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Soil organic, inorganic and total carbon stocks under different cropping pattern and soil profiles of Aurangabad district of Maharashtra

Tadi Rajasekhar and Vaidya PH

Abstract
Aurangabad district is located in the north central part of Maharashtra between 19^0 15’ and 20^0 40’ N latitude and 74^0 37’ and 75^0 52’ E Longitude. The mean maximum temperature 39.7 °C, the mean minimum temperature is 24.6 °C. The average annual rainfall is 619 mm. The elevation of the district was 500 meters above mean sea level. The length of growing period 145 and humidity period is 101 days. The geographical area is10, 107 Sq.km. The soils of the study area were shallow to deep, The maximum soil organic carbon stock (SOCS) was noticed at pigeon pea cropping pattern at 100 cm soil depth (13.6 tha-1) and which was varies from 7.74 to 13.6 tha^{-1}. The maximum soil inorganic carbon stock (SICS) was noticed at maize cropping pattern at 100 cm soil depth (16.36 tha^{-1}) and which was varies from 10.28 to 16.36 tha^{-1}. The Total carbon stock (TCS) was noticed at cotton cropping pattern at 100 cm soil depth (26. 17.36 tha-1) and which was varies from 18.2 to 26.17 tha^{-1}. The correlation between yield of cotton with SOCS (r=0.06), SIC (r=-0.28) and Total Carbon Stock (r=0.052); in Maize SOCS (r=0.42), SIC (r=-0.375) and Total Carbon Stock (r=0.043); and in pigeon pea SOCS (r=0.258), SIC (r=-0.161) and Total Carbon Stock (r=0.051).increasing clay content, good vegetation, crop rotation with legumes better water level increases the carbon stocks. High temperature, poor soil water conservation practices, high tillage operation leads to the development soil in organic stocks in the soil. The combination both soil organic and inorganic stocks known as total carbon stocks of the soil.

Keywords: Carbon stock, organic carbon stock (SOCS), inorganic carbon stock (SICS), total carbon stocks (TSC)

1. Introduction

Carbon is the basic unit for the development of soil ecosystem functions, it acts as carrier or medium for the lot of chemical reactions in the soil and earth ecosystems. It is an indicator to soil colour, soil health and soil microbial activity in the soil. It acts as an energy exchanger between the soil and atmosphere. It can enhance and develop the soil physical properties like bulk density, soil porosity, hydraulic conductivity, plant available water capacity, maintains soil thermal equilibrium and aeration and reduce soil crust formation. It also useful to chemical processes like cation exchange capacity, base saturation, exchange cations and act as a natural chelated agent. Carbon can be increasing the microbial activity and catalyst for the soil enzymatic activities like dehydrogenase (microbial respiration), cellulose, phosphatase, urease, Acyl-Sulphatase. It can develop the soil biodiversity encourages the soil beneficiary organisms, predators and maintains the soil ecological equilibrium. But now a days carbon content in the soil ecosystem decreasing gradually, at the same time carbon emissions in the atmosphere has increasing due to anthropogenic activities. The reduction of soil organic carbon concentration and increasing carbon emissions were burning issue in globally, because it causes lot of changes in weather calamities like global warming, greenhouse gas effect and increase in sea level. (Fortunate and colin 2004) [10]. The soil organic carbon concentration in most of the Indian soils were less than 10 g/kg and it is generally less than 5 g/kg. (Lal *et al*., 2004) [6]. The reason behind that was continuous monoculture, high tillage operations, traditional methods of cultivation practices like biomass burning, crop residues burning (Punjab, Haryana), podu method cultivation or jhuming-jhum cultivation (North East Hills), continuous rice cultivation (South India), high grazing in cultivation land, deforestation, cement manufacturing, fossil fuels and industrial pollution. Along with edaphic conservation method like cover crops, mulching, green manuring, ignoring soil health card results and enormously used plenty of or high doses of commercial fertilizer application causes the soil organic carbon decrease and soil health damage (Lal *et al*., 2004) [6].

The environmental issue high ozone (O_3strong oxidizer) concentration in the soil atmosphere causes lot of oxidations of soil organic carbon in the surface layer of soil (Tajji kou *et al.*, 2014) [29]. Soil carbon stock defined as the carbon stored in above biomass below biomass, plant litter deadwood/woody debris and final total soil collectively known as soil carbon stock or pool. The soil was the largest stock of carbon holding 1500 Pg. C (1pg = 10^{15} g), it was approximately twice the amount held in the atmosphere and thrice the amount held in the terrestrial vegetation. The soil Terrestrial vegetation reported 600 Pg. C and soil inorganic carbon stock contain 750-950 Pg. C. Recent methodologies like bio-char production, carbon sequestration, carbon stock or pool, crop residue, legume crop rotation, following forestry, Agro-forestry measures and biomass production management was required for restoration of soil health and soil organic carbon management. It is a major concern for the tropical soil.

