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**Research Article**

# IMPACT OF ORGANIC AND CONVENTIONAL (CHEMICAL) FERTILIZATION ON SOIL QUALITY AND ITS SEASONAL VARIATION

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**ABSTRACT**

This study was carried out to explore the seasonal variations in physico-chemical and microbiological characteristics of soil samples collected from different types of agricultural fields in confluence point of Vellar and Manimuthar river basin in Peruvarappur village, Cuddalore district, Tamilnadu. The fields were selected based on the fertilization type (Organic Fertilization [OF], Chemical Fertilization [CF]) over the past three years. Results showed that seasonally the pH is not varied in both fields, however; the seasonal average is slightly higher in CF field. The total nitrogen concentration showed a higher average in OF field (3.83±.73 g $kg^{-1}$) than CF field (2.70±0.51 g $kg^{-1}$). However, available K and P showed the average concentration is higher in CF field (64.35±4.04 and 77.15±2.07) than OF field (44.06±1.40 g $kg^{-1}$ and 64.0±9.7 g $kg^{-1}$). The higher seasonal average of Total Nitrogen (TC) and ammonium was found in OF field (29.95±2.48 and 3.63±0.29) than CF field (28.8±3.06 and 1.56±.38) Moreover, the seasonal average of Nitrate concentration was higher in CF field (24.61±2.28) than OF field (13.96±1.04). All the physico-chemical properties of both fields soil are increased every first monsoon season. Zinc and Manganese are the major metal components found in OF field (189.52±8.31 µg $g^{-1}$) and CF field (197.17±11.67 µg $g^{-1}$) respectively. Chemical fertilization increases the fungal population, however; it reduced the bacterial and actinomycetes population in CF field. The Non-linear incasement of analyzed soil parameters and the microbial population were observed in this study. The factors that control soil fertility are good in OF field than the CF field.

**Keywords:** Peruvarappur, Organic fertilization, Chemical fertilization, Heavy metal, Soil fertility.

## INTRODUCTION

The soil is one topmost thin and composite layer of earth and it was made up of many things like weathered rock particles, decayed plant and animal matter with varying ratios of minerals, air, water and organic material. The healthy soil consists of approximately 40 % mineral, 23 % water, 23 % air, 6 % organic material and 8% living organisms including animals, plants and microorganisms (Jafar *et al.*, 2014). The investigation of Physical, chemical and biological properties of soil will help to understand the fertility and productivity of the soil (Tamizhazhagan and Pugazhendy, 2016). Good productive soil builds the foundation for any successful cropland (Zaiad, 2001). A significant decline in soil productive capacity has been documented worldwide due to the inorganic contamination (Haque, 2007).

Soil as a module of the terrestrial ecosystem, fulfills many physical, chemical and biological activities that are important for plant growth (Jafar *et al.*, 2014). The qualities that are used to assess the ability of soil to fulfill storage of

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plant available water, supply of oxygen to roots, storage of nutrients for plant growth, provision of favorable conditions for seeding establishment and these functions include pH, cation exchange capacity and soil depth (Nwachokor *et al*., 2009). Recently, agriculture is facing difficulty with soil salinity. Almost 40% of the land surface in the world is pretentious by salinity related problems (Pandeeswari and Kalaiarasu, 2012). India is leading fertilizer use in the world. The use of chemical fertilizers resulted in increased crop productivity but a decrease in soil fertility.

The assortment of physical characteristics of soil associated with collection at small scales means that soil can contain a higher range of diversity of microorganisms in close proximity, and the chemical composition of soil is also highly varied in both vertical and horizontal dimensions (Dighton *et al*., 1997; Gallardo *et al.*, 2000; Bird *et al*., 2002). Research in soil microbial diversity over the last three decades has intensively focused on the understanding of microbial processes and its relationship with their habitat with a notable exception being those efforts focused on Rhizobium ecology. Understanding the subtleties of microbial diversity is at the heart of contemporary microbial diversity, and understanding of the soil microbial community in soil is probably the most challenging because of the extremely high microbial diversity in soil (Tiedje *et al*., 1999). The aim of the study, therefore, is to provide the baseline data to understand the seasonal variations in physico-chemical and microbiological characteristics of agricultural field soil and also tried to reveal the impact of organic and chemical fertilization on soil quality.

## MATERIALS AND METHODS

### Study area

Peruvarappur village (latitude 11°26'50'' N, longitude 79°27'58'' E) is located very near to the confluence point (latitude 11°41'49'' N, longitude 79°46'43'' E) of Manimuthar and Vellar rivers located in Virudhachalm and Chidambaram taluks, Cuddalore district, Tamilnadu, South East India. The area around the confluence point has annual rainfall of 1206 mm during the last 25 years. The soil type of this village is classified as rich and fertile grimy clay. Most usual agricultural crops cultivated by the farmers of this area are paddy, sugarcane, ground nut, gingelly and some varieties of commercial flowers.

