MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE 05					
SEMESTER -END EXAMINATION					
B.Sc (Hons.)Agri.					
MODEL ANSWER					
Semester	:	IV (New)	**Aca. Year**	:	**2018-2019**
Course No	:	SSAC-242	**Title**	:	**Problematic Soil and their management**
Credits	:	2(1+1)	**Total marks**	:	**40**
Day and Date	:		**Time**	:	**2 hrs**

SECTION "A"

Q.1 Wasteland:

It is general term which includes any type of land, irrespective of its ownership, which is producing less than 20% of its optimum biological productivity. It is also defined as the land which is degraded and is presently lying unutilized except a current fallow due to different constraints.

Culturable Wasteland: Lands which are capable of/ have the potential of development vegetative cover. They include - undulating upland, sloppy land, Shifting cultivation areas, sand dunes ravines lands, Water logged land, salt affected land, degraded forest land and pasture and nonforest plantation land and mining industrial wasteland.

Unculturable wasteland: Lands which cannot develop vegetative cover and include barren rocky areas and stip slopes and snow covered areas.

Q.2 **Soil quality** – The capacity of specific kinds of soil, function 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. Changes in the capacity of soil to function are reflected in soil properties that changes in response to management or climate

Soil Health – Soil Health is defined as the continued capacity of soil to function as a vital living system by recognizing that it contains biological elements that are key to ecosystem function within land use boundaries.

Indicator-

Chemical indicators - Electrical Conductivity, Soil Nitrate, Soil Reaction (pH)

Physical indicators- Aggregate Stability, Available Water Capacity, Bulk Density, Infiltration and Soil Structure.

Biological indicators -Particulate Organic Matter, Potentially Mineralizable Nitrogen, Respiration, Soil Enzymes and Total Organic Carbon.

Q.3 Characteristics of salt affected Soil

Soil Type	pH	Ece(dSm^{-1})	SAR	ESP
Saline Soil	8.5	> 4	< 13	< 15
Saline Alkali Soil	8.5	> 4	> 13	> 15
Alkali Soil	>8.5	< 4	>13	> 15
Degraded Alkali Soil	>8.5	< 4	> 13	> 15

Formation of salt affected Soil

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 maerial
8. Excessive use of basic fertilizers
9. Humid and semi humid region

Q.4 On the basis of the soil survey maps and reports, a 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, whereas those lands, which have the maximum limitations and the least capabilities, are placed in class VIII. The Capability classification consists of three categories

Capability classes– 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 .

Capability subclasses: These are based on kinds of dominant limitation such as wetness or excess water (w), climate (c), soil (s) and erosion (e).

Capability units:- These are further subdivisions of capability subclasses. A capability includes soils which are sufficiently uniform in their characteristics, potential and limitations and required fairly uniform conservation treatment and management practices.

Q.5 **Problematic Soil**: These soils need proper reclamation and management measures for their economical use in crop production.

First set has problem in physical characteristics and includes highly eroded soils, ravine land, soil on steeply sloping lands, highly permeable coarse textured soil, slowly permeable heavy texture soils, crusting soil and red chalka soils

The second set includes all the soils which have problem in their chemical characteristics. Acid, saline, saline-alkali soil and alkali soil constitute this set.

Q.6 **Acid Soils** – A soil having dominance of hydrogen (H^+) and aluminium (Al^{3+}) relative to hydroxyl (OH^-) ions is called as acid soil. Acid Soil is a base unsaturated soil which gives the soil to a pH lower than 7.0

Formation (sources) of acid soils

1. Carbon dioxide
2. Acid forming fertilizers
3. Acid parent material and sulphur
4. Plant roots and Humus
5. Leaching due to heavy rainfall
6. Acid rains
7. Removal of bases by crops
8. Hydroxides

Management of acid Soils

Lime Requirement – is defined as the amount of liming material that must be added to raise the soil pH to some prescribed value.