2. Material and Methods

2.1 Location

Aurangabad district is located in the north central part of Maharashtra between North Latitude 19^0 15' and 20^0 40' and East Longitude 74^0 37' and 75^0 52'. This district is surrounded by Jalgaon district of North, Nashik district in west, Ahmednagar and Beed district in south and Parbhani and Buldhana district in east. Aurangabad district has been divided in 9 talukas *viz*. Aurangabad, Kannad, Soyagaon, Sillod, Phulambri, Khuladabad, Vaijapur, Gangapur, and Paithan talukas. The district has geographical area of 10,107 sq. km., out of which 726 sq. km is occupied by forest while cultivated area is 8135.57 sq.km and net area sown is 6540 sq.km. Figure 1 shown the location sites of different cropping pattern under Aurangabad district.

2.2 Geology and parent material

The entire area is covered by the Deccan trap lava flows of upper cretaceous to lower Eocene age. The lava flows are overlain by thin alluvial deposits along the Kham and Sukhana River. The basaltic lava flows belonging to the Deccan Trap is the only major geological formation occurring in Aurangabad.

2.3 Natural vegetation and land use

The most of the area they cultivating cotton (*Gossypium hirsutum*) tur or red gram (*Cajanus cajan*), Maize (*Zea mays*), Wheat (*Triticum aestivum*) jowar (*Sorghum halepense*), bajra (*Pennisetum Americanum*) Bengal gram (*Cicer arietinum*), Sugarcane (*Saccharum officinalis*), Ginger (*Zingiber officinale*), Onion (*Allium sativum*) and fruit crops like Guava (*Psidium guajava*), mosambi (*Citrus limetta*), Pomegranate (*Punica granatum*) and mulberry (*Morus rubra*) Production unit. we have commonly observed weeds are Mexican Prickly poppy (*Argemone mexicana*), nut grass (*Cyperus rotundus*), garika (*Cynodon dactylon*) congress weed (*Parthenium hysterophorus*) celosia (*Celosia argentea*), we have been found out that vegetation and plantation trees are Babul (*Acacia nilotica*), neem (*Azadirachta indica*), Tamarinds (*Tamarindus indica*), Ber (*Ziziphus zuzube*), Mango (*Mangifera indica*), Sapota (*Achras zapota*), and moringa (*Moringa oleifera*).

2.4 Climate

The climate of the research conduct area was coming under the hot semi-arid Tropical condition. The mean maximum temperature of 32.45 °C, whereas the mean minimum temperature is 19.10 °C May is the hottest month with the mean maximum temperature 39.7 °C the mean minimum temperature of 24.6 °C. The average annual rainfall of the district 619 mm. The elevation of the district was 500 meters above mean sea level. The length of growing period 145 and humidity period is 101 days. Fig 1 shown the climatic data and water balance of Aurangabad district of Maharashtra.

Table 1: Climatic data and water balance of Aurangabad district (30 Years)

Month	Rainfall (mm)	Relative humidity (%)		Monthly temperature (Mean of daily)	
		AM	PM	MAX ℃	MIN ℃
January	2	70	40	29.0	12.3
February	1	64	36	32.0	14.9
March	5	57	31	35.3	18.7
April	1	56	28	38.8	22.9
May	2	67	31	39.7	24.9
June	112	81	44	34.4	23.0
July	134	87	59	29.7	21.7
August	141	89	61	29.1	21.2
September	141	88	58	30.2	21.4
October	55	78	45	31.8	19.7
November	18	72	41	30.3	15.5
December	7	70	40	29.1	13.0
	Total rainfall	Mean max. RH	Mean min. RH	Mean max. temp.	Mean min. Temp.
	619	73.25	42.83	32.45	19.10

Source: Dakore *et al.* (2021) Agroclimatic Atlas Maharashtra (Book), VNMKV, Parbhani.

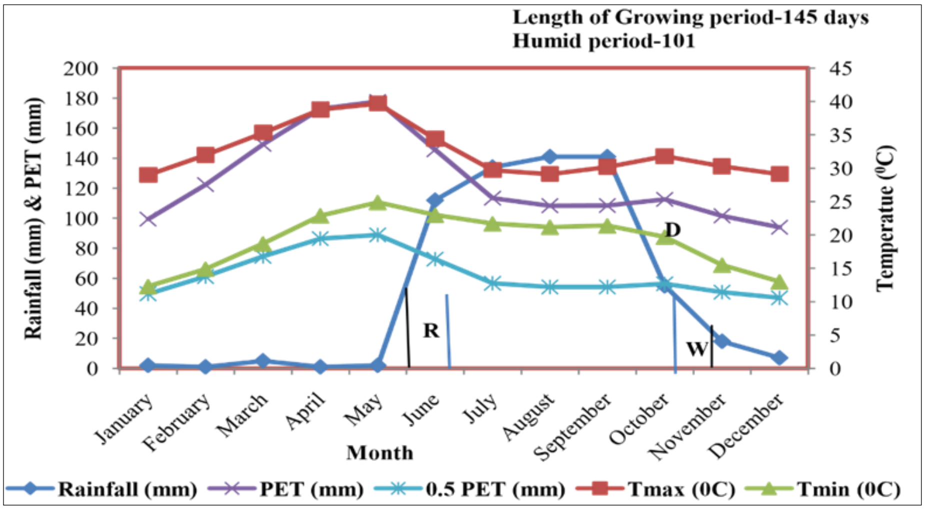

Fig 1: Last 30-year climatic data and water balance of Aurangabad district of Maharashtra

