PESTICIDES AND FERTILIZERS TECHNIQUE

SKILLS DEVELOPMENT PROJECT

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PREFACE

Pesticide and Fertilizer Technology plays a vital role in modern agriculture by improving crop production, protecting plants from pests and diseases, and maintaining soil fertility. With increasing pressure on farmers to produce more food in a sustainable way, the correct use of agrochemicals has become essential for ensuring food security, crop quality, and environmental safety.

This Trainer's Guide has been developed to support trainers, instructors, and field facilitators in delivering practical, skill-based learning on pesticides and fertilizers. The guide focuses on the diverse farming conditions of Khyber Pakhtunkhwa (KPK) and aims to help trainees understand both the scientific principles and practical applications of agrochemicals.

The material includes easy-to-understand theory, demonstrations, and hands-on activities that build real-world competency. A participatory approach has been used so that trainees can link classroom concepts with on-ground agricultural practices. This helps learners confidently apply fertilizers and pesticides in a safe, effective, and environmentally responsible manner.

Module 1: Introduction to Pesticides and Fertilizers

Module Duration:

- **Theory:** 2 Hours
- **Practical:** 5 Hours

1.1 Module Objectives

After completing this module, trainees will be able to:

1. Explain what pesticides and fertilizers are in simple and clear words.
2. Identify different types of pesticides and fertilizers used in Pakistan, especially KPK.
3. Understand why crops need pesticides and fertilizers.
4. Use pesticides safely — how to handle, mix, store, and spray properly.
5. Avoid common farmer mistakes that reduce yield or cause health problems.

1.2 Learning Units (LUs)

Learning Unit	Description	Key Learning Outcomes
LU 1: What Are Pesticides & Fertilizers?	Basic definitions and importance in agriculture	Trainees understand meaning & use
LU 2: Types of Fertilizers	Organic & inorganic fertilizers with examples	Identify major fertilizers used in Pakistan
LU 3: Types of Pesticides	Herbicides, insecticides & fungicides	Know purpose of each pesticide type
LU 4: Safe Use & Handling	PPE, storage, dosages, spray timings	Apply pesticides safely
LU 5: Environmental & Health Impacts	Effects of misuse	Adopt responsible practices

1.2.1 Understanding Pesticides and Fertilizers

A. What is Pesticides?

Pesticides are chemicals used to kill or control things that harm crops, such as:

- Insects (aphids, caterpillars)
- Weeds (unwanted plants)
- Diseases (fungus, blight, rust)
- Rodents (rats, mice)

Why we use pesticides:

- Protect crops from damage
- Increase yield
- Reduce losses
- Improve crop quality

B. What is Fertilizers?

Fertilizers give nutrients to plants so they grow better.

Nutrient	Role in Plant
Nitrogen (N)	Makes leaves green & big
Phosphorus (P)	Helps roots and flowering
Potassium (K)	Improves fruiting & disease resistance

1.2.2 Types of Fertilizers

A. Organic Fertilizers (Natural)

Examples:

- FYM (Farmyard manure)
- Compost
- Poultry manure
- Bone meal
- Neem cake

Benefits:

- Improve soil health
- Safe for environment
- Better water-holding capacity
- Improve soil structure

B. Inorganic / Chemical Fertilizers

Name	Nutrient	Use
Urea	Nitrogen	Boost leaf growth
DAP	Phosphorus + Nitrogen	Roots & flowering
SSP	Phosphorus	Long-term soil improvement
SOP / MOP	Potassium	Fruit size & quality
CAN	Nitrogen	Safe for vegetables

1.2.3 Types of Pesticides

Type	Controls	Examples (Pakistan / KPK)
Insecticides	Insects	Confidor, Karate
Fungicides	Fungal diseases	Ridomil, Mancozeb
Herbicides	Weeds	Glyphosate, Sencor
Rodenticides	Rats & mice	Zinc phosphide

1.2.4 Safe Use, Handling & Storage

A. PPE (Personal Protective Equipment)

Before mixing or spraying:

✔ Gloves
✔ Mask
✔ Cap/hat
✔ Goggles
✔ Long sleeves & shoes

B. Safe Mixing & Spraying Rules

- Always read the label
- Use correct dose
- Mix chemicals in open air
- Spray morning or evening
- Avoid wind or high heat
- Keep children and animals away

