

**Introduction:**

This course gives the awareness and to understand the student about the waterlogging and salinity problems in Pakistan.

**Course Objectives:**

The course is designed:

1. To provide an adequate knowledge about basic concepts of waterlogging, salinity and types of affected soils
2. To give an insight about principal responses and adaptations mechanisms of plants in response to salinity and waterlogging
3. To give an overview about various reclamation projects and practices to control waterlogging and salinity problems in Pakistan

**Course Detail:**

- 1. Introduction; Land and Water resources of Pakistan.**
- 2. Waterlogging:**
  - 2.1. Causes and effects of the problem
  - 2.2. Affects of waterlogging on soil and plant;
  - 2.3. Quality and characteristics of irrigation water
  - 2.4. Drainage water (characteristics & management).
- 3. Salinity & Sodicty:**
  - 3.1. Saline, sodic, and saline-sodic soils and their characteristics
  - 3.2. Origin of salinity and sodicty
  - 3.3. Extent of salinity and sodicty in Pakistan.
- 4. Response of Salt-Affected Soils:**
  - 4.1. Effect of solution composition on clay swelling and dispersion
  - 4.2. Effects of electrolytes and hydraulic conductivity of sodic soils
  - 4.3. Effect of exchangeable sodium percentage and electrolyte concentration on infiltration rate.
- 5. Plant Response to Salt-Affected Soils:**
  - 5.1. Principal responses of plants to salinity
  - 5.2. Mechanism of responses.
- 6. Reclamation & Management of Salt-Affected and Waterlogged Soils:**
  - 6.1. Mechanical methods (Tube wells, Surface and Sub-surface drainage)
  - 6.2. Chemical approaches (Use of soil amendments such as Gypsum, Sulfur, Farmyard Manure etc.)
  - 6.3. Biological techniques (Use of Biotechnology, Saline Agriculture and Forestry)
  - 6.4. Ecological options (development of Salt-affected and waterlogged areas as Rangelands and Pasturelands etc).
- 7. Measures Taken in Pakistan to Combat Waterlogging and Salinty/Sodicty Hazards:**
  - 7.1. Salinity control and reclamation projects
  - 7.2. Irrigation system rehabilitation programme
  - 7.3. Command water management programme
  - 7.4. On-Farm water management programme
  - 7.5. National drainage programme.

**Practicals:**

1. Sample collection, handling and sub-sampling
2. Determination of some physico-chemical properties of soil and water
3. Determination of calcium, magnesium, sodium, potassium and chloride in plant material by wet digestion method.

**Teaching-learning Strategies**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:**

1. Students will be able to define Saline, Saline sodic and Sodic soils
2. They will be able to describe, apply and integrate the basic concepts of Electrical conductivity, pH, CEC and SAR.
3. This will enable them qualify for basic to moderate level jobs involving knowledge of plants and agriculture.
4. The obtained knowledge shall also enable the students to enter into various entrepreneurial activities.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Recommended Readings:**

1. Abrol, I.P., J.S.P. Yadav and F.I. Masood. Salt-Affected Soils and their Management. Soil Bull. 390, FAO, Rome, Italy.
2. Ayers, R.S. And D.W. Westcot. Water Quality for Agriculture. Irrigation and Drainage Paper No. 29, FAO, Rome, Italy.
3. Ghafoor, A., M. Qadir and G. Murtaza. Salt-Affected Soils: Principles of Management. Allied Book Centre, Urdu Bazar, Lahore.
4. IWASRI-UNDP. Manual of Salinity Research Methods. International Waterlogging and Salinity Research Institute, Lahore.
5. Khan, M.A. And I. A. Ungar (Ed). Biology of Salt Tolerant Plants. Book Crafters. Chelsea, Michigan, USA.
6. Nazir. A. Water Resources of Pakistan. Nazir Sons Pub. Gulberg, Lahore.
7. Tanji. K.K. (Ed). Agricultural Salinity Assessment and Management. ASCE. NY, USA.
8. Pessarakali, M. (Ed). Handbook of Plant and Crop Stress. Marcel-Dekker Inc., NY, USA.
9. Richards L.A. (Ed). Diagnosis and Improvement of Saline and Alkali Soils. USDA Handbook No. 60. US. Printing Office, Washington, DC.
10. Rhoades, J.D., A. Kandiah And A.M. Mashil. The Use of Saline Waters for Crop Production. Irrigation and Drainage Paper No. 48, FAO, Rome, Italy.
11. Scheunian And Watina. Managing Salinization- Institutional Analysis of Public Irrigation Systems. Springer Verlag, Berlin.
12. SSRI. Reclamation and Management of Waterlogged Saline Soils. Soil Salinity Research Institute, Karnal, India.

13. Sumner, M.E. And Naidu. R. Sodic Soils: Distribution, Properties, Management and Environmental Consequences. Oxford University Press.
14. Waisal. Y. Biology of Halophytes. Academic Press, NY, USA.  
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