Model Answer

MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END EXAMINATION
B.Sc. (Hons) Agriculture

Semester : IV (New)	**Academic Year: 2023-24**
Course No. : SSAC-242	**Title: Problematic Soils and their Management**
Credit : 2(1+1)	**Total Marks: 40**
Day and Date:	**Time:**

NOTE :- 1. Solve ANY EIGHT questions from SECTION "A".
2. All questions from SECTION "B" are compulsory.
3. All questions carry equal marks.
4. Draw neat diagrams wherever necessary.

SECTION'A'

Q.1 Define soil quality and soil health. State the soil quality indicators.

Soil quality: The fitness of a specific kind of soil, to function within its capacity and within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation.

(1 m)

Soil health: The continued capacity of soil to function as a vital living system, within ecosystem and land-use boundaries, to sustain biological productivity, maintain or enhance the quality of air and water, and promote plant, animal and human health.

(1 m)

Soil quality indicators: **(2 m)**

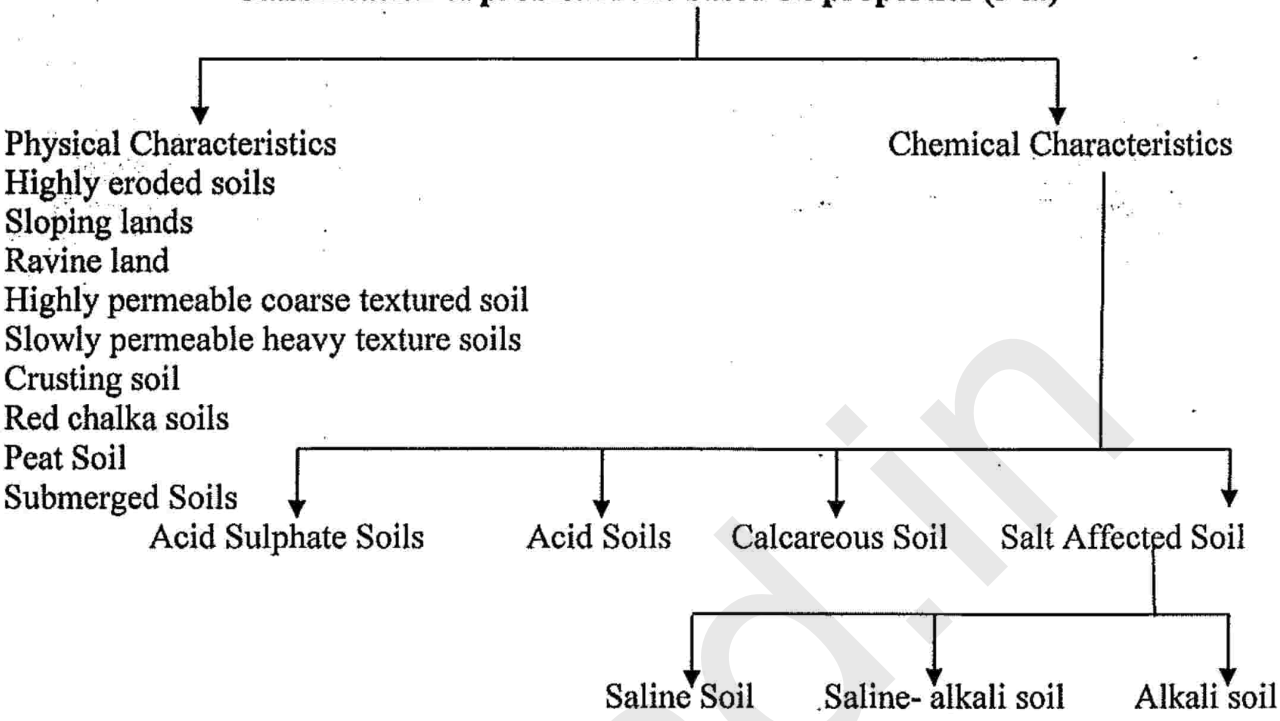
- Chemical indicators: Nutrient Cycling, Water Relations, Buffering
- Physical indicators: Physical Stability and Support, Water Relations, Habitat
- Biological Indicators: Biodiversity, Nutrient Cycling, Filtering

Q.2 What do you mean by problem soil? Write down classification of problem soil based on soil properties.

