International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(4): 1961-1968

Received: 18-05-2017
Accepted: 20-06-2017

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Soil quality changes under different fertilisation and cropping in a vertisol of Tamil Nadu

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Abstract
The research project was initiated to monitor the changes in soil quality in the intensive cropping systems under different fertilisation in an irrigated uplands. Different nutrient management practices viz., 100% organic, 100% inorganic, 50% organic + 50% inorganic were practiced under intensive cropping systems viz., green manure-cotton-maize, green manure-chillies- sunflower and green manure- brinjal- sunflower. The results emanated from the experiment showed that, better soil quality parameters such as soil dehydrogenase activity (115.4 mg TPF/kg/24 hrs), nutrient availability, higher water soluble organic carbon (SOC) (174 mg/kg) and potassium permanganate oxidisable carbon ($KMnO_4$ C) (562 mg/kg) and lower bulk density was observed in green manure- brinjal- sunflower cropping system. In the nutrient budgeting, negative N and K balance of 77.4 kg/ha and 3.5 kg/ha was recorded in the sunhemp-cotton-maize. Irrespective of the cropping system, MP3 recorded favourable soil quality parameters.

Keywords: cropping system, manure treatments, physical property, soil carbon pools, soil microbial population

Introduction

Increased application of chemical fertilizers has been the major input in achieving high production levels under intensive cropping system. But application of chemical fertilizers may have their effect on soil physical, chemical as well as biological properties. The excessive fertilizer use cause degradation of soil due to excess nutrient mining caused by the inadequate replenishment of nutrients by successive harvests. Under intensive cropping, two to three crops are being produced per year and the intensive cropping system removes 554 to 932 kg of NPK per hectare per year (Grewal and Singh, 1989). Continuous cropping without fertilizers or manures lowers the crop yields due to decline soil fertility due to nutrients removed by the crops. The long term use of heavy doses of fertilizers also cause nutritional imbalances. The emphasis should be given to increase the fertilizer use efficiency to prevent the long term pollution problems and help the resource poor farmers in saving the money they invested in fertilizer application.

Recent developments in the Indian agriculture and farming methods force to develop environmental friendly farming practices and produce quality led to widespread interest in organic way of farming than inorganic sources and integrated farming system. Organic way of farming is defined as a cultivation system that produce crops of maximum nutritional quality while respecting the environment and conserving soil fertility. This may be achieved by means of optimal utilisation of local resources and reducing the application of synthetic chemicals. Though soil quality parameters maintained, production wise, the yield compromise may happen. By taking into considerations of yield and soil quality, combination of nutrient sources application may be beneficial. In India, particularly Tamil Nadu, importance of nutrient source is given for vegetables and fruits only. In addition, the vegetable crops are grown in the peculiar area with intensive cultivation. Attempt to supplement crops with nutrients vary based on their need and farmers ability. Accordingly, some farmers are going with 100 % organic, some with 100 % inorganic and others with 50 % combination of both. In this situation, soil quality is very important.

Enzymes may respond to soil management changes more quickly than other soil parameters and it might be useful as early indicators of biological change (Bandick and Dick, 1999) [4]. Organic manures, such as animal manure, green manure, and crop residue, significantly increased the activity of a wide range of soil enzymes, as compared to unamended soil (Martens *et al*., 1992) [14].

A number of studies have shown that organic farming leads to higher soil quality and soil biological activity than conventional farming (Carpenter-Boggs *et al*., 2000; Fliessbach *et al*., 2000; Shannon *et al*., 2002) [6, 9, 23].

Nowadays, characteristic of soil fertility is integrating biological, chemical and physical properties of the soil which responsive to environment changes are important. (Dilly *et al*., 2007) [7]. Biological properties which governs the soil role in metabolism processes of materials and energy in ecosystems and represents an integrated index of soil physical-chemical conditions (Schutter & Fuhrmann, 2001) [22].

Soil quality changes under intensive cropping system of different nutrient application sources and cropping system with nutrient sources getting momentum. An understanding of microbial processes is important for the management of farming systems, particularly those that rely on organic nutrient input (Melero *et al*., 2007) [15]. Relatively limited research has been conducted on soil quality in different nutrient systems. Hence, the project was undertaken with different manure management practices with crops in a one of the important soil order Vertisol of Tamil nadu.

