global forum for rural advisory services
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IPM: Integrated Pest Management

FACILITATOR GUIDE

Global Forum for Rural Advisory Services (GFRAS)
c/o Agridea, Eschikon 28, 8315 Lindau, SWITZERLAND
Phone +41 (0)52 354 97 64, Fax +41 (0)52 354 97 97
info@g-fras.org, www.g-fras.org

Contents

Module 1: Integrated Pest Management

Pre-assessment

After reading through the preface and introduction, the students must complete the following pre-assessment to determine how comfortable they are with the topic by rating their knowledge on the topics on a scale of 1 to 5, circling the corresponding number.

	Question	**Self-assessment**				
		Low				**High**
1	How well can you explain what IPM and its components?	1	2	3	4	5
2	Do you know the benefits of IPM?	1	2	3	4	5
3	Are you able to explain what prevention of pest attack is and give examples of preventative action?	1	2	3	4	5
4	How well can you explain Responsible Pesticide Use and how this reduces risk?	1	2	3	4	5
5	Can you explain what is Personal Protective Equipment used in pesticide application?	1	2	3	4	5
6	What is your understanding of resistance to pesticides and how to manage this?	1	2	3	4	5
7	Can you describe what are counterfeit and illegal pesticides and their impact on IPM?	1	2	3	4	5
8	Are you able to describe the role that genetically-engineered plants can play in IPM?	1	2	3	4	5
9	Can you give examples of IPM in action?	1	2	3	4	5

Learner's own answer

Study Unit 1: Introduction to IPM

Session 1.1 What is IPM?

1. Answer the following questions by indicating whether the statement is true or false. Give the reason for your answer if false. (4)

1.1 The goal of IPM is to reduce the use of chemical pesticides

Answer: False. The goal of IPM is to manage pests in an economic viable, environmentally sound and socially acceptable way. Reduction in the use of chemical pesticides may be an outcome of IPM adoption.

1.2 The application of ecological science to the management of a farming system, that also takes into account socioeconomics and culture, is called agroecology

Answer: True

2. Answer the following in your own words. (4)

2.1 What are the three underlying principles of IPM?

Answer: 1. Understanding the agroecosystem and agroecology

2. Pests do not need to be completely eradicated

3. Maximising natural control

2.2 By adopting IPM, you will satisfy the requirements of Organic Agriculture certification. True or False?

Answer: False. IPM can use synthetic chemical inputs that are not allowed in organic agriculture.

Summative assessment: Unit 1

1. Fill in the missing words from the table below. (5)

integration	*agroecosystems*	*pest control techniques*	*economically justified*	*pesticides*

Integrated Pest Management (IPM) means the careful consideration of all available _____ and subsequent _____ of appropriate measures that discourage the development of pest populations and keep _____ and other interventions to levels that discourage the development of pest populations and keep pesticides and other interventions to levels that are _____ and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to _____ and encourages natural pest control mechanisms

Answer: Integrated Pest Management (IPM) means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agroecosystems and encourages natural pest control mechanisms

2. What are the benefits of IPM? (7)

Answer: 1. Improved profitability

2. Improved stable, reliable and quality crop yield

3. Reduced likelihood of pesticide resistance

4. Reduced risk of negative environmental impacts

5. Reduced risk of pesticide contamination of users and bystanders

6. Increased consumer confidence in food safety and quality

7. Improved access to markets

3. What sustainable development goals does IPM contribute directly to? (5)

Answer:-

SGD1: Zero Hunger

SGD3: Good Health and Well-Being

SGD6: Clean Water and Sanitation

SGD 14: Life Below Water

SGD 15: Life on Land

Total: 17 marks

Study Unit 2: Implementation of IPM

Session 2.1: Prevention

1 Fill in the missing words from the box below. (4)

Pest infestation	resistant	healthy	Pest damage	Attractive

Prevention is all about growing a _____ crop that is robust but does not provide either a source of _____ or becomes more _____ to infestation. A healthy crop is also more _____ to, and able to recover from, _____

Answer: Prevention is all about growing a healthy crop that is robust but does not provide either a source of pest infestation or becomes more attractive to infestation. A healthy crop is also more resistant to, and able to recover from, pest infestation.