Problematic Soil: These soils need proper reclamation and management measures for their economical use in crop production. Broadly these soils are grouped in two sets. **(1 m)**

Cont.....

Classification of problem soils based on properties (3 m)



Q.3. Enlist factors for the formation of salt affected soils. How irrigation water is involved in the formation of salt affected soils.

Formation of Saline Alkali Soils

1. Arid and semiarid region.
2. Poor drainage.
3. High water table.
4. Over flow of sea water over land.
5. Introduction of irrigation water.
6. Salts blown by wind.
7. Saline Nature of parent rock material.
8. Excessive use of basic fertilizers.
9. Humid and semi humid region **(2 m).**

Role of irrigation water: Injudicious and excess use of irrigation water, mono-cropping, clay soils, less drainage, intensive cultivation, less use of irrigation water, no irrigation water testing, use of high EC water plays dominant role for the formation of salt affected soils.**(2 m)**

Q.4 Define calcareous soil. Discuss in brief nutrient management in calcareous soils.

Calcareous soil: Soil containing sufficient free $CaCO_3$ and/or $MgCO_3$ to effervesce visibility treated with cold 0.1 N HCl. Scale to know calcareousness.**(1 m)**

Nutrient management in calcareous soils: (3 m)

- Higher $CaCO_3$ with alkaline pH affects directly or indirectly availability of nitrogen (N) phosphorus, magnesium, potassium, manganese, Zinc, iron and copper.
- Use of acid forming fertilizers such as ammonium sulphate and urea decreases soil pH which can enhance availability of nutrients.
- Green manuring, use of organic manures and deep ploughing helps in enhancing soil nutrient availability.

Q.5 Explain methods for reclamation of saline and sodic soil.

Saline Soils (2 m)

A) **Mechanical Methods**

1. Flooding and leaching down of the soluble salts.
2. Scrapping of the surface soil.

B) **Cultural Methods**

1. Providing proper drainage.
2. To use of salt free irrigation water
3. Proper use of irrigation water.
4. Planting or sowing of seed in the furrow.
5. Use of acidic fertilizers.
6. Use of organic manures.
7. Ploughing and levelling of land.
8. Retardation of water evaporation from the soil surface.
9. Growing of salt tolerant crops.

Sodic soil (2 m):

- Use of soluble calcium salts: Gypsum and calcium chloride
- Use of acids or acidic formers: Sulphur, Sulphuric acid, iron sulphates, iron pyrites with equations.

Use of gypsum requirement :

The amount of gypsum required to be added to a sodic soil to lower the ESP to desired value is known as gypsum requirement.

Management practices :

1. Use salt tolerant crops
2. Green manuring and organic manures.
3. Proper crop rotation
4. Use good quality irrigation water

Q.6 What do you mean by submerged and flooded soils? Write down in brief management of submerged soil.

- **Submerged soil** – These soils are referred to soils that are saturated with water for sufficiently long time annually to give the soil the distinctive gley horizons resulting from oxidation – reduction process having high water table. **(1 m)**
- **Flooded soils**
- Flooded soils, now known as Hydric soils, are characteristic of wetlands and irrigated fields cropped to rice (paddy soils). In them, water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year **(1 m)**.

Management of submerged soil (2 m)

1. Levelling of land.
2. Mechanical drainage.
3. Controlled irrigation.
4. Flood control measures.
5. Plantation of trees having high transpiration rate.
6. Check the seepage in the canals and irrigation channels.
7. Selection of crops and their proper varieties.
8. Sowing on bunds or ridges.
9. Nutrient management.

Q.7 Define soil and water pollution. State preventive measures for the control of soil and water pollution.