Influence of liming material on soil properties in relation to plant nutrition

Direct Effect :

1. Toxicity of al and Mn and reduced uptake and Mg
2. Removal of hydrogen ion

Indirect Effect

1. Phosphorous availability
2. Micronutrient availability
3. Nitrification
4. Nitrogen fixation
5. Soil physical condition
6. Diseases
7. Efficiency of fertilizers

Acid Sulphate Soils – Soil with sufficient sulphides (FeS2 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.

Formation of Acid sulphate soils

Management of Acid sulphate soils

Keeping the area flooded , Controlling water table and Liming and leaching.

Q.7 **Calcareous Soil**

Soil containing sufficient free $CaCO_3$ and/or $MgCO_3$ in varying proportion throughout the soil profile.

Effect on plant growth-

1. When it accumulates in the subsoil or in lower profile, it tends to form hardpan by cementing the soil particles. The hardpan is impermeable and is often the cause of water logging.
2. Reduces some plant nutrient because of high Ph and presence of free calcium and magnesium carbonate. It is often responsible for lime induced chlorosis of number of crops.
3. A high level of calcium exerts a depressing effect on absorption or uptake of nutrients like potassium and Magnesium by the plant and thus upsets its balanced nutrition.

Q.8 **Soil Compaction**

Soil compaction is the process in which soil particles are packed together in a closer state of contact indicated by a change in bulk density, porosity etc.

Changes occurred due to soil compaction

1. Compression of soil solids
2. Compression of liquid and gases
3. Changes in liquid and gas contents in the pore space(both macro and micro pore spaces)
4. Re-arrangement of soil solids

Soil Crusting – It is phenomenon associated with deterioration of soil structure, where the natural soil aggregates break and disperse.

Influence of soil crusting on soil productivity

1. Serious barrier for seedling emergence
2. Crust clogs the surface macro pores and inhibits the rate of infiltration of water in the soil causing runoff.

3. Loss of water storage in soil profile and less availability of water to plants
4. Causes interill soil erosion
5. Lack of soil aeration

Control of soil crusting

1. Surface mulch
2. Addition of organic matter
3. Application of soil conditioners i.epolyionic conditioners like HPAN (Hydrolyzed poly acrylonitrile), VAMA (Vinyl acetate maleic acid copolymer)and non soil conditioner like polyvinyl alcohol (PVA).
4. Application of gypsum, pyrite in sodic soil, lowering of exchangeable sodium percentage minimizes crust formation.
5. A light tillage while the soil is still moist break up the crust before it hardens.

Q.9 **Quality parameters of irrigation water**

1) Total concentration of soluble salts (EC)

2) Relative proportion of sodium to other cations (SAR)

3) Concentration of boron or other elements that may be toxic

4) Bicarbonates concentration as related to the concentration of calcium + magnesium.

Classification of Irrigation water

1) **Based on salinity hazard : Four salinity classes.**

Water class	**Electrical conductivity (d S m^{-1})**	**Salt concentration g/l**	**Suitability**
C1 : Low Salinity	01 – 0.250	Less than 0.16	Safe with likelihood of any salinity problem
C2 : Medium salinity	0.25 – 0.75	0.16 – 0.5	Will need moderate leaching
C3 : High salinity	0.75 – 2.25	0.5 – 1.5	Cannot be used on soils with restricted drainage
C4 : Very high salinity	2.25 – 5.00	1.5 – 3.00	Unsuitable under ordinary conditions.

2) **Based on Sodium (Alkali) hazard : SAR (Sodium adsorption ratio)**

SAR $= Na^{+} / (Ca^{++} + Mg) / 2$

Where Na^{+} Ca^{2+} Mg^{2+} represent the concentrations in milliequivalents per litre

Water class	SAR	Suitability
S_1 : Low sodium	0 – 10	Can be used on all soils with little danger of exchangeable sodium.
S_2 : Medium sodium	10 – 18	Produce appreciable hazard in fine textured soils, can be used in coarse textured soils.
S_3 : High sodium	18 – 26	Produce harmful levels of exchangeable sodium
S_4 : Very high sodium	more than 26	Unsuitable for irrigation.