### Experimental design

Two types of fields were selected in Peruvarappur village for collection of soil samples for physico-chemical and microbiological analysis. Both these two fields were selected based on their supplementary type during the crop period over the past three years. One was supplemented with organic composts (26.4% organic C, 2.5% total N, 1.6% $P_2O_5$ and 1.3% $K_2O$, made of composted pig manure, rice straw and green manures) and another field was supplemented with Chemical fertilizers (NPK inorganic fertilizer, in which 391 kg $ha^{-1}$ urea (46% N), 750 kg $ha^{-1}$ superphosphate and 183 kg $ha^{-1}$ potassium chloride (mixed and pilled) and chemical pesticides (Wang *et al*., 2017). Based on the use of type of supplement, the fields were named, the Organic supplemented field as organic fertilized field (OF field) (latitude 11°44'15'' N, longitude 79°45'83'' E) and inorganic chemical fertilizer supplemented field as chemical fertilized field (CF field) (latitude 11°43'42'' N, longitude 79°45'92'' E). The locations of fields selected for this study were shown in Figure 1. All the soil samples were collected from the fields after getting proper permission from the field owner.

### Sample collection

Sampling was done three times (February, June, October) per year up to three years (2013 October to 2016 June). Totally 18 soil samples were collected in triplicate with the help of sterile steel cooper in sterile sampling tube, capped and kept at refrigerated condition until taken to the laboratory. All visible soil organisms and coarse shell fragments, grass leaves and roots were removed manually. Then the physic-chemical and biological characteristics were analyzed.

### Physico-chemical analysis

The pH of the collected samples was determined by electrometric method prescribed by APHA (2005). The digital pH meter was calibrated with freshly prepared pH buffer solutions having the pH range of 4, 7 and 9.2. Total carbon (TC) was determined colorimetrically by the method recommended by Nelson and Sommers, (1996). Total nitrogen of the soil samples was determined by automatic Kjeldahl method (Bremer 1965). Nitrate ($NO_3^-$) and ammonium ($NH_4^+$) contents in soil were extracted with 2 MKCl and were quantified by Bran+ Luebbe GmbH-Auto Analyzer 3 (Norderstedt, Germany). Soil available phosphorus (AP) was extracted using sodium bicarbonate and then determined by the molybdenum-blue method. Soil available potassium (AK) was analyzed using flame atomic absorption spectrophotometry (Wang *et al*., 2017). The metal (Cd, Co, Cr, Cu, Mn, Ni, Pb and Zn) determination was carried out with an Inductively Coupled Plasma Atomic Emission Spectrometer (ICP/AES) Varian Vista Pro using internal standard calibration method (Mousumi *et al*., 2009).

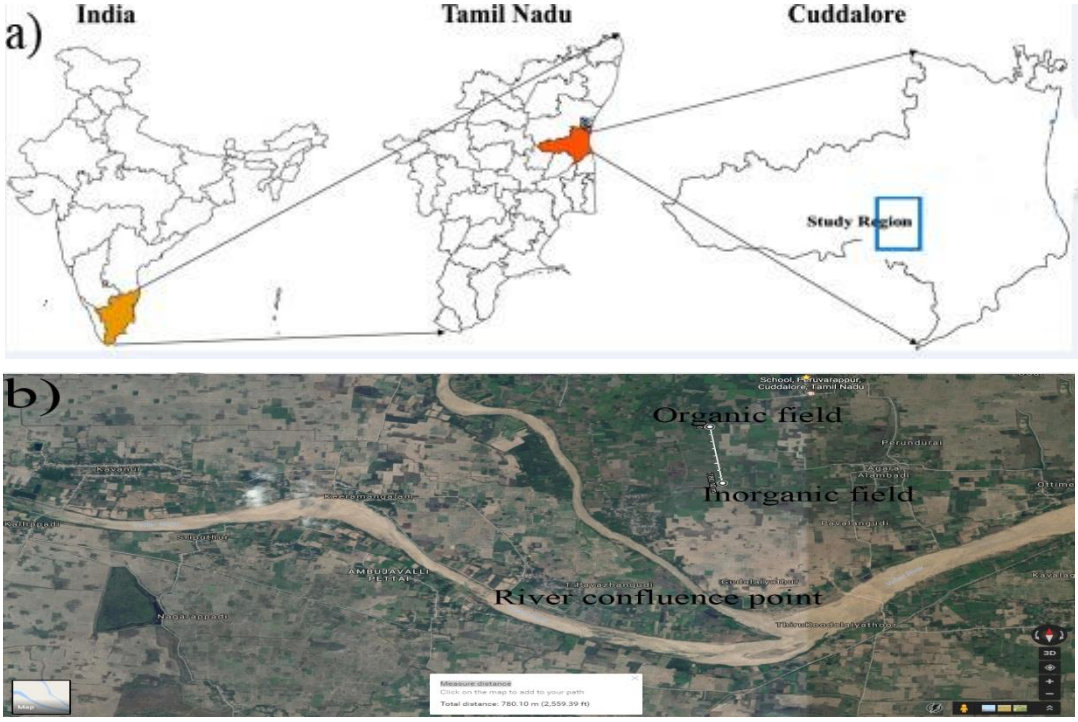


**Figure 1.** study area **a)**. Manimuthar and vellar river confluence region in Cuddalore district. **b)**. Locations of selected agricultural fields.

### Microbial population analysis

Ten grams of each soil sample were added to 95 mL of 0.1% (w/v) solution of sodium pyrophosphate. After homogenization for 30 min, this solution was decimally diluted ($10^{-1}$ to $10^{-7}$) and aliquots of the resulting solutions plated on appropriate culture media for bacteria, fungi and actinomycetes respectively. After the appropriate incubation time and temperature for bacteria, fungi and actinomycetes the colony forming units (CFU) were counted (Vieira and Nahas, 2005).

