MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE

SEMESTER END EXAMINATION

(MODEL ANSWER PAPER)

B. Sc. Honors (Agri.)

Semester : IV (New) Academic Year : 2022-23
Course No. : SSAC-242 Course Title : Problematic Soils & their Management
Credits : 2 (1+1)
Day & Date : Time : Total Marks: 40

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 degraded soil. Write in short about types of soil degradation.** (4M)

Ans: **Degraded soil:** Soils having unfavorable physicochemical and biological condition that it is unsuitable for agriculture production unless reclaimed.

Types of land degradation: Grouped in six classes 1. Water erosion 2. Wind erosion.3. Soil Fertility decline.4. Salinization 5. Water logging 6. Lowering of the water table.

1. **Water erosion:** Covers all forms of soil erosion by water, including sheet and rill erosion and ravening. Human-induced intensification of land sliding caused by vegetative clearance.
2. **Wind erosion:** Refers to loss of soil by wind, occurring primarily in dry regions.
3. **Soil fertility decline:** Refers to what is more precisely described as deterioration in soil physical, chemical and biological properties.
4. **Water logging:** Refers the lowering in land productivity through the rise in ground water close to the soil surface.
5. **Salinization:** is used in the broad sense, to refer to all types of soil degradation brought about by the increase of salt in the soil.
6. **Lowering of the water table:** It is self-explanatory form of land degradation brought about through tube well pumping of ground water for irrigation exceeding the natural recharge capacity,

Q.2 **Define soil quality. Discuss about different soil quality indicators.** (4M)

Ans: **Soil quality** can be defined as 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.

Ideal indicators should:

1. Correlate well with ecosystem processes.

2. Integrate soil physical, chemical, and biological properties & processes.

3. Be accessible to many users.

4. Be sensitive to management & climate.

5. Be components of existing databases.

6. Be interpretable

There are three main categories of soil indicators: chemical, physical and biological. Typical soil tests only look at chemical indicators. Soil quality attempts to integrate all three types of indicators. The categories do not neatly align with the various soil functions, so integration is necessary. The table below shows the relationship between indicator type and soil function.

Indicator category	Related soil function
Chemical	Nutrient Cycling, Water Relations, Buffering
Physical	Physical Stability and Support, Water Relations, Habitat
Biological	Biodiversity, Nutrient Cycling, Filtering

Organic matter, or more specifically soil carbon, transcends all three indicator categories and has the most widely recognized influence on soil quality. Organic matter is tied to all soil functions. It affects other indicators, such as aggregate stability (physical), nutrient retention and availability (chemical), and nutrient cycling (biological); and is itself an indicator of soil quality.

Q.3 **Define saline soil. Describe the management practices of saline soil.** (4M)

Ans: **Saline soils:** Saline soils have electrical conductivity of saturation extract more than 4 dS m^{-1} at 25^{0}C and exchangeable sodium percentage is less than 15 and the pH is less than 8.5. These soils correspond to Hilgard's (1906) white alkali soils and to solonchak's of the Russian soils scientists. The soluble salts are mainly of Na^+, Ca^{++}, Cl^- and SO_4^{-2}.

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.

Q.4 **Define coastal saline soils. State the problems of coastal saline soil.** (4M)

Ans: **Coastal saline soil:** is the soil which its amount of salinity is high enough to be dangerous for economic crops. Such soil is found in the coastal area where the sea is reached.

Problems existing in coastal saline soils:

1. The lands are subjected to the influence of tidal waves and periodical inundation by tidalwater.
2. Shallow water table enriched with salts contributes to increase in soil salinity during winter and summer months.
3. Heavy rainfall except in some part of Gujarat.
4. Poor surface and subsurface drainage conditions.
5. Lack of good quality irrigation water during dry period in certain areas.

Q.5 **How acid sulphate soils are formed?** (4M)

Ans: **Acid Sulphate Soils** – Soil with sufficient sulphides (FeS_2 and others) to become strongly acidic (pH < 3) when drained and aerated enough for cultivation are termed acid sulphate soils, also called as cat clays.