Soil pollution: soil pollution as part of land degradation is caused by the presence of Xenobiotic (human-made) chemicals or other alteration in

Water pollution: Impairment of water quality from its normal water quality is evaluated by its aesthetic, physical, chemical and biological properties which

the natural soil environment. It is typically caused by industrial activity, agricultural chemicals or improper disposal of waste. **(1 m)**

Preventive measures: (1 m)

i. Municipal waste water treatment.
ii. On site sanitation and safely managed sanitation.
iii. Industrial waste water treatment.
iv. Agricultural waste management treatment.
v. Erosion and sediment control from construction site
vi. Control of urban runoff

get influenced by Agricultural, industrial and anthropogenic use. **(1 m)**

Preventive measures: (1 m)

i. Reducing chemical fertilizer and pesticide use,
ii. Use of bio-fertilizers and manures
iii. Biological methods of pest control
iv. Phytoremediation or bioremediation
v. Use of soil conditioners and amendments

Q.8 Write down management practices for safe use of saline water for irrigation.

Management practices for the safe use of saline water for irrigation:

- Use of saline water on light textured soil
- Use of salt tolerant crops
- Special planting procedures that minimize salt accumulation in the vicinity of the seed;
- Irrigation to maintain a relatively high level of soil moisture
- Achieve periodic leaching of the soil;
- Use of land preparation to increase the uniformity of water distribution and infiltration,
- leaching and removal of salinity;
- Special treatments (such as tillage and additions of chemical amendments, organic matter and growing green manure crops) to maintain soil permeability and tilth.
- The crop grown, the quality of water used for irrigation, the rainfall pattern and climate, and the soil properties determine to a large degree the kind and extent of management practices needed.`

Q.9 Explain in brief land capability classification.

- Land capability classification has been developed in which every acre of land is classified according to its capabilities and limitations.
- There are eight capability classes, which are numbered from I to VIII.
- Those lands, which have the maximum capabilities and the least limitations, are placed in class 1,
- Those lands, which have the maximum limitations and the least capabilities, are placed in class VIII. The Capability classification consists of three categories
- Class I to Class IV encompasses land suitable for cultivation, unit class V to Class VIII includes land unsuitable for cultivation but suitable for permanent vegetation .

Q.10 Write short note. (Any two)

i. **SAR:**

Sodium adsorption ratio SAR $= Na^+ / \sqrt{Ca^{++} + Mg^{++}/2}$

Where Na^+, Ca^{2+} and Mg^{2+} represent the concentrations in mill equivalents per liter

Low SAR: 0-10: Can be used on all soils with little danger of exchangeable sodium.

Medium SAR: 10-18: Suitable for coarse textured soil, but needs care for fine textured soils.

High SAR: 18-26: Produce harmful levels of exchangeable sodium

Very high SAR: >26: Unsuitable for irrigation

ii. **Phytoremediation:**

Phytoremediation is a plant-based approach, which involves the use of plants to extract and remove elemental pollutants or lower their bioavailability in soil. Plants have the abilities to absorb ionic compounds in the soil even at low concentrations through their root system. Phytoremediation is much cheaper than chemical amelioration. Tress can extract pollutants from dipper layer of soil also. Further this technique also helps to improve soil structure also. Neem glyricidia etc.

iii. **Erosion:**

Soil Erosion – The detachment and transportation of soil mass from one place to another through the action of wind, water in motion or by the beating action of rain and biotic factors.

Factors causing Soil Erosion

1. Soil
2. Water
3. Wind
4. Biotic

Effect of Soil erosion

1. Loss of soil to support the growth of plant.
2. Deposition sediments, loads causing reverse to change course.
3. Variable seasonal flow of rivers and flooding.
4. Water pollution/air pollution.

SECTION 'B'

Q.11 Define

1.Amendment: 2.Acid soil 3.Bioremediation 4.Hydric soils

1. **Amendment:**
   Any material organic or inorganic in nature added to soil for improvement in physical, chemical and biological properties which helps in crop growth.
2. **Acid soil:**
   The soil containing higher concentration of H^+ and Al^{3+} in relation to OH^- ions and having pH less than 7
3. **Bioremediation:**
   The use of living organisms, like plants and bacteria to decontaminate affected areas by removing contaminants and toxic substances from soil, water, and other environments.
4. **Hydric soils:**
   Soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part.

Q.12 Do as directed

i. **Lime** is a chemical amendment is used for reclamation of acid soils.

ii. State the rating of high RSC irrigation water. **> 2.5 meq l^{-1}**

iii. Central soil salinity research station is located **Karnal.**

iv. Which soluble salts are present in brown saline soils? **$NaNO_3$**

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