Materials and methods

To monitor the soil health of intensive cropping systems under different manure management practices in irrigated uplands the research project was initiated. Different nutrient management practices viz., MP1: 100% organic (1/3rd each of vermicompost, FYM, Neem cake) MP2: 100% inorganic, MP3: 50% organic + 50% inorganic under intensive cropping systems such as CS1: Sunhemp-Cotton-Maize, CS2: Sunhemp-Chillies- Sunflower CS3: Sunhemp-Brinjal-Sunflower were tried. To study the effect of treatments on soil propertiesl, initial and post-harvest soil samples from three cropping systems were collected and analysed for physical properties, different organic carbon fractions, microbial population and enzyme activity. To construct nutrient budgeting the nutrient supplied through different means for different treatments were quantified. Initial soil properties are, soil texture: sandy clay loam particle size distribution: Sand = 54.10%, Silt = 13.8%, Clay = 32.1%, Bulk density: 1.52 Mg m^{-3}, Porosity : 52%, Particle density: 2.4 g cm^{-3}, EC: 0.35(dS m^{-1}), pH: 8.5, CEC (c mol (p+)/kg): 22.5, Organic carbon : 0.60 %, Available nutrients N = 269 kg/ ha, P =17.9 kg/ha, K= 690 kg/ha, Cu = 2.73 ppm, Zn= 4.5 ppm, Fe = 29.60 ppm and Mn = 10.60 ppm.

To study the nutrient cycling in the system, quantification of nutrients was attempted and the results are given in the Table4. It showed the quantity of nutrients added for MP1 i.e through FYM, Vermicompost and Neem cake in equal quantity as per An equivalent amount, for MP2 all the nutrient demand of the crop meet through inorganiccs alone and for MP3, the required nutrients will be divided into half, and 50% applied through organics and 50% applied through inorganics alone. Likewise total nutrients required for each cropping system as a whole calculated (table 4).

Results and discussion

Post-harvest soil samples were collected and analysed for different soil properties and the results are presented in this chapter.

Soil physical properties

The organics play a major impact on soil physical properties. The results from the table(1) reveals that, irrespective of the manures, the CS III (sunhemp -brinjal -sunflower)better in improving bulk density (1.35 Mg/m3) as well as porosity (48.03 %) and water holding capacity (47.80%). Irrespective of the cropping system, MP1 (organics alone) performs better in improving BD (1.33 Mg/m3), porosity (48.80%) and water holding capacity (49.80%) of the soil followed by MP3 (organics + inorganics)(BD (1.39 Mg/m3), porosity (47.30%) and water holding capacity (45.07%). The MP2 (inorganic alone) recorded higher BD (1.39 Mg/m3) and lower porosity (46.23%) and water holding capacity (43.27%) (table1and fig1). Similar results are in corroboration with the Paustian *et al*.(1995) [19]. Also Schjønning *et al*. (2002) [21] reported that, organically managed soil had greater fragment size, aggregate stability in water than conventionally managed soil

Soil carbon pools

Soil organic carbon reflecting the functional capability of soil to supply nutrients to lands, serve as an organic nutrient reserve and provide organic resources for stabilizing the soil surface against erosion. Soil organic matter can be related to most other indicators of soil quality. Based on recent literatures, instead of studying the SOC as a whole, different fractions of carbon are highly influenced by the management practices. Hence, in this project the carbon fractions such as water soluble, potassium permanganate oxidisable carbon and passive carbon pools were analysed and reported (table2 and fig2).

Table 1: Impact of nutrient management practices on soil physical properties under intensive cropping system

Treatments	BD Mg/m^3)	PD (Mg/m^3)	Total porosity (%)	MWHC (%)
CS1: Green manure-Cotton-Maize				
MP1: 100% organic	1.35	2.41	47.40	50.20
MP2: 100% inorganic	1.43	2.48	46.20	42.30
MP3: 50% org. + 50% inorg.	1.40	2.46	46.90	43.80
CS2: Green manure-Chillies- Sunflower				
MP1: 100% organic	1.35	2.49	49.50	47.90
MP2: 100% inorganic	1.42	2.51	45.70	42.30
MP3: 50% org. + 50% inorg.	1.41	2.50	47.20	44.50
CS3: Green manure-Brinjal-Sunflower				
MP1: 100% organic	1.30	2.45	49.50	51.30
MP2: 100% inorganic	1.38	2.43	46.80	45.20
MP3: 50% org. + 50% inorg.	1.36	2.49	47.80	46.90