3) **Based on Residual sodium carbonate (RSC)**

RSC $= \{ C0_3^{2-} + HCO_3^{-} \} + \{ Ca^{2+} + Mg^{2+} \}$

Expressed as milli equivalents per litre (me/1)

Water class	Rsc (Meq/1)	Suitability
Low Rsc	Less than 1.25	Safe for irrigation
Medium Rsc	1.25 – 2.50	Marginally safe
High Rsc	More than 2.5	Unsuitable for irrigation

4) **Concentration of Boron :**

Permissible limits of boron in ppm for irrigation water :

Boron class	Sensitive crop	Semi crops	Tolerant crops
1	Less than 0.33	Less than 0.67	Less than 1.00
2	0.33 – 0.67	0 – 1.33	1.00 – 2.00
3	0.67 – 1.00	1 – 2.00	2.00 – 3.00
4	1.00 – 1.25	2 – 2.50	3.00 – 3.75
5	More than 1.25	More than 2.50	More than 3.75

Tolerance of plants to Boron :

Tolerant - Sugarbeet, onion, Turnip, Cabbage, lettice,

Semitolerant - Sunflower, potato, Tomato, Radish, wheat,

Sensitive - Apple, grape, fig, cherry, Apricot, Orange

Q.10 **Bioremediation** is the use of living organisms for the recovery/cleaning up of a contaminated medium (soil, sediment, air, water).. Explain it in detail through MPT.

Multipurpose trees are trees that are deliberately grown and managed for more than one output. They may supply food in the form of fruit, nuts, or leaves that can be used as a vegetable; while at the same time supplying firewood, add nitrogen to the soil, or supply some other combination of multiple outputs. "Multipurpose tree" is a term common to agroforestry, particularly when speaking of tropical agroforestry where the tree owner is a subsistence farmer.

When a multipurpose tree is planted, a number of needs and functions can be fulfilled at once. They may be used as a windbreak, while also supplying a staple food for the owner. They may be used as fencepost in a living fence, while also being the main source of firewood for the owner. They may be intercropped into existing fields, to supply nitrogen to the soil, and at the same time serve as a source of both food and firewood.

Common multipurpose trees of the tropics include:

- *Gliricidia sepium* – the most common tree used for living fences in Central America, firewood, fodder, fixing nitrogen into the soil.
- Moringa *(Moringa oleifera)* – edible leaves, pods and beans, commonly used for animal forage and shade (it does not fix nitrogen as is commonly believed[1])
- Coconut palm – used for food, purified water (juice from inside the coconut), roof thatching, firewood, shade.
- Neem - limited use as insect repellent, antibiotic, adding nitrogen to the soil, windbreaks, biomass production for use as mulch, firewood.

Define the following

SECTION "B"

Q.11 **1. Remote sensing-** Remote Sensing can be defined as obtaining information about an object by observing it from a distance and without coming into actual contact with it.

2. RSC-$\{ C0_3^{2-} + HCO_3 \} + \{ Ca^{2+} + Mg^{2+} \}$, expressed as milli equivalents per litre (me/1).

3. Residual acidity-Aluminium hydroxyl ions, and hydrogen and aluminium ions present in non – exchangeable form with organic matter and clays account for residual acidity.

4. Lime requirement- is defined as the amount of liming material that must be added to raise the soil pH to some prescribed value.

~~5. SAR-~~Ratio for soil extracts and irrigation waters used to express the relative activity of sodium ions in exchange reactions with soil

~~6. 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.

Q.12 **Fill in the blank**

1. Saline Soil is also called ~~as~~ **White alkali soil/ solonachak's**
2. Accumulation of **ammonia** in flooded soils is a good index of the capacity of soil to meet the demand of rice crop.
3. Under submereged condition , mineralization of nitrogen is limited to ammonification stage due to **depletion of oxygen**
4. pH of acid Sulphate soil is **<4**