International Journal of
Life Sciences
International Peer Reviewed Open Access Refereed Journal

Special Issue A 12: March 2018:44-48
UGC Approved Journal No 48951

Original Article Open Access

# Soil fertility status under Rice based cropping systems in Gadchiroli Tehsil, Maharashtra, India

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**Manuscript details:**

Available online on
http://www.ijlsci.in

ISSN: 2320-964X (Online)
ISSN: 2320-7817 (Print)

**Editor: Dr. Arvind Chavhan**

**Cite this article as:**
Satpute GD, Rewatkar SB, Gupta RG (2018) Soil fertility status under Rice based cropping systems in Gadchiroli Tehsil, Maharashtra, India, *Int. J. of. Life Sciences*, Special Issue, A12: 44-48.



**ABSTRACT**

The present investigation was undertaken the study of soil fertility status under rice cropping in different villages of Gadchiroli Tehsil of Gadchiroli District (M.S). Ten villages are taken under the study. These villages are Gadchiroli, Gogaon, Amirza, Ambeshiwani, Dongarrgaon (Tukum), Lanzeda, Navegaon, Porla, Potegaon, Yewali. The soil samples were taken from 0-15 cm with the auger before and after the rice cultivation during the year 2014-15 and 2015-16. The pH values of soils in all the villages slightly acidic in nature varied from 5.99 to 6.11. The mean values of EC were found a range varying from 0.05 to 0.13ds/m. with the safe limit. Organic carbon was found in low range. The fertility status of soil could be evaluated using nutrient index method and fertility indicator. Evaluated nutrient index of soil using organic carbon, the soil samples showed low level.

**Keywords:** soil fertility, rice crop, Gadchiroli tehsil, Maharashtra.

## INTRODUCTION

Soil, the source of life, is the most vital and valuable natural resource which is not renewable quickly. Soil fertility is a dynamic natural property that can change through the impact of natural and human derived factors (Kavitha et al., 2015). Having detailed knowledge about soil fertility is a prerequisite for assessing the long-term impact of new intensive rice production technologies on paddy soils (Dobermann et al., 1997). An assessment of the soil fertility status by using a soil index could provide key information to improve strategies and effective techniques for the future to achieve sustainable agriculture. Soil Fertility Index (SFI) values can be used to develop fertility maps and make recommendations based on soil spatial variability in fertility management. The analysis, which allows the identification of the main limiting factors for agricultural production, and enables decision makers to enhance high quality crop

management, can increase land productivity (Rabia, 2012).

Soil fertility is defined as 'a measure by its capacity to support population of plants and animals above ground, flora and fauna below ground'. In other words, soil fertility is 'the state of a soil with respect to its ability to supply elements essential nutrients for plant growth without toxicity effect. Concentrations of any element'. This definition has not been true for all soils and as a result, the productivity of such soils is impaired. Productivity therefore is a characteristic of a soil to adequately support plants growing on it. (Abdullahi, (1997).

In India, low fertility of soils is the major constraint to achieving high productivity goals (SLUSI, 2010). In many parts of the country, soil fertility fluctuates throughout the growing season each year due to alteration in the quantity and availability of mineral nutrients through the addition of fertilizers, manure, compost, mulch, and lime in addition to leaching (Denis et al. 2017).

The fertility status of soils can be evaluated using nutrient index methods and fertility indicators. (RaviKumar and Somashekar, 2013), evaluated the nutrient index of soils using organic carbon, available P and available K concentrations as a measure of soil fertility in Varahi River basin, India. Similarly, fertility status of soils of several micro watersheds in Karnataka has been mapped and the nutrient status of these areas is well documented (Vishwanath, 2008; Pulakeshi et al., 2012; Vidyavathi, 2012). However, the fertility status of soils of Gadchiroli area yet not studied. Hence, we have chosen Soil fertility status under rice based cropping systems in Gadchiroli Tehsil, Maharashtra.

## MATERIAL AND METHODS

The study was carried out in 10 villages namely Gadchiroli, Gogaon, Amirza, Ambeshiwani, Dongarrgaon (Tukum), Lanzeda, Navegaon, Porla, Potegaon, Yewali. The soil samples were taken from 0-15 cm depth with the help of auger of 20 sites were randomly selected in each form; soil sampling was done in a zigzag pattern within each field and mixed thoroughly following a standard procedure for soil sampling and sample preparation (Andreas and Berndt, 2005). All the collected samples were air dried in shade, crushed gently with pestle and mortar, and then sieved through 2.0 mm sieve to obtain a uniform soil sample. The samples were analyzed for physicochemical properties by using standard methods of analysis for soil pH, electrical conductivity (EC) and soil organic carbon (OC).