Table 1a: Quantification of biomass addition to the soil (dry weight basis –kg/ha)

Treatments	I crop	II crop	III crop	Total biomass added
	Sunhemp	**Cotton**	**Maize**	
CS1 MP 1	2290	421	305	3016
MP 2	2470	425	308	3203
MP3	2480	428	312	3220
	2413	425	308	3146
	Sunhemp	**Chillies**	**Sunflower**	
CS2 MP 1	2310	185	285	2780
MP 2	2370	192	291	2853
MP 3	2380	198	298	2876
	2353	192	291	2836
	Sunhemp	**Brinjal**	**Sunflower**	
CS3 MP 1	2310	525	322	3157
MP 2	2470	535	321	3326
MP 3	2480	542	325	3347

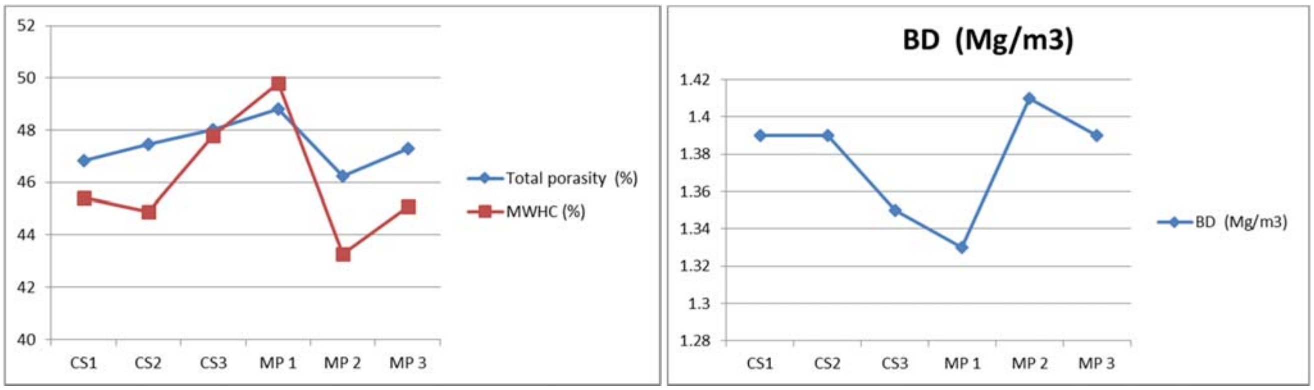


Fig 1: Impact of nutrient management practices on soil physical properties under intensive cropping system

Table 2: Impact of nutrient management practices on soil carbon pool under intensive cropping system

Treatments	Water soluble carbon (mg/kg)	Walkley and Black carbon (TOC) (mg/kg)	$KMnO_4$ carbon (Active C)(mg/kg)	Passive carbon (TOC-Active C) (mg/kg)
CS1: Green manure-Cotton-Maize				
MP1: 100% organic	165	6910	588	6157
MP2: 100% inorganic	156	6740	525	6059
MP3: 50% org. + 50% inorg.	162	6850	452	6236
CS2: Green manure-Chillies-Sunflower				
MP1: 100% organic	178	7210	625	6407
MP2: 100% inorganic	165	7100	586	6349
MP3: 50% org. + 50% inorg.	174	7150	610	6366
CS3: Green manure-Brinjal-Sunflower				
MP1: 100% organic	178	7310	654	6478
MP2: 100% inorganic	162	7210	610	6438
MP3: 50% org. + 50% inorg.	174	7250	625	6451