C. Safe Storage

- Keep pesticides in original bottles
- Store in locked cupboard
- Keep away from food & animals
- Never reuse pesticide bottles

1.2.5 Environmental & Health Impacts

Environmental Impacts (Misuse)

- Water pollution
- Killing useful insects (bees, ladybirds)
- Soil damage
- Air pollution

Health Problems

- Skin burns
- Breathing difficulty
- Eye irritation
- Poisoning, nausea, headache

Always wash hands, face, clothes after spraying.

1.3 Practical Units (PUs)

PU Code	Activity	Expected Output
PU 1.3.1	Identify local fertilizers & pesticides	Recognition chart
PU 1.3.2	Demonstrate PPE use	Proper safety gear worn
PU 1.3.3	Prepare spray mixture	Safe & accurate mixing
PU 1.3.4	Safe storage demonstration	Organized storage example
PU 1.3.5	Field visit to observe spraying	Field report

1.4 Assessment Criteria

Domain	Indicators	Method
Knowledge	Defines pesticides/fertilizers	Quiz / oral test
Skills	Uses PPE, prepares spray mixture	Demonstration
Attitude	Follows safety & hygiene rules	Trainer observation

Module 2: Chemistry and Classification of Agrochemicals

Module Duration:

- **Theory:** 2 Hours
- **Practical:** 5 Hours

2.1 Module Objectives

After completing this module, trainees will be able to:

1. Understand the chemical composition of fertilizers and pesticides.
2. Learn the basic chemical reactions relevant to agrochemicals.
3. Classify fertilizers and pesticides based on chemical structure and function.
4. Understand how agrochemicals degrade in the environment.
5. Apply knowledge to safe and effective use of chemicals in the field.

2.2 Learning Units (LUs)

Learning Unit	Description	Key Learning Outcomes
LU 1: Chemical Composition & Basic Reactions	Chemical makeup of fertilizers and pesticides, simple reactions	Trainees understand chemical properties & reactions
LU 2: Classification Based on Structure & Function	How chemicals are grouped by type, nutrient, or target pest	Trainees classify fertilizers and pesticides correctly
LU 3: Environmental Fate & Degradation	How chemicals break down in soil, water, and plants	Trainees understand persistence, leaching, and degradation

2.2.1 Chemical Composition & Basic Reactions

- Fertilizers contain elements like **N, P, K, Ca, Mg, S**.
- Pesticides include **organic molecules, salts, and formulations**.
- **Simple reactions:**
  - Nitrogen fertilizers react with water to form ammonia or nitrate.
  - Some pesticides degrade under sunlight (photodegradation).
- Trainees should understand **solubility, pH, and reaction safety**.

2.2.2 Classification Based on Chemical Structure & Function

A. Fertilizers

1. **Nitrogen fertilizers:** Urea, CAN
2. **Phosphorus fertilizers:** DAP, SSP
3. **Potassium fertilizers:** MOP, SOP
4. **Secondary & micronutrients:** Gypsum, Zinc sulfate

B. Pesticides

1. **Insecticides:** Organophosphates, pyrethroids
2. **Fungicides:** Mancozeb, Ridomil
3. **Herbicides:** Glyphosate, Sencor
4. **Rodenticides:** Zinc phosphide

Key: Classification helps choose the right chemical for crops and pests.

2.2.3 Environmental Fate & Degradation

- **Leaching:** Fertilizers can move into groundwater.
- **Volatilization:** Nitrogen fertilizers may release ammonia gas.
- **Biodegradation:** Microbes break down some pesticides naturally.
- **Photodegradation:** Sunlight can degrade certain chemicals.
- **Persistence:** Some chemicals stay long in soil and affect environment.

Goal: Trainees learn to select chemicals that are effective but minimize environmental risk.

