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Effect of different prevailing land use systems on soil properties in agro climatic zone-I of Bihar

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Abstract
The research was undertaken to study different land-use system prevailing in sub-humid northern Zone-I of Bihar on soil properties. Five representative land-use was selected and a composite soil sample was made from four soil depth (0-15, 15-30, 30-45, 45-60 cm). Statistical analysis two way (ANOVA) was applied, land-use and soil depth effect on various soil properties. The analyzed data revealed that soil texture analysis sand, silt and clay fraction in different land-use was found non-significant as texture is inherent property and it does not change over small period of small time. Soil organic carbon (SOC) was found to be significantly affected by land-use and ranged 5.55 to 2.98 (g kg^{-1}). SOC was found to affect positively superior soil properties in land-use having higher carbon in soil. Bulk density varied from 1.41 to 1.46 Mg m^{-3} while pH (7.91 to 8.23) and EC (0.48 to 0.34 dSm^{-1}) in different land-use system. Soil penetration resistance (Pr) ranged (1368.2 to 974.2 KPa) and MWD varied from (3.73 to 2.73mm) among different land-use. Among all land-use selected horticulture land-use was found superior over rice wheat and uncultivated land-use. Mango land-use was found superior over litchi land-use. The data from research suggest that horticultural land-use may be recommended in areas having poor soil properties which will enhance soil quality and sustainability of soil.

Keywords: Land-use system, soil depth, soil properties, soil texture, soil degradation, soil organic carbon

Introduction
Soil is non-renewable resource and it is basis of life on earth. It is most important component of terrestrial ecosystem and plays key role in various ecosystem functions. Agriculture started around 8000 BC since then soil has been exploited to feed growing population, there has been terrestrial land-use change which has affected our environment adversely, if this scenario continues situation may get more worsen causing threat to our food security. Lal., 2010 [8] reported that world cereal production has to be increased around 50% by 2050 to feed human population, on the other hand cereal production in sub-Saharan Africa and south Asia has declined or stagnated due to extractive farming, environmental degradation. Today's challenge is not only of increasing productivity but also of sustainability of soil.

Different land-use systems are known to affect physical, chemical and biological properties as due to micro-climate, organic input and management practices adopted (Fraterrigo *et al*. 2005) [3]. Land-use change from forest to cropland has degraded soil carbon resulting in enhanced level of carbon-dioxide in atmosphere as a consequence global warming being faced by word today. Earth tempt has increased by 0.76 °C since 1850 and global temperature likely to increase 1.8 to 4°C by next century (IPCC 2007) [6] and is increasing 0.158ºC per decade since 1975 (Greene and Pershing 2007) [5]. Hence the knowledge of soil properties is important for sustainable production system (Fesha et. 2002) and also information will help policy planners and implementing agencies in formulation of land restoration and reclamation strategies. On the basis of research finding suitable land-use may be recommended to farmers based on farmer's objective and land capability classification, soil type etc. The information regarding prevailing or adopted land-use effect on soil properties is scanty in Agro-climatic Zone-I of Bihar. Hence present research was undertaken to identify the potential land-use for adoption strategies.

Materials and Method
Experimental area was selected northern Zone-I of Bihar (Fig-1) which lies in Middle-Gangetic plain region of India having hot dry to moist sub humid with deep, loamy alluvium derived soils, Available water capacity (AWC)- low to medium and length of growing period (LGP) 180-210 days. Summers are hot and wet while cool and dry in winters, annual rainfall vary from 1400 to 1800 mm and PET demand is 1300 to 1500 mm which is lower than annual

rainfall (deficit during Feb to May). Soil moisture regime is broadly udicustic and soil temperature regime is hyperthermic as mean annual temperature of soil is over 22 ºC. The soils are mainly calcareous and moderately alkaline in nature.

Representative land-use Selection
Five land-use was selected after a preliminary survey based on discussion with experts and farmers. Primary data and GPS location was recorded. Area having prevailing land-use was selected which is being continued for more than 15 years of time period. In this research land-use selected for study were *viz*. Litchi Solo, Litchi Intercrop, Mango Solo, Rice-Wheat cropping system and uncultivated land. Orchards having recommended spacing of 8 X 8 m in Litchi and 10 X 10 m in mango were selected, which was most commonly practiced in these areas.

