**Assesment of soil physico-chemical quality indicators in rice soils of Villupuram district of Tamil Nadu, India**

**Abstract**

An assessment soil quality indicators study was conducted in rice growing block of Villupuram district Melmaliyanur. The present investigation entitled “Assessment of soil quality Indicators under nutrient management systems in different rice growing districts of Tamil Nadu ”was carried out during 2018-19 with the objectives: To assess the soil physico- chemical and biological quality parameters in rice soils of Tamil Nadu and compare soil quality indexing methods viz., Principal component analysis, Minimum data set and indicator scoring method and develop soil quality indices for formulating soil and crop management strategies. To fulfil these objectives a total of (36) soil samples were collected from Viliupuram district Melmaliyanur. block and TNAU research stations. (Needs more clarity)

**Keywords:** Physico-chemical quality indicator, soil quality, principal component analysis

**Introduction**

The paddy soil has easily declined of soil fertility and soil quality (soil degradation), particularly which used continuously. Some researcher stated that the characteristics of rice cultivation are consist of puddling during land preparation, the provision of water-logging and drying during plant maintenance. The land preparation may lead to the destruction of soil aggregates, which leads to soil particles and its other physical properties destruction (Sudaryanto, 2009). Practically, soil quality is not measureable; however, some indicators are possible to measure quantitatively. Various definitions of the indicators are indicated within the literature, it suggests an emphasis on measuring and monitoring soil properties that may affect soil’s ability to perform its proper function. The United States Department of Agriculture has defined the indicators of soil quality in terms of its measurable physical, chemical, and biological properties to monitor soil changes. In general, the values of indicators are taken to determine the soil’s ability to fulfill its functions (Anda, 2002). In fact, the Soil Quality Index (SQI) has recognized as a tool to determine an adaptive soil resource management (Karlen et al., 2001). In particular, this study attempts to investigate any condition which has a correlation between the indicators and soil quality status of old and new paddy fields through the SQI. The results were expected as a reference for other regions with similar conditions, it includes land management recommendations which has potential soil quality maintenance.

**Materials and methods**

**Study site and soil sample determination**

The study was conducted in Melmalaiyanur block of Cuddalore district, Tamil Nadu. Total rainfall of this region is 1200 mm. The district receives the maximum rainfall during the north-east monsoon season. The average temperature varies from 30°C to 41°C. The humidity is high in the order of 48 per cent.

The soils in the district are mostly forest soils and red soil. Alluvial soils are found in eastern side bordering coast. .Black soils are confined to low ground in select pockets in Vanur taluk.

The major crops cultivated in Villupuram district are paddy, sugarcane, maize, black gram, green gram and groundnut.

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| District Map of Viluppuram |

**Fig 1. Location of study area in Villupram district**

**Physicochemical indicators i**ncluded pH, EC was determined in 1:2 soil water suspensions using a combined pH meter (Jackson, 1973) and cation exchange capacity of soil was determined by using Neutral Normal Ammonium Acetate (Bower *et al*., 1952). Biological properties measured in terms of organic carbon by chromic acid wet digestion method (Walkely and Black, 1934). Soil available nitrogen was determined by Alkalaine potassium permanganate method (Subbaiah and Asija 1956), soil available phosphorus by 0.5M NaHCO3 (pH-8.5) extractable (Olsen *et al*, 1954), soil available potassium was determined by Flame photometric method (1N NH4OAC extractable) (Standford and English, 1949), soil available micronutrients, zinc, Fe was determined by DTPA Extraction, (Lindsey and Norvell, 1978). Soil available boron extracted by Hot water (Bremmer, 1965)

**Statistical analysis:** All the Statistical Analysis described in this chapter were performed using the softwares STATISTICA 10.0 and SPSS 20.0.

**Soil physico-chemical quality indicators of Villupuram district**

The pH of the rice soils of Melmalaiyanur block varied from 4.05 to 8.78. The low pH value could due to the non calcareousness . This corroborate with Yoganathan and Meena (2015). High pH value in Melmalaiyanur block could be due to the high base saturation

Aerobic rice farming registered the lowest pH value of 7.33. This could be due to the type of parent material and base saturation per cent. A similar trend of result was reported by Raheb and Heidari (2012).

In Melmalaiyanur block of Villupuram district, electrical conductivity of the soil samples ranged from 0.20 to 0.89 dS m-1. SRI method recorded the lowest EC value of 0.35 dS m-1. Highest EC value of 0.44 dS m-1 would be due to accumulation of ions . This is in agreement with the findings of Kumar et al. (2016)

The organic carbon of the rice soils of Melmalaiyanur block varied from 1.00 to 3.80 g kg-1 . Organic carbon content of 1.00 g kg-1 registered to be the lowest value in this block. This could be because due to the rapid oxidation of organic matter . Among the nutrient management practices, INM registered the highest organic carbon content of 3.98 g kg-1. This result is in line with Nayak *et al* (2012). Integrated nutrient management practices involving the input of green manure (GM), farmyard manure (FYM), crop residues and biofertilizers could improve N use efficiency, soil organic carbon, crop productivity and soil health , This corroborate with Garai *et al* (2014).

The cation exchange capacity varied from 20.00 to 80.00 cmol (p)+ kg-1. Wide variation in CEC could be attributed to the mineral and organic constituents. Organic farming registered the highest CEC value of 92.00 cmol (p)+ kg-1. This is in accordance with Nima *et al* (2020). Continuous incorporation of manure could improve the organo mineral complex, thereby CEC.