### Statistical analysis

The SAS statistical package (SAS Institute, Cary, NC, USA) was used for data analysis. When a significant F value was detected, Tukey's estimates of honest significant differences (HSD) were calculated from the ANOVA analysis. The level of statistical significance was set at 0.01. Counts were calculated as y ¼ log (x+1) where x was the number of CFU $g^{-1}$ soil.

## RESULTS

The physico-chemical characteristic of soil samples collected from selected agricultural fields were analyzed and depicted in table 1 and 2. The pH values of collected soil samples from OF field were ranged from 6.8±.01 to 7.2±.01. Maximum pH of 7.2 ± 0.01 was recorded in sample collected at first monsoon (June) in 2016 and the average pH of OF field during the study period is recorded as 6.9±.12. In CF field, the pH was ranged from 7.1±0.01 to 7.3±0.01. Maximum pH of 7.3 ± 0.01 was observed in samples collected at winter (February) and first monsoon (June) seasons in 2016. The average pH of inorganic field during the study period is recorded as 7.1 ± 0.07.

Total Carbon (TC) in OF field was ranged from 26.78±.02 g $Kg^{-1}$to 34.05±0.16 g $Kg^{-1}$and the maximum TC was found in a sample collected at First monsoon (June) in 2017. Throughout this experimental period the average TC was recorded as 29.95 ± 2.48 g $Kg^{-1}$ in OF field. TC in CF field was ranged from 24.40±0.14 to 32.73±0.09 and the maximum TC (32.73±.09) was found in samples collected at the first monsoon (June) in 2015. The average TC was recorded throughout this experiment is 28.8±3.06 g $Kg^{-1}$ in CF field. Total carbon in the OF field is higher than CF field due to the deposition of plant residues in OF field.

Nitrate content in OF field was ranged from 12.31±.05 g $Kg^{-1}$ to 15.43±.03 g $Kg^{-1}$ and the maximum nitrate content was found in samples collected at the first monsoon period (June) in 2017. The average nitrate concentration 13.96 ± 1.04 g $Kg^{-1}$ was recorded throughout this experimental period. In OF field the nitrate content was ranged from 21.31 ±. 06 g $Kg^{-1}$ to 29.13±.03 g $Kg^{-1}$ and the maximum nitrate concentration was observed in the sample collected at first monsoon period (June) in 2017. Seasonal average of nitrate content is 24.61±2.28 and it was higher than the OF field l.

**Table 1.** Seasonal variation of physico-chemical parameters in OF field soil.

| Sample ID | | pH | TC (g $Kg^{-1}$) | Nitrate (g $kg^{-1}$) | Ammonium (g $kg^{-1}$) | Total Nitrogen (g kg-$^1$) | Available Phosphorus (mg kg-$^1$) | Available Potassium (mg kg-$^1$) |
|---|---|---|---|---|---|---|---|---|
| 2014 | October | 6.9±.01 | 26.78±.02 | 12.31±.05 | 3.22±.04 | 2.84±.01 | 52.45±.03 | 42.57±.12 |
| 2015 | February | 7.1±.02 | 27.40±.04 | 12.64±.03 | 3.43±.01 | 3.08±.01 | 53.41±.04 | 42.69±.09 |
| | June | 7.0±.01 | 30.23±.03 | 14.56±.09 | 3.67±.01 | 3.87±.02 | 61.53±.01 | 43.13±.07 |
| | October | 6.9±.02 | 27.43±.12 | 13.27±.08 | 3.25±.03 | 3.21±.03 | 57.98±.01 | 43.09±.12 |
| 2016 | February | 6.9±.02 | 29.34±.07 | 13.73±.06 | 3.62±.05 | 3.74±.01 | 61.23±.06 | 43.46±.03 |
| | June | 7.2±.01 | 31.73±.27 | 14.82±.05 | 3.83±.06 | 4.01±.02 | 62.89±.02 | 44.89±.03 |
| | October | 7.0±.01 | 30.23±.16 | 14.31±.05 | 3.92±.02 | 3.95±.02 | 72.37±.03 | 44.58±.01 |
| 2017 | February | 6.8±.01 | 32.43±.19 | 14.62±.01 | 3.64±.07 | 4.63±.03 | 72.39±.01 | 45.58±.08 |
| | June | 7.1±.02 | 34.05±.16 | 15.43±.03 | 4.12±.07 | 5.14±.02 | 81.78±.03 | 46.57±.13 |
| Average | | 6.9±.04 | 29.95±.82 | 13.96±.34 | 3.63±.09 | 3.83±.24 | 64.0±3.23 | 44.06±.46 |

Values were expressed in mean ± SD. *Significant level was observed at 0.01 P value all parameters showed P < 0.01.

