Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

AGRSS401

BASIC KNOWLEDGE OF SOIL SCIENCE

Apply basic knowledge of soil science

Competence

RQF Level:4

Learning Hours

40

Credits: 4

Sector: Agriculture and food processing

Trade: Agriculture

Module Type: General

Curriculum: TVET Certificate IV in Agriculture

Issue Date: May,2023

<table>
<tr><td>Purpose statement</td><td colspan="5">This module describes the skills, knowledge and attitude required to apply basic knowledge of soil science. It is intended to the learners pursuing TVET Certificate IV in Agriculture. Upon completion of this module the learner will be able to identify Soil Types and Characteristics, conduct basic soil analysis, apply Soil Management Practices and apply Environmental and Safety practices under minimum supervision</td></tr>
<tr><td>Learning assumed to be in place</td><td colspan="5">Applied physics</td></tr>
<tr><td rowspan="6">Delivery modality</td><td colspan="2">Training delivery</td><td>100%</td><td colspan="2">Assessment</td><td>Total 100%</td></tr>
<tr><td colspan="2">Theoretical content</td><td>30%</td><td rowspan="4">Formative assessment</td><td>30%</td><td rowspan="4">50%</td></tr>
<tr><td colspan="2">Practical work:</td><td rowspan="3">70%</td><td rowspan="3">70%</td></tr>
<tr><td>Group project and presentation</td><td>….%</td></tr>
<tr><td>Individual project /Work</td><td>….%</td></tr>
<tr><td colspan="2"></td><td colspan="2">Summative Assessment</td><td>50%</td></tr>
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Elements of Competence and Performance Criteria

Elements of competence	Performance criteria
1. Identify Soil Types and Characteristics	1.1. The key physical properties of soil, such as texture, structure, and color, are described.
	1.2. Different soil types based on their mineral composition such as sandy, loamy, clayey are identified.
	1.3. The relevance of soil pH and its impact on plant growth is explained.
	1.4. Soil horizons and their significance in soil profiling are described.
2. Conduct basic soil analysis	2.1. Soil samples are collected using appropriate sampling techniques.
	2.2. Basic soil tests, including soil moisture content, soil pH, and soil nutrient analysis, are conducted.

	2.3. Soil test results to determine nutrient deficiencies or imbalances are interpreted.
	2.4. Appropriate soil amendments or treatments are recommended based on the test results.
3. Apply Soil Management Practices	3.1. The principles of soil conservation and erosion control are explained.
	3.2. Sustainable soil management practices, including crop rotation and cover cropping, are identified.
	3.3. Knowledge of soil fertility management techniques, such as fertilization and organic matter incorporation, is demonstrated.
4. Apply Environmental and Safety practices	4.1. Environmental regulations and guidelines related to soil management are complied with.
	4.2. Safety procedures when handling soil samples and soil amendments are followed.
	4.3. Soil samples and hazardous materials are disposed of in an environmentally responsible manner.
	4.4. Any environmental or safety incidents related to soil management are reported

Course content

Learning outcomes	At the end of the module the learner will be able to: 1. Identify Soil Types and Characteristics 2. Conduct basic soil analysis 3. Apply Soil Management Practices **4.** Apply Environmental and Safety practices
Learning outcome 1:Identify Soil Types and Characteristics	Learning hours: 7
Indicative content	
• Key Physical Properties of Soil ✓ Soil Texture: - Definition and Classification - Influence on Water Retention and Drainage - Soil Texture Triangle and Textural Analysis	

- ✓ Soil Structure:
- Types of Soil Structure
  - granular,
  - platy,
  - blocky
- Formation and Factors Influencing Structure
- ✓ Soil Color
- Factors Affecting Soil Color
- Indicators of Soil Health and Composition
- Soil Color Charts and Interpretation
- ✓ Sandy Soil
- Characteristics and Properties
- Advantages and Challenges in Agriculture
- ✓ Loamy Soil
- Characteristics and Properties
- Ideal Soil for Plant Growth
- ✓ Clayey Soil
- Characteristics and Properties
- ✓ Soil pH and Its Impact on Plant Growth
- Definition and Measurement of pH
- pH Scale and Ranges (Acidic, Neutral, Alkaline)
- Importance in Nutrient Availability
- ✓ Impact on Plant Growth
- pH Preferences for Different Crops
- Nutrient Uptake and pH Interaction
- pH Modification Techniques
  - lime application

