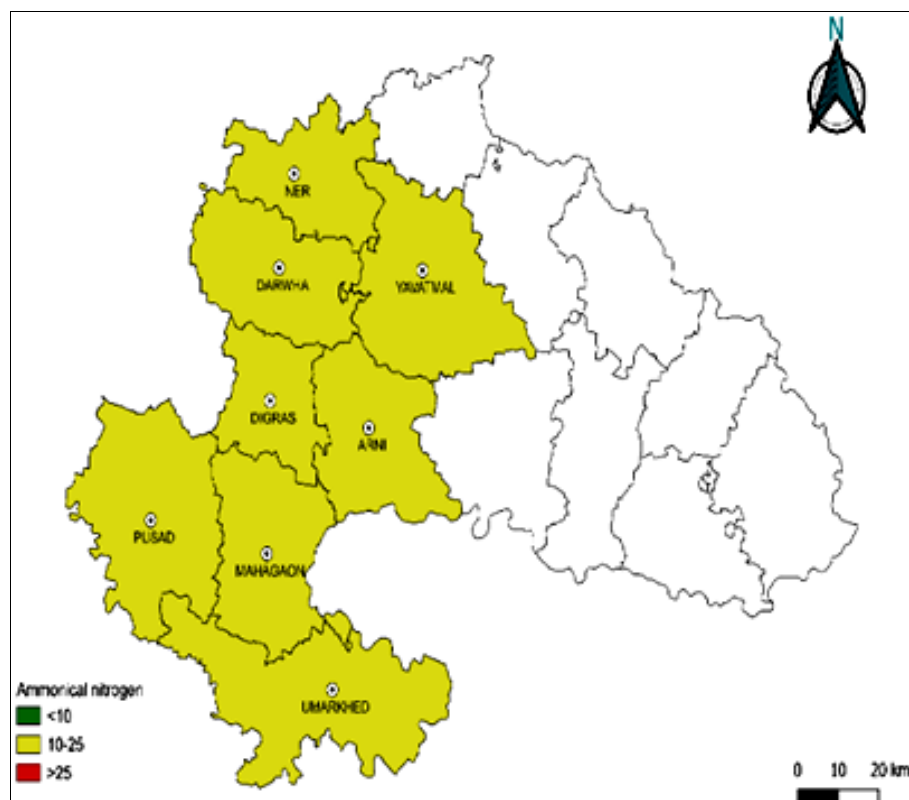


Fig 9: Map of NH_4^+ (mg kg^{-1}) in soils of western part of Yavatmal district

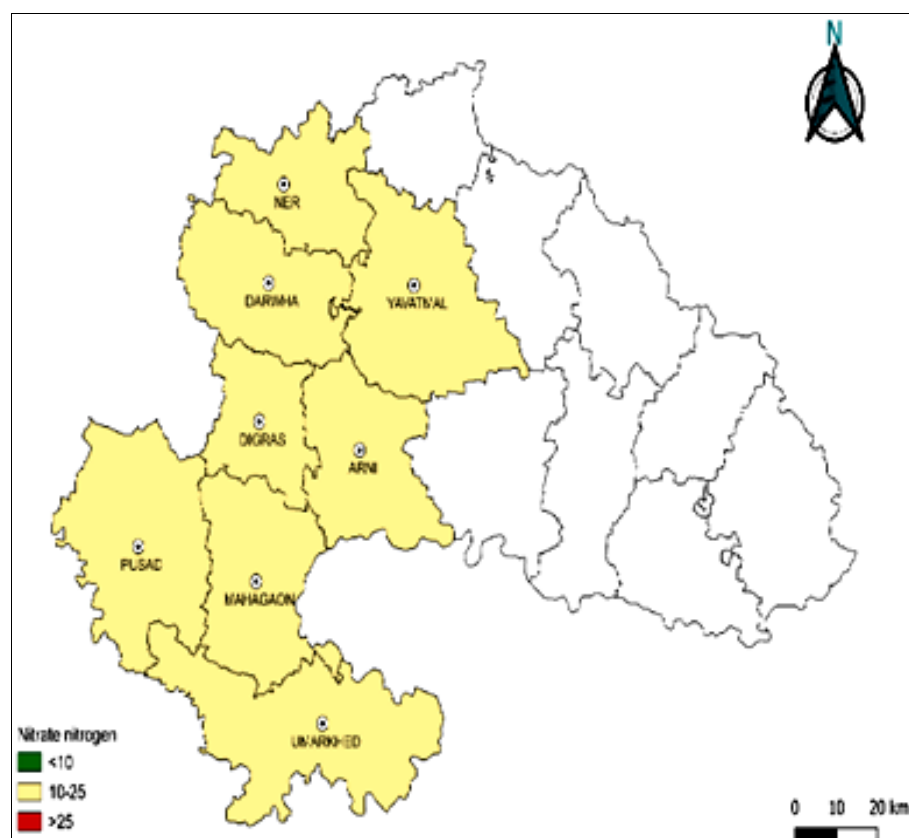


Fig 10: Map of NO_3^- (mg Kg^{-1}) in soils of western part of Yavatmal district

Conclusion

The present investigation it was concluded that the soils of western Yavatmal district were predominantly neutral to moderately alkaline and non-saline in nature. Organic carbon status varied from low to medium, while the majority of the soils were calcareous.

The overall available nitrogen status was low across the study area, indicating that nitrogen availability is an important nutrient constraint in these soils. Considerable spatial variation was observed in the concentrations of ammonical nitrogen and nitrate nitrogen among the eight talukas, reflecting differences in soil conditions and nitrogen dynamics. Yavatmal recorded the

highest mean concentrations of both ammonical and nitrate nitrogen, whereas Mahagaon recorded the lowest mean values.

The observed variation in soil nitrogen forms highlights the importance of site-specific nutrient management. Overall, balanced fertilization, appropriate nitrogen management and maintenance of soil organic matter are essential for improving soil fertility and sustaining crop productivity in the western part of Yavatmal district

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