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Study Of Occupational Intensity In Modern Settlement Of Balganga Valley, District – Tehri Garhwal (Uttarakhand).

ABSTRACT : This study was carried out in the modern settlement of Balganga Valley, District Tehri Garhwal (Uttarakhand), India. The aim of this study was mainly to reconstruct the intensity of occupation in different location of modern settlements through elemental analysis of anthropogenic soil. For this purpose, more than 200 soil samples were collected different village of Balganga Valley. Trace element analysis was conducted using the inductively coupled plasma emission spectrometer (ICP). The chemical analysis revealed the Anthropogenic soil from hearth and cooking areas (HCA), refuse deposition area (RDA) cow dung deposition area (CDA) and toilet are (TLA) are capable for holding rich composition of calcium magnesium, sodium, potassium and phosphorus, which anthropogenic soils from sleeping area (SLA), agricultural area (AGA) and barren land area (BLA) show a lower concentration of these elements, indicating that these soils are less capable for holding access composition of the said elements. On the basis this scientific analysis, we can say that race element analysis or significantly useful in identifying activity rich areas and non-activity areas in the past settlement. At the same time, the estimation of hydrogen ion concentration is also potentially helpful in

archaeological investigation.

INTRODUCTION : A numbers of studies have shown that human and animal activities are responsible for changing the chemical composition of soils (Edit, 1984; Cresser et al; 1993; Farswan and Pharswan, 2011). It has also been observed that human-affected soils are always different from sterile ones, but it depends on the rate of change in the natural content of soil due to the power of retention or fixation of chemical elements and farswan and Pharswan (2007) have fruitfully reported that the chemical content of soil reflect human activities, their functions and intensities. Therefore, burried soils can be considered a palimpsest of evidence for post human occupation.

However, archaeological data indicated that in terms of Indian archaeological and modern occupational soils, such types of analyses have not been systematically carried out. Only few workers have analysed soil samples from few modern and archaeological sites (Farswan et at- 2001, 2007; Pharswand and farswan 2007, 2010). Therefore, this study was carried out to fill up such a lacuna, which is going to be useful for the establishment of base line data for reconstructing the intensity of past occupation.

MATERIALS AND METHODS : In consists of a systematic collection of samples, estimation of hydrogen ion concentration, chemical digestion of samples, trace element analysis and statistical calculations and correlations.

(1) **Collection of Soil samples** : - For this study the soil samples were collected systematically from different locations i.c. hearth and cooking areas (HCAs), refuse deposition areas (RDAs), Cow dung deposition areas (CDAs), toilet areas (TLAs), sleeping area (SLAS), agricultural areas (AGAs), and barren land areas (BLAs) of villages sendul, Gangar, chamiyala, Lata, Budhakedar, Gofal and Aagar respectively. All these villages are located in Balganga Valley, a smaller tributary of rivalry Vilangana a total of 250 soil samples were collected and packed in airtight polythene bags with their respected sample number.

(2) **Determination of Hydrogen Ion Concentration** : - To see the acidic and alkaline nature of soil hydrogen ion concentration (PH) indifferent locations of each village was estimated using a field PH meter before collection of soil samples and after completion of sampling. Before pre-treatment, it was also estimated in the laboratory.

(3) **Pre-treatment of soil samples in the laboratory** : To remove moisteire, all collected samples were dried reparatory in a hot air oven using Petri dishes and crucibles at 100^0 c for at least 12 hours. Over dried samples were grinded mechanically using a hand mortar and passed through 2 mm rivres. In every stage of processing soil samples were marked with their respective sample numbers.

(4) **Chemical Digestion and Trace element Analysis** : After drying 200 mg of each sample were weighed into a polypropylene vial and 20 ml of 1 molar hydrochloric acid was added to each vial. All 250 samples were kept at room temperature (at 26^0c) for two weeks, but these samples were agitated regularly every day for proper dissolution. The resulting solution of each samples was filtered and finally the elemental composition of every sample was measured through inductively coupled plasma emission spectroscopy (ICP).

(5) **Statistical Analysis** : Results obtained from ICP were calculated statistically to get the mean value for each element in different locations of the villages, correlation between concentration of different elements and various locations were also established to see the pattern of activity in different villages.