**Fig :2 PHYSICO -CHEMICAL QUALITY INDICATORS STATUS OF VILLUPURAM DISTRICT (Needs more clarity on Y axis value)**

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**Fig : 3 PHYSICO -CHEMICAL QUALITY INDICATORS OF VILLUPURAM DISTRICT**

**(Needs more clarity on Y axis value, units, & spelling)**

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**Fig: 4 PHYSICO-CHEMICAL QUALITY INDICATORS OF VILLUPURAM DISTRICT**

**(Needs more clarity on Y axis value and x-axis parameters)**

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**Soil Fertility and its spatial variability**

Available N was deficient with values less than 410 kg ha-1 . The acute deficiency of N could be associated to and insufficient application of fertilizers and organic N sources. Organic farming registered the highest available N of 310 kg ha-1 . This result is in accordance with Urkurkar *et al* (2010)

Olsen – P was found to be low to high status. Organic farming registered the highest Olsen - P content of 40.00 kg ha-1. The organic matter forms a cover on sesquioxides and makes them inactive and thus reduces the phosphate fixing capacity of the soil, ultimately helps in release of ample quantity of phosphorus .

Available potassium was found to be medium to high status . Application of K through inorganic and organic sources could enhance the NH4OAc - extractable K. Several authors reported the increase in available K due to the combined application of organic and inorganic fertilizers (Rao *et al. (*2010).

The micronutrient status of the study area was grouped in to deficient / sufficient DTPA- Zinc content ranged from 4.52 to 8.99 mg kg-1. Similar result was reported by Yadav *et al* (2016). In a long term field experiment, Rahale and Sharmila (2019) observed that continuous fertilizers application enhanced available iron content of soil by two times. On the other hand, continuous cropping for seven years decreased soil zinc content as compared to fallow land, while continuous phosphatic fertilizers application reduced exchangeable Zn compared to control plot as noticed by Perumal *et al* (2019). They also recorded enhanced Zn levels due to application of organic manures.

DTPA - Fe varied from 5.11 to 9.30 mg kg-1. Bhavani *et al.* (2019) noticed that available Fe and Zn level in soil were not declined in FYM treated soil. Similarly, FYM application for five years increased the Zn content in the Vertisols of Akola was reported by Rao and Dakhore, (1994)

Hot water soluble boron content of the soil samples ranged from 0.11 to 0.57 mg kg-1. INM practice registered the highest available hot water soluble boron. This is in accordance with the findings of Immanuel *et al* (2019)

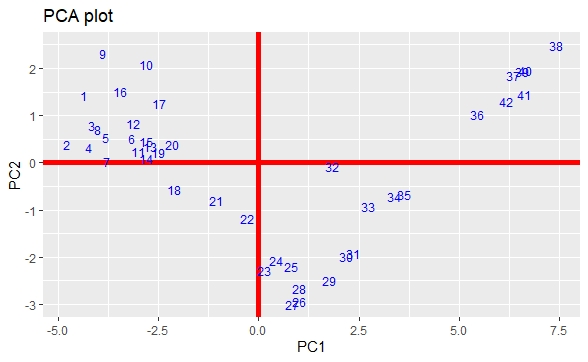
**Principal Component Analysis (Results needs still more clarity)**

Villlupuram districts soil variables from each PC were considered for minimum soil data set (MDS) The soil parameters selected from PC 1, PC 2, PC3, PC 4, PC5 were available nitrogen, MBN, available potassium, silt, EC, OC, EC, bulk density, sand and pH

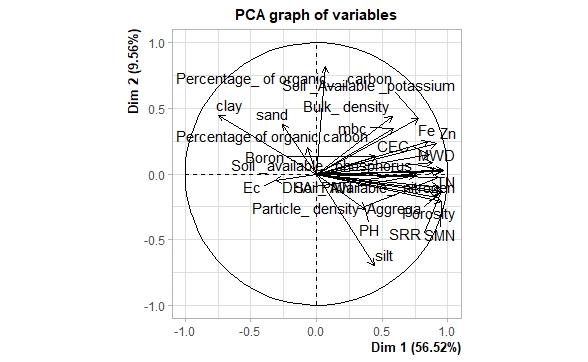
Villlupuram districts However , PCA Pt , PCA graph variables showed higher variables between these parameters indicated MBN has the highest factor loading was retained in the MDS

**Table: 1** **Villupuram District highly weighed parameters under Principal component Analysis**

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| Highy weighed parameters | PC 1 | PC 2 | PC 3 | PC 4 | PC 5 |
|  | Available Nitrogen | Available Potassium | EC | EC | pH |
|  | MBN | Silt | OC | Bulk density | Sand |



**Fig: 5 Villupuram District soil physico-chemical indicators in PCA plot variables**



**Fig: 6 Villupuram District soil physico-chemical indicators in PCA graph variables**

**Conclusion (still more clarity is needed)**

Soil quality index is a useful tool to assess soil health and well being. Few methods are available to estimate it. Among those PCA based scoring, ranking and weightage method gaining popularity. However, SQI assessment primarily depends on objectives of study or soil functions need to be addressed. Selection of MDS and its ranking play important role for determining SQI. However , PCA Pt , PCA graph variables showed higher variables between these parameters indicated soil available nitrogen only, which has the highest factor loading and was retained in the MDS. Villupuram district soil Physico-Chemical quality indicators Soil Microbial Biomass Nitrogen (MBN) high under based on the Principal Component Analysis .

**References (Alignment to be rectified)**

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