Types of acid sulphate soils

Potential acid sulphate soils

ASS which have not been oxidized by exposure to air are known as potential acid sulphate soils (PASS). They are neutral in pH (6.5-7.5), contain unoxidised iron sulfides, are usually soft, sticky and saturated with water and are usually gel like muds but can include wet sands and gravels have the potential to produce acid if exposed to oxygen.

Actual acid sulphate soils

When PASS are exposed to oxygen, the iron sulfides are oxidized to produce sulfuric acid and the soil becomes strongly acidic (usually below pH 4.0).These soils are then called actual acid sulphate soils (ASSS).They have a pH of less than 4.0, contain oxidized iron sulfides, vary in texture and often contain jarosite (a yellow mottle produced as a by-product of the oxidation process).

Formation of Acid sulphate soils:

Land inundated with waters that contain sulphates, particularly salt waters, accumulate sulphur compounds, which in poorly aerated soils are bacterially reduced to sulphates. Such soils are not usually very acidic when first drained in water. When the soil is drained and then aerated, the sulphide is oxidized to sulphate by a combination of chemical and bacterial action, forming sulphuric acids. The magnitude of acid development depends on the amount of sulphide present in the soil and the conditions and time of oxidation. If iron pyrite is present, the oxidized iron accentuates the acidity but not as much as aluminium in normal

acid soils because the the iron oxides are less soluble than aluminium oxides and so hydrolyze less.

Q.6 **What are the characteristics of calcareous soil? How calcareous soils affect plant growth?** (4M)

Ans:

Characteristics of Calcareous Soils

1. The clay complex is base saturated and calcium forms the predominant exchangeable base.

2. The soils are highly buffered in presence of water.

3. The soil reaction is slightly to moderately alkaline(pH 7.5 to 8.5)

Effects on plant growth

1. Accumulation of $CaCO_3$ forms hardpan by cementing the soil particles. The hardpan is usually impermeable and is very often cause of water logging.
2. Responsible for physiological disorders - Iron chlorosis can be a problem with some crops on high-pH, calcareous soils. Sorghum and soybeans are more affected by iron chlorosis than corn, wheat, or alfalfa. Marked differences in tolerance of calcareous soils also exist among horticultural crops.
3. Depressing effect on absorption of nutrients

Q.7 **Define soil erosion. Give the factors causing soil erosion.** (4M)

Ans:

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.
5. Air pollution.

Q.8 **Describe the effect of submergence on plant growth.** (4M)

Ans:

Effect of submergence on plant growth:

1) Due to submergence there is an inhibition of gas exchange within the root zone which has a potential to damage the roots and restricts nutrient uptake by the roots. Chlorosis of older leaves is observed due to root development

and slow uptake of nitrogen from anaerobic soil.

2) Due to submergence the exhibit increased stomata resistance as well as limited water uptake leading to internal water deficit .Low levels of O_2 may decrease hydraulic conductivity due to hampered root growth.
3) Oxygen deficiency generally leads to the substantial decrease in net photosynthetic rate which decrease the transpiration and photosynthesis is attributed to stomata closure.
4) In waterlogged plant, the concentration of reactive oxygen species (ROS) increases then normal plant .These ROS induce damage to a number of cellulose molecules and metabolites such as proteins ,lipids pigments and efficiency of PS-I and PS-II.
5) Submerge impede the diffusive escape of gases ethylene or CO_2 which results in accumulation of gases, due to which ethylene slow the roots extension and CO_2 can severely damage the roots of certain species like soybean (not rice).
6) The facultative anaerobes reduce nitrate to nitrite, nitrous oxide and nitrogen gas nitrogen unavailable to plants.
7) Submergence may increase the incidence of soil born fungal disease e.g. Infection on vegetables by Phytopthora (cause wilting) Pythium (damping off).
8) Self-Poisoning-Anaerobic roots may also die due to self-poisoning by products of anaerobic metabolism which acidify the cytoplasm and vacuole e.g. Acetaldehyde in anaerobic condition is converted into ethanol .Nitric oxide formed by action of nitrate reductase .Both ethanol and nitric oxide are poisonous for plant roots.

