ASSESSMENT OF PHYSICO – CHEMICAL PROPERTIES OF SOIL UNDER DIFFERENT ECO SYSTEMS OF GWALIOR REGION

Abstract

This investigation was carried out on the different ecosystem of Gwalior region, ITM university Gwalior, Madhya Pradesh, India. The experiment was planned in a randomized block design (RBD) with three replication and seven selected ecosystem viz. T1-Neem area, T2- Aonla area, T3- Duck house, T4- CRC-1 , T5- CRC-2, T6- Polyhouse and T7- Pond area. The results of the experiment revealed that the physical properties of the soil such as bulk density, porosity, soil texture of the soil improved with addition of organic matter likewise in duck house we found that organic matter of area was very as compared to another area at both surface and subsurface soil depth. The bulk density was lowest recorded at surface and sub surface soil in duck house and pond area respectively over the aonla and neem area. The available N, P, and K was highest recorded in the Duck house treatments as compare to aonla and neem area both surface and subsurface soil, respectively. The chemical properties of the soil such as organic carbon, available N, P, K and soil exchangeable Ca and Mg was highest recorded in the duck house due to the presence of high organic matter and pH in normal range which provide the available form of nutrient.

Key words: Ecosystem, Duck house, Poly house, Aonla area, CRC-1 and CRC-2

1. INTRODUCTION

Soil organic carbon (SOC) is the largest reserve of terrestrial organic carbon and therefore plays an important role in the global carbon cycle. Land use and agricultural practices such as tillage, irrigation, and fertilization affect SOC storage. It is a direct source of nutrients to plants, the release of which is dependent on microbial activity by affecting the cation exchange capacity (CEC). The role of land-use systems in stabilizing CO2 levels and increasing soil carbon sequestration has attracted considerable scientific attention in recent times. The type of land use system is an important factor in soil organic matter control, as it affects the quantity and quality of the input waste, the composting waste, the rate of soil stabilization, and the process organic matter in the soil. The SOM contains more reactive organic carbon than any other terrestrial basin, and in addition, it plays a key role in determining C stores in ecosystems and in regulating atmospheric CO2 concentrations.

Postetal.1982). At the decade scale, land use change (LUC) can strongly influence whether a particular region acts as a source or as a absorber of atmospheric CO2 (Freibauer et al.2004; Lal, 2004). Land management that disturbs the soil at least contributes to increased SOC accumulation, while strong disturbance leads to lower SOC. Changing land use from native ecosystems to farming ecosystems leads to a loss of carbon in the soil. On the other hand, the growth of vegetation on abandoned farmland increases C uptake capacity (Post and Kwon,2000). Soil organic carbon content is strongly influenced by agricultural management. Intensive farming without proper management practices has resulted in loss of SOC and nutrients. Proper crop rotation can increase or at least maintain the quantity and quality of SOC. Land use and cropping systems affect soil fertility and associated soil properties. Improving and maintaining SOC is closely linked to cropping systems, management practices and climate (Swati et al. 2016). However, the longitudinal distribution of soil organic carbon (SOC) in the soil profile is not clear. In soils below 30 cm depth, stored organic matter (SOM) flows are important for soil functions. In addition to the soil's inorganic

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carbon and SOC, the underlying soil layer contributes to the cycle of elements with consequential e.g. plant food. Despite the lower concentrations, the underlying soil layer is probably an important factor for long-term SOC storage, as the age of radiocarbon and the organic matter (OM) cycle time increases with the depth of the ground increases.

Hosur and Dasog (1995) watched pH of soil beneath trees diminished while, natural matter and replaceable calcium of the soils expanded. The supplement status of the soils was small changed by tree ranches. The supplement return through litterfall taken after the arrange Ca > K > N in D. sissoo and A. catechu and Ca > N > K in teak. Essentially, detailed a diminish in soil pH and EC as it were by 3-5% and 10% individually, whereas planting of trees expanded the level of soil natural carbon by 33-73%, cation trade capacity by 16-30%, accessible plant supplements by 8-30% and replaceable bases by 7-83%. They moreover found the useful impacts of the trees to be more apparent within the surface soil skylines than the sub-surface skylines. The soil natural carbon expanded with an increment in tree age. The soils beneath agroforestry had 2.9–4.8 Mg ha-1higher soil natural carbon than in sole trim. The agroforestry trees viz., poplar includes 3–4 t ha-1of litter (Rasool, 1996) from moment to the fifth year of ranch and physical boundaries like root and stem (Garrett and 2000) in back road editing lead to an increment in soil natural carbon through decreased soil disintegration, these are likely to impact the physico-chemical characteristics of soil especially their resistance (soil erodibility) to the affect of falling raindrops. The electric conductivity didn't have any critical distinction at the soil layer of to 15 cm and 15 to 30 cm beneath the tree species of T. arjuna and P. juliflora. Altogether higher natural carbon substance of 1.8 g kg-1in 15-30 cm profundity was recorded in P. j uliflora manor.

The physical properties of the soil have long been considered to have a major influence on the distribution, growth and development of crops. Bulk density is a measure of the percentage of porous space and solids in a soil. It affects root penetration and how much air and water the soil can hold. Texture and structure are two inherent features of soil that govern bulk density. Most soil bulk density varies between 1.0 g/cm3 and 2.0 cm3, and root penetration is severely affected at densities above 1.6 g/cm3. Lower soil mass density is desirable for plant growth, whether those plants are agricultural crops, trees or grasses. Other factors that have some influence on bulk density are the parent material and depth in the soil profile. Lower concentrations of organic matter, less agglomeration, fewer fine roots, lower numbers of soil microorganisms, all of these factors generally contribute to higher bulk densities. The addition of organic residues to the soil can reduce bulk density by improving soil structure and increasing pore space.

2. Material and Methods

2.1 Physical Properties

2.1.1 Soil moisture

Soil moisture content was determined using intact soil samples obtained at a soil depth of 0-15 cm for bulk density. Soil moisture is determined in the laboratory by gravimetric method (Richards, 1954). The earth core is saturated overnight, exposed to the saturated pressure plate and brought to equilibrium by the pressure plate device. Soil samples were equilibrated and in equilibrium at 15 bar. When the water flow through the drain pipe stops, the soil water content is calculated by weight at each applied pressure. The water content by volume was calculated by multiplying the water content by weight by the bulk density of the sample.

