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A Comparative Study of Physico-Chemical Parameters of Restored and Unrestored Soils of Two Villages of *Chaksu* Block, Jaipur, Rajasthan

Ruchi Middha*, Sonal Jain* and Shelja K. Juneja**
Department of Environmental Science, The IIS University, Jaipur

Abstract

Increasing trend in the frequency of natural events like earthquakes, floods, cyclones, etc due to increasing population has led to degradation of the ecosystems. To overcome the damage caused by such disturbances, the practice of ecological restoration has proven to be effective. It is the scientific study of renovating damaged ecosystems through human interference. In 1981, floods in the *Chaksu* block of Jaipur district resulted into massive erosion of the soil leaving the land unproductive which was later on taken up for the restoration by the forest department with the local people. This effort resulted in increased green cover and improved soil quality. The present study was conducted to measure physico-chemical characteristics of the soil samples which were collected from restored and unrestored sites from *Chandel kallan* and *Ram niwaspura* villages of *Chaksu* block, Jaipur. The soil parameters like pH, EC, WHC, MC, TH, Na, K, P and total N were analysed. The statistical comparison was done using student's t-test and results were found to be significant in all the physico-chemical parameters (except total nitrogen and Na).

Key words: flood, restoration, physico-chemical, characteristics, soil quality

Introduction

Ecosystems suffer considerable degradation and destruction due to both natural as well as anthropogenic causes that ruin biotic as well as abiotic environment. Increasing trend in the frequency of natural events like earthquakes, floods, cyclones, etc, due to increasing population has led to degradation of the ecosystems. Realizing the need, the concept of ecological restoration came up. Ecological restoration aims at rebuilding, initiating or speeding up the recovery of an ecosystem which has been damaged or degraded. It involves bringing back to nearly similar or same position or condition. Such kind of event has been observed in our study area *Chaksu* block of Rajasthan where a number of villages have been restored after the land was hit by flood in 1981 by the action of Dhund River. The flood resulted into the loss of vegetation leaving unproductive land behind. To restore the ecological integrity of the disturbed ecosystem, efforts were made with the aid of forest department and the local natives. In this paper, soils of restored and unrestored areas from both *Chandel kallan* and *Ramniwaspura* were evaluated to identify the success of the restoration programme as well as to analyse the soil quality.

Objectives of the study

- To examine the impact of restoration on the soil quality.
- To analyze the physico-chemical parameters of the restored soils with the unrestored soils of the areas

Study area

Chaksu (also known as Chatsu) was selected for the study which is a tehsil and municipality in the Jaipur district of Rajasthan. Chaksu is located at 26.600˚N 75.950˚E. The restored areas as well as unrestored areas were analyzed for soil physico-chemical characteristics like pH, Electrical Conductivity (EC), Total Hardness (TH),Organic Carbon(OC), Water Holding Capacity(WHC),Moisture Content (MC),Available Phosphorous(P), Available Sodium (Na), Potassium (K) and Total Nitrogen (N).

Site visit

The site was visited to select the village most representative of the restoration work carried out and also the unrestored site where no such work had been undertaken.

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Methodology

Collection of soil samples

Soil samples were collected from restored as well as unrestored sites from both the villages by random sampling. Soil samples were collected at a depth of 0-10cm in polythene bags and were labelled carefully.

Physico-chemical analysis of soil

Soil samples were analyzed for the chemical parameters such as pH, EC, OC, TH, Na, K,P & total N& physical parameters like WHC & MC. Organic carbon was measured by the procedure given by Walkley and Black(1934), exchangeable potassium and sodium by flame photometry method, total hardness by Versenate method, total nitrogen content by the Kjeldahl method(AOAC,1995), phosphorous uptake by Sodium Bicarbonate (Olsen *et al*;1954) method, soil pH and EC measured by Jackson method (1973).Physical parameters WHC and MC were analysed by Oven method.