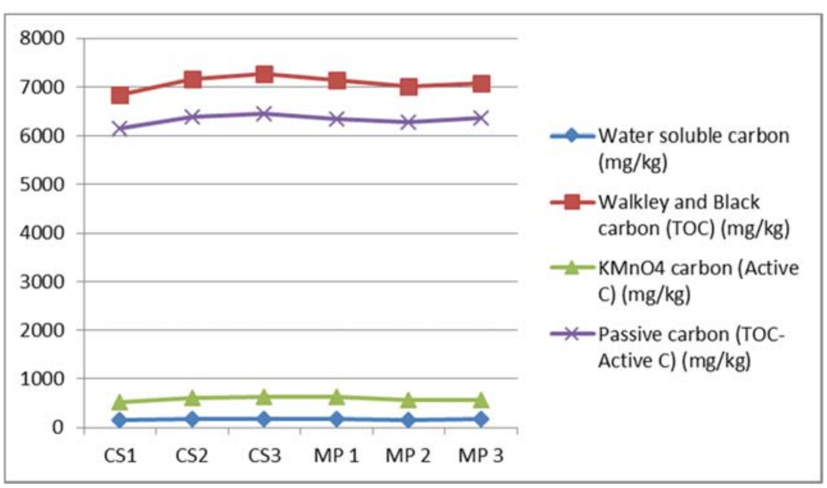


Fig 2: Impact of nutrient management practices on soil carbon pool under intensive cropping system

Water soluble carbon

The soil carbon as such organic form it would not change much. The literature says that the fractions of carbon sensitive to the management as well as source of material (Table3). The results from the table3 reveals that, irrespective of the manures, water soluble C fraction extracted more (172 mg/kg) from the CS II sunhemp-chillies-sunflower cropping pattern followed by CS III (170 mg/kg). Among the manurial treatments MP1 (organics alone) registered higher WSOC (174 mg/kg). Izquierdo *et al*. (2003) [10] reported that, values of water-soluble C were higher in the rainy season compared to the dry season. Pasture and forage areas had the highest percentage of stable aggregates in the rainy season, while polycrops developed soils with less stable aggregates. Crop rotations in agricultural soils may influence WSC concentration from year to year. It is known that plant roots exude easily metabolizable material. Cropping to legumes or including them into the rotation appears to increase the amount of WSC present in the soil by 2–44 kg ha^{-1} (Campbell *et al*., 1999)

Permanganate oxidisable carbon

The soil organic carbon and $KMnO_4$ C result reveals that, CS III registered higher value of 631 mg/kg. Irrespective of the cropping system, MP1 (organics alone) registered higher $KMnO_4$ C (622 mg/kg). Among the manurial treatments MP1 (organics alone) registered higher $KMnO_4$ C (622 mg/kg) than MP2 (574 mg/kg) and MP3(562 mg/kg). The increased labile carbon with manure addition reported by Rudrappa *et al*.(2005) [20].

Total Soil organic carbon

The soil organic carbon reveals that, CS III registered higher value of 7257 mg/kg). Irrespective of the cropping system, MP1 (organics alone) registered higher SOC (7143 mg/kg). Reported that organically managed soil had greater soil organic carbon and total nitrogen than conventionally managed soil as well as greater biological soil quality. The results also corroboration with Flieβbach *et al*.(2006) [16] that at the end of 21 years of crop rotation management, soil organic carbon and total nitrogen were greater under biodynamic management than conventional management, but organic management and integrated management (combination of manures, inorganic fertilizers, an herbicides) were intermediate

Passive carbon

The passive or inactive carbon is an important quality parameter in environmental point of view. Among the three cropping system, CS3 recorded higher passive carbon (6456 mg/kg) than CS2 (6374 mg/kg) and CS1 (6151 mg/kg). Among the nutrient sources, 100 % organic registered higher passive carbon of 6347 mg/kg and the lowest registered in 100 % inorganic (fig2).In the different cropping system also same trend of result followed.

Soil microbial properties

Soil microbial population is one of the important soil quality which was greatly influenced by organic and inorganics. The effect of organics on soil bacteria, fungi, actinomycetes and dehydrogenase enzymes are presented in the table 3 revealed that, irrespective of the manures, the CS III (sunhemp -brinjal –sunflower) cropping pattern better in improving bacteria (40 cfu x 10^6) g/soil), fungi (15 cfu x 10^4) g/soil) and actinomycetes (28 cfu x 10^3) g/soil) (fig3). Table 2a showed that the quantity of biomass addition to the soil was higher in the CS III which would have contributed to the better biological quality as well as organic carbon.Irrespective of the cropping system, MP1 (organics alone) performs better in improving bacteria (43 cfu x 106) g/soil), fungi (18 cfu x 104) g/soil) and actinomycetes (29 cfu x 103) g/soil) followed by MP3 (organics +inorganics) and MP2 (inorganic alone). Ngyugen (2003) [18] reported high aboveground biomass yield is obviously accompanied by an active root system, which releases an array of organic compounds into the rhizosphere. Plant roots release about 17 % of the photosynthates captured, most of which is available to soil organisms. These compounds support the growth of microbial community and result in increased population density.