## RESULTS AND DISCUSSION

### Soil pH

The measure of soil pH is an important parameter which helps in identification of chemical nature of the soil (Shalini et al., 2003), as it measures hydrogen ion concentration in the soil to indicate its acidic and alkaline nature of the soil. It follows from 0 to 7 are diminishing acidic, 7 to 14 increasing alkaline and 7 is neutral.

In the ten samples of Gadchiroli Tehsil, the variation of pH in June 2015 is from 6.00 to 6.11. The variation of pH in Dec. 2015 is from 6.00 to 6.08. The variation of pH in June 2016 is from 6.03 to 6.11. The variation of pH in Dec 2016 is from 5.99 to 6.11 were found.

### Electrical Conductivity (EC)

The electrical conductivity (EC) is the measure of the soluble salts present in the soil and is affected by cropping sequence, irrigation, land use and application of fertilizers, manure, and compost (Singh et al., 2016). High value of electrical conductivity represents higher degree of salinity. Excessive amount of dissolved salts in soil solutions causes hindrance in normal nutrient uptake process by either imbalance of ions uptake, antagonistic effect between nutrients or excessive osmotic potentials of soil solution or a combination of the three effects (Rahman et al., 2010).

In the ten samples of Gadchiroli Tehsil, the variation of EC in June 2015 is from 0.05 to 0.13. The variation of EC in Dec. 2015 is from 0.07 to 0.12. The variation of EC in June 2016 is from 0.06 to 0.11. The variation of EC in Dec 2016 is from 0.08 to 0.12 were found.

### Organic Carbon (OC)

Organic carbon has a vital role in agricultural soils It supplies plant nutrients, improves oil structure, improve water infiltration and retention, feeds soil micro flora and fauna, and enhance the retention and cycling of applied fertilizer (Johnston, 2007).

In the ten samples of Gadchiroli Tehsil, the variation of Organic carbon in June 2015 is from 0.28% to 0.53%. The variation of Organic Carbon in Dec. 2015 is from

0.23% to 0.45%. The variation of Organic carbon in June 2016 is from 0.26% to 0.53%. The variation of Organic carbon in Dec. 2016 is from 0.29% to 0.48%. In the Gadchiroli Tehsil, all the ten samples were in low range, as shown in Table No. 6.

**Table 1: Method were used for analyzed soil parameter**

| Sr. No. | Parameters | Method | References |
|---|---|---|---|
| 1. | Organic carbon | Combustion | Walkley and Black, (1934) |
| 2. | pH | Water extract (1:2.5) | Rhoades and Oster (1986) |
| 3. | Electrical Conductivity | Water extract (1:2.5) | Rhoades and Oster (1986) |

**Table 2: Soil samples collected from cultivator around of Gadchiroli Tehsil**

| Sr. No. | Name of village | Survey No. | Samples Code |
|---|---|---|---|
| 1 | Gadchiroli | 237/3 | Gd-1 |
| 2 | Gogaon | 441 [3079] | Gd-2 |
| 3 | Amirza | 354 [39] | Gd-3 |
| 4 | Ambeshivani | 136 [78] | Gd-4 |
| 5 | Dongargaon (Tukum) | 40 [23] | Gd-5 |
| 6 | Lanzeda | 196/ A/1 [3141] | Gd-6 |
| 7 | Navegaon | 158 [102] | Gd-7 |
| 8 | Porla | 296 [299] | Gd-8 |
| 9 | Potegaon | 30 [35] | Gd-9 |
| 10 | Yewali | 424 [419] | Gd-10 |

**Table 3: Showing the result of pH of paddy soil of Gadchiroli Tehsil**

| Sr. No. | Sample Code | pH | | | | Mean |
|---|---|---|---|---|---|---|
| | | (June-2015) | (Dec-2015) | (June-2016) | (Dec-2016) | |
| **1** | Gd-1 | 6.08 | 6.01 | 6.07 | 6.05 | 6.05 |
| **2** | Gd-2 | 6.07 | 6.06 | 6.06 | 6.07 | 6.06 |
| **3** | Gd-3 | 6.11 | 6.05 | 6.08 | 6.07 | 6.07 |
| **4** | Gd-4 | 6.01 | 6.00 | 6.08 | 6.09 | 6.04 |
| **5** | Gd-5 | 6.00 | 6.01 | 6.07 | 6.06 | 6.03 |
| **6** | Gd-6 | 6.10 | 6.08 | 6.03 | 6.01 | 6.05 |
| **7** | Gd-7 | 6.08 | 6.02 | 6.05 | 6.02 | 6.04 |
| **8** | Gd-8 | 6.09 | 6.05 | 6.07 | 6.07 | 6.07 |
| **9** | Gd-9 | 6.02 | 6.00 | 6.07 | 6.05 | 6.03 |
| **10** | Gd-10 | 6.03 | 6.01 | 6.11 | 5.99 | 6.04 |