**Table 2.** Seasonal variation of physico-chemical parameters in OF field soil.

| Sample ID | | pH | TC (g $Kg^{-1}$) | Nitrate (g $kg^{-1}$) | Ammonium (g $kg^{-1}$) | Total Nitrogen (g kg-$^1$) | Available Phosphorus (mg kg-$^1$) | Available Potassium (mg kg-$^1$) |
|---|---|---|---|---|---|---|---|---|
| 2014 | October | 7.2±.02 | 25.78±.31 | 21.31±.06 | 1.32±.04 | 2.84±.05 | 76.45±.45 | 61.57±.03 |
| 2015 | February | 7.2±.03 | 24.40±.14 | 22.64±.07 | 1.43±.08 | 2.08±.09 | 75.41±.23 | 60.69±.03 |
| | June | 7.1±.01 | 32.73±.09 | 25.36±.01 | 1.67±.03 | 2.08±.09 | 75.53±.09 | 61.13±.01 |
| | October | 7.2±.04 | 26.23±.04 | 23.57±.06 | 1.55±.04 | 2.27±.16 | 76.98±.12 | 61.09±.10 |
| 2016 | February | 7.3±.01 | 26.34±.13 | 23.73±.11 | 1.22±.06 | 2.74±.14 | 75.98±.04 | 63.46±.41 |
| | June | 7.3±.01 | 30.73±.28 | 26.62±.05 | 1.73±.02 | 2.61±.14 | 79.29±.01 | 69.29±.12 |
| | October | 7.1±.02 | 30.43±.11 | 24.31±.08 | 1.12±.08 | 2.95±.04 | 76.17±.09 | 64.58±.11 |
| 2017 | February | 7.1±.02 | 31.41±.10 | 24.82±.05 | 1.64±.04 | 3.63±.05 | 76.99±.15 | 65.08±.08 |
| | June | 7.2±.01 | 31.15±.07 | 29.13±.03 | 2.42±.05 | 3.14±.07 | 81.78±.07 | 72.27±.96 |
| Average | | 7.1±.02 | 28.8±1.02 | 24.61±.76 | 1.56±.12 | 2.70±.17 | 77.15±.69 | 64.35±1.34 |

Values were expressed in mean ± SD. *Significant level was observed at 0.01 P value all parameters showed P < 0.01.

Sample collected at first monsoon period (June) in 2017. The seasonal average of ammonium content was recorded at 1.56±.38 g $Kg^{-1}$ throughout this study period.

Total nitrogen (TN) content in OF field soil sample is ranged from 2.84±.01 g $Kg^{-1}$to 5.14±0.02 g $Kg^{-1}$ and the maximum TN was found in a sample collected at the first monsoon in 2017. The average TN concentration 3.83±.73 g $Kg^{-1}$ was found in this experimental period. The TN content in CF field samples was ranged from 2.08±.09 g $Kg^{-1}$ to 3.63±.05 g $Kg^{-1}$ and the maximum was observed in sample collected at winter (February) season in 2017. Average TN was recorded as 2.70±0.51 g $Kg^{-1}$.

Available Phosphorus (AP) content in OF field was ranged from 52.45±0.03 g $Kg^{-1}$ to 81.78±.03 g $Kg^{-1}$ and the maximum was in the sample collected at June, 2017. Throughout the experimental period, the average AP was noted as 64.0±9.7g $Kg^{-1}$. Phosphorus content in CF fieldwas ranged from 75.41±.23 g $Kg^{-1}$ to 81.78±.07 g $Kg^{-1}$ and the maximum was recorded in sample collected at first monsoon (June) period in 2017. Throughout the experimental period, the average AP content was noted as 77.15±2.07g $Kg^{-1}$.

Available potassium (AK) content in OF field was ranged from 42.57±0.12g $Kg^{-1}$ to 46.57±0.13 g $Kg^{-1}$ and the maximum was in the sample collected in June, 2017. Throughout the experimental period, the average AK content was noted as 44.06±1.40g $Kg^{-1}$. Phosphorus content in CF field was ranged from 60.69±.03 g $Kg^{-1}$ g $Kg^{-1}$ to 72.27±.96 and the maximum was recorded in sample collected at first monsoon (June) period in 2017. In OF field, the ammonium content was ranged from 3.22±.04 g $Kg^{-1}$ to 4.12±.07 g $Kg^{-1}$

and maximum ammonium content was recorded at the first monsoon period (June) in 2017. Throughout this experimental period the seasonal average of ammonium content of 3.63±0.29 g $Kg^{-1}$ was recorded in OF field. In CF field, the ammonium content ranged from 1.12±.08 g $Kg^{-1}$ to 2.42±.05 g $Kg^{-1}$ and maximum ammonium concentration was found in throughout the experimental period, the average K content was noted as 64.35±4.04 g $Kg^{-1}$.

The metal content in soil samples collected from organic and inorganic field were exhibited in table 3 and 4. The metal Cadmium is found in very trace in amount and its average concentration in OF field is 0.02±0.01µg $g^{-1}$ and in CF is 0.03±0.01 µg $g^{-1}$. Both the fields were highly accumulated by zinc and manganese then compared to other metal components. In OF field, the average manganese concentration is 187.97±13.76 µg $g^{-1}$ and it was less than the average of manganese concentration 197.17±11.67 µg $g^{-1}$ in CF field. The maximum manganese (204.99±.17 µg $g^{-1}$) content in CF field samples was found in a sample collected at the second monsoon (October) in2014. Zinc is identified as a second major heavy metal component in both fields. In OF field, it was higher (201.18±.03 µg $g^{-1}$) in the sample collected in February, 2017 (winter) and the seasonal average is recorded as 189.52±8.31 µg $g^{-1}$. In CF field, the maximum zinc concentration (201.28±.04 µg $g^{-1}$) was found in samples collected at second monsoon season (October, 2016) and the seasonal average is recorded as 187.46±11.23 µg $g^{-1}$ and it was lesser than the average of field.