Dehydrogenase activity

The more sensitive soil quality indicator is enzyme activity. Among the enzymes, dehydrogenase activity is the real indication of soil biological activity. The effect of organics on soil dehydrogenase enzymes is presented in the table 3 and fig3 revealed that, irrespective of the manures, the CS III (sunhemp -brinjal –sunflower) cropping system better in improving dehydroggenase avtvity (113.4 (mg TPF/kg/24 hrs). This may be due higher microbial activity which was registered in the present study itself (table 2) in the CS III which would have contributed to the better biological quality as well as organic carbon. Irrespective of the cropping system, MP1 (organics alone) performs better in improving bacteria (43 cfu x 106) g/soil), fungi (18 cfu x 104) g/soil), actinomycetes (29 cfu x 103) g/soil) and dehydrogenase activity(115.4 (mg TPF/kg/24 hrs) followed by MP3 (organics +inorganics) and MP2 (inorganic alone) (Table 2). The present study was supported by Liebig and Doran (1999) [13] and Doran,*et al*.(1998) [8] that soil microbial biomass carbon and dehydrogenase activity were greater under organic than under conventional management. Dehydrogenasee are greatly associated with microbial biomass, which in turn mediates the decomposition of organic matter. (Zhang *et al*. 2010) [25] Similar findings reported earlier by Brar *et al. (*2015) [5]. Babu *et al*. (2010) [3] reported that continuous use of organic addition sinificantly enhanced the DHA.

Table 3: Impact of nutrient management practices on soil biological properties under intensive cropping system

Treatments	Bacteria (cfu x 10^6) g/soil	Fungi (cfu x 10^4) g/soil	Actinimycetes (cfu x 10^3) g/soil	dehydrogenase activity (mg TPF/kg/24 hrs)
CS1: Green manure-Cotton-Maize				
MP1: 100% organic	41	17	29	129
MP2: 100% inorganic	29	10	22	90.5
MP3: 50% org. + 50% inorg.	35	14	24	110.3
CS2: Green manure-Chillies- Sunflower				
MP1: 100% organic	44	19	27	97.8
MP2: 100% inorganic	30	11	24	84.6
MP3: 50% org. + 50% inorg.	36	15	25	90.6

CS3: Green manure-Brinjal-Sunflower				
MP1: 100% organic	45	18	30	119.4
MP2: 100% inorganic	36	12	26	108.2
MP3: 50% org. + 50% inorg.	39	16	28	112.6

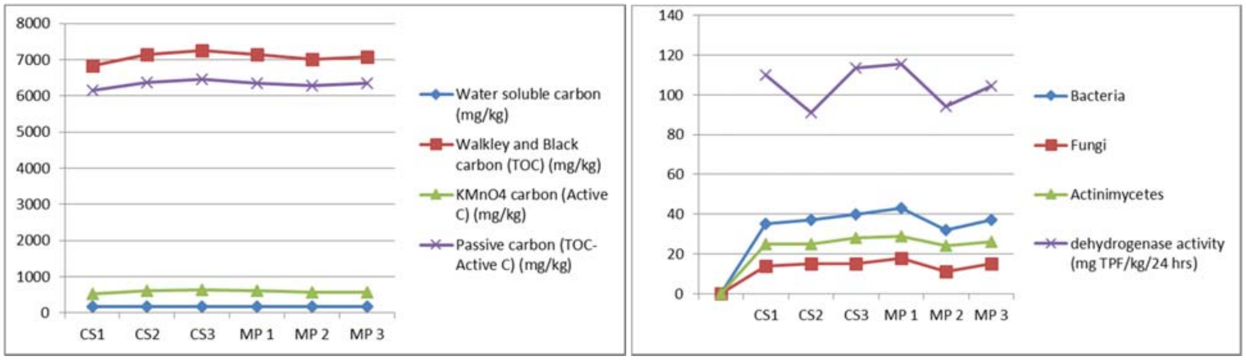


Fig 3: Impact of nutrient management practices on soil biological properties under intensive cropping system