2. Mark the prevention elements with an X in the table below (9)

Crop Location	*X*
Seed/Variety Selection	*X*
Strategic Planting and Crop Rotation	*X*
Land Preparation	*X*
Assessing Numbers of Pests Present	
Release of Natural Control Agents	
Sanitation	*X*
Application of Herbicide before Planting	
Optimising Plant Nutrition	*X*
Water Management	*X*
Preserving and Enhancing Biodiversity	*X*
Seed Treatment	*X*

3. How does strategic planting help prevent pest infestation? (5)

Answer: Similar crops planted in the same area can increase pest presence and should be avoided. In contrast, some crops will deter pests from another crop. Undersowing can prevent weeds. Asynchronous planting results in plants stages that are susceptible to pests always being present. Good timing of planting/sowing can result in the risk of peak pest attack being avoided.

4. What role does optimising plant nutrition play? (4)

Answer: Nutrients are essential to the plant. The right amount of nutrient helps to ensure good plant growth. Incorrect application can result in poor plant growth through not enough nutrients being available, can encourage pests through excessive leafy growth resulting in the plant environment being more attractive to pests and can pollute the environment through run-off of

excess fertiliser and, in some cases, increase greenhouse gas emissions through poor timing of organic fertiliser application resulting in insufficient time for decomposition.

Session 2.2: Monitoring

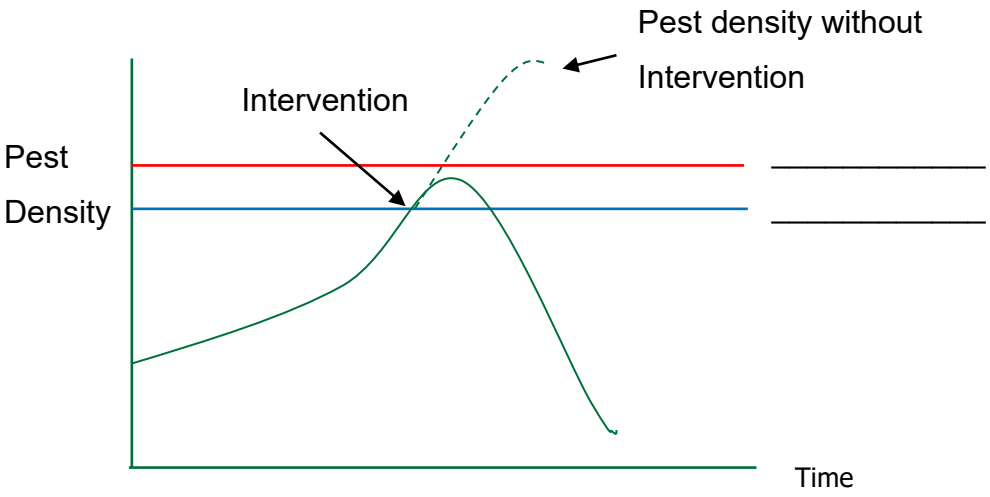
1. In your own words explain why monitoring of the crop is important and what is monitored. (5)

Answer: Monitoring is essential to determine if and what action or intervention should be taken to prevent economic damage to the crop. This involves assessing how well the crop is growing, what damage is occurring and the presence (and numbers) of pests and beneficial organisms.

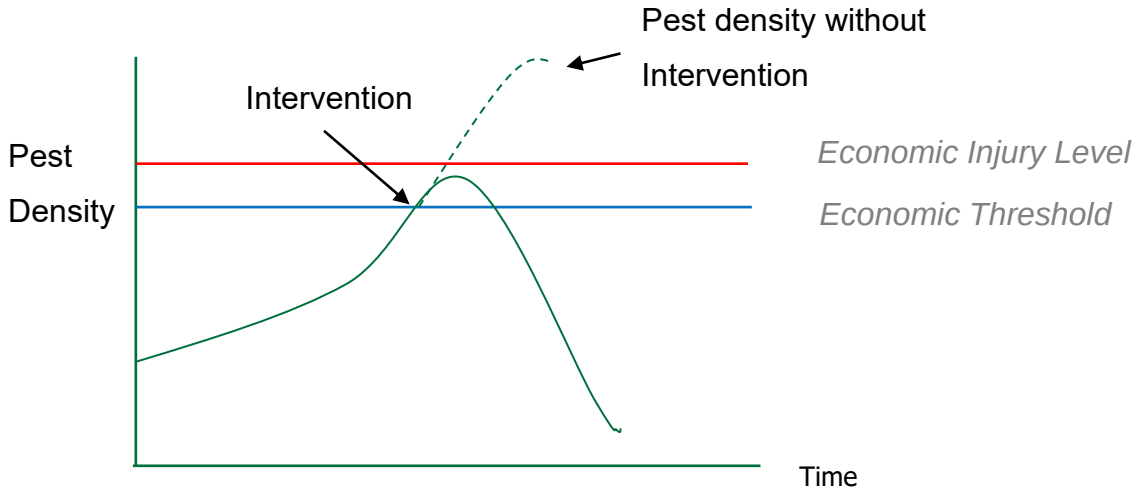
2. What methods of monitoring can be used? (5)