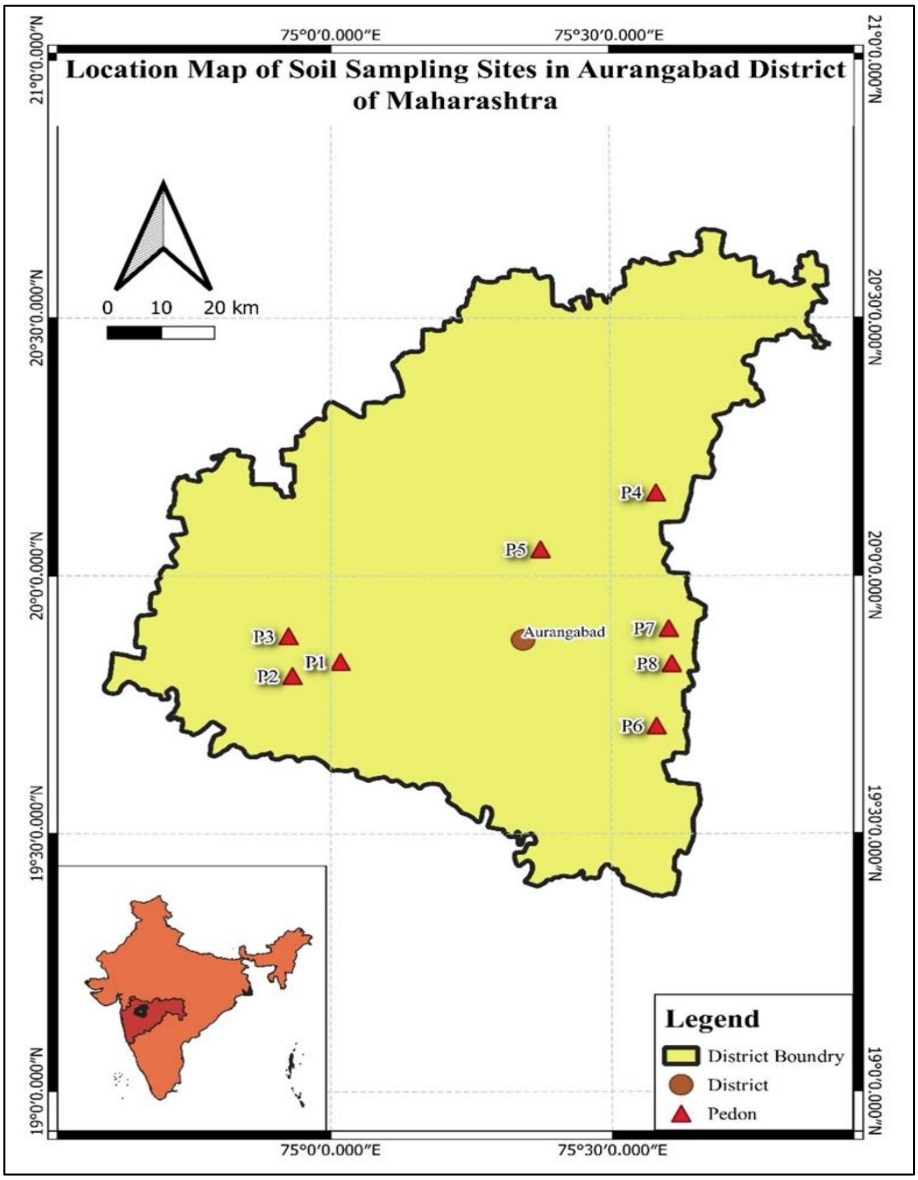

Fig 2: Location sites of different cropping and soil profiles of Aurangabad

2.5 Collection of soil samples

The studied research places were selected that adopted village of KVK Aurangabad. Total seven village were selected for soil survey and profile examination. The village names were following this 1. Shekta (Gangapur Thaluk), 2. Gopal wadi (Gangapur Thaluk), 3. Shankarpur (Gangapur Thaluk), 4. Borgav Arj (Phulambri Thaluk), 5. Murshidabad wadi (Aurangabad Thaluk), 6. Devgaeon (Python Thaluk), 7. Hasanbad wadi (Aurangabad Thaluk). the selected village were under different crops like cotton, red gram, maize, Jowar, Bajra, sugarcane by using GPS and SOI topo-sheet (Table 2) as per the (Soil Survey Staff, 1975). Examine soil profile and horizon wise samples were collected for laboratory analysis as wells as determination of final total carbon content and soil SIC and SOC, determination of carbon pool. The yield data were collected from adjoining area at soil profile (Mean of five farmers field).