2.1.2 Soil texture

Soil texture was determined by hydrometer method. In this method, the samples are first treated with hydrogen peroxide to remove organic matter and binders, then left to stand for two days and also retain the tracer in the beaker. After two days, the

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solution is heated to 80°C for at least 4 to 5 hours. It was then cooled and dried in an oven for 24 h and the final weight of the soil was taken with a beaker. And then define the texture based on the main soil particles.

2.2 Chemical properties of soil

2.2.1pH and EC

Air-dried soil samples at a depth of 0–15 cm were analyzed for EC and pH using potentiometric and conductivity methods, respectively. To determine the EC and pH of a soil, a soil type:water suspension of 1:2 was made by combining 20 g of sol dried in a 100 ml beaker with 40 ml of distilled water. For about 30 min, the sol suspension was stirred continuously and then allowed to stand until a clear supernatant was formed. During this time, the conductivity meter was calibrated with 0.01 M KCl solution and the pH meter was calibrated with buffer solutions with pH values of 7.0 and 9.2, respectively. First, the EC of the supernatant of each sample was determined using a conductivity meter. After EC measurement, the sample was mixed thoroughly with a glass rod to determine the pH of the soil solution using a pH meter.

2.2.2 Soil organic carbon

Soil samples were taken from a depth of 0-15cm, air-dried, ground into powder and passed through a 2.0mm filter before use to determine soil organic carbon content by wet digestion (Walkley) and Black, 1934).

2.2.3 available NPK

Available N was determined by alkaline permanganate method (Subbiah and Asija, 1956), available P by Olsen's method (Olsen et al., 1954) and available K using ammonium acetate method 17 (Jackson, 1973).

2.2.4 Available Ca, Mg and S

The digested solution was fed to Inductively coupled plasma - optical emission spectrometry (ICP-OES) (Spectra Genesis, Germany make) after standardization.

2.3Statistical analysis

The replications wise data of each treatment were analyzed in a randomized block design and the critical difference (CD) was used to compare the effect of the treatments at P = 0.05 by using OP STAT software (Sheoran et al., 1998).

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3. Experimental Findings

3.1 Chemical properties of soil

3.1.1 Soil pH

The highest pH was recorded in the aonla zone (8.50 and 8.40), followed by the Neem zone (8.21 and 8.10) at the surface and underground. The lowest pH was recorded in

the pond area (6.0 and 5.8) at the surface and in the ground and CRC-1 was at the same level as CRC-2 and the fish house area at two depth levels (0-15 and 15 - 30 cm) respectively.

Table 1. Soil pH at surface and subsurface soil of different ecosystem of Gwalior

Treatments	pH	
	0-15 cm	15-30 cm
Neem area	8.21^{b}	8.10^{b}
Aonla area	8.50^{a}	8.40^{a}
Duck house	6.42^{e}	6.24^{c}
CRC-1	6.71^{c}	6.56^{c}
CRC-2	6.70^{cd}	6.45^{cd}
Polyhouse	6.50^{de}	6.36^{cd}
Ponds	6.00^{f}	5.83^{f}

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

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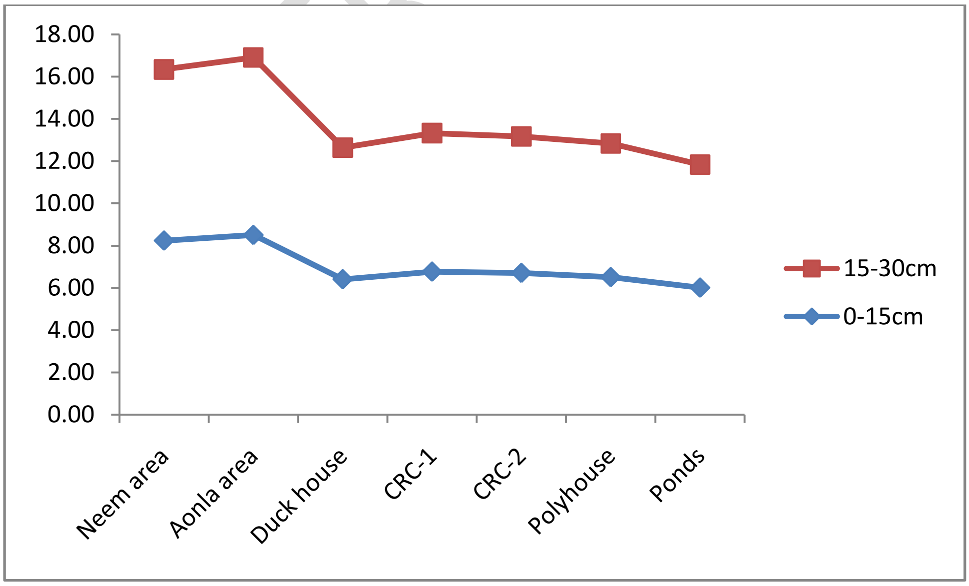

Fig. 1 Variation of pH in different ecosystem of Gwalior

Soil pH decreases significantly with increasing soil depth. Maximum soil pH (8.40) and significantly higher were observed at soil depths of 0–15 cm. This can largely be attributed to salt migration from deeper layers due to capillary force effects, which are often intensified during the dry season and low precipitation conditions.

3.1.2 Soil electrical conductivity

The highest EC was recorded in the aonla region (0.50 and 0.54 dS cm-1), followed by the Neem region (0.47 and 0.48 dS cm-1) at the surface and below ground, respectively. . The lowest EC was recorded in the pond area (0.42 and 0.41 dS cm-1) at the surface and in the ground and CRC-1 was at the same level as CRC-2 and the polyculture area at two levels. depth (0-15 and 15 -30 cm) respectively. The EC of soil under natural forest is higher than that of other land-use systems. This may be due to the enrichment of soil minerals with basic salts due to weathering and decomposition of the litter.