Soil Sampling and processing
Soil sampling from representative land-use was done by collecting five to ten points as per homogeneity of land and composite sample was made for every site location considering it replication of that land-use. Similarly composite soil sample randomly collected from four soil depth (0-15, 15-30, 30-45, 45-60 cm) from different selected land-use. For bulk density core sampler was used and for surface hardness digital cone penetrometer was used which was pushed in soil to desired depth. A total of 100 soil samples was collected (5 land-use X 4 depth X 5 replication). Soil sample was air dried, grinded and sieved through 2.0 mm sieve.

Soil Analysis
In laboratory soil samples were analysed following standard procedure. Soil texture particle size analysis was done through international pipette method (Piper, 1960) [14], the undisturbed soil sample collected through core sampler was used for bulk density (BD) estimation (Black, 1965) [1]. Digital cone penetrometer was used for estimating penetration resistance and data was recorded (Duiker, 2002) [2]. Mean weight diameter was also estimated through wet sieving (Yoder, 1936). Soil organic carbon estimated through rapid titration method (Walkley and Black, 1934) [16]. Soil reaction (pH) and electrical conductivity was done (1: 2 soil: water) following (Jackson, 1967) [7] procedure.

Statistical Analysis
The data obtained from laboratory was compiled and analysed using Excel software. The effect of land-use and soil depth on soil was analysed and interpreted through two way analysis of variance (ANOVA) and statistically different mean was identified using Least Significant Difference test (LSD) at 5% level ($p \leq 0.05$).

Result and discussion
Soil Texture
In the present study Sand %, silt%, Clay% among the different land-use did not varied much and found to be non-significant (table-1)as the texture of soil is inherent property of soil and it changes over very long period of time similarly main effect of soil depth was also found to be non-significant however it was observed movement of coarser particle i.e sand with depth decreased while movement of fine particle silt and clay was more to deeper layer of soil but the difference in variation among depth was not significant. The interaction effect (table-2) was also found non-significant. Among different land-use at different location soil texture varied from Sandy loam, Clay loam to Silt loam (table-3). Sand % ranged from highest 29.93 in top (0-15 cm) soil to lowest 25.11 in (45-60 cm) soil. Silt % ranged from lowest 47.08 in top soil(0-15 cm) to highest in lower depth (45-60 cm) while clay has similar trend like silt ranged from lowest 22.99% (0-15 cm) depth to highest 25.38% in lower depth (45-60 cm). Finer particle Clay and silt by illuviation process moves down to lower layers hence more in deeper layers (Moges *et al.* 2013) [13].

Bulk density
The observed data revealed that the main effect of different land-use and soil depth on bulk density varied significantly while their interaction effect was found non-significant. Among the different land-use, lowest bulk density was in Litchi solo and mango solo orchard while highest was found in uncultivated land-use. Mango and Litchi orchard did not varied significantly among themselves while both varied significantly with uncultivated land-use. While Litchi solo, mango solo and litchi intercrop were at par with both rice wheat and uncultivated land-use. The lowest BD was found in Litchi and Mango solo plantation (1.41Mg m^{-3}) and the highest was found in uncultivated land (1.46 Mgm^{-3}). Among different soil depth it varied from 1.36 (0-15cm) to 1.48 in lower depth (45-60 cm). The upper soil depth bulk density significantly varied with all three soil depth. Lemenih *et al.* 2005 [11] also observed bulk density varied with different land-use and soil depth. Soil organic carbon in tree based land-use is more due to more organic litter input which enhances more soil aggregates and more micro-pores thus increasing bulk density (Meena *et al.* 2018) [12]

Soil reaction (pH) and electrical conductivity (EC)
Soil pH and electrical conductivity found to vary significantly among different land-use and soil depth. Soil pH in land-use varied from 7.91 to 8.23, the lowest was recorded in mango plantation and highest in uncultivated land-use. Both Litchi and mango plantation was found significant over rice wheat and uncultivated land-use. Among different soil depth upper soil layer significantly varied from all lower soil depth. Electrical conductivity (EC) data revealed that the main effect significantly varied among land-use and soil depth. Highest EC was in uncultivated land-use (0.48 dSm^{-1}) and lowest in litchi intercrop (0.34 dSm^{-1}). Both litchi and mango land-use significantly varied from uncultivated and rice wheat land-use. With depth trend was observed EC decreased with depth significantly with each other varied from (0.69 to 0.27 dSm^{-1}). The interaction effect was found to be significant in electrical conductivity while non-significant in soil pH.