Table 2: GPS based soil sampling data under different cropping pattern

Name of the farmer	Village name	Thaluk	Latitude and longitude	Elevation MSL
Santhosh Jadhav	Shekta	Gangapur	19 ^{0} 50’ N to 75^{0} 1” E	492
Chadrasekhar Jagtap	Gopal wadi	Gangapur	19^{0} 50’16 “N to 74^{0} 57’22’’ E	490.35
Manish pol	Shankarpur	Gangapur	19^{o} 86’21’’ N to 74^{0} 94’31’’ E	495.25
Amole Bolande	Borgav Arj	Phulambri	20^{0} 16’ 19‘’ N to 75^{0} 58’ 15’’ E	601.00
Sanjay Pawar	Murshidabad wadi	Aurangabad	20^{0} 05’ N to 75^{0} 37’5’’ E	680.55
Sadhasiv Githe	Devgaon	Phythan	19^{0} 70’96’’N to 75^{0} 58’1’’E	540.24
Kacharusingh Golawal	Hasnabadwadi	Aurangabad	19^{0} 87’ 11’’ N to 75 ^{0} 60’ 32” E	554.47

2.6 Estimation of carbon stock / pool

The soil carbon stocks were estimated by mass, volume, and density relationship (Batjes, 1996) [2] and reported in the SOC pool (Mg ha^{-1} for a specific depth) was calculated by multiplying the SOC concentration g kg^{-1} with bulk density (Mg m^{-3}) and depth (m)

C Stock Depth = TC (i) * BD (i) * TH (i) *10^{-3} Mg kg^{-1} * 10^{4} m^{2} ha^{-1} eqn 1

Where

C stock Depth = Cumulative Soil carbon Stock (Mg ha^{-1})

TC (i) = Total soil C concentration in the layer (gC kg-1)
BD (i) = Total soil C concentration in the layer (Mg m^{-3})
TH (i) = thickness of the I^{th} layer (m)

Another method for soil carbon stocks calculation given below (Datta *et al*., 2015) [8] is most appropriate method than above
C stock depth = TC*BD*TH
TC = total carbon (gC kg^{-1}), BD = bulk density (Mg m^{-3}), TH = Thickness of the I^{th} layer (m)

Above method also used for the soil carbon stock calculation carbon stock for each layer of the dominant land use was calculated by multiplying the C stock obtained by equation 1 by the total area covered by a particular land use. Subsequently, C stock in each layer thickness was summed up to determine total C stock contained depth in cm for each land-use type. Difference in soil bulk density caused due to difference in land use or cover affects the calculation of carbon stock by influencing the amount of soil sample from the soil depth.

2.7 Soil Inorganic carbon

The soil inorganic carbon (SIC) the calculation carried out by using 12% carbon value in $CaCO_3$. The sum of SOC and SIC stock provides total carbon stock in soil (Bhattacharya *et al*., 2008) [3].

$$\text{SIC stocks in soils} = \frac{\text{C content (gg-1) x BD (Mg-3) x Area (mha) x soil depth (m)}}{\text{10 Here C content means 12 \% carbon value in } CaCO_3}$$

2.8 Calcium Carbonates ($CaCO_3$) Equivalent

For the determination of $CaCO_3$ equivalent, the soil was first treated with excess hydrochloric acid at known volume and the known strength (0.5 N) HCL to neutralize the whole carbonate. The soils were heated on hot plate on about 30 minutes the bring to condition closed to boiling cool and titrated with std. NaOH solution by using phenolphthalein as an Indicator.

3. Result and Discussion

3.1 Soil organic carbon stock

Soil carbon stocks (Table 3) under different cropping pattern and profiles *viz.* P_1 (*Lithic ustorthents*) contains 1.16 to 3.81 t $ha^{-1.}$ $P_{2,}$ $P_{4,}$ P_7 (*Calcic haplusterts*) contains 0.48 to 2.25 t ha^{-1}. P_3 (*Typic haplusterts*) contains 0.78 to 2.5 Pg. c. P_5 (*Typic haplustepts*) contained 4.66 to 10. 57 t ha^{-1}. Whereas Pedon P_6, P_8 (*Calcic Haplusterts*) contains around 1.26 to 2.31t ha^{-1}. This indicated that the maximum SOC at Lithic Ustorthent (Entisol) soil this may be due to low clay content as compare to organic residue. The soil organic carbon stock under sorghum cropping pattern shows P_1, were showed 1.16 to 3.81 t ha^{-1}, which was decreased with depth SOCS at 15, 100cm found 2.04 and 13.6 tha^{-1} respectively. among all cropping pattern pigeon pea having maximum SOC this may be due to addition of high amount of organic carbon and fixation of nitrogen. The maize cropping pattern P_3 showed the 0.78 to 2.5 tha^{-1} and decreased with depth, SOCS at 15, 100cm found 1.06 and 10.98 tha^{-1} respectively. Maize cropping pattern showed second high carbon stock due to cover crop practices. The cropping pattern under maize $P_{2,}$ P_4, P_6 showed carbon stock 0.78 to 2.5 t ha^{-1}. SOCS at 15, 100 cm varies from 1.18 to 1.54 and 7.92 to 10.27 tha^{-1} respectively. The cropping pattern cotton showed 0.45 to 2.18 t ha^{-1} and found increased with depth. SOCS at 15, 100 cm varies from 1.46 to 1.56 and 9.77 to 10.41 tha^{-1} respectively. From above result indicated that the maximum SOCS was noticed at pigeon pea followed by sorghum, cotton and maize.