Table 2. Soil EC at surface and subsurface soil of different ecosystem of Gwalior

Treatments	EC (dS cm^{-1})	
	0-15 cm	15-30 cm
Neem area	0.47^{b}	0.48^{b}
Aonla area	0.50^{a}	0.54^{a}
Duck house	0.45^{c}	0.45^{c}
CRC-1	0.46^{bc}	0.47^{bc}
CRC-2	0.45^{c}	0.46^{bc}
Polyhouse	0.45^{c}	0.45^{c}
Ponds	0.42^{d}	0.41^{d}

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

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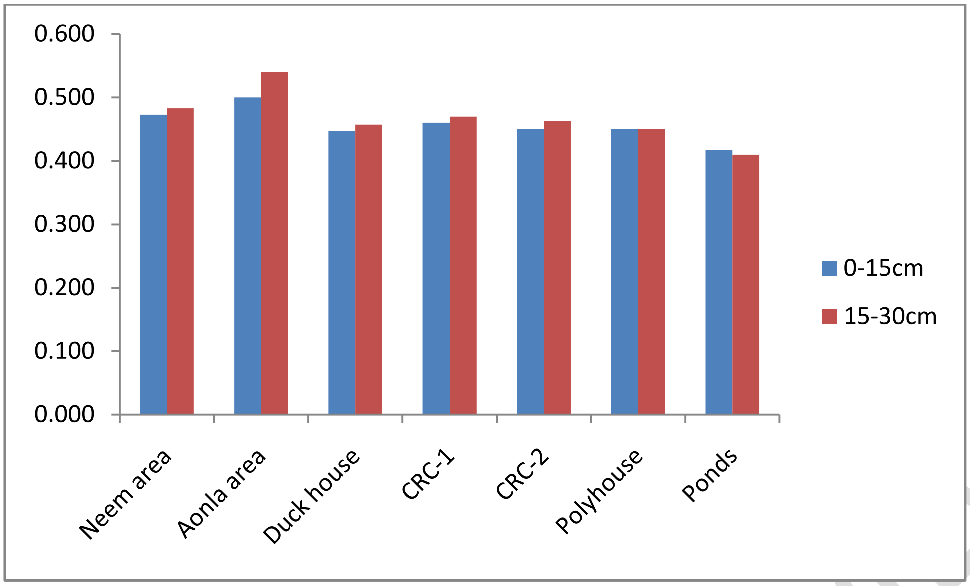

Fig 2. Variation of soil EC in different ecosystem of Gwalior

3.1.3 Soil organic carbon

The highest organic carbon was recorded in duck ponds (0.49 and 0.47%) and was significant for all treatments at the surface and subsoil, followed by the pond area. (0.47 and 0.45%) and from the compound housing area (0.46 and 0.43%).) for both the ground and the basement respectively, these two areas are at the same level at two levels of depth. The lowest organic carbon was recorded in the aonla region (0.39 and 0.40 dS cm-1) at the surface and in the ground, and CRC-1 was at the same level as CRC-2 and the multi-storey housing area in two levels of depth (0-15 and 15 -30 cm) respectively. Soil organic carbon plays an important role in the functioning of ecosystems. Therefore, loss of SOC can lead to reduced soil fertility, land degradation and even desertification.

Table 3. Soil Organic carbon at surface and subsurface soil of different ecosystem of Gwalior

	OC (%)	
	0-15cm	15-30cm
Neem area	0.41^{ef}	0.40^{b}
Aonla area	0.39^{e}	0.40^{b}
Duck house	0.49^{a}	0.47^{c}

CRC-1	**0.42^{de}**	**0.40^{bc}**
CRC-2	**0.44^{cd}**	**0.42^{ab}**
Polyhouse	**0.46^{bc}**	**0.43^{a}**
Ponds	**0.47^{bc}**	**0.45^{a}**

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

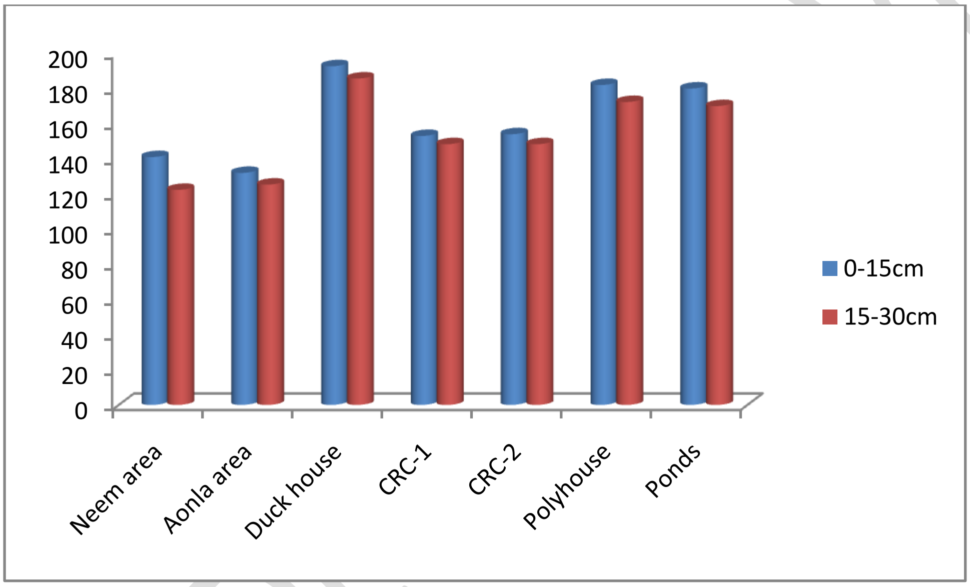

Fig 3. The graphical representation of Soil Organic carbon at surface and subsurface soil of different ecosystem of Gwalior

3.1.4 Soil Available Nitrogen

The available nitrogen (kg/ha) in soil is significantly influenced by different land use systems and at different soil depths (Table 4). Highest nitrogen was recorded in Duck house (190 and 184 kg/ha) followed by Polyhouse (186 ad 180 kg/ha) and Pond area (177 and 172 kg/ha) and it was significantly lowest in Aonla area(141and 136 kg/ha) and Neem area (150 and 143 kg/ha) at surface and subsurface level of soils respectively.

