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Physicochemical properties of tank silt of Latur and Osmanabad district

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Abstract
The present investigation entitled "Economic assessment of tank silt and tank silt hybridized soils of Latur and Osmanabad district" were carried out to study the total nutrients status of already collected tank silt samples from 25 different tanks (0-150 cm depth). The tank silt of the study area was found alkaline in nature (7.3 to 8.1), low to high organic carbon (0.41 to 7.13) and medium to highly calcareous in nature (3.8-22.5). The total macronutrients status viz. Total N, P, K and S varies from 0.046 to 0.094, 0.027 to 0.073, 0.11 to 1.12 and 0.199 to 0.619 per cent respectively with the mean values 0.065, 0.042, 0.506 and 0.29 per cent respectively. Total micronutrient status in tank silt for total Fe, total Zn total Mn and total Cu range between 4.05 to 7.56, 0.0064 to 0.0124, 0.001 to 0.159 and 0.0014 to 0.0138 per cent respectively with the mean values 5.43, 0.00777, 0.092 and 0.00917 per cent respectively.

Keywords: Tank silt, total macronutrient, total micronutrient

1. Introduction

In agriculture the removal of tank silt and its application on agricultural lands is traditional activity done by the villagers for the benefits of better crop growth. Poor management practices of catchment have resulted in silting of most of these water bodies and significant reduction of storage capacity. Silt deposit has not only reduced the storage capacity but also groundwater recharge, eutrophication of tanks and most importantly higher release of carbon to atmosphere through silt mediated anaerobic decomposition of organic carbon. Good practices such as desilting and application of silt to agricultural fields have been abandoned. Continued mining by crops and reduced application of organic manures has resulted in deficiency of several nutrients particularly that of micronutrients. Recycling of tank silt provides a win-win situation to both, improvement in soil health and renovation of the tank (Osman *et al.* 2009) [13].

Runoff water carries along nutrients and fine organic matter particulates from agricultural lands. Often the sources and pathways of nutrients moved by sediments in the runoff are difficult to fully identify. For rainfed farming system there is a need to capture significant amount of rainwater, which is generally lost as runoff and deep drainage. This stored water can be used for supplemental irrigation, increasing crop productivity and resource-use efficiency. However, deposition of sediment in tanks reduces its capacity and also hampers the additional water storage in the rainfed areas. Hence, removal of sediments from tanks is a relevant approach for rainfed farming systems.

The tank sediment contained 50 to 71 per cent silt and clay. The organic carbon (C) content varied from 5.4 g C kg^{-1} to 27.2 g C kg^{-1} suggesting large variation in the eroded material. The N content in the sediment samples varied from 340 mg N kg^{-1} to 1760 mg N kg^{-1}sediment with an average N content of 719 mg N kg^{-1}sediment. This value is almost double of the soil N content in the nearby fields. Similarly, the P content, microbial counts, organic C and microbial biomass C of the sediment varied across the tanks. Based on the economic value of N and P plant nutrients returned to the fields, the average benefit-cost (B/C) ratio of desilting works was calculated to be 1.17. Addition of sediments back to the agricultural lands not only returns back the nutrient-rich fine fractions with high C values but also restores the soil microbial biodiversity in the system (Padmaja *et al.* 2003) [14].

The nutrient deficiency in soils, the increased demand for food production, increased use of synthetic fertilizers and increasing market price of the same makes the process of tank desilting and application of silt to cropland soil a sustainable farm practice. Application of sediment desilted from the water tanks to agricultural fields appears to be an economically viable option for returning nutrients back to the soil. The methodology used for extrapolation could be up scaled and used for computing sediment yield, nutrient content and their economic value. There is need for further studies in order to understand the parameters involved in such nutrient substitutions, the sedimentation and evaluation of the value.

2. Material and Methods

The present investigation on tank silt and tank silt hybridized soil of Osmanabad and Latur district located between 18^0 05' to 18^0 25' N latitude and 76^0 25' to 77^0 25' longitude and 18^0 28' to 19^0 28' North latitude and 76^0 25' to 77^0 25'East longitude respectively. The area is covered by the basaltic lava- flows. Same layer of the lava-flow are hard and compact while other are soft. These basalt flows are the result of intense volcanic activity during cretaceous Eocene period (almost seventy million year ago). When the lava flows were ejected through long narrow fissures on the earth surface. The area has very shallow cover of gravelly sediments over a hard basaltic Lithic or paralithic contact within 50 cm of the surface. These soils were treated with tank silt at different rate (0-6000 m^3/ha) from adjoining tank and mixed (hybridized) with underlined murrum layer of very shallow soil by deep ploughing and intercultural operation. This investigation was carried out to study the physico-chemical characteristics and total nutrients status of already collected 25 tank samples of different tanks of Osmanabad and Latur district.

