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Assessment of inorganic nitrogen fractions and available Nitrogen in soils of eastern part of Yavatmal district in Vidarbha region

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Abstract

Nitrogen availability in soil is an important factor influencing crop growth and soil fertility, particularly in intensively cultivated areas. The present study was undertaken to assess the status of available nitrogen and inorganic nitrogen fractions in the soils of the eastern part of Yavatmal district in the Vidarbha region of Maharashtra. The study covered eight talukas, namely Babulgaon, Kalamb, Ghatanji, Ralegaon, Maregaon, Kelapur, Wani and Zari-Jamani. A total of 80 surface soil samples were collected from a depth of 0–15 cm from selected agricultural fields. The soil samples were analysed for pH, electrical conductivity, organic carbon, calcium carbonate, available nitrogen, ammonical nitrogen ($\text{NH}_4^+\text{-N}$) and nitrate nitrogen ($\text{NO}_3^-\text{-N}$). The soils were found to be neutral to moderately alkaline, with pH values ranging from 7.17 to 8.01 and a mean of 7.61. Electrical conductivity remained low, varying from 0.16 to 0.42 dS m^{-1} , while organic carbon ranged from 2.83 to 7.10 g kg^{-1} , with a mean of 4.51 g kg^{-1} . Calcium carbonate content varied from 4.00 to 9.88 per cent. The available nitrogen status of the soils was very low to low, with a mean content of 161.14 kg ha^{-1} and a range of 125.44 to 198.68 kg ha^{-1} . Ammonical nitrogen ranged from 13.60 to 24.80 mg kg^{-1} , with a mean of 18.12 mg kg^{-1} , whereas nitrate nitrogen varied from 12.60 to 24.90 mg kg^{-1} , with a mean of 17.75 mg kg^{-1} . The results showed considerable variation in the distribution of available nitrogen and its inorganic forms across the study area. Overall, the soils of eastern Yavatmal showed a low supply of available nitrogen, indicating the need to consider spatial variation in soil nitrogen status while planning nitrogen management for crop production. The study therefore provides useful information on the existing nitrogen status of agricultural soils in the eastern part of Yavatmal district.

Keywords: Available nitrogen, Ammonical nitrogen, Nitrate nitrogen, Inorganic nitrogen fractions, Yavatmal, Vidarbha

Introduction

The Yavatmal district is a prominent agricultural area within the Vidarbha region, sometimes referred to as Maharashtra's "Cotton District." The district encompasses a geographical expanse of over 13.52 lakh hectares, with nearly 9.61 lakh hectares dedicated to agriculture. Cotton, soybean, pigeon pea, and sorghum are the primary kharif crops, while wheat and chickpea are significant rabi crops. The region experiences an average yearly precipitation of approximately 926 mm, predominantly occurring during the monsoon period (Anonymous, 2024) [2]. The eastern part of Yavatmal district, comprising the talukas of Babulgaon, Kalamb, Ghatanji, Ralegaon, Maregaon, Kelapur, Wani, and Zari-Jamani.

Nitrogen is an element that is consistently insufficient in soil compositions. It holds an essential position in many metabolic routes in plants and constitutes a significant part of proteins, nucleic acids, chlorophyll, and certain hormones. It has been estimated that about 85 percent of the total nitrogen is in an organically bound state (Aggarwal *et al.*, 1990) [1]; according to Walia *et al.* (1998) [13], a smaller segment exists in inorganic forms, such as exchangeable $\text{NH}_4^+\text{-N}$, $\text{NO}_3^-\text{-N}$, and $\text{NO}_2^-\text{-N}$. The persistent application of organic amendments in conjunction with fertilizers might promote the mineralization and immobilization of nutrients for plants (Srivastava and Lal 1998) [11], consequently impacting the levels of various forms of nitrogen in the soil.

2. Materials and Methods

Yavatmal is a significant district within the Vidarbha region of Maharashtra and is located in the southeastern area of the state. The region is situated between 19°26' and 20°42' north latitudes and 77°18' and 79°09' east longitudes, corresponding to the Survey of India Toposheets 55-L, 55-P, 56-I, and 56-M. The district encompasses an approximate geographical expanse of 13,594 square kilometers and is bordered by Amravati District to the north, Wardha District to the northeast, Chandrapur District to the east, Nanded District to the southwest, and

Adilabad District of Telangana State to the south and southeast. The current study was conducted in the eastern region of Yavatmal district, which includes eight talukas: Babulgaon, Kalamb, Ghatanji, Ralegaon, Maregaon, Kelapur (Pandharkawda), Wani, and Zari-Jamani. The research zone constitutes a significant agricultural expanse within the Vidarbha region, distinguished by its primarily black soils. The eighty corresponding surface soil samples (0–15 cm) were collected from selected fields of eight talukas.