Soil enzymes are produced by plants, animals and microorganisms, and may be present in dead cells and cell debris and also adsorbed by clay or incorporated into humic substances (Allison, 2005) [2]. Hydrolytic enzymes make nutrients available to plants and soil microorganisms from a wide range of complex substrates and are influenced by soil properties such as pH, organic matter and texture, and also by farming management (Joanisse *et al*., 2008; Li *et al*., 2008) [11, 12]. Among other indices, enzyme activity is proposed as an index of soil fertility or contamination (Nannipieri *et al*., 2000; Li *et al*., 2008) [17, 12]. These enzymes are non-cellular and persist for a long time in the soil matrix though they are sensitive to abiotic factors, especially to fertilizers (Zakarauskaitė *et al*., 2008) [24].

System Level Nutrient Budgeting

Determination of nutrient budgeting will give idea of nutrient depletion or addition by the crops as well as by the effect of treatments. This is also one of the soil quality parameter. To calculate the nutrient budgeting, quantification of nutrients added, nutrient removal by the crops (straw and grain), and available nutrients in the post-harvest soil is essential. From the mentioned data, nutrient budgeting was calculated for individual nutrients separately. The results are presented in the tables 5, 6 and 7.

Nitrogen Budgeting

The results given in the nitrogen balance sheet shows that CS I- green manure-cotton-maize is with negative nitrogen balance though it recorded lower nutrient uptake than other cropping sequence, also the availability of nitrogen is lower in the post-harvest soil. It indicates that the nitrogen might have lost through various means in the CSI. The CS III shows the positive nutrient balance. Because with the limited nitrogen supply the Cropping system utilised the nitrogen effectively also the nitrogen might have moved from the reserve (Table 5 and fig4). In all the manure plots registered positive nitrogen balance.

Phosphorus Budgeting

In the phosphorus nutrient budgeting, highest nutrient removal of 87.2 kg/ha was observed in the CSI green manure cotton maize cropping sequence followed by CS III (55.0 kg/ha) and CSII (48.7 kg/ha). Irrespective of the cropping system MP3 (organics +inorganics) recorded higher P uptake (68.8kg/ha). In the phosphorus budgeting, irrespective of cropping system, MP2 is expected to be maintaining high P in soil, due to fixation the P builds up is not possible in the soil. Though higher P available initially as per record, it shows higher nutrient loss through more negative value. The p nutrient is concerned the P is fixed in the soil above certain level. (Table6and fig4).

Potassium Budgeting

The potassium budgeting of table 9 reveals that, the CS II green manure –chillies-sunflower removed higher K nutrient of 170.6 kg/ha followed by CSII (163.4 kg/ha).In the nutrient balance value,though nutrient added is high in CS I. The balance is in negative side. Irrespective of the cropping system MP3 (Org + Inorganics) recorded higher K uptake of 165.8 kg/ha followed by MP2 (inorganiccs alone) 163.1 kg/ha. In the CS II and III the nutrients applied is low but nutrient uptake is high, availability also maintained in the soil. Hence the K balance is in positive. The available K might be due to release of non-exchangeable K. irrespective of the cropping system, the MPI (organics) has negative balance because, the applied K through organics is high, but removal is low. (Table7 and fig4).

Table 4: Quantification of nutrient added through different sources

Cropping pattern	Nutrients added through Inorganic (kg/ha)			Quantity of organics added			Nutrients added through organic (kg/ha)			Total nutrients added		
	N	P	K	VC	FYM	NC	N	P	K	255.0	97.8	184.9
CS1 MP 1	0	0	0	5667	16346	3400	255.0	97.8	184.9	255.0	122.5	110.0
MP 2	255	122.5	110	nil			0.0	0.0	0.0			255.0
MP 3	127.5	61.25	55	2833	8173	1700	127.5	48.9	92.4	180.0	69.0	130.5
CS2 MP 1	0	0	0	4000	11538	2400	180.0	69.0	130.5	180.0	150.0	90.0
MP 2	180	150	90	nil			0.0	0.0	0.0			180.0
MP 3	90	75	45	2000	5769	1200	90.0	34.5	65.2	160.0	61.4	116.0
CS3 MP 1	0	0	0	3322	9631	1993	160.0	61.4	116.0	160.0	140.0	90.0