Table 4. Soil Available-N at surface and subsurface soil of different ecosystem of Gwalior

	N Kg ha-1	
	0-15cm	15-30cm
Neem area	150[e]	143[d]
Aonla area	141[f]	136[e]
Duck house	190[a]	184[a]
CRC-1	171[c]	165[c]
CRC-2	165[d]	160[c]
Polyhouse	186[A]	180[a]
Ponds	177[b]	172[b]

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

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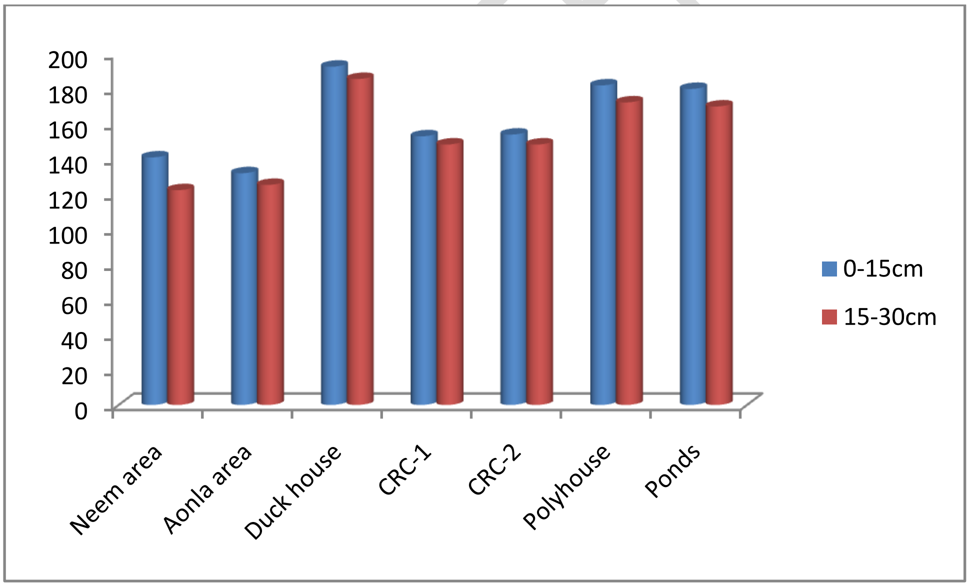

Fig 4. Graphical representation of Soil Available-N at surface and subsurface soil of different ecosystem of Gwalior.

Nitrogen availability in the soil decreased significantly with increasing soil depth. The maximum available nitrogen and significantly higher were recorded at 0-30 cm. This

may be due to higher organic residue turnover in the upper layer than in the deeper layers.

3.1.5 Soil available phosphorus

Phosphorus availability in the soil varies considerably under different land use systems and at different soil depths (Table 5). The highest phosphorus levels were recorded in the duck house (14.30 and 13.76 kg/ha), followed by the large barn (13.0 and 13.50 kg/ha) equivalent to the soil in the pond area and The lowest amounts were found in the neem zone (9.10 and 8.40) followed by the aonla zone (8.37 and 7.77 kg/ha) in the surface and subsoil, respectively.

Table 5. Soil available phosphorus and subsurface soil of different ecosystem of Gwalior

Treatment	P kg/ha	
	0-15cm	15-30cm
Neem area	9.00[d]	8.43[d]
Aonla area	8.37[e]	7.77[d]
Duck house	14.3[a]	13.76[a]
CRC-1	12.11[c]	11.00[c]
CRC-2	12.40[c]	10.77[c]
Polyhouse	13.0[b]	13.50[b]
Ponds	11.5[b]	9.97[b]

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

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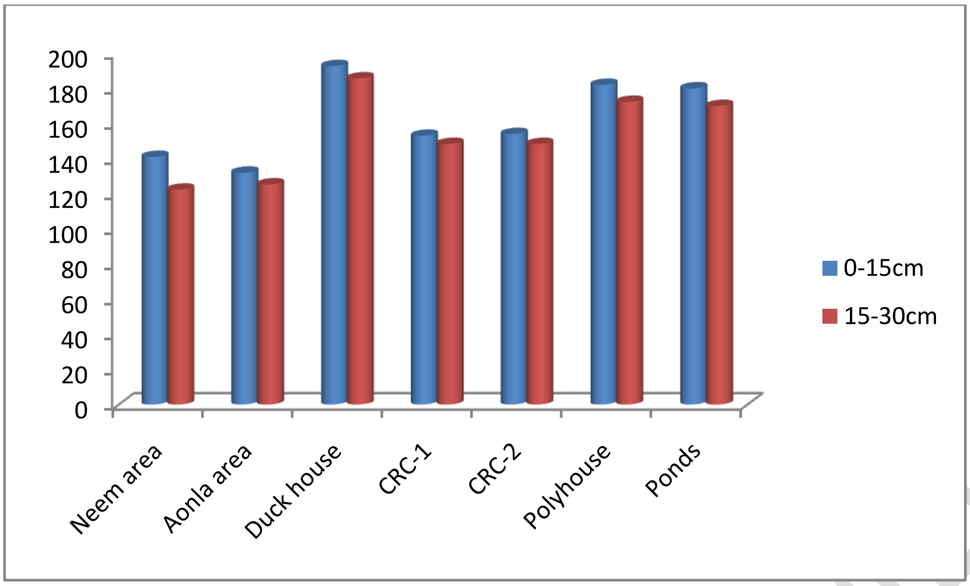

Fig 5. The graphical distribution of soil available phosphorus and subsurface soil of different ecosystem of Gwalior.

3.1.6 Soil available potassium

The available potassium in soil is significantly influenced by different land use systems and soil depths (Table 6). Significantly highest potassium was recorded in Duck house (292 and 282 kg/ha) followed by Poly house (282 and 272 kg/ha) and Pond area (280 and 270 kg/ha) and the lowest potassium was found in aonla area (232 and 225 kg/ha) at the both surface and subsurface soil respectively.