Table 1: Sites of sampling

Sample No.	Farmer name	Taluka	Village name	Latitude	Longitude
S ₁	Praful Ramchandra Ivate	Babulgaon	Veni	20.528784	78.262031
S ₂	Baliram Chintaman Sahare	Babulgaon	Madani	20.481895	78.258299
S ₃	Sanjay Janardhan Alone	Babulgaon	Mubarakpur	20.588874	78.25146
S ₄	Mukind Dyanedhwar Renghe	Babulgaon	Sawangi	20.583536	78.258534
S ₅	Yogesh Madan Raut	Babulgaon	Chimnapur	20.512947	78.117193
S ₆	Dharmpal Dhomaji Wankhade	Babulgaon	Umari	20.506463	78.151622
S ₇	Rameshwar Mahadev Raut	Babulgaon	Gondhali	20.614507	78.234838
S ₈	Shankarrao Dasharath Arade	Babulgaon	Wadgaon	20.609064	78.251238
S ₉	Pravin Gangadhar Ashtkar	Babulgaon	Gimona	20.549219	78.135659
S ₁₀	Vasudev Vittal Zate	Babulgaon	Antargaon	20.528456	78.134775
S ₁₁	Sanjay Premdas Wagade	Kalamb	Narsapur	20.473472	78.287861
S ₁₂	Praful Hanuman Kothari	Kalamb	Mawalni	20.394203	78.297215
S ₁₃	Hemant Vasant Malkapure	Kalamb	Manjarwaghal	20.475209	78.39185
S ₁₄	Gajanan Balkrushan Muke	Kalamb	Nimbhora	20.482316	78.408946
S ₁₅	Deorao Kisan Tandulkar	Kalamb	Shingnapur	20.46071	78.364788
S ₁₆	Manisha Vijay Gedekar	Kalamb	Sonegaon	20.487675	78.389866
S ₁₇	Gajanan Bhimrao Dhole	Kalamb	Mawalni	20.481877	78.373427
S ₁₈	Mineshvar Tumbak Hande	Kalamb	Wandli	20.506575	78.413508
S ₁₉	Dawat Bapurao Varhade	Kalamb	Ichora	20.482206	78.307321
S ₂₀	Kishana Bapurao Thakare	Kalamb	Asthi	20.476052	78.312007
S ₂₁	Sudaman Sakharan Ingole	Ghatanji	Khapri	20.117698	78.35555
S ₂₂	Nutan Sagar Kawale	Ghatanji	Yevti	20.166258	78.27919
S ₂₃	Maroti Ramkrushna Atram	Ghatanji	Wasri	20.094186	78.370646
S ₂₄	Madhav Vithobaji Kothakar	Ghatanji	Undarni	20.052417	78.220902
S ₂₅	Pankaj Govinda Gawande	Ghatanji	Shiroli	20.074132	78.241163
S ₂₆	Santosh Laxman Kothekar	Ghatanji	Shiroli	20.073039	78.249319
S ₂₇	Shashikala Vasanta Kardbhuje	Ghatanji	Rampur	20.052579	78.225884
S ₂₈	Premila Goverdhan Kadu	Ghatanji	Junoni	20.072734	78.2785
S ₂₉	Datta Bapurao Jamdapure	Ghatanji	Murli	20.156776	78.282421
S ₃₀	Kishor Gunaji Borkute	Ghatanji	Akpuri	20.184544	78.575746
S ₃₁	Rajeshwar Narayan Meshram	Ralegaon	Sawarkhed	20.229915	78.592197
S ₃₂	Govinda Bhutu Rampure	Ralegaon	Ghubadheti	20.243648	78.585917
S ₃₃	Ashok Gangadhar Dambhare	Ralegaon	Atmardi	20.287555	78.614695
S ₃₄	Dyaneshwar Tulshiram Bondade	Ralegaon	Wardh	20.225766	78.56351
S ₃₅	Praful Ramaji Pazare	Ralegaon	Loni	20.266935	78.546264
S ₃₆	Ashok Rajanna Guntawar	Ralegaon	Sakhi-Kh	20.236045	78.528829
S ₃₇	Megha Mithun Shendre	Ralegaon	Loni	20.2632	78.52296
S ₃₈	Uttam Zitruji Gujarkar	Ralegaon	Pimpalgaon	20.324697	78.626294
S ₃₉	Dilip Sadashiv Thakare	Ralegaon	Sarati	20.259412	78.509421
S ₄₀	Gajanan Gulab Lende	Ralegaon	Kopari	20.39151	78.575595
S ₄₁	Rekha Gondibaba Khiratkar	Maregaon	Dhamani	20.13032	78.78996
S ₄₂	Mahadev J. Pachbhai	Maregaon	Hatwanjari	20.07591	78.71873
S ₄₃	Subhash Dadaji Rampure	Maregaon	Khekadwai	20.0653	78.6468
S ₄₄	Dursing Lakshman Jadhav	Maregaon	Vasantnagar	20.06629	78.6468
S ₄₅	Dinkar Kashinath Nehare	Maregaon	Ghoguldara	20.117957	78.703581
S ₄₆	Kashiram Letu Atram	Maregaon	Bihadipod	20.151832	78.70996
S ₄₇	Anil Bhaskar Wankhade	Maregaon	Jankaipod	20.05874	78.69641
S ₄₈	Baliram Shamrao Alam	Maregaon	Mendhani	20.11824	78.72711
S ₄₉	Madhukar Warlu Mathankar	Maregaon	Jankaipod	20.06685	78.682528
S ₅₀	Pundalik Shankar Pimapsalshende	Maregaon	Mendhani	20.11824	78.72711
S ₅₁	Umesh Pandurang Markhande	Kelapur	Padha	20.09076	78.59119
S ₅₂	Nareish Haribhau Kale	Kelapur	Padha	20.87051	78.59828
S ₅₃	Umesh Ramdas Wad	Kelapur	Konghara	20.07257	78.54844
S ₅₄	Devidas Vitthal Wad	Kelapur	Konghara	20.07341	78.55061