MP 2	160	140	90	nil			0.0	0.0	0.0			160.0
MP 3	80	70	45	1661	4816	997	80.0	30.7	58.0	255.0	97.8	184.9

Table 5: Impact of nutrient management practices on system level nitrogen budgeting under intensive cropping system

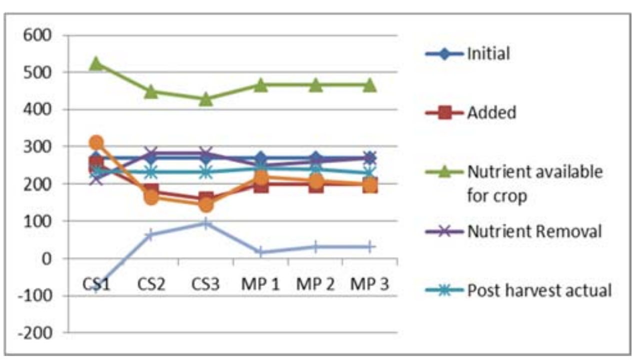
Treatments	Initial (a)1	Added (b)2	Nutrient available for crop (a+b)3	Nutrient Removal (c)4	Post-harvest (Actual)(d)5	Post-harvest (expected) e =(3-)6	Nutrient balance (5-6)
CS1: Green manure-Cotton-Maize							
MP1: 100% organic	269.0	255.0	524.0	193.1	243.0	330.9	-87.9
MP2: 100% inorganic	269.0	255.0	524.0	215.9	238.0	308.1	-70.1
MP3: 50% org. + 50% inorg.	269.0	255.0	524.0	229.8	220.0	294.2	-74.2
CS2: Green manure-Chillies-Sunflower							
MP1: 100% organic	269.0	180.0	449.0	269.0	233.0	180.0	53.0
MP2: 100% inorganic	269.0	180.0	449.0	282.6	238.0	166.4	71.6
MP3: 50% org. + 50% inorg.	269.0	180.0	449.0	295.8	223.0	153.2	69.8
CS3: Green manure-Brinjal-Sunflower							
MP1: 100% organic	269.0	160.0	429.0	282.7	233.0	146.3	86.7
MP2: 100% inorganic	269.0	160.0	429.0	280.9	242.0	148.1	93.9
MP3: 50% org. + 50% inorg.	269.0	160.0	429.0	284.1	246.0	144.9	101.1

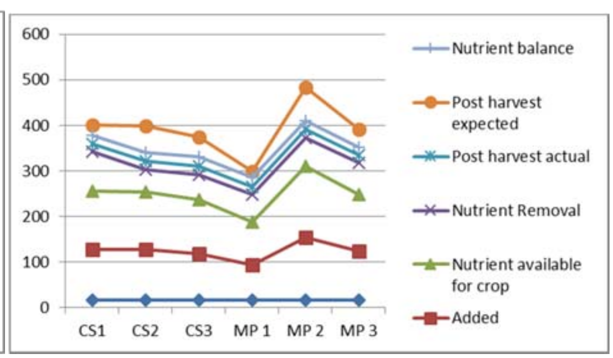
Table 6: Impact of nutrient management practices on system level soil phosphorus budgeting under intensive cropping system

Treatments	Initial (a)1	Added (b)2	Nutrient available for crop(a+b)3	Nutrient Removal (c)4	Post-harvest (Actual) (d)5	Post-harvest (expected)e =(3-4)6	Nutrient balance (5-6)
CS1: Green manure-Cotton-Maize							
MP1: 100% organic	17.7	97.8	115.5	78.9	18.2	36.6	-18.4
MP2: 100% inorganic	17.7	122.5	140.2	86.5	17.8	53.7	-35.9
MP3: 50% org. + 50% inorg.	17.7	110.1	127.8	96.2	16.6	31.7	-15.1
CS2: Green manure-Chillies-Sunflower							
MP1: 100% organic	17.7	69.0	86.7	46.4	19.2	40.3	-21.1
MP2: 100% inorganic	17.7	150.0	167.7	47.1	19.5	120.6	-101.1
MP3: 50% org. + 50% inorg.	17.7	109.5	127.2	52.7	17.6	74.6	-57.0
CS3: Green manure-Brinjal-Sunflower							
MP1: 100% organic	17.7	61.4	79.1	54.4	21.3	24.6	-3.3
MP2: 100% inorganic	17.7	140.0	157.7	53.1	19.2	104.6	-85.4
MP3: 50% org. + 50% inorg.	17.7	100.7	118.4	57.4	17.8	61.0	-43.2