3.2 Soil inorganic carbon stock (SIC)

Soil inorganic carbon (SIC) in the soil in the form of precipitation of calcium carbonate which responsible for increasing SIC in soil. The soil inorganic carbon (SIC), the calculation was made using 12 percent C value in $CaCO_3$ (Bhattacharya *et al*., 2009) [5]. The primary source of inorganic carbon in soil is carbonate of calcium and magnesium. Soil inorganic carbon could pedogenic in the nature of their origin (Fig. 3).
Formation of pedogenic carbonate through dissolved CO_2 (carbonic acid) in presence at Ca^{++} and Mg++ ions are common in semi-arid and arid climate however, pedogenic carbonate formation may also take place in sub humid climate depending on soil pH. The formation of pedogenic carbonate in the soils under study is pronounced as evidenced by considerable presence of SIC in the formation of $CaCO_3$

(Vaidya and Pal, 2002) [24].

The soil inorganic carbon stock (Table 3) under different cropping and soil profiles of Aurangabad *viz.* p_1 *(Lithic Ustorthents*) contains (5.53 to 10.8 tha^{-1}). P_2, P_4, P_7 *(Calcic Haplusterts)* contains (3.6 to 47.4 tha^{-1}). P_6, P_8 *(Calcic Haplusterts*) contains around (5.02 to 21.7 tha^{-1}). The maximum SICS was noticed at Calcic Haplusterts as compare to other soil. This may be due to precipitation of calcium carbonate under semiarid environment Vaidya and Pal 2002 [24] and Zade, 2007 [28].

The soil inorganic carbon stock cropping Aurangabad district were cotton cropping pattern showed P_6, P_7, P_8 varies between 5.02 to 21.7 t ha$^{-1.}$ and which was found increased with depth, SICS at 15, 100 cm varies from 0.98 to 1.29 and 13.6 to 49.9 tha^{-1} respectively. The maize cropping pattern showed P_3 varies from soil inorganic carbon stock 5.46 to 12.8 t ha^{-1}, SICS at 15, 100 cm has 0.98 and 12.41 tha^{-1} respectively. The maize cropping pattern showed soil inorganic carbon 4.07 to 47.4 tha^{-1}. SICS at 15, 100 cm varies from 0.79 to 2.01 and 10.28 to 16.36 t ha^{-1} respectively. Under sorghum pattern shows soil inorganic carbon 5.46 to 12.8 t ha^{-1} SICS at 15, 100 cm has 0.98 and 12.41 t ha^{-1} respectively. (Fig. 4). The data indicated that the maximum SICS was noticed in cotton and maize as compare to pigeon pea this may be due to reduce the formation of pedogenic calcium carbonate under semiarid climate due to addition plant residue and it support to control the aired environment is soil (Balpande *et al.*, 1997 and Vaidya and Pal, 2002) [1, 24]. (Fig 4) P_3, P_4, P_7 *(Calcic Haplusterts)* contains (4.58 to 47.4 t ha) the soils exhibits high soil inorganic carbon due to high soil depth and lower availability of water causes the accumulation of calcium carbonate increases gradually and it is directly proportional to soil inorganic carbon (Bhattacharya *et al*., 2004) [4].

3.3 Total soil carbon stock

Total soil carbon stock referred as a sum of SOC stock and SIC stock gave the total carbon (TC) stock in soil (Bhattacharya *et al*., 2008.) [3]