S ₅₅	Anil Namdev Punekar	Kelapur	Karanwadi	20.08831	78.43966
S ₅₆	Varsha Chandrakant Raut	Kelapur	Belori	19.98168	78.5788
S ₅₇	Shashikala Dubaji Thakre	Kelapur	Belori	19.97385	78.53838
S ₅₈	Anil Vasanta Deshattiwar	Kelapur	Marath Wakadi	19.98673	78.51228
S ₅₉	Rahul M. Nehare	Kelapur	Tad Umari	19.98015	78.56449
S ₆₀	Ramjan S. Jatu	Kelapur	Tad Umari	20.01432	78.57324
S ₆₁	Vijay Ganpat Dongarkar	Wani	Keshav Nagar	19.89594	78.97919
S ₆₂	Suryabhan Sambhaji Rasekar	Wani	Welabai	19.89217	78.98098
S ₆₃	Surendra Jagannath Nande	Wani	Chargaon	19.97905	78.99225
S ₆₄	Kartik Bapuji Wasekar	Wani	Shelu	19.98315	79.01356
S ₆₅	Jayant Vijay Asutkar	Wani	Borgaon	19.91411	78.97588
S ₆₆	Ganesh Dattu Chincholkar	Wani	Mendholi	19.94299	78.94867
S ₆₇	Shantaram Hepat	Wani	Bhalar	20.02478	79.03908
S ₆₈	Nilesh Asutkar	Wani	Bhalar	20.02477	79.03908
S ₆₉	Praful Pandharinath Kale	Wani	Wargaon	19.97202	78.98281
S ₇₀	Shyam Bapurao Vaidya	Wani	Wargaon	19.98048	78.97897
S ₇₁	Dinesh Madhavarao Mavale	Zari-Jamani	Yeoti	19.825089	78.756192
S ₇₂	Sadhana Satish Sarad	Zari-Jamani	Muchhi	19.851372	78.750897
S ₇₃	Madhumati Kisanrao Thakare	Zari-Jamani	Kodpakhindi	19.880906	78.708572
S ₇₄	Harshal Manohar Hemane	Zari-Jamani	Chalbardi	19.856064	78.7132
S ₇₅	Aravind Balkrushna Bahale	Zari-Jamani	Mangurla Kh	19.874078	78.72885
S ₇₆	Ramdas Namdeo Mithe	Zari-Jamani	Zari	19.854603	78.724492
S ₇₇	Gopal Chintaman Dahare	Zari-Jamani	Zari	19.854358	78.720164
S ₇₈	Suvarna Chintaman Shende	Zari-Jamani	Pandharkawada	19.847722	78.796536
S ₇₉	Vasudeo Laxman Tandulkar	Zari-Jamani	Marki Bk	19.850206	78.774686
S ₈₀	Vanita Ramdas Thakare	Zari-Jamani	Marki Kh	19.864989	78.777992

A 1:2.5 soil-water suspension was used to determine the pH and electrical conductivity of the soil (Jackson, 1973) [8]. Organic carbon was determined by the modified Walkley and Black method was followed by Jackson, (1973) [8]. Whereas calcium carbonate was estimated using rapid titration method described

by Piper (1966) [10]. The available nitrogen was estimated through alkaline permanganate method as suggested by Subbiah and Asija (1956) [12]. Soil nitrogen fractions, viz., NH₄-N and NO₃-N were determined by the MgO-Devarda alloy steam distillation method described by Bremner (1965) [7].