Result and Discussion : The aim of this study to reconstrut the intensity of occupation in different location of modern settlement through trace element analysis of anthropogenic soil, which were recovered from different villages of Balganga Valley in district Tehri, Uttarakhand. Earlier studies have suggested that the intensity of occupation was calculated using the relative concert ration of organic phosphorus in soil (Proven, 1971, proud foot, 1976 Conway, 1983 Deotare, 1990, Nautiyal et al, 1992 Farswan and Nautiyal, 1997) etc.., but later on specific studies on trace element analysis of anthropogenic soils also revealed that concentration of some other elements i.e., calcium, Magnesium, sodium, potassium, and iron are also useful for calculation the intensity of past occupation (Farswan el al, 2001, 2007)

In this investigation, we have estimated hydrogen ion concentration (PH) indifferent location of modern settlement, which are presented in Table 1. Hydrogen ion concentration is generally estimated to see the nature of soil i.e. acidic and chlorine. PH played an important role for preservation of archaeological artefacts, it is slightly acidic (PH 5.5 – 6.9) and slightly alkaline (7.1.-8.5) anthropogenic sois are favourable for preservation of archaeological artefacts (Deet & and Dethlefren, 1963, Linder Holm and Lundberg, 1994)

Table 1 : Hydrogen ion conceritration (PH) in different location of various settlements Balganga Valley

Location of settlement	Hydrogen ion concentration				
	Sendul	Gangar	Lata	Gofal	Aagar
Hearth and cooking Areas (HCAs)	08.60+ 0.10	08.15 +0.35	08.96 + 0.25	08.75+ 0.90	08.75+ 0.95
Refuse Deposition	06.25+2.0	06.42+0.12	06.23+0.3	06.25+0.25	06.25+0.15

Areas (RDAs)			6		
Cow Dung Deposition Areas (CDAs)	06.50+0.95	06.70+0.30	06.60+0.25	06.90+0.75	06.90+0.75
Toilet Areas (TLAs)	06.75+0.22	06.50+0.50	06.30+0.52	06.40+0.35	06.45+0.50
Sleeping Areas (SLAs)	07.65+0.25	07.70+0.35	07.25+0.25	07.75+0.50	07.40+0.35
Agricultures Areas (AGAs)	07.60+0.40	07.80+0.50	07.70+0.60	07.80+0.25	07.90+0.25
Barren Land Areas (BLAs)	07.70+0.65	07.90+0.20	07.82+0.25	07.75+0.50	07.85+0.35

Table 2 : Concentration of Phosphorus (P) in Different Location of Various settlements of Balganga Valley

Location of settlement	Hydrogen ion concentration				
	Sendul	Gangar	Lata	Gofal	Aagar
Hearth and cooking Areas (HCAs)	4875.85	4850.75	4750.00	4800.00	4750.00
Refuse Deposition Areas (RDAs)	5245.50	5125.00	5320.50	5280.10	5150.10
Cow Dung Deposition Areas (CDAs)	5015.25	4910.10	4850.10	4920.80	5010.35
Toilet Areas (TLAs)	5325.50	5280.50	5150.50	5160.30	5175.50
Sleeping Areas (SLAs)	2825.75	2810.10	2850.00	2825.25	2790.75
Agricultures Areas (AGAs)	2915.10	2885.50	2780.30	2810.50	2910.00
Barren Land Areas (BLAs)	1750.50	1790.00	1770.50	1785.25	1750.25

Table 3 : Concentration of Calcium (Ca) in Different Location of Various settlements of Balganga Valley

Location of settlement	Hydrogen ion concentration				
	Sendul	Gangar	Lata	Gofal	Aagar
Hearth and cooking Areas (HCAs)	54950.20	55390.20	54920.20	54900.95	55850.50

Refuse Deposition Areas (RDAs)	52650.50	53990.50	54115.50	52995.15	54905.25
Cow Dung Deposition Areas (CDAs)	57220.00	58100.00	57100.35	57100.00	56970.50
Toilet Areas (TLAs)	49250.50	48120.20	47950.00	46010.85	48135.25
Sleeping Areas (SLAs)	15110.00	16010.00	14500.10	16115.90	15375.85
Agricultures Areas (AGAs)	22790.25	20995.90	23100.25	22095.65	23150.45
Barren Land Areas (BLAs)	17120.00	16125.25	15990.75	17105.15	15990.95

It is evedent from 1^{H} value estimated from this study (Table 1) that anthropogenic soils from RDA sand and TLAs of every villages were acidic in nature, while in SLAs and BLAs the nature of soil was slightly alkaline in nature. However, hydrogen ion concentration also indicated that the soils of HCAs were alkaline, but it was immoderately acidic in CDAs.

The results obtained from ICP are calculated statistically, and the concentration of different trace elements is presented in Tables 2, 3, 4, 5, 6 and 7. The result presented in Table 2 indicated a higher level of phosphorus in HCAs, RDAs, CDAs and TAs of modern self laments of Balganga Valley, while in AGAs, SLAs and BLAs these values are comparatively deceased. It is also observed that the pattern of phosphorous levels was similar in different locations of every village of Balganga Valley.