The bulk density of tank silt was determined by clod coating technique (Black, 1965) [2]. pH of 1:2.5 soils (tank silt): water suspension was determined electrometrically using pH meter as per method described by Jackson, (1973) [8]. Electrical conductivity of 1:2.5 soils (tank silt): water suspension as per the method describe by Jackson, (1973) [8]. The calcium carbonate was estimated by rapid titration method as described by Piper (1950) [17]. Modified Walkley and Black's rapid titration method was followed for estimating the organic carbon content (Jackson, 1958) [7]. The total nitrogen was estimated by micro-kjeldhal distillation method after digestion of the tank silt samples with sulphuric acid and digestion mixture (K_2SO_4, $CuSO_4$and selenium in 100:20:1 ratio respectively) (Page *et al.*, 1982) [15]. The total phosphorus was estimated by Vanadomolybdate phosphoric yellow colour methods after perchloric acid digestion (Page *et al.*, 1982) [15]. The total potassium was estimated by using flame photometer after HF and $HClO_4$ digestion method (Page *et al.*, 1982) [15]. Total sulphur was estimated in diacid digestion mixture (Chapman and Pratt, 1961) [3] from the di acid extract of soil, total sulphur was determine by turbidimetric methods as described by Chesnin and Yein (1951) [4]. The total micronutrients (Fe, Cu, Zn, Mn) were estimated by using atomic absorption spectrophotometer after HF and $HClO_4$ digestion method (Page *et al.*, 1982) [15].

3. Result and Discussion

The present investigation was carried on an economic evaluation of tank silt of Twenty five tanks of Osmanabad and Latur district. The tank silt samples were analyzed for total nutrient status.

3.1 Properties of tank silt.

The bulk density of tank silt varies from 1.2 to 1.4 Mg m^{-3} with an average value 1.3 Mg m^{-3} (Table 1). The low bulk density of tank silt comparatively than the soil of adjoining area. The pH of tank silt showed ranges between 7.3 to 8.1, with an average value 7.7. The tank silt soils are slightly to moderately alkaline in reaction. Similar result was also reported by Vaidya and Dhawan (2015) [19] and Palwade *et al.* (2016) [16]. The EC of tank silt ranges between 0.10 to 0.62 d Sm^{-1} with an average value 0.28 dSm^{-1} (Table 1) which is in normal range of EC which is well within a safe limit designated for normal soils (Richards, 1954), Krishnappa *et al.*(1998) [9] reported that the similar result i.e. EC of tank sediments varied from 0.04 to 0.1 $dSm^{-1}$and also reported by Vaidya and Dhawan (2015) [19] and Palwade *et al.* (2016) [16]. The calcium carbonate content in tank silt varied from 3.8 to 22.5 per cent (Ambi Tank) which is correspond to low to very high with an average value 10.9 per cent. The high amount of calcium carbonate in tank silt due to water stagnation which favors to precipitation of $CaCO_3$ (Wely, 1961 and Lyle 1971) [21, 11] and accumulation of $CaCO_3$ in tank silt during dry period and on the other hand many organism utilized calcium and carbonate ion to form $CaCO_3$ skeletons, shells and teeth and they do so mainly on the surface of tank. The high calcium carbonate in soil affects the available water holding capacity of soil which has a great influence on crop production under rainfed conditions. The organic carbon content showed that most of the tank silt were low to high organic carbon. Tank silt showed organic carbon range from 0.41 to 1.00 per cent (Bangarwadi Talaw) with average value 0.70 per cent, which is higher than the adjoining area of soil. Vaidya and Dhawan (2015) [19] and Palwade *et al.* (2016) [16].