Statistical Analysis

Each of the analysis was performed in triplicates. The significance of the results were drawn by comparison of restored and unrestored soil samples by using Students one sample t-test at significance level ($p<0.05$, $p<0.1$).

Results and Discussion

The results of physico-chemical properties of the Restored and Unrestored (Control) soil samples are shown in the following tables.

Village	pH*	EC* (mS)	OC* (%)	TH* (ppm)	MC (%)	WHC** (%)	P* (Kg/ha)	Na (mg of Na/g of soil)	K** (mg of K/g of soil)	N_{tot} (%)
CK 1	7.47	0.13	0.886	0.8	3.39	32.07	0.06	5.5	13.9	0.1
CK 2	7.47	0.16	1.02	0.8	3.39	33.01	0.09	11.7	13.4	0.04
CK 3	7.46	0.12	0.886	0.6	3.5	37.38	0.06	5.5	6.8	0.07
CK 4	7.47	0.13	0.886	0.8	3.33	31.01	0.06	5.2	7.7	0.07
CK5	7.47	0.16	1.02	0.8	6.37	37.04	0.09	7.4	4.1	0.07
CK CNT	7.49	0.1	1.22	0.6	2.88	30.7	0.1	5.4	3.6	0.07

Table 1: Showing Physico-chemical characteristics of restored and unrestored soil samples of *Chandel kallan* village of *Chaksu* block, *Jaipur* district. CK= Chandel kallan (Restored site), CK CNT= Chandel kallan Control (Unrestored site)

Village	pH**	EC (mS)	OC* (%)	TH* (ppm)	MC (%)	WHC* (%)	P* (Kg/ha)	Na (mg of Na/g of soil)	K(mg of K/g of soil)	N_{tot} (%)
RNP1	6.36	0.16	0.521	1.0	1.194	272.2	0.14	7.6	0.7	0.04
RNP2	7.82	0.18	0.521	0.8	1.38	267.1	0.15	12.4	0.8	0.04
RNP3	8.06	0.17	0.365	0.8	0.956	267.5	0.12	8.8	1.1	0.04
RNP4	7.53	0.17	0.365	0.6	1.007	272.8	0.24	16.3	0	0.04
RNP5	7.66	0.17	0.313	0.8	1.66	279.7	0.14	102.6	4.8	0.04
RNP CNT	8.24	0.17	0.573	0.6	1.191	233.1	0.05	##	0	0.04

Table 2: Showing Physico-chemical characteristics of restored and unrestored soil samples of *Ramniwaspura* village of *Chaksu* block, *Jaipur* district. RNP=Ramniwaspura (Restored site), RNP CNT=Ramniwaspura Control (Unrestored site), ## = Concentration to high to be evaluated

Here, *, ** significant at $p<0.05$, $p<0.1$ respectively

Soil pH denotes soil's acidity or alkalinity and is the measure of Hydrogen ions (H^+) in the soil solution. Higher the H^+ ion concentration, lower is the pH value and vice-versa (Alvarez *et al*; 1988). The pH range of 6.8 to 8.0 has been recommended optimum for plant's growth (Jain *et al*; 2015; Raman & Sathiyanarayanan, 2009). The pH of *Chandel kallan* soil samples ranged from neutral to mildly alkaline whereas in *Ramniwaspura*, it ranged from slightly acidic to alkaline. The difference between pH values of restored and unrestored soil samples of both the villages were found to be significant and within the optimum range. In maintaining soil's fertility, pH plays a significant role (Patil *et al*; 2014).

Electrical Conductivity/Conductance (EC) is a good sign for the crops as it helps in the absorption of the nutrients (Martin *et al;* 2011). Greater the ion concentration in soil solution; more is the EC (Ashraf *et al*; 2012). EC of the restored soil samples were higher than that of the unrestored soil sample in case of *Chandel kallan* whereas in case of *Ramniwaspura*, the values of restored soil sample were same as compared to unrestored sample. The difference between EC values of the restored and unrestored soil samples was significant in *Chandel kallan* whereas it was non-significant in *Ramniwaspura*. Low value of EC is found to be appropriate for growth of plants indicating higher fertility (Jain *et al;* 2015).Proper amount of pH and EC leads to the maximum availability of the nutrients, reduced accessibility of the toxic elements and increased activity of micro-organisms (Raman & Sathiyanarayanan, 2009).