**Table 4: Showing the result of EC of paddy soil of Gadchiroli Tehsil**

| Sr. No | Sample Code | EC | | | | Mean |
|---|---|---|---|---|---|---|
| | | (June-2015) | (Dec-2015) | (June-2016) | (Dec-2016) | |
| **1** | Gd-1 | 0.05 | 0.8 | 0.06 | 0.09 | 0.07 |
| **2** | Gd-2 | 0.08 | 0.07 | 0.07 | 0.09 | 0.07 |
| **3** | Gd-3 | 0.08 | 0.09 | 0.08 | 0.07 | 0.08 |
| **4** | Gd-4 | 0.09 | 0.10 | 0.11 | 0.09 | 0.09 |
| **5** | Gd-5 | 0.12 | 0.10 | 0.11 | 0.08 | 0.10 |
| **6** | Gd-6 | 0.10 | 0.12 | 0.11 | 0.12 | 0.11 |
| **7** | Gd-7 | 0.12 | 0.11 | 0.11 | 0.12 | 0.11 |
| **8** | Gd-8 | 0.08 | 0.08 | 0.06 | 0.07 | 0.07 |
| **9** | Gd-9 | 0.07 | 0.08 | 0.09 | 0.10 | 0.08 |
| **10** | Gd-10 | 0.13 | 0.12 | 0.11 | 0.11 | 0.11 |

**Table 5: Showing the result of organic carbon of paddy soil of Gadchiroli Tehsil**

| Sr. No. | Sample Code | OC (%) | | | | Mean |
|---|---|---|---|---|---|---|
| | | (June-2015) | (Dec-2015) | (June-2016) | (Dec-2016) | |
| 1 | Gd-1 | 0.28 | 0.23 | 0.26 | 0.29 | 0.26 |
| 2 | Gd-2 | 0.43 | 0.41 | 0.46 | 0.43 | 0.43 |
| 3 | Gd-3 | 0.47 | 0.41 | 0.49 | 0.43 | 0.45 |
| 4 | Gd-4 | 0.43 | 0.40 | 0.45 | 0.39 | 0.41 |
| 5 | Gd-5 | 0.32 | 0.27 | 0.33 | 0.27 | 0.29 |
| 6 | Gd-6 | 0.53 | 0.45 | 0.53 | 0.48 | 0.49 |
| 7 | Gd-7 | 0.35 | 0.33 | 0.36 | 0.33 | 0.33 |
| 8 | Gd-8 | 0.43 | 0.41 | 0.45 | 0.39 | 0.42 |
| 9 | Gd-9 | 0.42 | 0.38 | 0.37 | 0.38 | 0.38 |
| 10 | Gd-10 | 0.37 | 0.35 | 0.36 | 0.36 | 0.36 |

**Table 6: Tabulated formats of range of soil organic carbon**

| Range of OC | Name of Samples | No. of Samples |
|---|---|---|
| Low Range (< 0.50 %) | Gd-1, Gd-2, Gd-3, Gd-4, Gd-5, Gd-6, Gd-7, Gd-8, Gd-9, Gd-10 | 10 |
| Middle Range (0.50 to 0.75%) | Nil | Nil |
| High Range ( > 0.75 % ) | Nil | Nil |

$$\text{Nutrient Index} = \frac{\text{No .of samples in low range X 1 + No of samples in medium range X 2 +No. of samples in high range X 3}}{\text{Total number of samples}}$$

$$\text{Nutrient Index} = \frac{10 \text{ X } 1 + 0 \text{ X } 2 + 0 \text{ X } 3}{10}$$

$$\text{Nutrient Index} = 1.00$$

**Table 7. Nutrient index with range and remarks**

| Nutrient Index | Range | Remarks (OC) |
|---|---|---|
| I | Below 1.67 | Low |
| II | 1.67-2.33 | Medium |
| III | Above 2.33 | High |

**Nutrient index:**

In order to compare the level of fertility of one area with those of another it is necessary to obtain a single value for each nutrient. Here the nutrient index introduced by Parker et al., (1951) is useful. The percentage of samples in each of the three classes, low medium and high is multiplied by 1, 2 and 3 respectively and divided by total number of samples to give the index.

## CONCLUSION

The physico-chemical properties of soil were analyzed for 10 villages of Gadchiroli tehsil of Gadchiroli district. The parameter such as pH, Electrical Conductivity and Soil Organic Carbon were undertaken for study. The pH values of soils in all the villages slightly acidic in nature. The values of EC with the safe limit. Organic carbon was found that the samples in low range, the fertility status of soil could be evaluated using nutrient index method, the soil samples showed low level.

**Conflicts of interest:** The authors stated that no conflicts of interest.

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