2.3 Practical Units (PUs)

PU Code	Activity	Expected Output
PU 2.3.1	Identify chemical composition of fertilizers	Chart with N, P, K values
PU 2.3.2	Observe simple chemical reactions	Demonstration results
PU 2.3.3	Classify fertilizers & pesticides	Correct classification chart
PU 2.3.4	Observe environmental degradation	Field / lab observation report
PU 2.3.5	Discussion on safe selection & use	Trainee presentation

2.4 Assessment Criteria

Domain	Indicators	Method
Knowledge	Understand chemical composition & classification	Quiz / oral test
Skills	Classify chemicals, observe reactions	Demonstration / lab
Attitude	Follow safety & environmental precautions	Trainer observation

Module 3: Formulation and Manufacturing Techniques

Module Duration:

- **Theory:** 2 Hours
- **Practical:** 5 Hours

3.1 Module Objectives

After completing this module, trainees will be able to:

1. Identify raw materials used in fertilizers and pesticides.
2. Understand different formulation processes.
3. Learn about equipment and technology used in manufacturing.
4. Understand packaging, labeling, and storage standards.
5. Apply knowledge for safe handling of agrochemicals in production and field use.

3.2 Learning Units (LUs)

Learning Unit	Description	Key Learning Outcomes
LU 1: Raw Materials & Formulation Processes	Sources of chemicals and steps to make fertilizers/pesticides	Trainees understand how agrochemicals are made
LU 2: Equipment & Technology	Tools, machines, and modern production techniques	Trainees can identify equipment and its use
LU 3: Packaging, Labeling & Storage	How products are packed, labeled, and stored safely	Trainees follow proper packaging & storage guidelines

3.2.1 Raw Materials & Formulation Processes

- **Fertilizer raw materials:** Urea, DAP, MOP, phosphoric acid, potash, micronutrients
- **Pesticide raw materials:** Active ingredient (AI), solvents, emulsifiers
- **Formulation types:**
  - **Solid:** Granules, powders
  - **Liquid:** Emulsifiable concentrates, solutions
  - **Suspension concentrates (SC)**

Goal: Trainees understand the process from raw material to finished product.

3.2.2 Equipment & Technology

- **Mixers & blenders** for powders & granules
- **Spray dryers & coating machines**
- **Quality control instruments**: pH meters, moisture analyzers
- **Modern technology:** Automated filling, labeling, and packaging lines

3.2.3 Packaging, Labeling & Storage

- **Packaging:** Bags, bottles, drums depending on formulation
- **Labeling must include:**
  - Product name and type
  - Active ingredient (AI) concentration
  - Safety instructions and expiry date
- **Storage guidelines:**
  - Dry, ventilated, away from sunlight
  - Separate fertilizers and pesticides
  - Locked storage, out of reach of children

3.3 Practical Units (PUs)

PU Code	Activity	Expected Output
PU 3.3.1	Identify raw materials in lab/store	List of raw materials with properties
PU 3.3.2	Observe formulation process	Demonstration record
PU 3.3.3	Identify and operate basic equipment	Correct usage and safety checklist
PU 3.3.4	Practice labeling and packaging	Properly labeled sample
PU 3.3.5	Demonstrate correct storage	Organized storage example

3.4 Assessment Criteria

Domain	Indicators	Method
Knowledge	Raw materials, formulations, equipment, packaging	Quiz / oral test
Skills	Identify materials, equipment use, label correctly	Demonstration
Attitude	Follow safety and handling standards	Trainer observation

Module 4: Application Methods and Safety Procedures

Module Duration:

- **Theory:** 1 Hours
- **Practical:** 5 Hours

4.1 Module Objectives

After completing this module, trainees will be able to:

1. Understand different methods to apply fertilizers and pesticides effectively.
2. Learn how to operate application equipment safely.
3. Identify and use proper Personal Protective Equipment (PPE).
4. Follow safe handling, storage, and first-aid procedures.
5. Minimize environmental and health risks during application.