Table 6. Soil available potassium at surface and subsurface soil in different ecosystem of Gwalior

Treatments	K kg/ha	
	0-15cm	15-30cm
Neem area	241^{c}	222^{d}
Aonla area	232^{d}	225^{e}
Duck house	292^{a}	285^{a}
CRC-1	253	248
CRC-2	241^{d}	222^{d}
Polyhouse	282^{b}	272^{a}

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Ponds	280^{c}	270^{c}

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

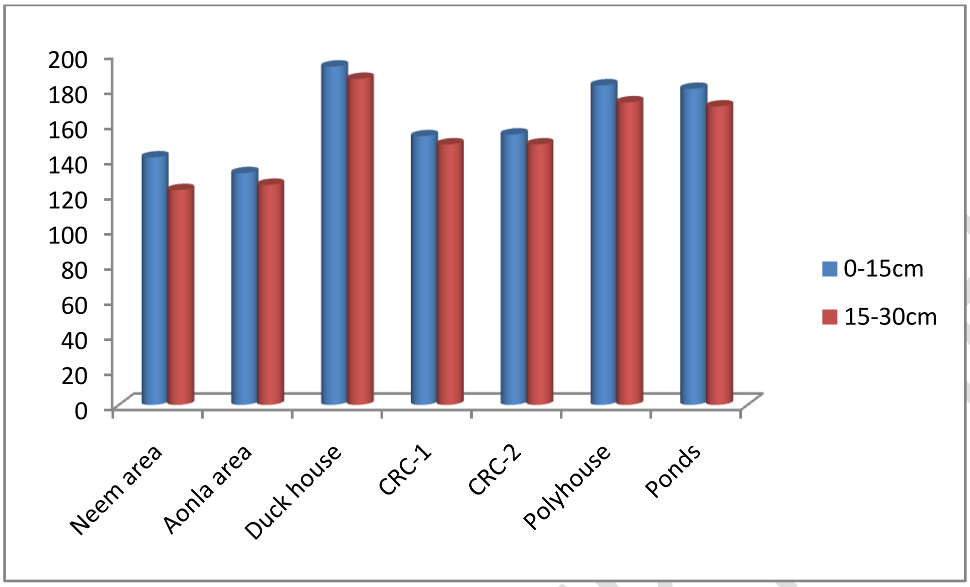

Fig 6. The graphical distribution of soil available potassium at surface and subsurface soil in different ecosystem of Gwalior.

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3.1.7 Soil exchangeable calcium

Highest Soil exchange able calcium was recorded in Aonla area (4.63 and 4.56 kg/ha) followed by Neem area (4.43 and 4.23 kg/ha) and lowest value of soil exchangeable Mg recorded in pond area (3.30 and 3.20 kg/ha) and Duck house (3.40 and 3.36 kg/ha) at surface and subsurface level of soils respectively. While CRC-1 and CRC -2 are the at par to each other.

Table 7. Soil exchangeable calcium at surface and subsurface soil in different ecosystem of gwalior

Treatments	Ca kg/ha	
	0-15cm	15-30cm
Neem area	7.33^{ab}	7.43^{ab}

Aonla area	7.60[a]	7.76[a]
Duck house	5.16[d]	5.13[c]
CRC-1	6.40[c]	6.43[b]
CRC-2	6.53[bc]	6.40[b]
Polyhouse	6.40[c]	6.30[b]
Ponds	4.63[d]	4.53[c]

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

3.1.8 Soil exchangeable magnesium

Highest Soil Exchangeable magnesium was recorded in Aonla area (4.63 and 4.56 kg/ha) followed by Neem area (4.43 and 4.23 kg/ha) and lowest value of soil exchangeable Mg recorded in pond area (3.30 and 3.20 kg/ha) and Duck house (3.40 and 3.36 kg/ha) at surface and subsurface level of soils respectively. While CRC-1 and CRC -2 are the at par to each other.

Table 8. Soil exchangeable magnesium at surface and subsurface soil in different ecosystem of gwalior

Treatments	Mg	
	0-15cm	15-30cm
Neem area	4.43[a]	4.23
Aonla area	4.63[a]	4.56[a]
Duck house	3.40[c]	3.36[c]
CRC-1	4.10[ab]	4.10[b]

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CRC-2	4.26^{ab}	4.13^{b}
Polyhouse	3.70^{bc}	3.46^{c}
Ponds	3.30^{c}	3.20^{c}

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

3.1.9 Soil available Sulphur

Sulfur availability in the soil is strongly influenced by different soil types as well as at different soil depths (Table 9). In soil, sulfur exists as sulfate minerals (such as calcium sulfate, magnesium sulfate, and potassium sulfate), as sulfide gas, and elemental sulfur. All of these forms must be oxidized or mineralized to a form of sulfate that can be used by plants. This process is promoted by bacteria. The process of mineralization and sulfur fixation takes place continuously in the soil. Sometimes it's pure mineralization, and sometimes it's pure fixation. It is similar to the mineralization of organic nitrogen to nitrate. Sulfur may become unavailable due to its binding to clay particles in some soils, especially in kaolinite clays, which are the main source of minerals in the study area. This has only a negative charge on one side of the clay lattice and a positive charge on the other side, so the negatively charged sulfur ions will attach to those positively charged sites. Acidic soils will also retain sulfur because sulfur availability is controlled by microbial activity and at acidic pH microbial activity will be low.

Table 9. Soil available Sulphur at surface and subsurface soil in different ecosystem of gwalior

Treatments	S kg/ha	
	0-15cm	15-30cm
Neem area	17.20^{ab}	16.13^{a}
Aonla area	18.57^{a}	16.93^{a}
Duck house	12.20^{ac}	10.30^{d}

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CRC-1	16.20^{ab}	14.50^{b}
CRC-2	16.23^{ab}	14.50^{b}
Polyhouse	15.03^{b}	12.23^{c}
Ponds	10.43^{c}	7.77^{e}

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

3.2 PHYSICAL PARAMETER

3.2.1 Soil texture

Texture of the studies area mostly in sandy loam in nature except pond area which are coming the silty clay loam. Primary particle are found in the soil three types which are Sand, Silt and clay (%), so there is sand percentage (70%) of the soil in most of the area which had studies except pond area (40%) while silt and caly percentage are10 to 20% and clay 10 to 15% but in case of pond area silt and clay are 35 and 20 % respectively, which are significantly better texture than other area for the better crop production.

Table 10.Primary Particles at surface under the different ecosystem of gwalior

Treatments	Texture (Surface)		
	Sand (%)	Silt (%)	Clay (%)
Neem area	71.17^{a}	16.14^{d}	12.01^{d}
Aonla area	71.91^{a}	18.01^{c}	10.01^{e}
Duck house	72.03^{a}	18.02^{c}	10.02^{e}
CRC-1	71.17^{a}	15.06^{e}	14.01^{c}
CRC-2	72.03^{a}	12.00^{f}	14.02^{c}
Polyhouse	65.05^{c}	19.03^{b}	16.01^{b}
Ponds	45.05^{d}	35.03^{a}	20.03^{a}

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Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

Similar results are found at subsurface soil while sand and silt percentage immensely decreases with the increasing of soil depth. But clay percentage was found increases with increasing the depth of soil.