Chromium concentrations in both OF and CF fields were analyzed and seasonal average is 81.67±5.20 µg $g^{-1}$ and 85.18±3.79 µg $g^{-1}$ respectively. The maximum chromium concentration in OF field was recorded as 88.98±.12 µg $g^{-1}$ in the sample collected at first monsoon (June) period in 2015. In CF field, the maximum chromium content (88.98±.12 µg $g^{-1}$) was observed in a sample collected at the first monsoon (June) period 2017.

**Table 3.** Heavy metal concentration in CF field soil (µg $g^{-1}$).

| Sample ID | | Cadmium | Cobalt | Chromium | Copper | Manganese | Nickel | Palladium | Zinc |
|---|---|---|---|---|---|---|---|---|---|
| 2014 | October | 0.01±.0001 | 8.96±.25 | 87.56±.98 | 16.43±.04 | 176.37±.06 | 32.87±.13 | 27.37±.41 | 187.38±.08 |
| 2015 | February | 0.03±.0001 | 8.46±.09 | 79.67±.11 | 17.78±.12 | 167.45±.01 | 32.47±.21 | 28.45±.43 | 186.56±.04 |
| | June | 0.01±.0001 | 9.31±.05 | 88.98±.12 | 16.34±.14 | 168.45±.09 | 30.67±.07 | 28.67±.04 | 178.56±.14 |
| | October | 0.02±.0001 | 7.55±.21 | 75.07±.82 | 14.62±.47 | 194.50±.62 | 27.62±.59 | 21.10±.67 | 182.02±.45 |
| 2016 | February | 0.02±.0001 | 7.32±.18 | 78.53±.23 | 15.34±.76 | 189.41±.92 | 28.79±.45 | 23.54±.98 | 189.92±.94 |
| | June | 0.04±.0002 | 7.73±.13 | 76.75±.21 | 14.56±.83 | 192.45±.12 | 24.45±.72 | 21.59±.10 | 182.34±.13 |
| | October | 0.05±.0003 | 9.23±.27 | 78.56±.14 | 17.27±.13 | 200.34±.45 | 43.48±.04 | 25.97±.43 | 198.45±.11 |
| 2017 | February | 0.04±.0001 | 9.45±.31 | 82.15±.09 | 18.58±.27 | 201.59±.27 | 45.38±.01 | 29.98±.34 | 201.18±.03 |
| | June | 0.04±.0001 | 8.45±.16 | 87.79±.07 | 12.94±.19 | 201.23±.11 | 42.28±.09 | 23.87±.07 | 199.21±.06 |
| | Average | 0.02±.0048 | 8.49±.26 | 81.67±1.73 | 15.98±.59 | 187.97±4.58 | 34.22±2.53 | 25.61±1.07 | 189.52±2.77 |

Values were expressed in mean SD. *Significant level was observed at 0.01 P value. All parameters showed P < 0.01 except cadmium.

Table 4**.** Heavy metal concentration in CF field soil (µg $g^{-1}$).

| Sample ID | | Cadmium | Cobalt | Chromium | Copper | Manganese | Nickel | Palladium | Zinc |
|---|---|---|---|---|---|---|---|---|---|
| 2014 | October | 0.05±.0001 | 8.63±.09 | 86.36±.16 | 17.59±.23 | 204.99±.17 | 39.26±.16 | 27.44±.04 | 167.98±.03 |
| 2015 | February | 0.06±.0002 | 10.56±.14 | 88.15±.38 | 19.78±.04 | 198.23±.18 | 31.12±.03 | 29.53±.13 | 178.99±.08 |
| | June | 0.03±.0001 | 9.43±.11 | 83.29±.23 | 20.12±.09 | 193.54±.04 | 36.57±.21 | 29.25±.26 | 195.56±.01 |
| | October | 0.04±.0003 | 10.49±.09 | 81.45±.04 | 21.27±.11 | 201.59±.06 | 37.34±.36 | 30.16±.09 | 199.23±.02 |
| 2016 | February | 0.02±.0001 | 9.23±.05 | 82.76±.45 | 18.45±.12 | 202.17±.12 | 26.87±.05 | 26.65±.01 | 187.27±.02 |
| | June | 0.02±.0001 | 9.31±.05 | 88.96±.12 | 14.62±.47 | 200.34±.45 | 24.45±.72 | 29.98±.34 | 182.34±.13 |
| | October | 0.04±.0002 | 9.45±.31 | 78.56±.14 | 20.12±.09 | 167.45±.01 | 32.47±.21 | 29.53±.13 | 201.28±.04 |
| 2017 | February | 0.02±.0001 | 7.73±.13 | 88.15±.38 | 16.34±.14 | 201.23±.11 | 43.48±.04 | 29.53±.13 | 178.99±.08 |
| | June | 0.04±.0002 | 9.45±.31 | 88.98±.12 | 16.34±.14 | 204.90±.17 | 24.45±.72 | 29.53±.13 | 195.56±.01 |
| | Average | 0.03±.004 | 9.36±.28 | 85.18±1.26 | 18.29±.73 | 197.17±3.89 | 32.89±2.26 | 29.06±.39 | 187.46±3.74 |

Values were expressed in mean ± SD. *Significant level was observed at 0.01 P value. All parameters showed P < 0.01 except cadmium.