- Soil Horizons and Soil Profiling:
- ✓ Soil Horizons
- Definition and Types (O, A, E, B, C, R)
- Characteristics and Composition of Each Horizon
- Role in Soil Development and Classification
- ✓ Soil Profiling
- Soil Profile Description and Interpretation
- Importance in Land Use Planning and Agriculture
- Soil Profile Observation Techniques

Resources required for the learning outcome	
Equipment	Gloves, Oven or Drying Equipment, Spectrophotometer

Materials	Field Notebook, Reference Charts
Tools	pH meters, moisture meters, soil thermometers, Soil Test Probes, Hand Trowel, Soil Auger, Beakers, test tubes, and pipettes
Facilitation techniques	• Brainstorming, group discussion and oral presentation • Watching of audio visual, simulation •Practical exercise
Formative assessment methods	• Written assessment • Oral question • Performance assessment

Learning outcome 2: Conduct basic soil analysis	**Learning hours: 20**
Indicative content	

- Soil Sampling Techniques
- ✓ Importance of Soil Sampling
- Soil Variability
- Proper Sampling for Accurate Results
- Ensuring Representative Samples
- ✓ Soil Sampling Methods
- Grid Sampling
- Random Sampling
- Depth-Based Sampling
- Equipment and Tools for Sampling
- Basic Soil Tests
- ✓ Soil Moisture Content
- Significance in Irrigation Management
- Methods of Soil Moisture Measurement
- Using Moisture Data for Irrigation Scheduling
- ✓ Soil pH Measurement:
- Importance of pH in Nutrient Availability
- pH Testing Methods (pH meters, soil test kits)
- Interpretation of pH Results
- ✓ Soil Nutrient Analysis:
- Essential Nutrients for Plant Growth (N, P, K, etc.)
- Collecting Soil Samples for Nutrient Analysis
- Laboratory vs. On-Site Testing
- Interpreting Soil Test Results

- ✓ Nutrient Deficiencies and Imbalances
- Reading Soil Test Reports
- Identifying Nutrient Deficiencies and Excesses
- Impact on Plant Health and Productivity
- ✓ Nutrient Recommendations:
- Calculating Fertilizer Requirements
- Formulating Customized Fertilizer Blends
- Organic vs. Inorganic Fertilizers
- Recommending Soil Amendments:
- ✓ Types of Soil Amendments:
- Lime for pH Adjustment
- Organic Matter (Compost, Manure)
- Micronutrient Supplements
- Gypsum for Soil Structure Improvement
- ✓ Application Methods and Timing:
- Spreading Amendments
- Incorporating Amendments into Soil
- Monitoring and Post-Treatment Evaluation

Resources required for the indicative content	
Equipment	Gloves, Oven or Drying Equipment, Spectrophotometer
Materials	Field Notebook, Reference Charts
Tools	pH meters, moisture meters, soil thermometers, Soil Test Probes, Hand Trowel, Soil Auger, Beakers, test tubes, and pipettes
Facilitation techniques	• Brainstorming, group discussion and oral presentation • Watching of audio visual, similation • Practical exercise
Formative assessment methods	• Written assessment • Oral question • Performance assessment

Learning outcome 3: Apply basic Soil Management Practices	Learning hours: 8

Indicative content

- Principles of Soil Conservation and Erosion Control:

✓ Soil Erosion:

- Causes and Consequences of Erosion
- Soil Erosion Types
  - Water,
  - Wind
- Impact on Soil Health and Productivity

✓ Soil Conservation Principles:

- Reduce Soil Disturbance (Minimum Tillage)
- Soil Cover (Crop Residue Management)
- Contour Farming and Terracing
- Windbreaks and Shelterbelts
- Erosion Control Structures
  - Silt Fences,
  - Check Dams

- Sustainable Soil Management Practices

✓ Crop Rotation:

- Benefits of Crop Rotation
- Rotation Patterns and Crop Selection
- Pest and Disease Management

✓ Cover Cropping:

- Purpose and Advantages of Cover Crops
- Selection of Suitable Cover Crops

✓ Reduced or No-Tillage Farming:

- Conservation Tillage Methods
- Equipment and Technology for No-Tillage
- Soil Health Improvement through Reduced Tillage

- Soil Fertility Management Techniques:

✓ Fertilization Practices:

- Types of Fertilizers (Organic, Inorganic)
- Fertilizer Application Methods
  - Broadcast,
  - Banding
- Calculating Nutrient Requirements

✓ Organic Matter Incorporation:

- Benefits of Organic Matter in Soil
- Composting Techniques
- Incorporating Organic Matter
  - Green Manures,
  - Mulching

✓ Nutrient Cycling:

- Recycling Crop Residues
- Crop-Livestock Integration for Nutrient Management
- Nutrient Budgeting and Monitoring

Resources required for the indicative content	
Equipment	Gloves, Oven or Drying Equipment, Spectrophotometer
Materials	Field Notebook, Reference Charts
Tools	pH meters, moisture meters, soil thermometers, Soil Test Probes, Hand Trowel, Soil Auger, Beakers, test tubes, and pipettes
Facilitation techniques	• Brainstorming, group discussion and oral presentation • Watching of audio visual, simulation •Practical exercise
Formative assessment methods	• Written assessment • Oral question • Performance assessment

Learning outcome 4: Apply Environmental and Safety practices	**Learning hours: 5**

Indicative content

- Environmental Regulations and Compliance:
- ✓ Environmental Regulations:
- Overview of Relevant Local and National Regulations
- Environmental Protection Agencies and Authorities
- Soil Management and Land Use Regulations
- ✓ Compliance Requirements:
- Permits and Authorizations for Soil-Related Activities
- Documentation and Record-Keeping
- Reporting Obligations for Environmental Compliance
- Safety Procedures in Soil Management:
- ✓ Personal Protective Equipment (PPE):
- Proper Selection and Use of PPE
- Examples of PPE for Soil Sampling and Handling
- Respiratory Protection in Dusty Environments

- ✓ Safe Handling of Soil Samples:
- Procedures for Collecting and Transporting Samples
- Preventing Cross-Contamination
- Safe Storage and Labeling
- ✓ Safe Handling of Soil Amendments:
- Handling and Application Safety Measures
- Chemical Safety and Hazardous Materials Handling
- Responsible Disposal of Soil Samples and Hazardous Materials:
- ✓ Environmental Responsibility:
- Risks Associated with Inappropriate Disposal
- Environmental Impact of Soil and Chemical Disposal
- Legal and Ethical Considerations
- ✓ Proper Disposal Methods:
- Soil Sample Disposal Guidelines
- Hazardous Waste Disposal Protocols
- Recycling and Reuse Practices
- Incident Reporting:
- ✓ Importance of Incident Reporting:
- Early Detection and Response to Environmental and Safety Issues
- Preventing Escalation of Incidents
- Legal and Organizational Requirements
- ✓ Reporting Procedures:
- Internal Reporting Protocols
- Communicating with Relevant Authorities
- Documentation and Record-Keeping

Resources required for the indicative content	
Equipment	Gloves, Oven or Drying Equipment, Spectrophotometer
Materials	Field Notebook, Reference Charts
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Facilitation techniques	• Brainstorming, group discussion and oral presentation • Watching of audio visual, similation • Practical exercise
Formative assessment methods	• Written assessment • Oral question

	• Performance assessment

Reference:

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