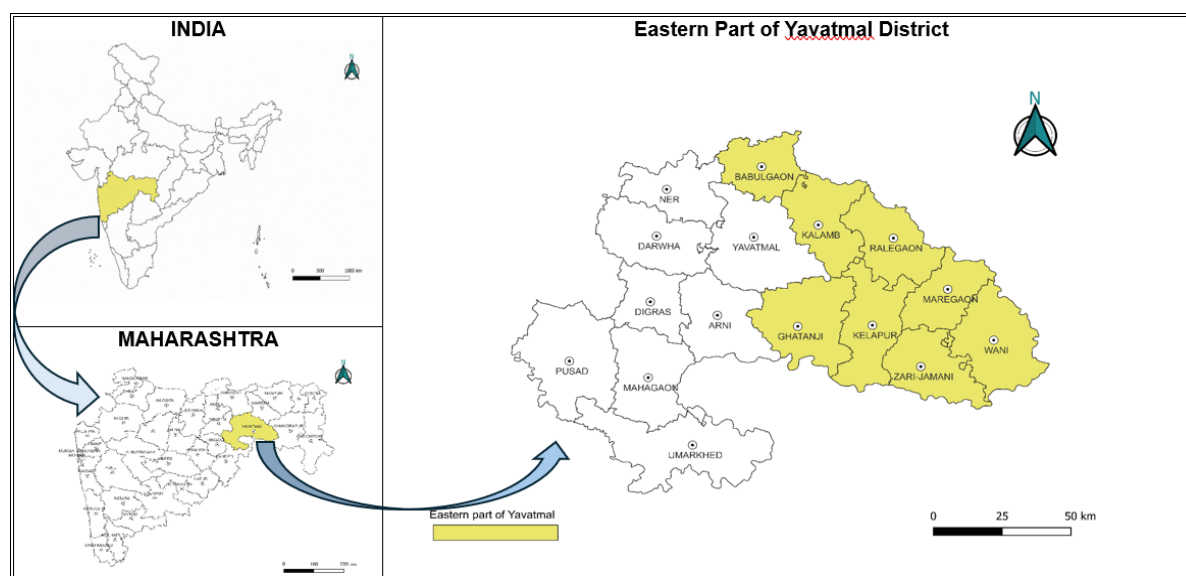


Fig 1: Geographical location of the study area

3. Results and Discussion

3.1 Soil properties

the soils of the eastern parts of Yavatmal are neutral to moderately alkaline, with the mean soil pH being 7.61 and values ranging from 7.17 to 8.01. The lowest pH of soil, 7.17, was recorded in the Mawalni village of Kalamb and the Ghoguldara village of Maregaon, and the highest pH, 8.01, was observed in the Madani village of Babulgaon taluka. The pH results obtained in the present study agreed with the findings of Bhokare and Wankhade (2024) [6, 14] and Bhaskar *et al.* (2026) [4]. While electrical conductivity (EC) of the soil samples in the eastern region of Yavatmal ranged from 0.16 dS m⁻¹ to 0.42 dS

m⁻¹, with the mean of 0.31 dS m⁻¹, the maximum EC of 0.42 dS m⁻¹ was recorded in the Wargaon village of Wani taluka, and the minimum EC of 0.16 dS m⁻¹ was observed in the Junoni and Akpuri villages of Ghatanji taluka. Bhokare and Wankhade (2025) [6, 14] and Bhaskar *et al.* (2026) [4] reported similar levels of soil electrical conductivity. The organic carbon (OC) content in eastern parts of Yavatmal is low to moderately high, with a mean of 4.51 g kg⁻¹ ranging from the lowest 2.83 g kg⁻¹ in Shiroli village in Ghatanji taluka to the highest 7.10 g kg⁻¹ in the Keshav Nagar and Wargaon villages of Wani taluka. The present organic carbon results are consistent with the findings of Jangir *et al.* (2019) [9] and Bhagat *et al.* (2024) [3], who also

identified analogous changes in soil organic carbon concentration. The Mubarakpur village of Babulgaon taluka has the highest 9.88 percent calcium carbonate (CaCO_3) content, while the Konghara village of Kelapur taluka has a minimum of

4.00 percent CaCO_3 content. The mean CaCO_3 content in eastern regions of Yavatmal is 7.85 percent. The findings of CaCO_3 in the present study were comparable to those of Wankhade (2015) [14].

Table 2. Chemical properties of soils in eastern parts of the Yavatmal district

Soil sample	pH	E.C. (dSm^{-1})	O.C. (g kg^{-1})	CaCO_3 (%)
S ₁	7.82	0.40	4.91	8.00
S ₂	8.01	0.40	3.33	8.38
S ₃	7.94	0.31	3.26	9.88
S ₄	7.81	0.39	4.74	9.38
S ₅	7.96	0.33	3.93	9.75
S ₆	7.83	0.35	5.76	9.13
S ₇	7.65	0.30	5.68	8.63
S ₈	7.98	0.38	4.87	9.63
S ₉	7.72	0.39	4.53	8.13
S ₁₀	7.45	0.29	4.66	7.88
S ₁₁	7.42	0.30	3.24	9.85
S ₁₂	7.17	0.32	4.15	9.13
S ₁₃	7.29	0.31	5.26	7.25
S ₁₄	7.19	0.25	2.94	9.00
S ₁₅	7.56	0.40	4.46	8.59
S ₁₆	7.24	0.30	4.67	8.00
S ₁₇	7.31	0.27	3.85	8.78
S ₁₈	7.34	0.31	4.33	7.56
S ₁₉	7.32	0.40	3.16	7.86
S ₂₀	7.28	0.29	4.15	7.67
S ₂₁	7.90	0.17	4.01	7.12
S ₂₂	7.51	0.19	3.34	8.87
S ₂₃	7.58	0.21	3.25	9.62
S ₂₄	7.80	0.26	3.35	8.12
S ₂₅	7.66	0.17	2.83	9.62
S ₂₆	7.61	0.25	3.67	9.00
S ₂₇	7.54	0.17	4.18	9.50
S ₂₈	7.48	0.16	4.24	5.37
S ₂₉	7.91	0.17	3.56	9.75
S ₃₀	7.65	0.16	4.14	7.87
S ₃₁	7.82	0.28	4.13	8.63
S ₃₂	7.61	0.34	4.83	8.14
S ₃₃	7.65	0.27	3.84	8.46
S ₃₄	7.58	0.34	2.97	9.52
S ₃₅	7.84	0.36	3.53	7.93
S ₃₆	7.44	0.27	4.60	9.00
S ₃₇	7.76	0.30	4.34	9.12
S ₃₈	7.86	0.39	4.27	7.96
S ₃₉	7.54	0.27	3.77	9.00
S ₄₀	7.32	0.26	5.33	6.20
S ₄₁	7.57	0.38	5.83	6.94
S ₄₂	7.49	0.38	4.15	9.23
S ₄₃	7.58	0.37	4.35	7.16
S ₄₄	7.52	0.35	4.91	8.94
S ₄₅	7.17	0.30	4.74	7.35
S ₄₆	7.85	0.40	4.43	9.67
S ₄₇	7.81	0.40	5.16	8.24
S ₄₈	7.62	0.38	4.22	9.10
S ₄₉	7.71	0.31	4.19	9.42
S ₅₀	7.43	0.37	5.25	8.82
S ₅₁	7.57	0.29	3.78	8.25
S ₅₂	7.58	0.35	5.87	5.75
S ₅₃	7.57	0.27	4.52	5.13
S ₅₄	7.27	0.25	6.31	4.00
S ₅₅	7.71	0.30	4.22	5.38
S ₅₆	7.62	0.32	4.97	7.63
S ₅₇	7.73	0.31	5.57	5.25
S ₅₈	7.42	0.27	4.82	6.00
S ₅₉	7.86	0.38	3.93	4.63

