CHAPTER IV
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ANALYSIS OF SOIL AND WATER

COLLECTION AND PREPARATION OF SOIL SAMPLES:

Samples of soil were generally collected from virgin land. The surface layer upto 3" was collected separately in most of the cases. Samples were taken upto 2-3' depth. Normally sampling was done with a cylindrical auger, but whenever necessary representative layers of the profiles were sampled after digging a pit of 3' x 2' x 3' (4'). The various portions of a particular depth interval were intimately mixed and about 3 lbs. of the sample was placed in a brown paper bag, which in its turn was kept in a Khakhi calico bag, bearing a number. A record slip was kept in each bag, showing the location of the site and description of various profile features. The approximate distance between two sites was normally one fourth to half a mile. In some places the sites were selected in view of change in vegetation or of distinct profile features met with.

About half the original sample was retained for observation of structure, colour etc. The remaining sample was put in sun-shine for air drying and subsequently ground in an iron mortar, without crushing.
ultimate particles. The ground sample was shifted in sieve with round holes, 2 mm. in diameter and the coarse material again returned to the mortar for further grinding. The process was continued until most of the sample, except stones, gravels and organic residue - ( if any ), was reduced to adequate fineness. The bulk sample was thoroughly mixed. The sample thus prepared was stored in labelled, ground glass stoppered bottle.

COLLECTION OF WATER SAMPLES:

Water samples were collected in thoroughly clean amber coloured bottles, of about 2 lbs. capacity, properly corked, sealed and numbered. A general description of the site, the depth of the source etc., were recorded in a day to day diary. Samples of water were brought to the laboratory and analysed.

ANALYSIS OF THE SAMPLES OF SOIL AND WATER:

(i) Soil Samples:

The following determinations were generally carried out with soil samples, adopting standard procedures:

1. Analysis of a saturation extract of soil for various cations and anions and determination of pH and electrical conductivity.
2. Alkaline Earth Carbonates,
3. Mechanical Analysis,
(ii) Water Samples:

Samples of water were analysed adopting standard procedures. The following determinations were generally carried out:

1. pH,
2. Electrical Conductivity,
3. Dissolved Solids,
4. Sodium,
5. Potassium,
6. Calcium,
7. Magnesium,
8. Chloride,
9. Sulphate,
10. Carbonate - Bicarbonate,

No attempt was made to estimate Boron. ANALAR chemicals were used throughout the work. All measuring apparatus like the burettes, pipettes etc., were calibrated before use.

METHODS OF ANALYSIS:

It would be convenient to discuss the methods of analysis in the following order.

(i) Methods of water analysis;
(ii) Methods of soil analysis.
METHODS OF WATER ANALYSIS

1. **pH determination.**
   
   Ref: (5) pp. 317-323,
   
   (1) p. 102,
   
   (4) pp. 139-145.

   pH was determined using glass electrode, with the Beckmann H₂ model pH meter.

2. **Electrical Conductivity.**
   
   Ref: (5) pp. 311-315,
   
   (9) p. 161.

   The specific conductivity was determined by using a potentiometer (Leeds & Northrup, potentiometer, 7651, U.S.A.), as a conductivity bridge. The temperature variation was noted during and after the conductivity measurement of the sample. The temperature correction was applied according to Table 15, Ref: (1). The specific conductivity was calculated. All the results are represented at 25°.

3. **Dissolved Solids.**
   
   Ref: (1), p. 142.

   A suitable aliquot of filtered sample was evaporated and weighed.

4. **Sodium.**
   
   Ref: (1), p. 144.

   Sodium was estimated gravimetrically as sodium zinc uranyl acetate.
5. **Potassium.**
   Ref: (1), p.145,
   Potassium was estimated gravimetrically as di-potassium sodium cobaltinitrite.

6. **Calcium and Magnesium.**
   Ref: (1) p. 94,
   Calcium and magnesium were estimated volumetrically using standard E.D.T.A. solution.

7. **Chloride.**
   Ref: (5) p.209,
   (3) p.311,
   (11) p.536.
   Chloride was estimated volumetrically using standard silver nitrate solution.

8. **Sulphate.**
   Ref: (3) p.478,
   (1) p.146.
   Sulphate was estimated gravimetrically as BaSO$_4$.

9. **Carbonate-Bicarbonate :**
   Ref: (1) p.145,
   (7) p. 13.
   Carbonate and bicarbonate were estimated volumetrically using standard sulphuric acid solution.

10. **Nitrate.**
    Ref: (1) p.100.
    Nitrate was estimated colorimetrically by Phenol-disulphonic acid method.
METHODS OF SOIL ANALYSIS

1. Preparation and analysis of Saturation Extract.

Ref: (1) pp. 84-88.

Saturation soil paste was prepared according to the criteria suggested by the U.S.D.A. Paste was transferred to a filter funnel. The extract was collected by applying vacuum. Conductivity of the extract was measured as detailed previously. The extract was diluted to a suitable volume. The diluted extract was used for estimation of Na⁺, K⁺, Ca⁺⁺, Mg⁺⁺, Cl⁻, SO₄²⁻, CO₃⁻, HCO₃⁻, and NO₃⁻.

2. Alkaline - Earth Carbonates


Alkaline earth carbonates were estimated volumetrically using standard hydrochloric acid and bromo-thymol blue indicator.


Ref. (1), p.105, (2), p.223,

Organic matter was estimated volumetrically using standard dichromate solution.

4. Mechanical Analysis.

Ref:(12), p.231, pp.241-244, (10), p.5,
Organic matter and CaCO$_3$ were decomposed from 20 g. soil. Coarse Sand was separated by the use of a standard sieve, while silt and clay fractions were determined by the pipette method. Fine sand was determined by the beaker method.

5. **Cation Exchange Capacity.**

Ref: (1) p. 101,

(6) p. 65.

Cation Exchange Capacity was determined by using NaOAc, Ethyl alcohol and NH$_4$OAc solutions.

6. **Exchangeable Cations.**

Ref: (1) pp. 100-102,

(6) p. 89,

(17) p. 73.

Exchangeable Na and K were calculated by subtracting the amounts of Na and K dissolved in the saturation extract (meq./100 g.) from the amounts extracted by the NH$_4$OAc solution. Difference between T.E.C. and exchangeable (Na + K) was considered to give the value of exchangeable (Ca + Mg.).
REFERENCES

1. Diagnosis and Improvement of Saline and Alkali Soils (Agriculture Handbook No. 60), U.S. Dept. of Agriculture, 1953.