Soil organic matter or soil organic carbon is one of the significant chemical parameter of soil quality. It affects soil porosity & promotes gas exchange reactions & water relations. It has an important role to play in carbon cycle, nutrient availability & its release, affecting biological & chemical processes (Johnson 1985; Henderson, 1995; Nambiar, 1997). Our results showed that amount of OC in *Chandel kallan and Ramniwaspura* restored soil samples had significant difference and were significantly higher as compared to unrestored soil samples. In our study, growing tree cover in the restored areas supports improved soil OM mainly because of the presence of organic waste residues which are responsible for adding more OM after their decay. Most soils have values between 0.5-1.3 and values higher than 0.60 may cause damage to sensitive plants like onions (Raman & Sathiyanarayanan, 2009). According to Micheni *et al*; 2004 in maintaining soil's physical, chemical and biological properties and the crop productivity and yield, soil OM has a major role to play. Significance of soil OM in soil stabilization has been well established (Tisdall and Oades, 1983; Chaney and Swift, 1984).

Deficiency of potassium in plants leads to non-utilization of nitrogen & water effectively, make the plant susceptible to diseases. Mostly potassium exists as exchangeable cation (Raman & Sathiyanarayanan, 2009). The amount of potassium was found to be significantly higher in case of *Chandel kallan* restored soil samples as compared to unrestored soil samples whereas, in case of *Ramniwaspura*, the values of potassium in restored and unrestored soil samples were not significantly different. Increase in K might be due to soil saturation which resulted in widening of clay minerals, releasing previously fixed K and large storage of fertilizers resulted in dissolution of these within the flood water. This could also be related to increased phosphorus and secondary nutrient Mg on the sediment soils of flooded lands (Kalshetty *et al* (2012). Increased quantity of potassium in the soil leads to high osmotic pressure in the plant, thereby increasing its water absorptive capacity (Joseph, 2005).

Phosphorous acts as a limiting nutrient present in plant nuclei & serves as storage for energy (Jain *et al*; 2014). Its high concentration in the soil leads to good growth of plants (Tautua *et al*;2014). Value of phosphorus was high in restored soil samples of both the villages in comparison to the unrestored soil samples. The amount of phosphorus was found to be significantly high in restored soils as compared to unrestored soils in both the villages. Higher amount of phosphorus is possibly due to higher organic matter content. Soils rich in organic matter deliver organic phosphates to the plants as compared to the soils with low organic content (Miller & Donahne, 2001).High amount of phosphorus is found in soils with minimum leaching effect in comparison to the soils with maximum leaching (Ashraf *et al;*2012).

The most abundant minerals found in soil are Ca and Mg. Magnesium (Mg) together with phosphorus drives plant metabolism & is a major part of chlorophyll (Raman & Sathiyanarayanan, 2009). Sufficient amount of Ca is made available to the plants by properly limed soils with adequate moisture content (Raman &

Sathiyanarayanan, 2009). Values of total hardness (Ca and Mg) were found to be higher with no major difference in restored soil samples of both the villages as compared to unrestored soils. These nutrients are found in small quantity and are termed as secondary nutrients (Iwai, 1961). These nutrients enhance the structure of the soil and in doing so, improve water penetration and supply favourable environment for plant growth and micro-organisms (Jain *et al*;2015).Soils having low Mg amount do not generally cause any kind of problem unless the exchangeable cations are in good balance (Raman & Sathiyanarayanan, 2009).

A good physical condition of soil is reflected by its good water holding capacity (Soffe, 1995). Results revealed that restored soil samples of *Ramniwaspura* and *Chandel kallan* villages had ability to absorb more water than unrestored soil samples.