3.2 Total nutrients status in tank silt.

The total nitrogen in tank silt maximum at Hangarga talaw (0.094 per cent) and minimum at Benitra prakalp (0.046 per cent). Similar results were also reported by Padmaja *et al.* (2003) [14] total nitrogen content in tank silt of Madak district of Andhra Pradesh varies from 0.034 to 0.176 per cent and Binitha (2006) [1] reported that 0.052 to 0.112 per cent in North Karnataka. The maximum total phosphorus content was noticed at Sukni talaw (0.073per cent) and minimum at Bangarwadi talaw (0.027 per cent). Similar result also reported by Padmaja *et al*. (2003) [14] the total P content in tank silt varies from 0.008 per cent to 0.112 per cent in Madak district of Andhra Pradesh. The total potassium in tank silt varied in the range between 0.11 to 1.12 per cent with the mean value 0.506 per cent. The maximum total potassium content was noticed at Jakekur (1.12 per cent) and minimum at Sakul prakalp (0.11 per cent). Similar result also quoted by Binitha (2006) [1] the total K content in tank silt of North Karnataka varies from 0.21 to 0.26 per cent. The maximum total sulphur content in tank silt was noticed at Bhosga talaw (0.619 per cent) and minimum at Hiwra talaw (0.199 per cent). Similar result was recorded by the Gajbhiye and Bhoye (2014) the total sulphur content soils of Lohara tahsil of Osmanabad in Vertisols varied widely from 544.00 (0.054%) to 3489.00 (0.34%) mg $kg^{-1}$with a mean value of 1862.14 (0.18%) mg kg^{-1}. The total sulphur content in tank silt higher than the soil of adjoining area. This may be due to tank silt having high amount of organic matter and soil biota (Vaidya and Dhawan, 2015., Palwade *et al.*,2016) [19, 16]. The total iron in tank silt varied in the range between 4.05 (Sukni talaw) to 7.56 (Bangarwadi talaw) per cent with the mean value 5.43 per cent. Similar result was recorded by the Malewar and Randhawa (1978) [12] the total iron in soils of Marathwada ranged from 3.25 to 6.08 per cent in calcareous soil and 3.69 to 7.04 per cent in non-calcareous soils. The total iron in the tank silt was observed higher than the soil of adjoining area. The total zinc in tank silt varied in the range between 0.0064 (Bhosga talaw) to 0.0124 (Hiwra talaw) per cent with the mean value 0.00777 per cent. Similar results were also reported by the Binitha (2006) [1] and Sharma *et al.* (2006) [18]. The total Zn in tank silt of North Karnataka varied from 0.005

to 0.0073 per cent. The total manganese in tank silt varied in the range between 0.001 (Ghodki-pimpalgaon talaw) to 0.159 (Dhoki talaw) per cent with the mean value 0.092 per cent. The similar results were reported by Binitha (2006) [1], the tank silt content total Mn varies from 0.0303 to 0.0392 per cent in North Karnataka. The total copper in tank silt varied in the range between 0.0014 to 0.0138 per cent with the mean value 0.00917 per cent. Similar observation also recorded by the Binitha (2006) [1] and Sharma *et al.* (2006) [18] the silt content total Cu varies from 0.0096 to 0.0147 per cent in North Karnataka.