S ₆₀	7.39	0.26	4.22	6.88
S ₆₁	7.52	0.31	7.10	6.38
S ₆₂	7.42	0.30	6.66	5.63
S ₆₃	7.63	0.31	6.81	5.38
S ₆₄	7.71	0.33	4.97	7.00
S ₆₅	7.82	0.36	5.16	4.88
S ₆₆	7.80	0.40	5.57	4.63
S ₆₇	7.72	0.38	6.21	5.50
S ₆₈	7.73	0.30	4.07	7.88
S ₆₉	7.96	0.42	5.27	6.13
S ₇₀	7.71	0.39	7.10	5.50
S ₇₁	7.72	0.37	4.32	9.63
S ₇₂	7.48	0.29	4.52	9.25
S ₇₃	7.58	0.32	3.81	8.88
S ₇₄	7.59	0.34	3.74	6.83
S ₇₅	7.43	0.26	4.61	7.14
S ₇₆	7.89	0.41	4.51	9.55
S ₇₇	7.31	0.25	5.25	7.56
S ₇₈	7.68	0.26	4.23	6.93
S ₇₉	7.76	0.31	3.33	9.67
S ₈₀	7.41	0.23	3.92	8.97
Mean	7.61	0.31	4.51	7.85
Range	7.17-8.01	0.16-0.42	2.83-7.10	4.00-9.88
C.V.	2.76	21.49	21.11	19.65

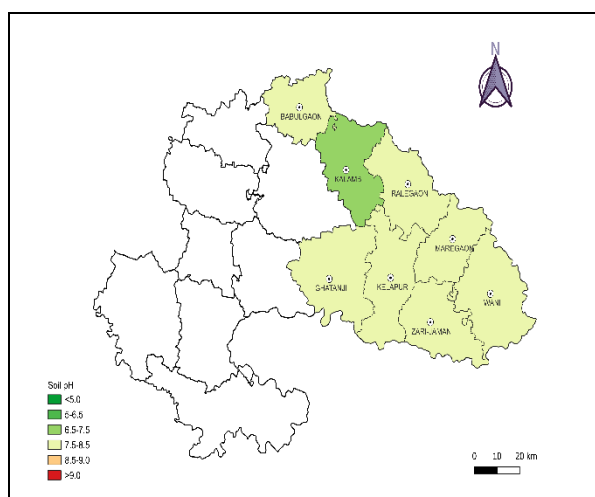
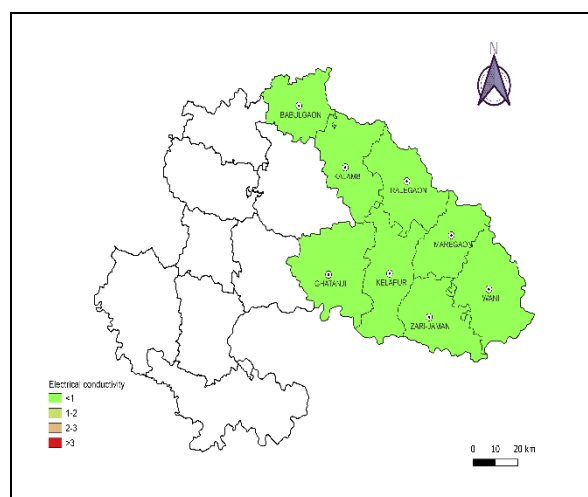
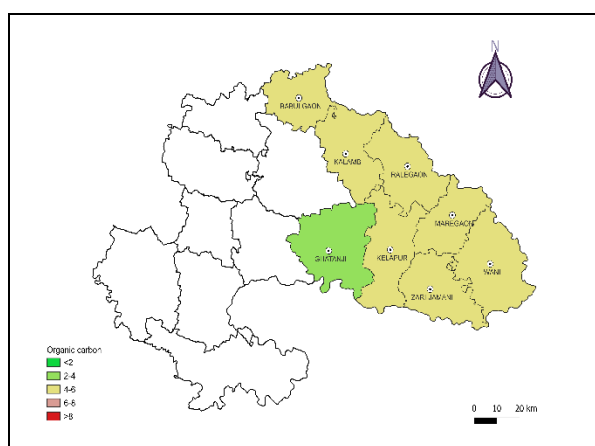
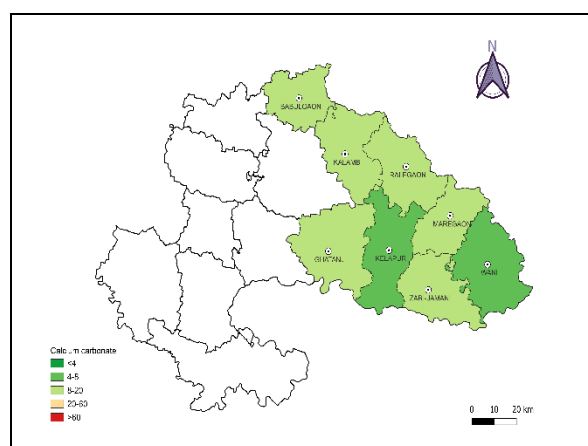