A significant increase in the concentration of calcium (ca) has been observed in the soils of HCAs, CDAs, and TAs as compared with BLAs of the settlement (Table 3), while it was normal in SLAs, and AGAs. However, results mentioned in Table 1,5, 6 and 7 also revealed the concentrations of magnesium (mg), Potassium (K), Iron (Fe) and sodium (Na) also show similar pattern in different locations of settlements. ca, mg, fe, Na and K are useful for reconstructing the intensity of occupation and based on trace element analysis, rich occupational intensity locations i.e., HCAs RDAs, CDAs and TAs are significantly identified. These identified locations can be traced out in archaeological sites as well.

Mean while, it is also clear from the estimation of hydrogen ion concentration (Table 1) that in acidic and alkoline soil, i.e. HCAs, RDAs and TAs, concentration of trace elements were increased in a unique manner as compared with a slightly alkaline medium, i.c. AGAs, BlAs and SLAs. However, a moderate concentration of trace elements is recorded in moderately acidic soil, i.c. in CDAs. This shows the potentiality of hydrogen ion concentration in archaeological investigation.

Table 4 : Concentration of Magnesium (mg) in Different Location of Various settlements of Balganga Valley

Location of settlement	Hydrogen ion concentration				
	Sendul	Gangar	Lata	Gofal	Aagar
Hearth and cooking Areas (HCAs)	8290.00	8285.45	8325.00	8310.75	829.45
Refuse Deposition Areas (RDAs)	4610.25	7650.90	7725.25	7810.25	7680.50
Cow Dung Deposition Areas (CDAs)	4590.05	7390.50	7350.45	7500.10	7425.15
Toilet Areas (TLAs)	4450.25	7310.95	7305.10	7185.45	7190.85
Sleeping Areas (SLAs)	1090.87	2210.05	2215.65	2205.05	2200.00
Agricultures Areas (AGAs)	1475.75	3675.88	3775.80	3685.45	3750.15
Barren Land Areas (BLAs)	1585.50	2610.65	2605.05	2615.80	2610.35

Table 5 : Concentration of Potassium (K) in Different Location of Various settlements of Balganga Valley

Location of settlement	Hydrogen ion concentration				
	Sendul	Gangar	Lata	Gofal	Aagar
Hearth and cooking Areas (HCAs)	4790.15	4695.50	4698.75	4790.00	4780.50
Refuse Deposition Areas (RDAs)	4610.10	4495.10	4495.50	4585.75	4575.10
Cow Dung Deposition Areas (CDAs)	4590.05	4635.50	4650.05	4650.15	4625.50
Toilet Areas (TLAs)	4500.45	4450.80	4435.65	4425.85	4480.45
Sleeping Areas (SLAs)	1075.08	1085.45	1095.05	108/5.15	1075.00
Agricultures Areas (AGAs)	1505.05	1485.65	1510.00	1495.50	1502.15
Barren Land Areas (BLAs)	1580.20	1587.90	1590.15	1575.40	1590.56

Table 6 : Concentration of Iron (fe) in Different Location of Various settlements of Balganga Valley

Location of settlement	Hydrogen ion concentration				
	Sendul	Gangar	Lata	Gofal	Aagar
Hearth and cooking Areas (HCAs)	8795.90	8850.15	8965.75	8965.00	8895.45
Refuse Deposition Areas (RDAs)	8125.30	8075.25	8125.10	8050.25	8115.50
Cow Dung Deposition Areas (CDAs)	8050.25	8125.12	8150.15	8120.50	8090.78
Toilet Areas (TLAs)	7810.35	7950.50	7885.90	7910.75	7895.75
Sleeping Areas (SLAs)	2390.10	2315.85	2350.08	2345.25	2375.15
Agricultures Areas (AGAs)	38585.90	3890.10	3910.85	3965.75	3910.40

Table 7 : Concentration of Sodium (Na) in Different Location of Various settlements of Balganga Valley

Location of settlement	Hydrogen ion concentration				
	Sendul	Gangar	Lata	Gofal	Aagar
Hearth and cooking Areas (HCAs)	7085.75	7085.15	7098.00	7095.00	7091.15
Refuse Deposition Areas (RDAs)	6690.25	6595.50	6605.15	6550.15	6610.25
Cow Dung Deposition Areas (CDAs)	6725.15	6690.75	6590.75	6610.25	6710.50
Toilet Areas (TLAs)	6695.50	6733.25	6715.50	6690.75	6680.50
Sleeping Areas (SLAs)	1685.65	1710.50	1720.45	1725.50	1745.15
Agricultures Areas (AGAs)	2310.10	2405.35	2415.15	2435.08	2475.10
Barren Land Areas (BLAs)	1625.50	1650.25	1685.50	1692.15	1667.45

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