Q.9 **What is pollution? Write in brief about the kinds of pollutants.** (4m)

Ans: **Soil pollution:** soil pollution as part of land degradation is caused by the presence of man-made chemicals or other alteration in the natural soil environment. It is typically caused by industrial activity, agricultural chemicals or improper disposal of waste.

Kinds of Soil Pollutants

1. Pesticides.
2. Inorganic contaminants mostly heavy metals.
3. Organic wastes – municipal and industrial wastes.

4. Fertilizers and other salts

5. Radionuclides.

Q.10 **What is quality irrigation water? Describe the management practices of soil under saline water irrigation.** (4M)

Ans: **Quality irrigation water:** The suitability of water for irrigation should be evaluated on the basis of criteria indicative of its potential to create soil conditions hazardous to crop growth (or to animals or humans consuming those crops).

Managing soils under saline water irrigation

Tillage - is a mechanical operation that is usually carried out for seedbed preparation, soil permeability improvement, to break up surface crusts and to improve water infiltration. If tillage is improperly executed, it might form a plough layer or bring a salty layer closer to the surface. Sodic soils are especially subject to puddling and crusting; they should be tilled carefully and wet soil conditions avoided. Heavy machinery traffic should also be avoided. More frequent irrigation, especially during the germination and seedling stages, tends to soften surface crusts on sodic soils and encourages better stands.

Deep ploughing - refers to depths of ploughing from about 40 to 150 cm. It is most beneficial on stratified soils having impermeable layers lying between permeable layers. Deep ploughing to 60 cm loosens the aggregates, improves the physical condition of these layers, increases soil-water storage capacity and helps control salt accumulation when using saline water for irrigation. Crop yields can be markedly improved by ploughing to this depth every three or four years. The selection of the right plough types (shape and spacings between shanks), sequence, ploughing depth and moisture content at the time of ploughing should provide good soil tilth and improve soil structure.

Sanding - is used in some cases to make a fine textured surface soil more permeable by mixing sand into it, thus a relatively permanent change in surface soil texture is obtained. When properly done, sanding results in improved root penetration and better air and water permeability which facilitates leaching by saline sodic water and when surface infiltration limits water penetration. The method can be combined with initial deep ploughing.

Chemical Amendments - Gypsum is by far the most common amendment for sodic soil reclamation, particularly when using saline water with a high SAR value for irrigation. Calcium chloride is highly soluble and would be a satisfactory amendment especially when added to irrigation water. **Lime** - is not an effective amendment for improving sodic conditions when used alone but when combined with a large amount of organic manure it hasa beneficial effect.

Sulphur- too can be effective; it is inert until it is oxidized to sulphuric acid by soil micro-organisms. Other sulphur-containing amendments (sulphuric acid, iron sulphate, aluminium sulphate) are similarly effective because of the sulphuric acid originally present or formed upon microbial oxidation or hydrolysis.

Organic and green manures and mulching: Incorporating organic matter into the soil has two principal beneficial effects of soils irrigated with saline water with high SAR and on saline sodic soils: improvement of soil permeability and release of carbon dioxide and certain organic acids during decomposition. This will help in lowering soil pH, releasing

calcium by solubilization of $CaCO_3$ and other minerals, thereby increasing EC_e and replacement of exchangeable Na by Ca and Mg which lowers the ESP.

SECTION B

Q.11 Define following. (4m)

1. **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
2. **Soil pollution:** soil pollution as part of land degradation is caused by the presence of Xenobiotic (human- made) chemicals or other alteration in the natural soil environment.
3. **Phytoremediation-** When higher plants are used for bioremediation the process is called Phytoremediation.
4. **Remote Sensing:** It can be defined as obtaining information about an object by observing it from a distance and without coming into actual contact with it.

Q.12 State True or False (4 m)

1. Deforestation reduces the soil erosion process. **(False)**
2. Saline soil is having pH greater than 8.5. **(False)**
3. Lime is used for reclamation of acidic soil. **(True)**
4. More availability of nutrient is in neutral pH range. **(True)**

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