Other metal components *viz.*, cobalt, copper, nickel and palladium in OF field soil samples have the average concentration of 8.49±0.80, 15.98±1.78, 34.22±7.59 and 25.61±3.23 µg $g^{-1}$ respectively. In CF field, the average concentration is 9.36±0.86, 18.29±2.21, 32.89±6.78 and 29.06±1.19 µg $g^{-1}$ respectively for cobalt, copper, nickel and palladium. In OF field cobalt (9.45±.31 µg $g^{-1}$), copper (18.58±.27 µg $g^{-1}$) nickel (45.38±.01 µg $g^{-1}$) and palladium (29.98±.34 µg $g^{-1}$) was highly found in samples collected at the winter season 2017 (February).

The microbial populations in soil samples collected The microbial populations in soil samples collected from agricultural fields were characterized and illustrated in figure 2. Compared with both OF field and CF field soil samples, the bacteria and actinomycetes highly present in OF field however, the fungal population was higher in CF field. Bacterial counts slightly varied from season to season in both OF and CF fields and it was high in first monsoon period (June) of every year. Compared with both fields it was high in OF field then CF field. Maximum bacterial count of 198±.34 CFU X $10^7$ $g^{-1}$ and 121±2.35 CFU X $10^7$ $g^{-1}$ was found in the first monsoon (June) season in 2016 respectively OF field and CF field. Fungi population revealed that significantly higher in CF as compared to OF field. Seasonal variation the fungal counts was higher in first monsoon season in both OF field 71±.56 CFU X $10^2$ $g^{-1}$ (2017) and CF field 102±.54 CFU X $10^2$ $g^{-1}$ (2015). An actinomycetes population was varied from season to season due to the weather condition. However, it was higher in OF field than compared to CF field due to the type of fertilization. The maximum actinomycetes counts of 124±.23 CFU X $10^5$ $g^{-1}$ and 89±.21 CFU X $10^5$ $g^{-1}$ in First monsoon season in the year 2017 and 2017 respectively for OF field and CF field. The non-linear enhancement of microbial populations was observed in both fields throughout this study period.

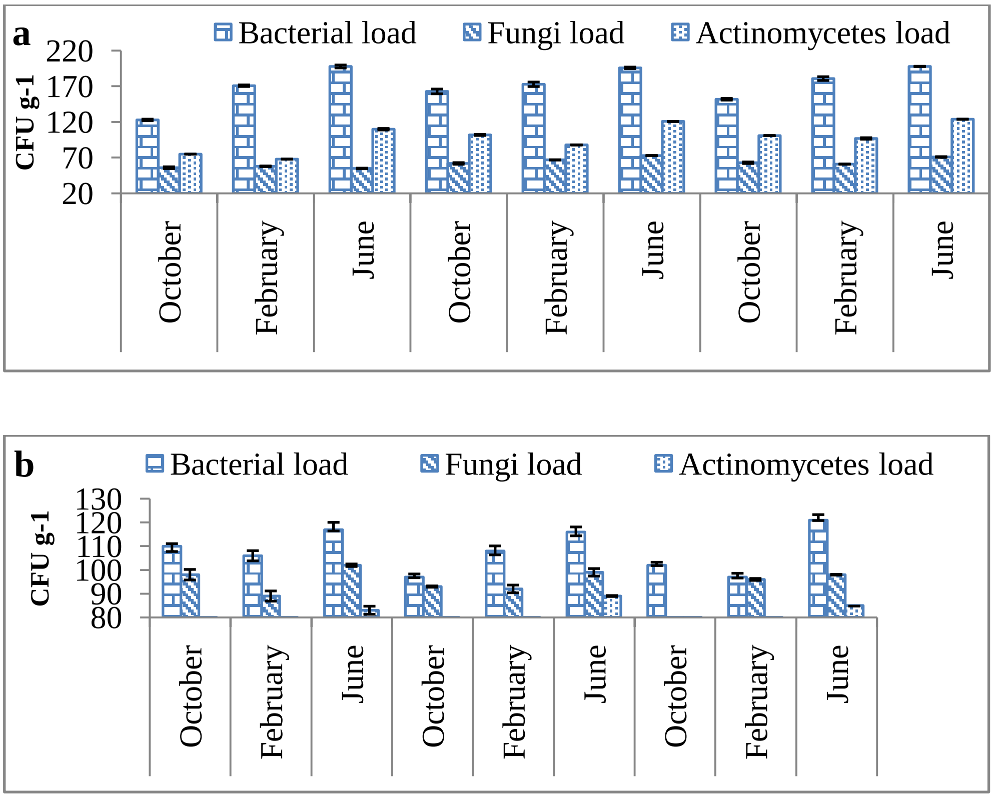


**Figure 2.** Seasonal variations of microbial populations (Bacteria (CFU X $10^7$ $g^{-1}$), fungi (CFU X $10^2$ $g^1$) and actinomycetes (CFU X $10^5$ $g^{-1}$) in **a)** Organic fertilized (OF) field, **b)** chemical fertilized (CF) field. Error bars indicate SD.

## DISCUSSION

The findings of the present study demonstrated that the application of inorganic and organic fertilizers in agricultural fields over past three years (2014 October to 2017 June), soil physico-chemical properties significantly changed. Inorganic fertilization significantly increased soil available nutrients such as nitrate, available phosphorus and available potassium while organic fertilization significantly increased the soil electrical conductivity, total carbon, and total nitrogen and ammonium contents. Similarly, ten years practiced CF field and OF field highly changed the soil physico-chemical and microbiological properties in the paddy field. The soil pH increased in the OF treatment, however, it decreased in the CF treatment (Wang *et al.*, 2017).