4.2 Learning Units (LUs)

Learning Unit	Description	Key Learning Outcomes
LU 1: Application Methods & Equipment	Different spraying, broadcasting, and fertigation methods	Trainees can choose the right method and equipment
LU 2: Safety Measures & PPE	Protective clothing and gear for safe use	Trainees properly wear PPE during application
LU 3: Handling, Storage & First-Aid Practices	Safe chemical handling, storage, and emergency response	Trainees handle chemicals safely and know first-aid steps

4.2.1 Application Methods & Equipment

- **Fertilizer application:**
  - Broadcasting, band placement, fertigation, foliar spraying
- **Pesticide application:**
  - Knapsack sprayers, motorized sprayers, boom sprayers
- **Key tips:**
  - Calibrate equipment before use
  - Apply at correct rate and timing

4.2.2 Safety Measures & Personal Protective Equipment (PPE)

- **Mandatory PPE:**
  - Gloves, mask, goggles, cap/hat, long sleeves, boots
- **Additional measures:**
  - Avoid eating/drinking during spraying
  - Wash hands and face after work
  - Do not spray near water bodies or windy areas

4.2.3 Handling, Storage & First-Aid Practices

- **Handling:**
  - Read labels and follow instructions
  - Do not mix incompatible chemicals
- **Storage:**
  - Keep in original containers
  - Store in locked, ventilated area away from children and food
- **First-aid:**
  - Skin contact: Wash with soap and water
  - Eye contact: Rinse with clean water for 15 minutes
  - Ingestion: Do not induce vomiting; seek medical help immediately

4.3 Practical Units (PUs)

PU Code	Activity	Expected Output
PU 4.3.1	Demonstrate different application methods	Correct application procedure
PU 4.3.2	Use PPE correctly	All trainees wearing proper safety gear
PU 4.3.3	Calibrate sprayers	Accurate dose applied
PU 4.3.4	Safe chemical handling demonstration	Safe handling checklist followed
PU 4.3.5	First-aid practice	Correct response to simulated exposure

4.4 Assessment Criteria

Domain	Indicators	Method
Knowledge	Correct application methods, PPE, safety rules	Quiz / oral test
Skills	Apply chemicals using safe methods, wear PPE	Demonstration
Attitude	Follow safety protocols, report accidents	Trainer observation

Module 5: Environmental and Health Impacts of Agrochemicals

Module Duration:

- **Theory:** 1 Hours
- **Practical:** 5 Hours

5.1 Module Objectives

After completing this module, trainees will be able to:

1. Understand how fertilizers and pesticides affect the environment.
2. Recognize health risks associated with agrochemical misuse.
3. Learn sustainable management practices to reduce harm.
4. Apply responsible chemical use to protect soil, water, and biodiversity.
5. Promote safe habits among farmers to prevent accidents and illness.

5.2 Learning Units (LUs)

Learning Unit	Description	Key Learning Outcomes
LU 1: Environmental Impacts of Agrochemicals	Pollution, soil degradation, water contamination	Trainees can identify environmental hazards
LU 2: Health Impacts of Agrochemicals	Effects of exposure on humans	Trainees recognize health risks and symptoms
LU 3: Safe Management & Sustainable Practices	Responsible use, alternatives, biofertilizers	Trainees adopt eco-friendly practices

5.2.1 Environmental Impacts of Agrochemicals

- **Soil:**
  - Excess chemicals alter pH, reduce fertility, and harm beneficial microbes
- **Water:**
  - Runoff pollutes rivers, ponds, and groundwater
- **Air:**
  - Spraying can cause drift, volatilization, and local air contamination
- **Biodiversity:**
  - Kills pollinators and beneficial insects
  - Affects birds, fish, and other wildlife

5.2.2 Health Impacts of Agrochemicals

- **Acute exposure:**
  - Skin irritation, eye burns, nausea, headache
- **Chronic exposure:**
  - Respiratory problems, liver/kidney damage, neurological disorders

- **High-risk groups:**
    - Farmers, pesticide mixers, sprayers, and children near fields

5.2.3 Safe Management & Sustainable Practices

- Use correct doses and avoid over-application
- Employ integrated pest management (IPM) and biofertilizers
- Rotate crops and reduce chemical dependency
- Store chemicals safely and avoid contamination of food and water
- Educate farmers and communities on safety and environmental protection

5.3 Practical Units (PUs)

PU Code	Activity	Expected Output
PU 5.3.1	Identify potential environmental hazards in fields	Observation report
PU 5.3.2	Demonstrate safe chemical use	Checklist followed
PU 5.3.3	Simulate exposure scenario and first-aid	Correct response recorded
PU 5.3.4	Introduce sustainable alternatives (biofertilizers/biopesticides)	Practical demonstration
PU 5.3.5	Field visit to observe chemical impacts	Field observation report