Sodium is considered as a necessary nutrient for higher plant as it gets involved in regeneration of phosphoenol pyruvate in C4 plants (Ashraf *et al*; 2012). High Na concentration poses a threat on soil permeability (APHA, 1995), its texture and also reduces the soil's water intake (Patil *et al*;2014). The results revealed that there was not much difference in Na values of restored and unrestored soil samples of *Chandel kallan* but in *Ramniwaspura*, value of unrestored soil sample was too high than restored soil samples. There was no significant difference in Na content of *Chandel kallan* and *Ramniwaspura*.

Results for both the villages showed that MC was higher in restored soil samples as compared to unrestored soil samples but were not significant in *Chandel kallan* and *Ramniwaspura.* Nitrogen is needed for plant's growth & is a component of plant protein, nucleic acid & chlorophyll (Jain *et al*; 2014). No major change in values of total nitrogen of restored and unrestored sites of both the villages was found. The results revealed that value of total nitrogen in restored and unrestored soil samples of both the villages were not significant. Reduced levels of nitrogen were also observed by Kalshetty *et al* (2012) on flooding of cultivated areas from river Krishna in Southern India.

Conclusion

In order to verify the effectiveness of the restoration effort taken up by the local natives collaborated with the forest department, the physico-chemical parameters of the restored soil and the unrestored soil of the areas were analyzed and compared. Ossom and Rhykerd, 2007 established that soil chemical properties control growth and development of plant along with the concentration of various mineral nutrients at the offset of cropping season. The findings of our study revealed that there was significant difference between all the physico-chemical parameters (except total nitrogen, Na) of the soils of restored and unrestored areas. The results obtained were in harmony with our view that restoration programme taken up has proved to be beneficial in improving soil's quality. Such projects undertaken by the other government states would help in achieving targeted tree cover in the specified area. This kind of work focused largely on community participation, women empowerment, improved financial and educational status and better living style. By replicating such kind of work elsewhere, rural people could be made to learn how environment building helps them in getting their livelihood, better lifestyle, fuel for consumption and fodder for their animals.

References

- AOAC, 1995. Official methods of analysis. 16th edn. Association of Official Analytical Chemists, Washington, DC
- American Public Health Association (APHA), American Water Works Association and Water Pollution control Federation (1995) .Standard Methods for the examination of Water and Waste Water. 19th Ed.
- Alvarez, S.,Warncke,D.D.(2005). Soil moisture and temperature effects on nitrogen release from organic nitrogen sources. *Soil Sci Soc Am J.***69**:1844-1855.
- Ashraf,M., Bhat,G.A.,Dar, I.Y. and Ali, M.(2012). Physico-Chemical Characteristics of the Grassland Soils of Yusmarg Hill Resort (Kashmir, India).*Ecologia Balkanica.***4(1)**:31-38.
- Chaney, K.and Swift,R.S.(1984) The influence of organic matter on aggregate stability in some British soils .*J.Soil Sci.***35**:223-236.
- Davis, R.D.,Charlton-Smith, C.H.,Stark,J.H.and Campbell, J.A.(1998).Distribution of metals in grassland soils following surface applications of sewage sludge. *Environmental Pollution.***49**:99-115.