Soil pH is an easily measured yet reliable indicator of soil quality, crop performance nutrient cycling and biological activity and can serve quick indicator of plant available nitrate – N (Johnson *et al*., 2005). Results from this study showed the average pH of OF field is neutral because no factors induce changes in pH. But in the CF field, the pH was varied from season to season over this study period. Due to chemical fertilization there was slight increase in the soil pH of CF field. Slightly basic or low acidic pH soil usually suitable for rice cultivation (Sharma, 2015).

Total carbon and nitrogen concentration in the OF field is higher than CF field due to the deposition of plant residues in OF field. Velayudha and Poongothai (2014) reported that the N, P and K content in soil from tsunami affected area in Nagapattinam 178, 22 and 272 kg/H respectively. This study showed, Potassium content in both fields was appropriate for better crop cultivation but it was significantly higher in CF field.

Metal is most harmful insidious pollutant in the soil because of their non-degradability and their potential cause of adverse effect on soil microorganisms (Lokande and Kalekar, 2000). Mary, (2012) reported that the mean concentration of zinc is 19.46 ppm in soil samples collected in Colachel estuary region, Kanniyakumari district, Tamilnadu. The Nickel concentration depends on the origin of the soil and pathogenic prefers (Adriano, 1986). In the present study, nickel concentration varies seasonally and the seasonal average is34.22±7.59 µg g-1 and 32.89±6.78 µg g-1 respectively for OF and CF fields.

Prabhahar *et al*. (2011) stated concentration of all metal accumulation in vellar river is higher in the monsoon season of the every year. This investigation showed seasonally there are no major variations found in metal concentration, however, a minute increment was observed in first monsoon season. Due to the use of organic manure, OF field becomes good in fertility and microbial diversity than CF field, which leads to the microbial degradation of metals in OF field.

The microbial diversity of the soil is the important scenario for soil fertility and degradability of organic matter in the soil (Tamizhazhagan *et al.,* 2016). In the present study, the chemical fertilization significantly decreased the bacterial and fungal population, however; it increased the fungal population in CF field. Organic fertilization significantly increased the population of bacteria and actinomycetes. Similarly, Wang *et al*. (2017) reported that the use of chemical fertilizers in the paddy field, that significantly increased the fungal richness than the field fertilized with organic fertilizers. Similar results were also found in previous studies in the arable soil (Shen *et al*., 2010; Zhong *et al*., 2010). Geisseler and Scow (2014) appraised that the response of bacteria and fungi to the long-term application of mineral fertilizers were different, the application of mineral N fertilizer usually promoted the growth of fungi (Ai *et al*., 2012; Bohme *et al*., 2005; Esperschutz *et al*., 2007). This present study revealed that the microbial richness was increased in both OF and CF fields at every monsoon season.

The continuous use of chemical fertilizers and pesticides residues highly deposited in the soil and resulting poor soil fertility. It is also possible that detrimental residues may remain in the edible portion of vegetation or plants and may affect humans because humans are at the top of the food chain and are, therefore, most susceptible (Bakore *et al*., 2004). Over accumulation of pesticide residues in agricultural soil will reduce the microbial population.

## CONCLUSION

The work has assessed the impact of organic and chemical fertilization on the physico-chemical and biological characteristics of soil samples collected from two types of agricultural field. Organic fertilization improved the soil fertility by increasing the total carbon, total nitrogen and ammonium concentration. Chemical fertilization constantly alters the physico-chemical characteristics of CF field soil that gives reducing the impact on the bacterial and actinomycetes population. Seasonally no remarkable variations observed in heavy metal concentration. Organic fertilizer (OF) field showed the appropriate bacterial and actinomycetes populations over crop cultivation, moreover, the fungal population did not increase by the application of organic fertilizers. The fungal richness was remarkably increased in the field fertilized with chemical fertilizers. Further, the seasonal variations showed that the microbial count was higher in every first monsoon. It was recommended that the continuous use of chemical fertilizers will reduce the soil quality of the field. Hence in organic fertilization at most caring of soil and its consistency will improve the productivity of crops and maintain the soil ecosystem for sustainable agriculture.

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## REFERENCES

Adriano, D.C. 1986. Trace Elements in the Terrestrial Environment. Springer and Verlag were INC. New York, pp. 533.

Ai, C., Liang, G., Sun, J., Wang, X. and Zhou, W., 2012. Responses of extracellular enzyme activities and microbial community in both the rhizosphere and bulk soil to long-term fertilization practices in a fluvo-aquic soil. G*eoderma* 173, 330–338.

APHA, 2005. Standard Methods for the Examination of

Water and Wastewater; 21st Edition, American Public Health Association, Washington DC, pp.1200.

Bakore, N., John, P. and Bhatnagar, P., 2004. Organochlorine pesticide residues in wheat and drinking watersamples from Jaipur, Rajasthan, *India Environ. Monit. Assess*., 98, 381–389.

Bird, S.B., Herrick, J.E., Wander, M.M. and Wright, S.F., 2002. Spatial heterogeneity of aggregate stability and soil carbon in semi-arid rangeland. *Environ. Pollut*. 116, 445-455.

Bohme, L., Langer, U. and Bohme, F., 2005. Microbial biomass, enzyme activities and microbial community structure in two European long-term field experiments. Agric. *Ecosyst. Environ.* 109, 141-152.