There is change in soil organic carbon pools when natural ecosystem is converted into agro-ecosystem and or land use changed over time, the magnitude of changes depends on land use, management, and ecological factors, such as, temperature, precipitation, soil types and native vegetation. Quantification of changes in the SOC pool as a results of agricultural land use provides a reference point regarding sequestration potential of SOC stock estimation, most of the carbon stocks more in high rainfall, high vegetation, humid climates compared to arid climates. (Fig. 5) The total carbon under P_2, P_4, P_7, Calcic Haplusterts showed soil total carbon varies from 14.56 to 24.91 t ha^{-1}. The soil total carbon stock under (*Lithic Ustorthents)* P_1 at 15, 100 cm and total profile depth was found 3.23, 25.57 and 14.56 t ha^{-1} respectively, the soil total carbon stock under *Calcic Haplusterts* P_2, P_4 and P_7 at 15, 100 cm and total profile depth was varying from 2.00 to 2.85, 18.2 to 24.07 and 17.13 to 24.91 t ha^{-1} respectively. The soil total carbon stock under *Typic Haplusterts* P_3, at 15, 100 cm and total profile depth was found 2.58, 23.39 and 35.09 t ha^{-1} respectively (Fig 5). The soil total carbon stock under P_6, P_8 *Calcic Haplustepts* was found at 15, 100 cm and total profile depth was varying from 2.48 to 2.58, 26.17 to 59.98 and 15.66 to 78.00 t ha^{-1} respectively. The cropping pattern wise total carbon stock under different cropping pattern were cotton P_6, P_7, P_8 at 15,100 cm and profile depth varies from 2.48 to 2.85, 24.07 to 59.98 and 15.66 to 36.02 t ha-^{1} respectively. Whereas under maize TCS at 15,100 cm and profile depth varies from 2.33 to 3.26, 18.2 to 24.1 and 17.13 to 36.11 tha-^{1}respectively. The cropping pattern pigeon pea TCS were found at 15,100 cm and profile depth was 3.23, 25.57 and 14.56 tha-^{1}respectively. The maize cropping pattern P3 Showed total soil carbon stocks were found at 15,100 cm and profile depth was 2.58, 23.39 and 35.09 tha^{-1}respectively. (Fig. 6) This indicated that the maximum TOC was noticed at calcic Haplusterts. This may be due to high amount of SIC. Similar observation also noticed by Wagh, 2018.

Table 3: Soil organic carbon, soil inorganic stock and total carbon stocks of soils under different cropping pattern and soil profiles of Aurangabad district of Maharashtra.

Horizon	Depth (cm)	SOCS (t ha^{-1})	SOCS (tha^{-1}) 15 cm depth	SOCS (tha^{-1}) 100 cm depth	SOCS (t /ha^{-1}) Total profile depth	SIC (t ha^{-1})	SICS (t /ha^{-1}) 15 cm depth	SICS 100 cm depth (t ha^{1})	Total SICS total profile depth (t ha^{1})	Total Carbon stock throughout profile (t ha^{-1})		
										15 cm	100 cm	Profile depth
Pedon 1 Shekta, tq. Gangapur, district Aurangabad (*Lithic Ustorthents*) pigeon pea cropping pattern												
Ap	0-28	3.81	2.04	13.6	8.16	5.53	1.19	11.97	6.4	3.23	25.57	14.56
Ac	28-50	2.24				10.8						
Cr	50-60	1.16				7.8						
Pedon 2 Gopalwadi, tq Gangapur, district Aurangabad (*Calcic Haplusterts*) maize cropping pattern												
Ap	0-22	2.24	1.54	10.27	10.27	4.07	0.793	12.36	12.36	2.33	22.68	22.63
Bw_1	22-40	1.36				4.6						
Bw_2	40-64	1.47				8.7						
Bss_1	64-72	5.13				3.6						
Bss_2	72-100	1.6				13.7						
Bss_3	100-120	0.074				28.8						
Pedon 3 Shankarpur, tq. Gangapur, district, Aurangabad (*Typic Haplusterts*) sorghum cropping pattern												
Ap	0-28	2.5	1.6	10.98	16.47	5.46	0.98	12.41	18.62	2.58	23.39	35.09
Bw_1	28-48	2.2				7.1						
Bw_2	48-60	1.56				6.17						
Bss_1	60-102	1.62				11.5						
Bss_2	102-132	1.45				12.8						
Bss_3	132-150	0.78				8.08						
Pedon 4 Borgaon arj, tq. Phulambri, District, Aurangabad (*Calcic Haplusterts*) maize cropping pattern												
Ap	0-18	1.42	1.18	7.92	7.44	4.58	0.82	10.28	9.69	2	18.2	17.13
Bw_1	18-46	1.71				7.84						
Bw_2	46-56	0.78				10.21						
Bss_1	56-75	1.72				9.41						
Bss_2	75-94	1.35				11.29						
Cr	94 -140	1.27				47.4						

