Lecture 7

PHYSICAL CHARACTERISTIC OF SOIL
Physical characteristics of soil:

1. Colour
2. Texture
3. Structure
4. Density, porosity
5. Consistency
6. Soil water
   - Soil temperature
   - Soil aeration
SOIL COLOUR

Importance:

- influence heat absorption.
- indicate drainage status.
• Indicate type of parent material. E.g. soil formed from basalt is dark in colour (Siri Kuantan). Granite result in light coloured soil (Siri Rengam).
• Colour may be used to differentiate the horizons.
Determination of soil colour

Munsell Color Chart

- Hue: relation to RGB scheme
- Value: lightness
- Chroma: strength or intensity

Dry and moist colors
<table>
<thead>
<tr>
<th>MUNSELL COLOUR CHART</th>
<th>HUE 10YR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/1</td>
</tr>
<tr>
<td></td>
<td>/2</td>
</tr>
<tr>
<td></td>
<td>/3</td>
</tr>
<tr>
<td></td>
<td>/4</td>
</tr>
<tr>
<td></td>
<td>/6</td>
</tr>
<tr>
<td></td>
<td>/8</td>
</tr>
</tbody>
</table>

**VALUE (NILAI)**

- 8/
- 7/
- 6/
- 5/
- 4/
- 3/
- 2/

**CHROMA (KROMA)**

| 10YR 5/3 |

**SATU MUKASURAT DARIPADA BUKU CARTA WARNA MUNSELL**

*Jika sesuatu tanah itu mempunyai warna hampir dengan warna ini dalam Carta Warna Munsell, maka ia mempunyai warna berkod Munsell*
Mottles in soils – colour of mottles indicate drainage condition

Fe depletions along soil pores (channels). The pores are approximately 1 cm wide.

Fe masses (roughly 5 cm wide) with diffuse boundaries in an Fe-depleted matrix.

Plates from Richardson and Vepraskis, 2001, Wetland Soils: Genesis, Hydrology, Landscapes and Classification.
• Grey colour indicate poor drainage—presence of ferrous (Fe II)

• Reddish/yellowing colour indicate good drainage—presence of ferrie (III). E.g. Ultisol & Oxisol

• Dark/black colour indicate high content of organic matter or manganese oxide.
SOIL TEXTURE

• Soil separates or particles according to size gipsite, sand, silt and clay.

• Texture influence physical and chemical characteristic of soil.
• **Definition**: Texture in the relative composition of sand, silt and clay (Particle size distribution- 2mm)
  - organic matter, \( \text{CaCO}_3 \), iron oxide, etc is not included.
<table>
<thead>
<tr>
<th>NAMA PUING TANAH</th>
<th>SAIZ (mm)</th>
<th>ISSS$^1$</th>
<th>USDA$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kelikir$^3$</td>
<td>&gt; 2</td>
<td>&gt; 2</td>
<td></td>
</tr>
<tr>
<td>Pasir</td>
<td>2 - 0.02</td>
<td>2 - 0.05</td>
<td></td>
</tr>
<tr>
<td>Kelodak</td>
<td>0.02 - 0.002</td>
<td>0.05 - 0.002</td>
<td></td>
</tr>
<tr>
<td>Lempung</td>
<td>&lt;0.002</td>
<td>&lt;0.002</td>
<td></td>
</tr>
</tbody>
</table>
• Texture of soil – determined according to the textural classes using the Textural Triangle.
Textural Triangle
Importance of soil texture

1. Influence ion adsorption/ desorption (ion exchange).

2. Determines the capacity of the soil to hold nutrients.
Determination of soil texture
Modern approaches use mechanical methods for particles size distribution.
STOKE's LAW
Particles will settle in the water according to Stokes Law:

\[ V = \frac{2}{9}(r_g - r_w) \cdot g \cdot \frac{r^2}{h} \]

where

- \( V \): the settling velocity
- \( r_g \): density of the mineral grain (2.6 - 2.8 g/cm³ for clay minerals)
- \( r_w \): density of water (1 g/cm³)
- \( g \): acceleration due to gravity (980 cm/sec²)
- \( r \): radius of the mineral particle (10-4 cm for clays)
- \( h \): viscosity of water (10-2 g/cm/sec²)
Structure:
Grade, size and type
SOIL STRUCTURE

• Arrangement of the soil particles e.g. sand, silt and clay into stable unit – ‘aggregate or ped’

• Basic unit of aggregates join together – bigger aggregate
Soil Structure - Type

- Granular
  - (Soil aggregates)

- Blocky
  - (Subangular)
  - (Angular)

- Platy

- Prismatic

- Columnar

- Wedge

- Single Grain
  - (Mineral/rock grains)

- Massive
  - (Continuous, unconsolidated mass)
Classification of soil structure

1. Structureless

2. With structure

i. Structureless
   - Loose
   - Massive

ii. With structure
   - Type
   - Size
   - grade
i) Type of structure

- Berlapis (Platy)
- Prisma (Prismatic)
- Kolumnar (Columnar)
- Blok bersegi (angular blocky)
- Blok subsegi (subangular blocky)
- Berbutir (granular)
- Remah (crumb)
<table>
<thead>
<tr>
<th>Size Class</th>
<th>Code</th>
<th>Criteria: structural unit size (mm)</th>
<th>Granular Platy Thickness</th>
<th>Columnar, Prismatic, Wedge</th>
<th>Angular &amp; Subangular Blocky</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Fine (Very Thin)²</td>
<td>vf (vn)</td>
<td>&lt; 1</td>
<td>&lt; 1</td>
<td>&lt; 10</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Fine (Thin)²</td>
<td>f (tn)</td>
<td>1 to &lt; 2</td>
<td>10 to &lt; 20</td>
<td>5 to &lt; 10</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>m</td>
<td>2 to &lt; 5</td>
<td>20 to &lt; 50</td>
<td>10 to &lt; 20</td>
<td></td>
</tr>
<tr>
<td>Coarse (Thick)²</td>
<td>co (tk)</td>
<td>5 to &lt; 10</td>
<td>50 to &lt; 100</td>
<td>20 to &lt; 50</td>
<td></td>
</tr>
<tr>
<td>Very Coarse (Very Thick)²</td>
<td>vc (vk)</td>
<td>≥ 10</td>
<td>100 to &lt; 500</td>
<td>≥ 50</td>
<td></td>
</tr>
<tr>
<td>Extr. Coarse</td>
<td>ec</td>
<td>—</td>
<td>≥ 500</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>
iii) Grade

- A measure of strength – stability of the aggregate

**Soil Structure - Grade**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Code</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structureless</td>
<td>0</td>
<td>No discrete units observable in place or in hand sample.</td>
</tr>
<tr>
<td>Weak</td>
<td>1</td>
<td>Units are barely observable in place or in a hand sample.</td>
</tr>
<tr>
<td>Moderate</td>
<td>2</td>
<td>Units well-formed and evident in place or in a hand sample.</td>
</tr>
<tr>
<td>Strong</td>
<td>3</td>
<td>Units are distinct in place (undisturbed soil), and separate cleanly when disturbed.</td>
</tr>
</tbody>
</table>
Factors influencing formation of aggregates

1. Wetting and drying

2. Freezing and melty

3. Cementing agent – organic matter, clay, iron oxides, Ca and Mg carbonate
4. Plant roots

5. tillage

6. Animal activities
Soil management to improve structure

- liming
- minimum tillage
- addition of organic matter
- mulching
- soil conditioning amendment