Table 1: Physicochemical properties of tank silt

Tank No.	Name of tank and village	Bulk density (Mgm^{-3})	pH	EC ($d\ Sm^{-1}$)	$CaCO_3$ (%)	OC (%)	Total N (%)	Total P (%)	Total K (%)	Total S (%)	Total Fe (%)	Total Zn (%)	Total Mn (%)	Total Cu (%)
1	Terna Dam	1.3	7.3	0.22	14.3	0.71	0.052	0.046	0.73	0.286	4.80	0.0065	0.021	0.00675
2	Khed&Alnitalaw	1.4	8.0	0.42	15.0	0.90	0.087	0.027	0.26	0.419	5.22	0.0082	0.158	0.00290
3	Wagholi	1.3	7.8	0.21	12.3	0.62	0.073	0.047	0.36	0.235	6.16	0.0079	0.034	0.00795
4	Dhoki	1.2	7.5	0.10	15.0	0.63	0.066	0.031	0.59	0.215	4.68	0.0070	0.159	0.00845
5	HatlaiTalaw	1.3	7.8	0.12	10.8	0.91	0.080	0.027	0.22	0.283	4.89	0.0081	0.137	0.01345
6	PimpalgaonGhodki	1.3	7.6	0.62	08.7	0.71	0.075	0.044	0.83	0.288	4.77	0.0066	0.001	0.0088
7	BangarwadiTalaw	1.3	7.7	0.32	04.4	1.00	0.094	0.027	0.26	0.272	7.56	0.0071	0.014	0.01265
8	HiwraTalaw	1.3	7.8	0.10	04.4	0.71	0.062	0.028	0.28	0.199	6.18	0.0124	0.015	0.0138
9	Ambi Tank	1.3	8.1	0.31	22.5	0.50	0.058	0.033	0.55	0.218	4.87	0.0082	0.024	0.01265
10	Sina-Kolegaon Dam	1.3	7.9	0.43	18.8	0.41	0.069	0.039	0.81	0.329	4.86	0.0080	0.129	0.01155
11	Sonari Dam	1.3	7.8	0.22	10.1	0.52	0.065	0.035	0.28	0.268	5.46	0.0082	0.136	0.01085
12	Khasapuri Dam	1.3	7.9	0.20	12.1	0.70	0.055	0.03	0.26	0.244	5.39	0.0078	0.156	0.00855
13	HangargaTalaw	1.3	7.9	0.10	15.1	0.42	0.094	0.045	0.73	0.268	5.08	0.0074	0.083	0.00835
14	BarudTalav	1.3	8.0	0.20	13.8	0.80	0.052	0.051	0.31	0.235	4.83	0.0074	0.151	0.01265
15	Bori Dam	1.4	7.8	0.21	03.8	0.51	0.049	0.043	0.64	0.249	7.41	0.0096	0.136	0.01200
16	Nim-Terna	1.3	7.9	0.30	08.0	0.41	0.049	0.055	0.74	0.252	4.56	0.0070	0.013	0.00590
17	BhosgaTalaw	1.3	8.0	0.20	15.0	0.60	0.084	0.06	0.42	0.619	7.34	0.0064	0.121	0.00690
18	BenitraPrakalp	1.4	7.8	0.20	06.9	0.60	0.046	0.037	0.77	0.230	4.78	0.0078	0.001	0.00335
19	Jakekur	1.2	7.6	0.52	11.8	0.83	0.047	0.033	1.12	0.251	4.56	0.0070	0.013	0.0094
20	BalsurTalaw	1.3	7.8	0.20	10.0	0.60	0.081	0.051	0.78	0.235	5.24	0.0090	0.149	0.0130
21	Nalegaon	1.2	7.7	0.31	11.6	0.67	0.063	0.050	0.44	0.309	4.77	0.0066	0.144	0.0032
22	Sakulprakalp	1.3	7.6	0.31	09.4	0.51	0.058	0.066	0.11	0.340	4.81	0.0069	0.141	0.0014
23	Mortalwadi	1.3	7.6	0.39	09.6	0.73	0.048	0.027	0.59	0.329	6.12	0.0081	0.101	0.0128
24	Sukni	1.3	7.7	0.33	09.8	0.85	0.064	0.073	0.22	0.345	4.05	0.0080	0.122	0.0120
25	Ekurka	1.3	7.8	0.21	13.8	0.57	0.051	0.051	0.35	0.359	7.45	0.0071	0.152	0.01005
Mean		1.3	7.7	0.28	10.9	0.70	0.060	0.040	0.510	0.290	5.43421	0.0077	0.0924	0.00917

4. Conclusions

The tank silt of the study area was found slightly alkaline in nature (7.3 to 8.1), low to high organic carbon (0.41 to 7.13) and medium to highly calcareous in nature (3.8-22.5). The total macro nutrients status viz. total N, P, K and S varies from 0.046 to 0.094, 0.027 to 0.073, 0.11 to 1.12 and 0.199 to 0.619 per cent respectively with the mean values 0.065, 0.042, 0.506 and 0.29 per cent respectively. Total micronutrient status in tank silt for total Fe, total Zn total Mn and total Cu range between 4.05 to 7.56, 0.0064 to 0.0124, 0.001 to 0.159 and 0.0014 to 0.0138 per cent respectively, with the mean values 5.43, 0.00777, 0.092 and 0.00917 per cent respectively. The total nutrients status in tank silt was found higher than the soils of adjoining area.

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