Horizon	Depth (cm)	SOC ($t\ ha^{-1}$)	SOC ($t\ ha^{-1}$) 15 cm depth	SOC (tha^{-1}) 100 cm depth	SOC ($t\ /ha^{-1}$) Total profile depth	SIC ($t\ ha^{-1}$)	SIC ($t\ /ha^{-1}$) 15 cm depth	SIC 100 cm depth ($t\ ha^{1}$)	Total sic total profile depth ($t\ ha^{1}$)	Total Carbon stock throughout profile ($t\ ha^{-1}$) 15 cm	100 cm	Total profile depth
Pedon 5 Murshidabad Wadi, tq. Phulambri, district Aurangabad ((*Typic Haplustepts*) maize cropping pattern												
Ap	0-26	2.01	1.16	7.74	11.61	11.7	2.1	16.36	24.5	3.26	24.1	36.11
Bw_1	26-50	0.979				9.5						
Bw_2	50-91	0.75				19.15						
Cr	91-150	0.87				15.37						
Pedon 6, Devgaon, tq. Paithan, district Aurangabad (Calcic *Haplustepts*) cotton cropping pattern												
Ap	0-15	2.05	1.46	9.77	5.86	6.1	1.12	16.4	9.8	2.58	26.17	15.66
Bw_1	15-30	1.09				6.6						
Cr	30-60	0.635				18.51						
Pedon 7, Hasnabadwadi. Tq. And district Aurangabad (*Calcic Haplusterts*) cotton cropping pattern												
Ap	0-21	2.18	1.56	10.41	10.41	6.6	1.29	13.6	14.5	2.85	24.07	24.91
Bw_1	21-42	0.83				6.83						
Bw_2	42-77	1.15				8.01						
Cr_1	77-83	0.47				8.75						
Cr_2	83-100	0.45				12.94						
Pedon 8, Hasnabadwadi. Tq. And district Aurangabad (*Calcic Haplustepts*) cotton cropping pattern												
Ap	0-22	2.31	1.5	10.08	13.1	5.02	0.98	49.9	64.9	2.48	59.98	36.02
Bw_1	23-42	1.50				8.2						
Cr	42-62	1.26				21.7						

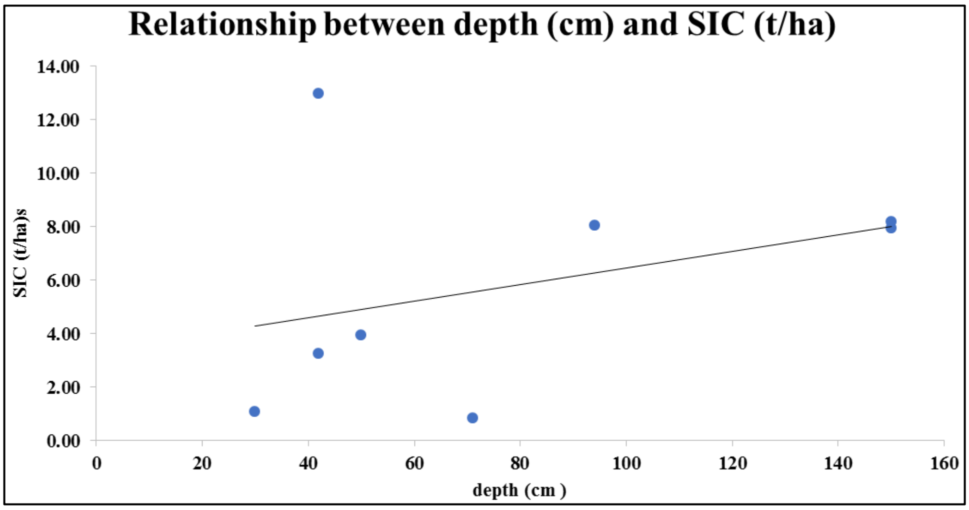

Fig 3: Represent the relationship between depth (cm) and SIC (t/ha) under different soil type of Aurangabad

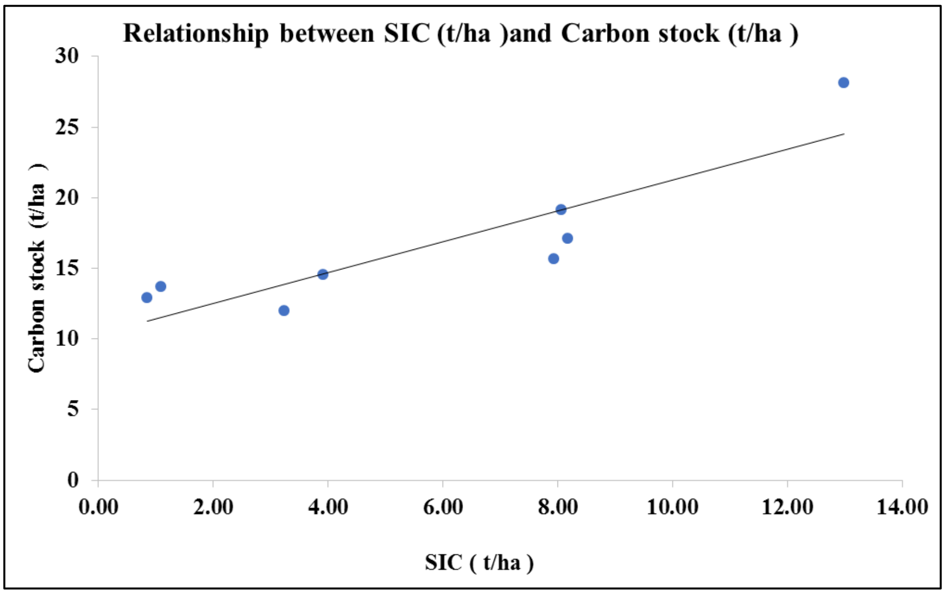

Fig 4: Represent the relationship between SIC (t/ha) and carbon stock (t/ha) under different cropping pattern of Aurangabad