Chatterjee, M., Massolo, S., Sarkar, S.K., A.K. Bhattacharya, Bhattacharya, B.D., Satpathy, K.K. and Saha, S., 2009. An assessment of trace element contamination in intertidal sediment cores of Sunderban mangrove wetland, India for evaluating sediment quality guidelines. *Environ. Monit. Assess.*, 150, 307-322.

Dighton, J., Jones, H.E., Robinson, C.H. and Beckett, J., 1997. The role of abiotic factors, cultivation practices and soil fauna in the dispersal of genetically modified microorganisms in soils. *Appl. Soil Ecol*. 5, 109 – 131.

Esperschutz, J., Gattinger, A., Mader, P., Schloter, M. and Fliessbach, A., 2007. Response of soil microbial biomass and community structures to conventional and organic farming systems under identical crop rotations. FEMS *Microbiol. Ecol*. 61, 26-37.

Gallardo, A., Rodriguez-Saucedo, J.J., Covelo, F. and Fernandez-Ales, R., 2000. Soil nitrogen heterogeneity in a Dehesa ecosystem. *Plant Soil.* 222, 71-82.

Geisseler, D. and Scow, K.M., 2014. Long-term effects of mineral fertilizers on soil microorganisms–a review. *Soil Biol. Biochem*., 75, 54-63.

Haque, A.A.M., Jayasuriya, Salokhe, V.M., H.P.W., Tripathi, N.K. and Parkpian, P., 2007. Assessment of influence and inter-relationships of soil properties in irrigated rice fields of Bangladesh in GIS and factor analysis. *Agr. Eng. Int. CIGR* E-J., 9, 1-17.

Jafar Ahamed, A., Loganathan, K. and Ananthakrishnan, S., 2014. Assessment of Soil Parameters and Microbes in Amaravathi River Bed Area, Karur District, Tamil Nadu, India. *J. Environ. Nanotechnol.* 3, 150-155.

Johnson, C.K., Eigenberg, R.A., Doran, J.W., Wienhold, B.J., Eghball, B. and Woodbury, B.L., 2005. Status of soil electrical conductivity studies by central states researchers, *Trans. Am. Soc. Agr. Eng.,* 48(3), 979-989.

Lokande P.S. and Kalekar, R., 2000. Comparative toxicity of four heavy metals to fresh water fishes. *J. Aquact. Biol.,* 15, 95-98.

Nwachokor, M.A., Uzu, F.O. and Molindo, W.A., 2009. Variations in physicochemical properties and productivity implications for four soils in the derived savannah of southern Nigeria, Am. *Eurasian J. Agron*., 2(3), 124-129.

Pandeeswari, N. and Kalaiarasu, S., 2012. Studies on the physico-chemical properties of the soil samples collected from different locations of tsunami affected soils of Cuddalore district of Tamil Nadu, *Int. J. Curr. Res.,* 4(7), 143-145.

Prabhahar. C., Saleshrani, K. and Tharmaraj, K., 2011. Seasonal Distributions of Heavy Metals in Vellar River, Vellar Estuary and Portonovo Coastal Waters, South East Coast of India. *Int. J. Pharm. Biol. Arch.,* 2(6),1692-1694.

Sharma, C., 2015. Physico-chemical Properties of Soils with Special Reference to Organic Carbon Stock under Different Land Use Systems in Dimoria Tribal Belt of Assam. *J. Agr. Vet. Sci.,*. 8(3), 32-36.

Shen, J.P., Zhang, L.M., Guo, J.F., Ray, J.L. and He, J.Z., 2010. Impact of long-term fertilization practices on the abundance and composition of soil bacterial communities in Northeast China. *Appl. Soil Ecol.,* 46, 119-124.

Tamizhazhagan, V. and Pugazhendy, K., 2016. Physico-chemical parameters from the Manappadaiyur and swamimalai fresh water Ponds, *Indo Am. J. Pharm. Sci.,* 3(5), 444-449.

Tamizhazhagan, V., Pugazhendy, K., Sakthidasan V., Revathi, K. and Bharanithran M., 2016. Investigation of microbial count in the soil and earthwarm gut (*Eudrilus eugeniae*). *Innov. J. Agr. Sci.,* 4(3), 7-9.

Tiedje, J.M., Brempong, S.A., NuEsslein, K., Marsh, T.L. and Flynn, S.J., 1999. Opening the black box of soil microbial diversity. *Appl. Soil Ecol*., 13, 109-122.

Velayudha Das, M. and Poongothai, S., 2014. Spatial Analysis of Soil and Water Quality in Tsunami Affected Areas of Nagapattinam District, Tamilnadu, India. *Int. J. Eng. Res. Appl.,* 4(9), 167-173.

Vieira, F.C.S. and Nahas, E., 2005. Comparison of microbial numbers in soils by using various culture media and temperatures. *Microbiol. Res.,* 160, 197-202

Wang, J., Song, Y., Tengfei, M., Raza, W., Li, J., Jillian, G., Howland, Huang, Shena, Q., 2017. Impacts of inorganic and organic fertilization treatments on bacterial and fungal communities in a paddy soil. *Applied Soil Ecol.,* 112, 42-50.

Zaiad, G.M., 2001. Physico-chemical analysis of soils in Al-Khums city, Libya, *J. Appl. Sci. Res.,* 6(8), 1040-1044.

Zhong, W., Gu, T., Wang, W., Zhang, B., Lin, X., Huang, Q. and Shen, W., 2010. The effects of mineral fertilizer and organic manure on soil microbial community and diversity. *Plant Soil*, 326, 511–522.