- Henderson, G.S.(1995). Soil organic matter: a link between forest management and productivity. ? In: Proceedings of the 8th North American Forest Soils. Soil Science Society of America , Madison, WI, pp.419-435.
- Iwai, I. 1961. Australian Journal Soil Resources, 11: 153.
- Jackson, M. L. (1973). Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi.
- Johnson, D.W.(1985) Forest nutrient cycles as affected by climate, species composition, stand age and intensive harvesting. IEA/ENFOR Report no.1, pp 15
- Joseph,J.(2005) *Environmental analysis: water and soil samples in various selected areas of Calicut District.*University of Calicut.
- Jain, S.A.,Jagtap,M.S.and Patel,K.P.(2014). Physico-Chemical Characterization of farmland Soil used in some villages of Lunawada Taluka.Dist:Mahisagar (Gujarat).*India International Journal of Scientific and Research Publications.* **4(3)**:1-5.
- Jain, S., Middha,R.,Juneja,S.K.and Kaushik,P.(2015).Comparative Physico-Chemical Analysis of Restored and Unrestored Soils of Village Thooni Ram Laxmanpura of Chaksu Block, Jaipur, Rajasthan. *International Journal of Current Research.***7(5)**:15706-15710.
- Kalshetty, B. M., Giraddi, T. P., Sheth, R. C., and Kalashetti, M. B. (2012). "River Krishna Flood Effects on Soil Properties of Cultivated Areas in Bagalkot District, Karnataka State," *Global Journal of Science Frontier Research Chemistry*, 12 (6-B), Version 1.0.
- Miller, R.W. and Donahue,R.L.(2001).Soils in our Environment.7th Ed. Prentice Hall, Inc.Upper Saddle River, New Jersey.
- Maiti S. K. (2003). Analysis of Physical Parameters of Soil (Chapter 10) in book: Handbook of Methods in Environmental Studies: Air, Noise, Soil and Overburden analysis. ABD Publishers, Jaipur, India. 2:142-161.
- Maiti, S. K. 2003. Analysis of Chemical Parameters of Soil (Chapter 11) in book: Handbook of Methods in Environmental Studies: Air, Noise, Soil and Overburden analysis. ABD Publishers, Jaipur, India. 2:162-209.
- Micheni,A.,Kihanda,F.,Irungu,J.(2004) Soil organic matter (SOM): the basis for improved crop production in arid and semi-arid climate of eastern Kenya. Managing nutrient cycles to sustain soil fertility in sub-Saharan Africa.pp.608.
- Martin,C.(2011)Resources, Agriculture Solutions LIC.
- Nambiar, E.K.S.(1997) Sustained productivity of forests as a continuing challenge to soil science .*Soil Sci.Soc Am. J.***60**:1629-1642.
- Olsen, S.R.,C.V.Cole,F.S.Watanbe, and L.A.Dean (1954) Estimation of available phosphorous in soils by extraction with sodium bicarbonate.USDA Circular.939,1-19.Gov.Printing Office Washington,DC.
- Ossom,E.M., and Rhykerd, R.L.(2007) Effects of Corn (*Zea mays* L.) and grain legume associations on soil mineral nutrient concentration, soil temperature, crop yield, land equivalent ratio and gross income in Swaziland.In: Proceedings of the 8th Afr.Crop Sci. Conf, 27-31 Oct,2007, El-Minia, Egypt.
- Patil,S.S.,Gandhe,H.D.and Ghorade,I.B.(2014)Physicochemical Properties of Soil Samples of Ahmednagar Industrial Area.*Environment.***3(4)**:81-82.
- Raman , N. And Sathiyanarayanan, D. (2009) Physico-Chemical Characteristics of Soil AND Influence of Cation Exchange Capacity of Soil In and Around Chennai. *Rasayan J.Chem.***2(40)**:875-885.
- Soffe, R.E. 1995. In: The agricultural Notebook, 19th Edition. Black well Science, Oxford.
- Tisdall, J.M. and Oades, J.M.(1982).Organic matter and water stable aggregates in soils. *J.Soil Sci.***33**:141-163.
- Tautua, A.,Bamidele, M.W.Onigbinde,A.O. and Ere,D.(2014) Assessment of some heavy metals and physicochemical properties in surface soils of municipal open waste dumpsite in Yenagoa, Nigeria.*African Journal of Environmental science and Technology.***8(1)**:41-47.
- Wilson, E.O.(1992) The Diversity of Life.New York:W.W.Norton and Company.Walkley,L.P and Black, J.A. (1934) An examination of the Detjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method.Soil Science,37,29-38.