5.4 Assessment Criteria

Domain	Indicators	Method
Knowledge	Environmental and health effects, sustainable practices	Quiz / oral test
Skills	Safe chemical use, emergency response	Demonstration
Attitude	Responsible and sustainable behavior	Trainer observation

Module 6: Quality Control and Testing of Pesticides and Fertilizers

Module Duration:

- **Theory:** 2 Hours
- **Practical:** 5 Hours

6.1 Module Objectives

After completing this module, trainees will be able to:

1. Understand the principles of quality control (QC) in fertilizers and pesticides.
2. Learn standard laboratory testing and analysis procedures.
3. Ensure compliance with national and international standards.
4. Identify substandard or adulterated agrochemicals.
5. Apply QC measures to improve crop safety and productivity.

6.2 Learning Units (LUs)

Learning Unit	Description	Key Learning Outcomes
LU 1: Principles & Procedures of Quality Control	QC concepts, sampling, and inspection	Trainees understand QC objectives and procedures
LU 2: Laboratory Testing & Analysis Methods	Chemical, physical, and biological testing	Trainees can conduct basic lab tests and interpret results
LU 3: Compliance with National & International Standards	Fertilizer and pesticide regulations	Trainees can check product compliance and safety

6.2.1 Principles & Procedures of Quality Control

- **Key aspects:**
  - Sampling techniques: random, composite
  - Inspection of raw materials and finished products
  - Documentation and record-keeping
- **Goals:**
  - Ensure product efficacy
  - Protect human health and environment
  - Reduce crop losses due to poor-quality products

6.2.2 Laboratory Testing & Analysis Methods

- **Fertilizers:**
  - Nutrient content (NPK analysis)
  - Moisture content, pH, and solubility

- **Pesticides:**
  - Active ingredient concentration
  - Toxicity and degradation analysis
- **Tools & Equipment:**
  - Spectrophotometers, titration kits, chromatography
- **Interpretation:** Compare results with labeled claims and standards

6.2.3 Compliance with National & International Standards

- **Pakistan Standards:**
  - PSQCA guidelines for fertilizers and pesticides
- **International standards:**
  - FAO, WHO, Codex Alimentarius
- **Implementation:**
  - Label accuracy, storage conditions, and expiry dates
  - Reporting and corrective actions for non-compliance

6.3 Practical Units (PUs)

PU Code	Activity	Expected Output
PU 6.3.1	Inspect fertilizer and pesticide samples	Correctly documented inspection
PU 6.3.2	Conduct basic lab tests for NPK and active ingredients	Accurate lab results
PU 6.3.3	Compare product results with label claims	Identify compliant/non-compliant products
PU 6.3.4	Demonstrate proper storage and labeling	Organized and safe storage setup
PU 6.3.5	Prepare QC report	Complete and accurate report

6.4 Assessment Criteria

Domain	Indicators	Method
Knowledge	Understand QC principles, lab tests, standards	Quiz / oral test
Skills	Conduct tests, identify substandard products	Demonstration
Attitude	Maintain accuracy, safety, and compliance	Trainer observation

Module 7: Integrated Pest and Nutrient Management (IPNM)

Module Duration:

- **Theory:** 1 Hours
- **Practical:** 5 Hours

7.1 Module Objectives

After completing this module, trainees will be able to:

1. Understand the principles of Integrated Pest Management (IPM) and Integrated Nutrient Management (INM).
2. Recognize the role of biofertilizers and biopesticides in sustainable agriculture.
3. Apply strategies that reduce chemical use while maintaining crop productivity.
4. Monitor pest and nutrient levels effectively.
5. Promote environmentally responsible and cost-effective farming practices.