Fig 2: Spatial distribution of soil pH in the study area

Fig 3: Spatial distribution of EC (dSm⁻¹) in the study areaFig 4: Spatial distribution of OC (g Kg⁻¹) in the study areaFig 5: Spatial distribution of CaCO₃ (%) in the study area

3.2 Available nitrogen

The available nitrogen content of soil is presented in Table 3. In the soils of the eastern parts of the Yavatmal district, the status of available nitrogen is very low to low. The mean value of

available nitrogen in the study area is 161.14 kg ha⁻¹, ranging from a minimum of 125.44 kg ha⁻¹, recorded in Wasri village of Ghatanji taluka, to a maximum of 198.68 kg ha⁻¹, recorded in Padha village of Kelapur taluka. The existing findings were

similar to the outcomes reported by Jangir *et al.* (2019)^[9].

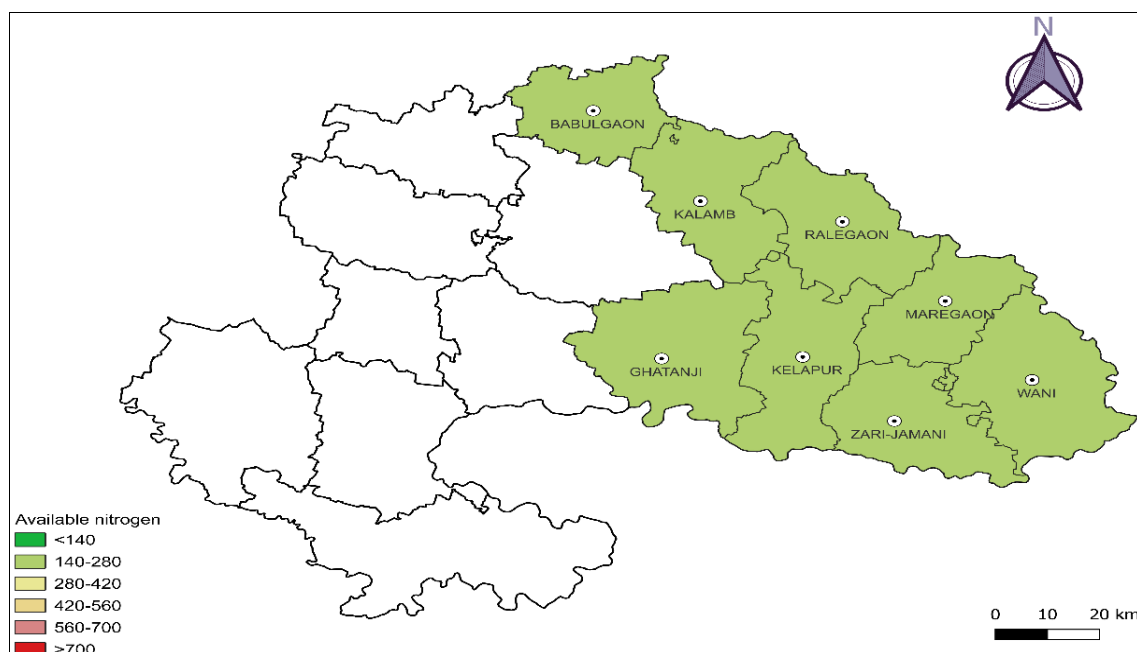


Fig 6: Spatial distribution of available nitrogen (kg ha^{-1}) in the soils of the study area

3.3 Inorganic nitrogen fractions

The mean ammonical nitrogen ($\text{NH}_4^+\text{-N}$) content of the soil samples collected from the selected eight talukas is 18.12 mg kg^{-1} . Values of ammonical nitrogen range from 13.60 mg kg^{-1} to 24.80 mg kg^{-1} , with the highest ammonical nitrogen content observed in Padha village of Kelapur taluka and the lowest ammonical nitrogen content in Shirol village of Ghatanji taluka

and Atmudi village of Ralegaon taluka. Nitrate nitrogen ($\text{NO}_3^-\text{-N}$) content of the soil ranges from 12.60 mg kg^{-1} to 24.90 mg kg^{-1} with a mean of 17.75 mg kg^{-1} . Lowest nitrate nitrogen ($\text{NO}_3^-\text{-N}$) content of the soils in eastern parts of the Yavatmal district is in the Vasantnagar village of Maregaon taluka and highest in the the Wargaon village Wani taluka.