Table 7: Impact of nutrient management practices on system level soil potassium budgeting under intensive cropping system

Treatments	Initial (a)1	Added (b)2	Nutrient available for crop(a+b)3	Nutrient Removal (c)4	Post-harvest (Actual)(d)5	Post-harvest (expected)e =(3-4)6	Nutrient balance (5-6)
CS1: Green manure-Cotton-Maize							
MP1: 100% organic	690	184.9	874.9	153.9	674.0	721.0	-47.0
MP2: 100% inorganic	690	110	800	164.2	667.0	635.8	31.2
MP3: 50% org. + 50% inorg.	690	147.4	837.4	172	670.0	665.4	4.6
CS2: Green manure-Chillies-Sunflower							
MP1: 100% organic	690	130.5	820.5	142.2	685.0	678.3	6.7
MP2: 100% inorganic	690	90	780	143.1	635.0	636.9	-1.9
MP3: 50% org. + 50% inorg.	690	110.2	800.2	146.4	622.0	653.8	-31.8
CS3: Green manure-Brinjal-Sunflower							
MP1: 100% organic	690	116	806	148.5	654.0	657.5	-3.5
MP2: 100% inorganic	690	90	780	152	631.0	628.0	3.0
MP3: 50% org. + 50% inorg.	690	103	793	148.9	620.0	644.1	-24.1





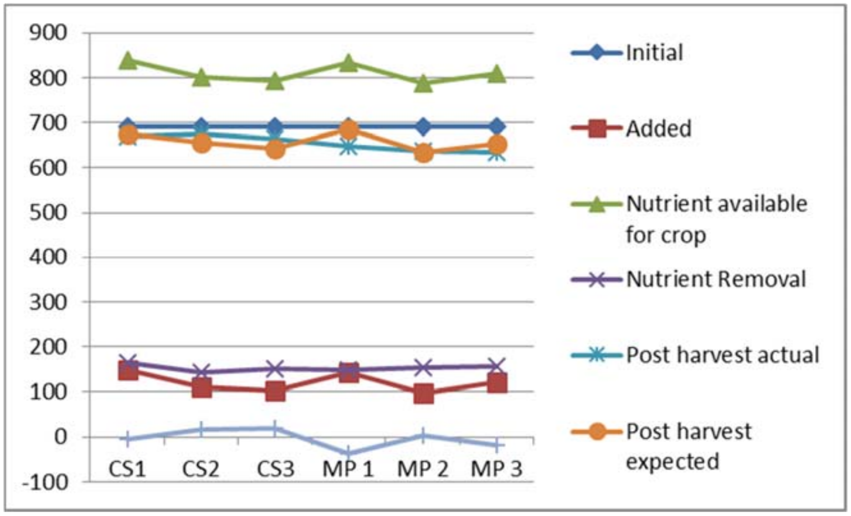


Fig 4: Impact of nutrient management practices on soil nutrient budgeting under intensive cropping system

Conclusion

The results obtained from the present study revthat, irrespective of the cropping system, the 100 % organics applied treatment recorded better soil quality parameters such as soil dehydrogenase activity, nutrient balance and soil physical properties. Among the three cropping systems, better soil quality is observed in CS3 : Sunhemp- Brinjal- Sunflower with higer SOC, Dehydrogenase activity and physical properties such as porosity and maximum water holding capacity. The lesson learnt from this study state that, instead of studying SOC, the fractions will give meaningful result. Also microbial study paves way for delineating soil. The nutrient budgeting makes us to learn how the management practices and cropping system influence the soil fertility. Continuous use of inorganic fertilizers mainly consisting major nutrients NPK in large quantities and neglecting organic and bio fertilizers paved the way for deterioration of soil health and in turn ill effects on plants, human being and cattle. Integrated nutrient supply system plays a vital role in sustaining soil fertility on long term basis.

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