Answer: Scouting (Field Monitoring), Trapping, Remote Sensing, Precision Agriculture, Modelling.

3. Fill in the missing words on the graph. (4)



Answer:



Session 2.3 What is intervention?

1. Biological Control includes the use of products from living organisms, True or False. (2)

Answer: True

2. Describe three disadvantages of Cultural/Mechanical Control (6)

Answer: 1. Can be labour intensive

2. Timing can be important

3. Can lead to skeletal/muscular fatigue

3. Fill in the spaces using the words in the table below: (4)

Death	biochemical	pest biology	Disrupts

Pesticide Mode/Site of Action can be defined as the _____ process by which a pesticide _____ normal _____ usually resulting in the _____ of the pest.

Answer: Pesticide Mode/Site of Action can be defined as the biochemical process by which a pesticide disrupts normal pest biology usually resulting in the death of the pest.

Summative assessment: Unit 2

1. Describe the three components of IPM (12)

Answer:-

- *Prevention aimed at preventing the build-up of pests. This includes understanding the local conditions (agroecology), selection of varieties and crop management.*
- *Monitoring the crop for pest and natural control mechanisms, as well as damage. This involves regular in section of the field and/or climatic conditions, identification of any issues and determination of the need for action;*
- *Intervention using mechanical, biological or chemical measures when needed to prevent unacceptable losses to yield or quality. This involves choice of action to be made, planning the approach to be taken and implementing responsible.*

2. What factors influences the decision to carry out pest control interventions? (10)

Answer:-

- *Economic Threshold*
- *Trends – is the pest population and/or the beneficial organisms increasing or decreasing?*
- *If crop damage has been noticed, is the pest that caused the damage still present and in numbers to cause more?*
- *Are the weather conditions likely to favour increase or decrease in pest numbers?*
- *What is the stage of the crop (will it likely recover from pest attack? Is it close to harvest?)*

3. Describe the types of Intervention that can be made. (12)

Answer:-

- *Cultural/Mechanical Control – cultural practices normally falls under prevention, but can be used as an intervention, such as flooding of a rice field to control weeds. Mechanical control – sometimes called physical control – uses farm machinery/tools or manual methods of control.*
- *Biological Control – uses living organisms or the products from living organisms to control pests*
- *Chemical Control – uses organic or inorganic chemicals to control pests*

Total: 32 Marks

Study Unit 3: Responsible Use of Pesticides

Session 3.1: Pesticide poisoning

1. What are the three principle methods that a pesticide can enter the body? (3)

Answer: through the skin (including the eyes); through the mouth (ingestion); through the lungs (breathing)

2. Risk = Hazard + Exposure. True or False? (2)

Answer: False. Risk = Hazard x Exposure

3. Mark with an X the principles that should be followed when choosing a chemical pesticide? (5)

Right type for the pest	*X*
Cheapest available	
Works in a way that optimises control	*X*
Less hazardous	*X*
Formulation that is safer to handle	*X*
Broad spectrum to kill more pest types	
Safer packaging	*X*

Session 3.2: Read and understand the pesticide label

1. Which of the following is **not** normally on a typical pesticide label? (2)

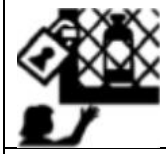
Product Name, Active Ingredient, Dose Rates, Price, Safety Precautions

Answer: Price

2. Place the colour of the colour bands in order of hazard/toxicity (1 = most toxic, 4 = least toxic. (4)

	3
	4
	1
	2

3 What do the following pictograms mean? (6)

	*When Handling Dry Formulations*
	*Keep locked and out of reach of Children*
	*Wash after Use*

4. What is the pre-harvest interval (PHI)? (4)

Answer: the minimum time that must be left between a pesticide application to a crop and the crop harvest

Session 3.3: Application Equipment

1. What single nozzle is suitable for Herbicides, Insecticides and Fungicides? (4)

Answer: Flat Fan Nozzle

2. In your own words, how do you determine the Volume Rate for application? (6)

Answer (either one of two or both accepted):

Spray a known volume of water into the target (crop or weed) and measure the area it covers.