Table 3: Available nitrogen and Inorganic nitrogen fractions in soils of eastern parts of the Yavatmal district

Soil sample	Available nitrogen (Kg ha^{-1})	NH_4^+ (mg Kg^{-1})	NO_3^- (mg Kg^{-1})
S ₁	179.26	20.10	21.60
S ₂	155.27	17.20	21.90
S ₃	150.64	15.60	19.80
S ₄	175.62	18.00	19.60
S ₅	170.54	18.50	18.70
S ₆	188.16	23.50	21.60
S ₇	187.61	23.10	22.10
S ₈	189.26	23.50	23.20
S ₉	169.38	21.50	20.60
S ₁₀	156.80	16.80	17.30
S ₁₁	137.97	13.80	14.10
S ₁₂	150.53	16.80	14.80
S ₁₃	179.35	16.80	17.60
S ₁₄	130.90	14.50	16.30
S ₁₅	146.35	16.70	17.60
S ₁₆	163.06	14.60	16.40
S ₁₇	144.26	17.40	15.60
S ₁₈	156.80	18.40	16.60
S ₁₉	154.53	14.70	16.20
S ₂₀	163.06	17.60	15.80
S ₂₁	163.06	16.40	14.40
S ₂₂	137.97	16.80	14.30
S ₂₃	125.44	16.60	15.40
S ₂₄	144.25	14.20	15.80
S ₂₅	131.25	13.60	13.80
S ₂₆	156.90	16.80	16.30
S ₂₇	154.21	16.80	15.60
S ₂₈	170.53	18.20	14.60
S ₂₉	126.63	13.90	14.80

S ₃₀	166.80	17.60	16.50
S ₃₁	169.34	18.40	16.80
S ₃₂	170.32	17.60	15.90
S ₃₃	160.44	13.60	14.80
S ₃₄	144.25	14.40	13.70
S ₃₅	148.66	16.90	14.60
S ₃₆	163.07	14.40	15.60
S ₃₇	165.35	14.20	16.60
S ₃₈	175.61	16.80	14.20
S ₃₉	156.80	13.80	13.20
S ₄₀	175.61	18.60	17.20
S ₄₁	168.35	22.40	16.90
S ₄₂	149.08	14.80	12.80
S ₄₃	140.63	16.40	16.60
S ₄₄	159.62	14.80	12.60
S ₄₅	154.28	17.60	15.20
S ₄₆	152.39	14.40	13.10
S ₄₇	160.73	17.60	15.40
S ₄₈	148.67	19.60	13.40
S ₄₉	146.90	16.80	14.40
S ₅₀	164.49	18.40	19.30
S ₅₁	150.21	24.80	23.40
S ₅₂	198.68	22.40	23.20
S ₅₃	168.58	18.70	20.60
S ₅₄	197.88	23.60	23.10
S ₅₅	188.74	22.40	22.60
S ₅₆	162.74	18.60	20.20
S ₅₇	190.36	20.40	21.60
S ₅₈	176.17	20.50	19.60
S ₅₉	152.34	18.20	18.70
S ₆₀	167.53	18.50	20.40
S ₆₁	188.16	23.50	22.50
S ₆₂	181.89	23.70	23.30
S ₆₃	177.32	23.20	23.80
S ₆₄	164.50	22.80	23.20
S ₆₅	175.26	22.20	23.30
S ₆₆	157.63	21.60	21.20
S ₆₇	163.07	21.60	23.40
S ₆₈	169.34	22.40	21.60
S ₆₉	156.80	18.60	19.10
S ₇₀	188.26	23.70	24.90
S ₇₁	154.63	17.00	16.60
S ₇₂	148.76	16.20	16.90
S ₇₃	137.98	15.40	15.30
S ₇₄	142.52	14.60	15.30
S ₇₅	163.07	16.80	15.70
S ₇₆	156.80	18.40	16.10
S ₇₇	178.34	18.60	16.80
S ₇₈	150.49	17.60	15.30
S ₇₉	136.64	15.40	15.80
S ₈₀	145.28	16.80	15.30
Mean	161.14	18.12	17.75
Range	125.44-198.68	13.60-24.80	12.60-24.90
C.V.	10.31	16.88	18.78