Table 11. Primary Particles at subsurface under the different ecosystem of gwalior

Treatments	Texture (Surface)		
	Sand (%)	Silt (%)	Clay (%)
Neem area	65.67[a]	17.50[d]	16.83[c]
Aonla area	63.33[a]	19.36[c]	17.30[c]
Duck house	64.67[a]	19.63[c]	15.70[c]
CRC-1	66.33[a]	16.36[de]	17.32[c]
CRC-2	65.67[a]	15.10[e]	19.31[b]
Polyhouse	58.33[b]	21.53[b]	20.17[b]
Ponds	41.67[c]	35.10[a]	23.38[a]

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

3.2.2 Bulk density

Bulk density was highest recorded in the neem area (1.44 and 1.43 g/m^3) followed by the aonla area (1.42 and 1.39 g/m^3) and the lowest bulk density was recorded in the duck house (1.30 and 1.28 g/m^3) while CRC-1 and CRC-2 are the at par to each other. This trends was found in surface and subsurface both depth of the soil similarly.

Table 12. Bulk density at surface and subsurface under the different ecosystem of gwalior

Treatments	BD g/m^3	
	0-15cm	15-30cm
Neem area	1.44[a]	1.43[a]

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Aonla area	**1.42^{a}**	**1.39^{b}**
Duck house	**1.30^{a}**	**1.28^{b}**
CRC-1	**1.42^{a}**	**1.39^{b}**
CRC-2	**1.31a**	**1.38b**
Polyhouse	**1.34^{a}**	**1.33^{b}**
Ponds	**1.38^{a}**	**1.34^{b}**

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

3.2.3 Porosity (%)

In Duck house porosity was recorded higher than other area which are significantly better for the soil aeration. while CRC-1 and CRC-2 are the at par to each other and lowest porosity was found in the aonla area (46.41and 47.21 %) followed by the neem area (45.03 46.03 5).

Table 13. Porosity at surface and subsurface under the different ecosystem of gwalior

Treatments	**Porosity (%)**	
	0-15cm	**15-30cm**
Neem area	**45.03^{a}**	**46.03^{b}**
Aonla area	**46.41^{a}**	**47.21^{ab}**
Duck house	**50.81^{a}**	**51.57^{ab}**
CRC-1	**46.54^{a}**	**47.67^{ab}**
CRC-2	**50.56^{a}**	**47.79^{ab}**
Polyhouse	**49.43^{a}**	**49.81^{ab}**

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Ponds	47.29^{a}	49.30^{ab}

Mean in the column followed by common letters (a-f) are not statistically different at 5% level of significance according to DMRT.

V. DISCUSSION

The diverse methods of managing soil nutrients on a long-term basis have affected the physical and chemical characteristics of soils that in turn affect crop yields. In this chapter the results of these changes in soil properties are discussed below.

5.1 Chemical properties of different ecosystems of soil

5.1.1 pH and EC

The highest pH and EC were found in the aonla and neem regions due to the presence of highly basic cations and the large amount of carbonet and sodium bicarbonate increasing the pH and EC. Water scarcity is a major problem in this area as more salts evaporate at the surface of the soil as water rises in the capillaries increasing the pH and EC of the soil. While the lowest pH and Ec values were found in the duck house, followed by the more numerous coops due to the abundance of bacteria that decompose organic residues and release pH-lowering substances. Similarly, Hong et al. (2018) also found that there was a significant neutralization of soil pH due to afforestation. Thus, afforestation lowers the pH in relatively alkaline soils and can also increase in relatively acidic soils, leading to long-term neutralization. The likelihood of that happening depends on creating an overall balance of hydrogen ions produced in the soil during nutrient cycling and many other processes (garbage decomposition, enzymatic activity of microorganisms, etc.). , root exudates, etc.) occur in soil ecosystems and #40; Rukshana et al., 2014). Sharma et al. (2009) also reported that the EC of the soil in the agroforestry system was significantly higher than that in the cropland and agro-horticultural systems. Soil EC decreased significantly with increasing soil depth. A maximum EC value of 0.088 dS/m was observed at 0-20 cm. Similar trends were reported by Newaj et al. (2007) and Akhtar et al. (2008). Ghimire (2010) also reported that EC was higher in the upper layer and decreased with increasing depth.

5.1.2Soil organic carbon

Soil organic carbon was highest recorded in duck houses, which is significant compared to the entire study area, followed by multi-cow houses. Due to the presence of higher organic matter content and organic residues are decomposed by bacteria in the soil. The lowest organic carbon values are found in the neem and aonla zones due to higher soil temperatures and less water availability, which are favorable conditions for the loss or decomposition of organic carbon in the soil. According to Kay and Angers (1999), regardless of soil type and climatic conditions, if COS content is less than 1%, potential yield may not be obtained because COS can affect physical, chemical and physical properties. soil biology and biology. Researchers elsewhere have also reported that continuous farming depletes SOCs and degrades soil quality relative to native vegetation (NF), regardless of the farming system implemented. (Reeves, 1997; Bowman et al. 1990, Bremer et al. 1994). In tree-based land-use systems, the higher organic carbon content can be attributed to variable litter turnover as well as different roots and decomposition rates of organic matter by these

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plants. additional. In the present study, litter accumulation was estimated in four tree species and in natural forests. Maximum COS (0.81%) and significantly higher were observed at 0-20 cm. depth and lowest (0.36%) observed at 40-60 cm. The higher soil organic carbon accumulation above the surface layers in tree-based land use systems could be due to waste accumulation and rotation. The decomposition and incorporation of carbon released into the soil will contribute to the elevation of the soil organic carbon status. Similar variations in SOC with increasing soil depth have been reported by previous studies (Swamy and Puri, 2005; Chauhan et al., 2010 and Ghimire, 2010).