Soil organic carbon (%)
The land-use effect on mean value of soil organic carbon significantly varied, highest observed in mango solo 5.55 (g kg^{-1}) to lowest 2.98 (g kg^{-1}) in rice wheat. The mean difference between litchi solo, litchi inter crop with mango solo was found significant while all three horticulture land-use found significant over rice wheat and uncultivated land-use. It was also observed that uncultivated and rice-wheat significantly varied. Soil organic carbon with depth found decreasing trend and varied from (5.68 to 3.27), all the soil depth was found to be significantly varied with each other. The interaction effect of land use and soil depth was found to be non-significant.

Penetration resistance (PR)

Penetration resistance was found highest in uncultivated land (1368.2 KPa) (table-4) and lowest in the mango solo plantation (974.2 KPa). Mango and litchi plantation land-use was found to be significant over rice wheat and uncultivated land-use. Mango solo mean value was found to be non-significant over litchi solo land-use.

Mean weight diameter (MWD)

The data analysis of MWD revealed that it varied significantly among different land-use. Highest MWD was observed in mango solo plantation (3.73 mm) where as lowest MWD value (2.73mm) in rice wheat land-use. The mango, litchi and litchi intercrop land-use was found significantly superior over rice wheat and uncultivated land-use.

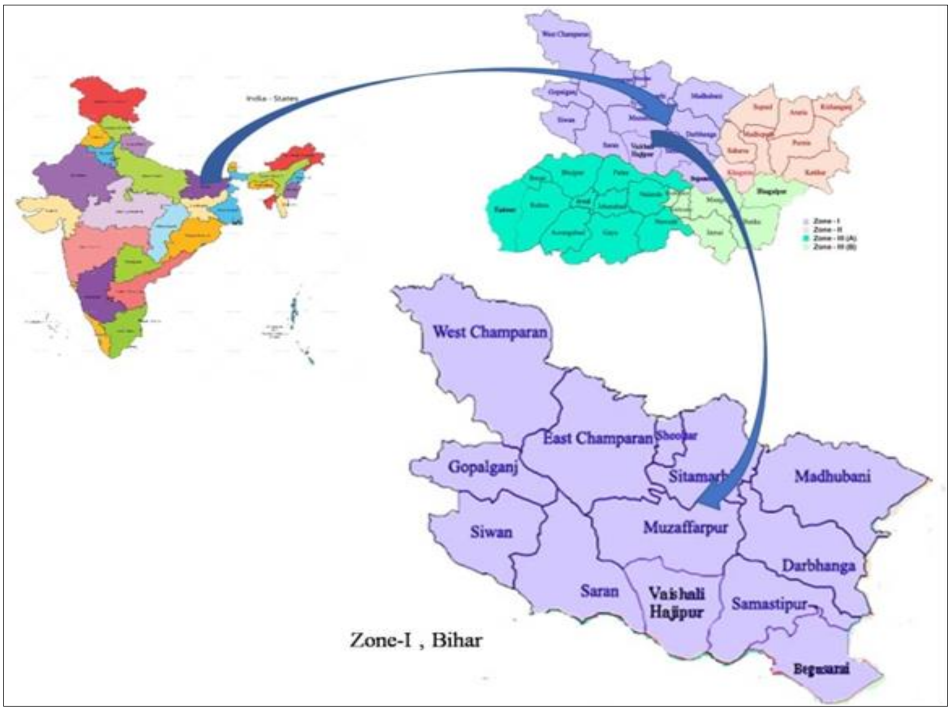

Fig 1: Experiment area north Zone-I of Bihar.