7.2 Learning Units (LUs)

Learning Unit	Description	Key Learning Outcomes
LU 1: Concepts & Principles of IPM & INM	Overview of integrated approaches to manage pests and nutrients	Trainees understand IPM & INM concepts and benefits
LU 2: Role of Biofertilizers & Biopesticides	Use of microbial fertilizers and eco-friendly pest controls	Trainees can identify and apply bio-products effectively
LU 3: Sustainable Strategies for Pest & Nutrient Management	Crop rotation, monitoring, reduced chemical input	Trainees can design sustainable management plans

7.2.1 Concepts & Principles of IPM & INM

- **IPM Principles:**
  - Monitor pest populations
  - Use biological control agents (e.g., predators, parasitoids)
  - Apply chemicals only when necessary
- **INM Principles:**
  - Combine organic and inorganic fertilizers
  - Balance nutrient supply with crop requirements
  - Improve soil fertility and reduce nutrient losses

7.2.2 Role of Biofertilizers & Biopesticides

- **Biofertilizers:**
  - Nitrogen-fixing bacteria, phosphate-solubilizing microbes
  - Enhance soil health and reduce chemical fertilizer dependency
- **Biopesticides:**
  - Microbial agents (Bacillus thuringiensis)
  - Botanical extracts (Neem, Pyrethrum)
  - Safe, eco-friendly, and target-specific

7.2.3 Sustainable Strategies for Pest & Nutrient Management

- Crop rotation and intercropping to break pest cycles
- Timely application of fertilizers and organic amendments
- Monitoring soil nutrient levels and pest populations
- Minimize environmental contamination and chemical residues

7.3 Practical Units (PUs)

PU Code	Activity	Expected Output
PU 7.3.1	Identify biofertilizers and biopesticides	Correct identification chart
PU 7.3.2	Demonstrate proper use of bio-products	Safe and effective application
PU 7.3.3	Monitor pest populations and crop nutrient levels	Observation and record report
PU 7.3.4	Plan crop rotation and nutrient management	Practical field plan
PU 7.3.5	Evaluate effectiveness of IPNM strategy	Field evaluation report

7.4 Assessment Criteria

Domain	Indicators	Method
Knowledge	Understand IPM, INM, and sustainable practices	Quiz / oral test
Skills	Apply biofertilizers, monitor pests, manage nutrients	Demonstration
Attitude	Promote eco-friendly and responsible farming	Trainer observation

KP-RETP – Component 2: Classroom SECAP Evaluation Checklist

Purpose:

To ensure that classroom-based skills and entrepreneurship trainings under KP-RETP are conducted in an environmentally safe, socially

inclusive, and climate-resilient manner, in line with the Social, Environmental, and Climate Assessment Procedures (SECAP).

Evaluator: _____

Training Centre / Location: _____

Trainer: _____

Date: _____

Category	Evaluation Points	Status		Remarks /Recommendation
		Yes	NO	
Social Safeguards	Is the training inclusive (equal access for women, youth, and vulnerable groups)?			
	Does the classroom environment ensure safety and dignity for all participants (no harassment, discrimination, or child Labor)?			
	Are Gender considerations integrated into examples, discussions, and materials?			
	Is the Grievance Redress Mechanism (GRM) process, along with the relevant contact number, clearly			

	displayed in the classroom			
	Are the Facilities and activities being accessible and inclusive for specially-abled (persons with disabilities)			
Environmental Safeguards	Is the classroom clean, ventilated, and free from pollution or hazardous materials?			
	Is there proper waste management (bins, no littering)			
	Are materials used in practical sessions environmentally safe (non-toxic paints, safe disposal of wastes)?			
	Are lights, fans, and equipment turned off when not in use (energy conservation)?			

Climate Resilience	Are trainees oriented on how their skills link with climate-friendly practices (e.g., renewable energy, efficient production, recycling)?			
	Are trainers integrating climate-smart examples in teaching content?			
	Are basic health and safety measures available (first aid kit, safe exits, fire safety)?			
	Is the trainer using protective gear or demonstrating safe tool use (where relevant)?			
Institutional Aspects	Is SECAP awareness shared with trainees (via short briefing, posters, or examples)?			
	Are trainees encouraged to report unsafe, unfair,			

	or environmentally harmful practices?			
Overall Compliance	Overall SECAP compliance observed	☐ High ☐ Medium ☐ Low		

Overall remarks/ recommendations			
Name	**Designation**	**Signature**	**Date**