5.1.3 Soil Available NPK

Available NPK was the highest recorded in the barn due to the highest nutrient availability and inorganic form of nutrients for plant growth. Next is the polyhouse under the polyhouse adding crop residues to replenish nutrients after decomposition. And the lowest nutrients are metabolized in the neem and aonla regions because the low water availability is not enough to decompose the plant residues and render the nutrients in the soil in solution form, after which nitrogen is lost through the process. evaporates and P and K are fixed in the soil.Nitrogen availability in the soil decreased significantly with increasing soil depth. The maximum available nitrogen and significantly higher were recorded at 0-30 cm. This may be due to higher organic residue turnover in the upper layer than in the deeper layers. Duan et al. (2019) and Bhardwaj et al. (2001) also reported a trend to decrease available N content with increasing soil depth in high density poplar plantations. Ghimire (2010) also reported similar results.The higher available phosphorus may also be due to the higher acid phosphatase activity in agroforestry and farmland compared with other land-use systems, because of the excretion of organic anions and the of acid phosphatase from plant roots increases P mobilization in the rhizosphere (Radersma and Grierson, 2004;). The lowest available P was recorded in A. hirsutus producing the greatest litter volume with the lowest decomposition rate (0.61 years-1). The quality of litter and the rate of decomposition also affect the availability of nutrients in the soil. In Chinese fir, decay is reported to be low, with nutrients slowly returning to the soil during short rotations, leading to poor soil fertility (Sheng and Fan, 2002; Sheng). et al., 2003). P available in the soil decreased significantly with increasing soil depth, i.e. from 0-20 cm to 40-60 cm. Maximum and significantly higher available P (20.15 kg/ha) was recorded at soil depths from 0 to 20 cm. These trends are consistent with previous findings (Duan et al., 2019; Lei et al., 2019; and Ghimire, 2010). K available in the soil decreased significantly with increasing soil depth, i.e. from 0 to 30 cm. The maximum available K was recorded at soil depths from 0 to 15 cm. A downward trend was observed with successive increases in soil depth as a consequence of greater litter fall and good root regeneration in the surface layer. A similar decrease with soil depth was also reported by Bhardwaj et al. (2001), Mishra and Swamy (2007).

5.1.4 Soil exchangeable Ca and Mg

Ca and Mg exchange in the soil In the duck house, the Ca and Mg exchange in the soil was recorded to be the highest compared to other study areas, followed by the pond and the compound house area, because in this area, the organic carbon in the soil is high. most, is the main factor for soil -Soil exchange Ca and Mg. while the lowest Ca and Mg were recorded in the neem zone and aonla zone because Ca and Mg are fixed in the form of corbonet, bicarbonate and hydroxide. The neem and aonla areas have a high pH range favorable for these nutrients in the soil micelle. Aweto and Dikinya (2003) reported that calcium and magnesium were higher in the soil under the tree tops and this was mainly due to the accumulation of litter. Ca content in litter was

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recorded as the highest in natural forest (2.67%) along with S. macrophylla (2.26%) (Table 8). Thus, the difference in Ca exchange in the soil may be due to the age of the plant. and species composition of land use systems. Soil exchange calcium decreased significantly with increasing soil depth. Maximum (2.90 meq/100 g soil) and significantly higher calcium were observed at soil depths of 0-20 cm compared with other soil depths. Exchanged shifts decrease with increasing soil depth. This may be due to the continuous addition of litter over many years and also because these soils remain undisturbed for many years.The higher Mg content in tree-based systems may be due to the addition of more litter, which in turn adds large amounts of nutrients and organic matter to the soil and subsequently facilitated downward movement. favorable by improving permeability under the tree canopy. Differences in exchange bases (Ca and Mg) between land-use systems can be attributed to leaching losses, low bedrock content and clay mineral ratio, as well as conversion of forest soils to other types of soil. other land use. Wakene and Heluf (2003) reported that continued cultivation and use of acid-forming inorganic fertilizers deplete exchangeable Ca and Mg. Magnesium exchange in the soil decreased significantly with soil depth, and significantly higher and maximum magnesium concentrations (0.68 meq/100 g soil) were observed at soil depths of 0–20 cm.

5.1.5 Soil available sulfur

The highest soil available sulfur was found in duck coops, followed by pond areas and treehouse areas due to more soil organic matter and low pH. while the lowest sulfur was recorded in neem and aonla due to the high pH range which reduces the sulfur availability in the soil. Sulfur may become unavailable due to its binding to clay particles in some soils, especially in kaolinite clays, which are the main source of minerals in the study area. This one has only negative charges on one side of the clay lattice and positive charges on the other side, so negatively charged sulfur ions attach to these positive sites. Acidic soils will also retain sulfur because sulfur availability is controlled by microbial activity and at acidic pH microbial activity will be low.

5.2 Physical properties of different ecosystem soil

Physical properties of soil was better condition recorded in the duck house and polyhouse due to the presence of more number of soil micobes which makes the soil porus and increase the porosity of the soil and decrease the bulk density of the soil. While bulk density was highset recoded in aonla area and neem area due to presence of less quantity of soil organic matter. Means soil physical properties mainly depends on the soil organic matter and porosity which can improve the soil structure and soil health.

6. Conclusion

This study was carried out in different ecosystem of Gwalior region under this study we take the samples from aonla area, neem area, pond area, duck house, polyhouse as well as CRC-1 and CRC-2. Under this study we analyse the soil physical and chemical properties of the different ecosystem of the Gwalior region.

Under this study we found that pH and EC was lowest in the duck house and pond area followed by polyhouse. While highest value was found in the neem area and aonla area because the high salt concentration and high temperature.

Soil organic carbon was highest found in duck house followed by the pond area and poly house while lowest soil organic carbon found in the aonla and neem area dueto

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the higher temperature which decompose the soil organic matter and loss the soil organic carbon.

Soil available nitrogen, phosphorus and potassium was significantly higher found in the duck house followed by the pond area and poly house while lowest value of primary nutrient was recorded in aonla area and neem area.

Soil exchangeable Ca and Mg was highest recorded in the duck house ecosystem followed by the pond and polyhouse area while lowest value was recorded in the aonla area and neem area. Same trend was found for the soil available sulphur in the soil.

Soil physical properties also found better condition in duck house area followed by the pond and polyhouse area while poor condition of soil was recorded in neem area and aonla due to lowest amount of soil organic material as well as less porosity.

So overall these ecosystem duck house was found better and significant ecosystem for the physical as well as chemical properties of the soil. Followed by the polyhoiuse and pond ecosystem while crop production purpose CRC-1 and CRC-2 are the better ecosystem.