Table 1: Effect of different land use and soil depth on soil properties

Land use systems (L)	Sand%	Silt%	Clay%	BD(Mg m^{-3})	pH	EC(dSm^{-1})	OC%
Land use systems (L)							
Litchi Solo (T1)	24.14	50.77	22.39	1.41	8.03	0.39	4.73
Litchi Intercrop (T2)	24.16	50.24	23.09	1.42	8.2	0.34	4.07
Mango Solo (T3)	23.96	46.15	26.88	1.41	7.91	0.45	5.55
Rice -Wheat (T4)	29.58	45.21	23.38	1.45	8.26	0.38	2.98
Uncultivated (T5)	23.7	48.56	25.1	1.46	8.23	0.48	3.82
SEm±	1.97	2.29	1.19	0.014	0.037	0.011	0.096
C.D.(P=0.05)	NS	NS	NS	0.04	0.1	0.03	0.27
Soil depth (cm)							
0-15	29.93	47.08	22.99	1.36	7.99	0.69	5.68
15-30	28.58	47.68	23.74	1.42	8.12	0.36	4.41
30-45	26.99	48.47	24.55	1.45	8.16	0.31	3.56
45-60	25.11	49.52	25.38	1.48	8.23	0.27	3.27
SEm±	1.76	2.05	1.06	0.0122	0.0327	0.0096	0.09
C.D.(P=0.05)	NS	NS	NS	0.03	0.09	0.03	0.24

Table 2: Interaction effect of different land use and soil on soil properties at various soil depth.

Land use systems X Soil Depth	Sand%	Silt%	Clay%	BD(Mgm^{-3})	pH	EC(dSm^{-1})	OC%
Land use systems (L)							
Litchi Solo (T1)							
0-15	29.26	49.68	21.06	1.33	7.85	0.71	6.28
15-30	27.76	50.18	22.06	1.4	8.04	0.31	4.98
30-45	26.24	50.9	22.86	1.44	8.1	0.29	4.01
45-60	24.14	52.3	23.56	1.48	8.13	0.26	3.64
Litchi Intercrop (T2)							
0-15	28.76	49.14	22.1	1.35	8.08	0.58	5.49
15-30	27.7	49.56	22.74	1.42	8.21	0.29	4.23
30-45	26.06	50.46	23.48	1.44	8.23	0.27	3.41
45-60	24.16	51.8	24.04	1.47	8.29	0.23	3.16

Mango Solo (T3)							
0-15	29.56	45.14	25.3	1.34	7.78	0.81	7.32
15-30	28.04	45.78	26.18	1.39	7.9	0.41	5.93
30-45	26.34	46.34	27.32	1.43	7.94	0.32	4.69
45-60	23.96	47.34	28.7	1.49	8.03	0.28	4.25
Rice –Wheat (T4)							
0-15	33.4	43.74	22.86	1.38	8.14	0.47	4.1
15-30	32.08	44.76	23.16	1.44	8.24	0.38	3
30-45	30.61	45.79	23.6	1.48	8.29	0.36	2.48
45-60	29.58	46.54	23.88	1.5	8.35	0.32	2.32
Uncultivated (T5)							
0-15	28.66	47.7	23.64	1.42	8.1	0.89	5.21
15-30	27.34	48.1	24.56	1.45	8.23	0.43	3.91
30-45	25.68	48.84	25.48	1.48	8.25	0.32	3.18
45-60	23.7	49.6	26.7	1.49	8.33	0.29	2.97
SEm±	3.93	4.59	2.377	0.0273	0.0732	0.0215	0.192
C.D.(P=0.05)	NS	NS	NS	NS	NS	0.06	NS