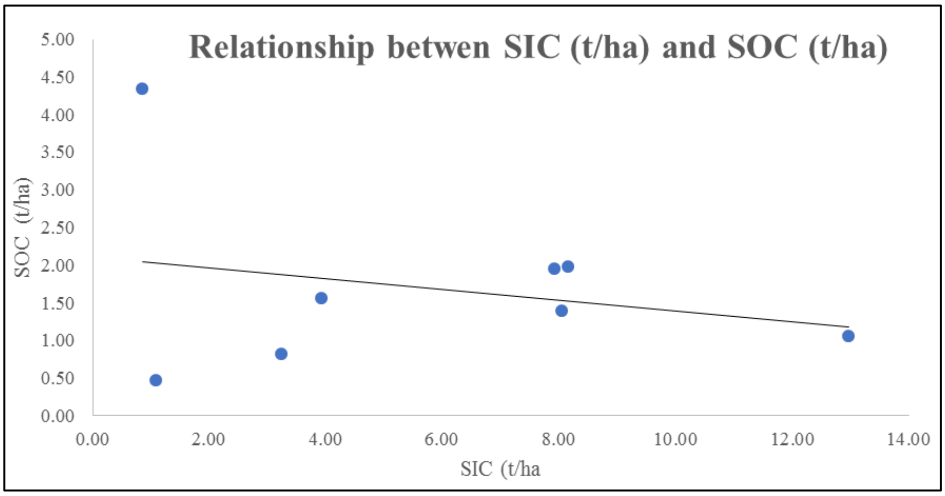

Fig 5: Represent the relationship between SIC (t/ha) and SOC (t/ha) under different cropping pattern of Aurangabad

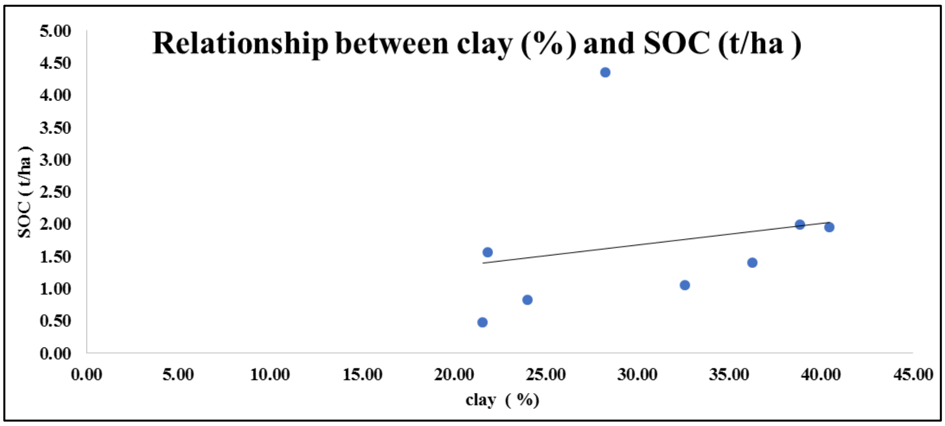

Fig 6: Represent the relationship between Clay (%) and SOC (t/ha) under different cropping pattern of Aurangabad

4. Conclusion

The organic carbon stocks recorded in red gram cropping pattern and soil profile P_1 (*Lithic Ustorthents*) contains 1.16 to 3.18 t ha^{-1}. Among all the cropping pattern and soil profile under Aurangabad district red gram cropping pattern recorded high organic carbon stocks 1.16 to 3.18 tha^{-1} the reason behind that high crop litter and legume crop rotation. The soil inorganic carbon stocks maximum recorded under Cotton cropping pattern SOIL PROFILE P_8 (*Calcic Haplusterts*) 5.02 to 21.7 tha^{-1}. the reason behind that the semi-arid climate and high evapotranspiration losses and poor soil water and edaphic conservation practices and high temperature leads to the accumulation of calcium carbonates, magnesium carbonates increase the soil inorganic carbon content in the soil. The total carbon stocks (TC) referred as a sum of soil organic carbon stocks (SOC) and soil inorganic carbon stocks (SIC).The total carbon stocks recorded under cotton cropping pattern soil profile P_8 (*Calcic Haplusterts*) was 59.98 tha^{-1}. The surface organic carbon stocks and cultivated soil layer highest in red gram cropping 3.81 t ha^{-1} as compared to the maize, cotton, sorghum cropping pattern. The soil inorganic carbon stocks maintain good all cropping patterns but soil organic carbon stocks levels not in all the cropping pattern except red gram cropping pattern.

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