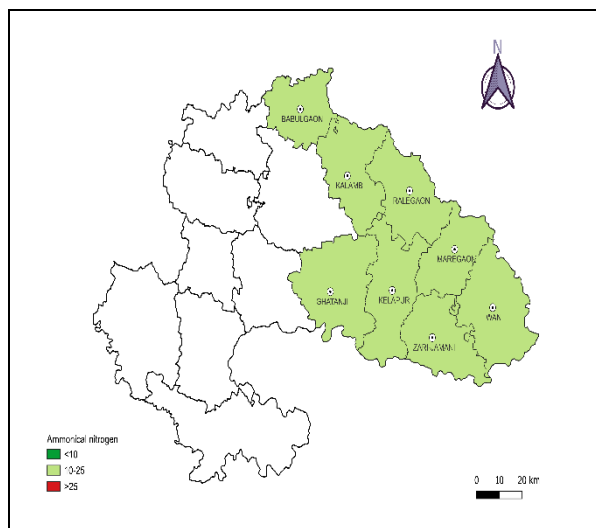


Fig 7: Spatial distribution of NH_4^+ (mg kg^{-1}) in the study area

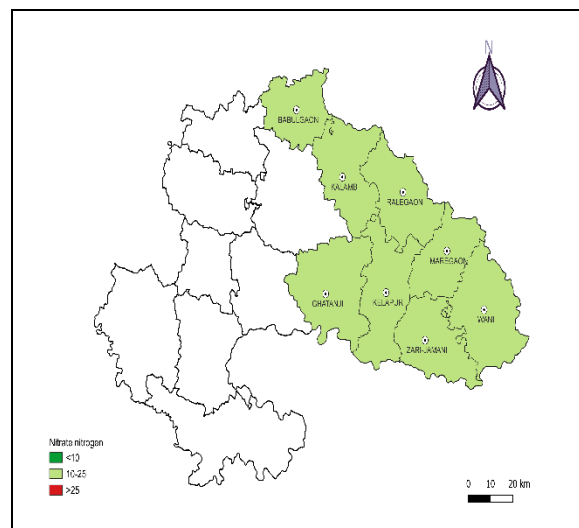


Fig 8: Spatial distribution of NO_3^- (mg kg^{-1}) in the study area

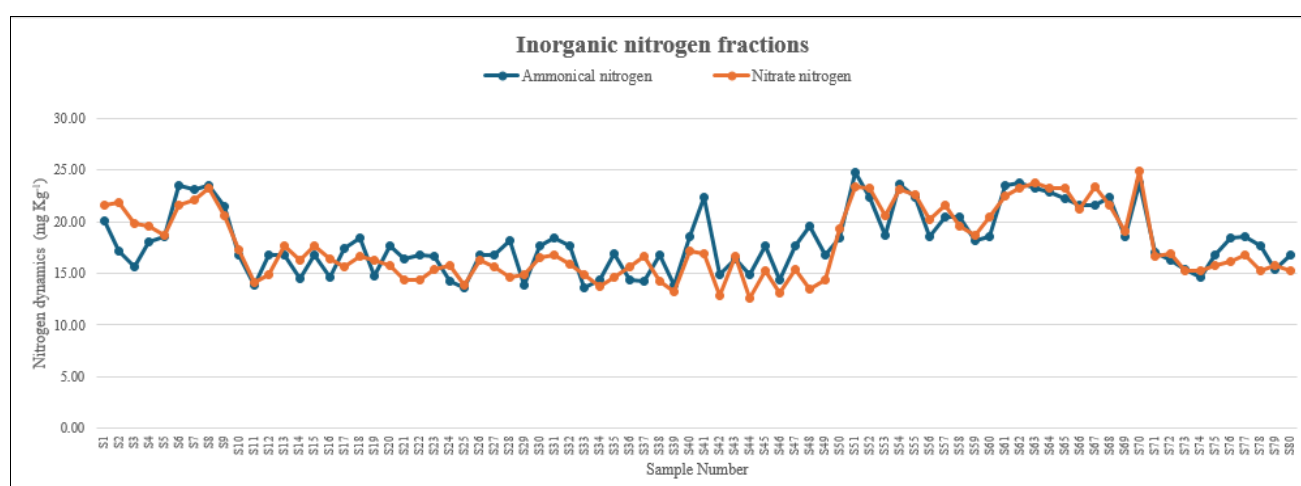


Fig. 8: Inorganic nitrogen fractions in soils of study area

4. Conclusion

The present study assessed the available nitrogen and inorganic nitrogen fractions in the soils of the eastern part of Yavatmal district covering eight talukas and 80 surface soil samples. The soils were generally neutral to moderately alkaline, with low electrical conductivity and variable organic carbon and calcium carbonate contents. The mean soil pH, EC, organic carbon and CaCO_3 were 7.61, 0.31 dS m^{-1} , 4.51 g kg^{-1} and 7.85 per cent, respectively. The available nitrogen status of the soils was found to be very low to low, with values ranging from 125.44 to 198.68 kg ha^{-1} and a mean of 161.14 kg ha^{-1} . Considerable variation was also observed among the sampling locations. The inorganic nitrogen fractions showed mean $\text{NH}_4^+\text{-N}$ and $\text{NO}_3^-\text{-N}$ contents of 18.12 and 17.75 mg kg^{-1} , respectively, with ranges of 13.60–24.80 and 12.60–24.90 mg kg^{-1} . Overall, the study indicates that nitrogen is an important limiting nutrient in the agricultural soils of eastern Yavatmal. The variation observed in available nitrogen, ammonical nitrogen and nitrate nitrogen across the study area reflects differences in soil properties and nutrient dynamics. Therefore, proper assessment of soil nitrogen status and balanced nitrogen management based on local soil conditions are important for maintaining soil fertility and supporting sustainable crop production in the region.

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