Table 3: Soil texture in different land use at different location

Land Use	Texture and Location of different land use				
Litchi solo	Mushahari, Muzaffarpur	Birauli, Samastipur	Gauspur Sitamadhi	Katarmala Vaishali	Mehsi, E.Champaran
Texture	Silty loam	Clay Loam	Silty loam	Silty loam	Silty loam
Litchi Intercrop	Mushahari, Muzaffarpur	Birauli, Samastipur	Mehsi, E. Champaran	Mehsi, E. Champaran	Katarmala Vaishali
Texture	Silty loam	Clay Loam	Silty loam	Silty loam	Silty loam
Mango solo	Birauli, Samastipur	Gauspur Sitamadhi	Mahnar, Vaishali	Mehsi, E. Champaran	Patory, Samastipur
Texture	Clay Loam	Silty loam	Clay Loam	Silty loam	Clay Loam
Rice Wheat	Mahnar,Vaishali	Patory, Samastipur	Chakiai, E. Champaran	Mushahari, Muzaffarpur	Dholi Muzaffarpur
Texture	Clay Loam	Clay Loam	Silty loam	Silty loam	Sandy Loam
Texture	Clay Loam	Silty loam	Silty loam	Clay Loam	Silty loam

Table 4: Effect of different land use on soil surface penetration resistance and mean weight diameter.

Land use systems (L)	Pr (KPa)	MWD (mm)
Litchi Solo (T1)	977.6	3.62
Litchi Intercrop (T2)	1063.2	3.26
Mango Solo (T3)	974.2	3.73
Rice -Wheat (T4)	1135.8	2.73
Uncultivated (T5)	1368.2	3.17
SEm±	26.9	0.133
C.D.(P=0.05)	81.5	0.0403

Conclusion

The research data reveals that the different land-use and soil depth affects the soil properties. Horticulture tree based land-use system found to be better than rice wheat and uncultivated land due to more organic input in horticulture land-use.

References

1. Black CA. Methods of soil analysis, Part-II, America Society of Agronomy. Inc. Madison. USA, 1965.
2. Duiker SW. Diagnosing soil compaction using a penetrometer. Agronomy Facts 63. 2002.
3. Fraterrigo JM, Turner MG, Pearson SM, Dixon P. Effects of past land-use on spatial heterogeneity of soil nutrients in southern Appalachian forests ecological monographs. The Ecol Soc Am. 2005;75:215-230.
4. Fu B, Chen L, Ma K, Zhou H, Wang J. The relationships between land-use and soil conditions in the hilly area of the loess plateau in northern Shaanxi, China. Catena. 2000;39:69-78.
5. Greene CH, Pershing AJ. Climate drives sea change. Science. 2007;315:1084–1085. (doi:10.1126/science.1136495)
6. IPCC. Climate change 2007: fourth assessment report of the intergovernmental panel on climate change (IPCC), WMO, UNEP, 2007.
7. Jackson ML. Soil Chemical Analysis. New Delhi: Prentice Hall of India. 1967.
8. Lal R. Enhancing Eco-efficiency in Agro-ecosystems through Soil Carbon Sequestration Published in Crop Sci. 2010;50:S-120–S-131.
9. Lal R. Digging deeper: A holistic perspective of factors affecting soil organic carbon sequestration in agroecosystems. Global Change Biology. 2018;24(8):1-17.
10. Lal R. Managing soils and ecosystems for mitigating anthropogenic carbon emissions and advancing global food security. Bio Science. 2010;60:708-721.
11. Lemenih M, Karltun E, Olsson M. Assessing soil chemical and physical property responses to deforestation and subsequent cultivation in small holders farming system in Ethiopia. Agriculture, Ecosystems and Environment. 2005;105(1-2):373-386.
12. Meena VS, Mondal T, Pandey BM, Mukherjee A, Yadav RP, Choudhary M. Land-use changes: Strategies to improve soil carbon and nitrogen storage pattern in the mid-Himalaya ecosystem, India. Geoderma. 2018;321:69–78.
13. Moges A, Dagnachew M, Yimer F. Land-use Effects on Soil Quality Indicators: A Case Study of Abo-Wonsho Southern Ethiopia. Applied and Environmental Soil Science, Article ID 784989:1-9. 2013.
14. Piper CS. Soil and Plant Analysis. Inter Science Publishers, New York, NY. 1960, 128-136.
15. Richards LA. Diagnosis and Improvement of Saline-alkali Soils. Agriculture Handbook No. 60, USDA, Washington. 1954.
16. Walkley AJ, Black IA. Estimation of soil organic carbon by chromic acid titrationmethod. Soil Science. 1934;37:29-38.