REFERENCES

Nelson, D.W. and L. E. Sommers,1982. Total carbon, organic carbon and organic matter. In Methods of Soil Analysis, Part 2nd Ed. Chemical and Microbiological properties. A. L. Page (eds.). ASA, Madison, 539-579.

Freibauer, A., M.D.A. Rounsevell, P. Smith, and J. Verhagen, 2004.Carbon sequestration in the agricultural soils of Europe, Geoderma. 122: 1- 23.

Lal, R., 2004. Soil carbon sequestration impact on global climate change and food security .Soil Science, 304:1623-1627.

Post, W. M. and K. C. Kwon, 2000. Soil carbon sequestration and land-use change: processes and potential. Global change Biology, 16: 317-328.

Swati, 2016. Land use and cropping effects on carbon in black soils of semiarid tropical India. India. Current Science. 110: 9.

Richard, L.A., 1954. Diagnosis and improvement of saline and alkali soils, USDA Agric. Handbook 60, U.S. Govt. Printing Office, Washington, D.C. 160.

Walkley, A.J. and I. A. Black, 1934. Estimation of soil organic carbon by the chromic acid titration method. Soil Science, 37: 29-3

OLSEN, S. R., COLE, C. V., AND DEAN, L. A., 1954, Estimation of available phosphorus in soil by extraction with sodium carbonate. In: Black, C. A. (ed.) Methods of soil analysis, Part 2. American Society of Agronomy Inc. Publisher, Medison, Wisconsin, USA. pp. 1044-1046.

HONG, S., PIAO, S., CHEN, A., et al., 2018, Afforestation neutralizes soil pH. Nat Commun, 9: 520.

RUKSHANA, F., BUTTERLY, C. R., XU, J. M., BALDOCK, J. A., AND TANG, C. X., 2014, Organic anion-to-acid ratio influences pH change of soils differing in initial pH, J. Soils Sediment, 14: 407–414.

SHARMA, K. L., RAJU, K. R., DAS, S. K., RAO, PRASAD, B. R. C., KULKARNI, B. S., SRINIVAS, K. GRACE, J. K. ,MADHAVI, M. GAJBHIYE AND PRAVIN, N., 2009, Soil Fertility and Quality Assessment under Tree-, Crop-, and Pasture-Based Land-Use systems in a Rainfed Environment. Commun. Soil Sci. & Plant Anal., 40(9-10): 1436-1461.

UNDER PEER REVIEW

NEWAJ, R., DAR, S. A., BHARGAVA, M. K., YADAV, R. S. AND AJIT, 2007, Effect of management practices on growth of white siris (Albizia procera), grain yield of intercrops, weed population and soil fertility changes in agrisilvicuture system in semi-arid India. Indian J. Agri. Sci., 77 (7): 403-407.

AKHTAR, J., SAQIB, Z. A., QURESHI, R. H., HAQ, M. A., IQBAL, M. S., AND MARCAR, N. E., 2008, The effect of spacing on the growth of Eucalyptus camaldulensis on salt-affected soils of the Punjab, Pakistan. Can. J. For. Res., 38(9): 2434-2444

GHIMIRE, T. B., 2010, Effect of fertility levels on mustard (Brassica juncea L.) productivity under varying poplar tree densities. Ph.D. Thesis. G.B. Pant University of Agriculture & Technology, Pantnagar-263 145, Uttarakhand.309p.

KAY, B. D., AND ANGERS, D. A., 1999, Soil Structure, in: Sumner M.E. (Ed.), Handbook of Soil Science, CRC Press: Boca Raton, USA, 229–276.

BOWMAN, R. A., REEDER, J. D., AND LOBER, R. W., 1990, Changes in soil properties in a Central Plains rangeland soil after 3, 20, and 60 years of cultivation. Soil Sci., 150: 851–857.

BREMER, E, JANZEN, H. H., AND JOHNSTON, A. M., 1994, Sensitivity of total light fraction and mineralizable organic matter to management practices in a Lethbridge soil. Can. J. Soil Sci, 74: 131–138.

REEVES, D. W., 1997, The role of soil organic matter in maintaining soil quality in continuous cropping systems, Soil Tillage Res., 43: 131–167.

SWAMY, S. L., AND PURI, S., 2005, Biomass production and carbon sequestration of Gmelina arborea in plantation and agroforestry system in India. Agroforest. syst., 64: 181–195. doi:10.1007/s10457-004–3.

CHAUHAN, S. K., SHARMA, S. C., BERI, V., RITU, YADAV, S., AND GUPTA, N., 2010, Yield and carbon sequestration potential of wheat (Triticum aestivum)-poplar (Populus deltoides) based agri-silvicultural system. Indian J. Agri. Sci., 80 (2): 129-135.

GHIMIRE, P., BHATTA, B., POKHREL, B., KAFLE, G., AND PAUDEL, P., 2018, Soil Organic Carbon Stocks Under Different Land Uses in Chure Region of Makawanpur District, Nepal. Saarc. J. Agri., 16(2): 13-23.

DUAN, A., LEI, J., HU, X., ZHANG, J., DU, H., ZHANG, X., GUO, W., AND SUN, J., 2019, Effects of Planting Density on Soil Bulk Density, pH and Nutrients of Unthinned Chinese Fir Mature Stands in South Subtropical Region of China, For., 10: 351

RADERSMA, S., AND GRIERSON, P. F., 2004, Phosphorus mobilization in agroforestry: organic anions, phosphatase activity and phosphorus fractions in the rhizosphere. Plant & Soil, 259: 209–219.

LEI, J., DU, H., DUAN, A., AND ZHANG, J., 2019, Effect of Stand Density and Soil Layer on Soil Nutrients of a 37-year-old Cunninghamia lanceolata Plantation in Naxi, Sichuan Province, China, Sustain., 11: 5410.

BHARDWAJ, S. D., AND PANWAR AND GAUTAM, S., 2001, Biomass pro- duction potential and nutrient dynamics of Populus del- toides under high density plantations. Indian For., 127: 144-153.

SWAMY, S. L., MISHRA, A., AND PURI, S., 2007. Comparison of growth, biomass and nutrient distribution in five promising clones of Populus deltoides under an agrisilviculture system. Biore. Techn., 97: 57–68.

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