Or

Have a known area of target and measure how much water is necessary to cover it.

Then

$$\text{Volume Rate} = \frac{10{,}000.}{\text{Area Sprayed}} \times \text{Number of litres sprayed}$$

3. Mark with an X the correct statement. (4)

Spray during the middle of the day when it is less windy	
Do not spray when raining	X
Walk upwind when spraying so the spray blows away from you	X
Point the spray lance in front so that you can see what is being sprayed	

Session 3.4: Personal Protective Equipment (PPE)

1. Fill in the missing words from the table below. (5)

last line	risk	application technique	handling	first line

PPE is essential to reduce the _____ of contamination from pesticides. While important, it is the _____ of defence, good _____, proper sprayer maintenance and proper _____ are the _____ of defence.

Answer: PPE is essential to reduce the risk of contamination from pesticides. While important, it is the last line of defence, good handling, proper sprayer maintenance and proper application technique are the first line of defence.

2. Which of these statements is False? (4)

a. Gloves should be worn over shirt sleeves.

b. Boots should be worn over trousers.

Answer: b

3. Which of the following is not normally needed to be worn for application of pesticides? (4)

Apron, Boots, Gloves

Answer: Apron

Summative assessment: Unit 3

1. Fill in the missing words from the table below. (4)

acceptable level	benefits	IPM	Risks

The Responsible Use of pesticides is an important part of _____, which helps to manage risk and keep it at an _____ where the _____ of pesticide use far outweigh the _____.

Answer: he Responsible Use of pesticides is an important part of IPM, which helps to manage risk and keep it at an acceptable level where the benefits of pesticide use far outweigh the risks.

2. List the nine easy steps of the Responsible Use of Pesticides (18)

Answer:-

- *Only use pesticides when needed. Get advice when needed on what to buy and purchase from authorised retailers*
- *When transporting ensure pesticides are securely stored away from people, animals and food*
- *When storing pesticides make sure they are kept in a well-ventilated, securely locked place*
- *Carefully read the product label and follow instructions*
- *Check sprayers for leaks and nozzle wear. Wear PPE for mixing and loading the sprayer*
- *Triple rinse empty containers into the spray tank. Puncture the container and take to the nearest approved collection site.*
- *When spraying always wear PPE and use calibrated equipment with no leaks. Spray early morning and late evening when it is less windy. Do not drink, eat or smoke when spraying*
- *Do not spray pesticides near water sources. Do not pollute the environment through misuse or leaving empty containers in the field*
- *After spraying take a shower and put on clean clothes. Wash equipment and PPE while protecting water sources and the environment. Store all equipment separately and safely.*

3. What are the eight steps of (backpack) sprayer maintenance? (8)

Answer:-

- *Check hoses for wear*
- *Check hose clips and replace broken clips*

- *Check on/off switch for smooth operation*
- *Check and replace damaged seals*
- *Lubricate piston seal with light oil*
- *Replace damaged nozzles*
- *Replace damaged valves*
- *Wash sprayer after use*

Total: 30 marks

Study Unit 4: Pesticide Resistance Management

Session 4.1: What is Pesticide Resistance and How does it Develop?

1. Resistance in insects, mites or rodents can occur because the pest changes behaviour. True or False? (4)

Answer : True

2. In your own words explain pesticide resistance. (8)

Answer : Pesticide resistance is the genetic ability of some individuals in a pest population to survive an application or applications of pesticides and develops when a pesticide that works in the same way (Mode or site of action) is used over several generations of the pest. Resistance develops at the population level and is an inherited trait.

3. Which of the following practices promote resistance? Mark with an X. (4)

Continual and frequent use of the same pesticide on a pest population.	*X*
Use of selective pesticides.	
The use of application rates which are below those recommended on the label	*X*
Poor coverage of the area being treated.	*X*
Use of genuine products	
Areas where there is little or no immigration of susceptible individuals from outside.	*X*

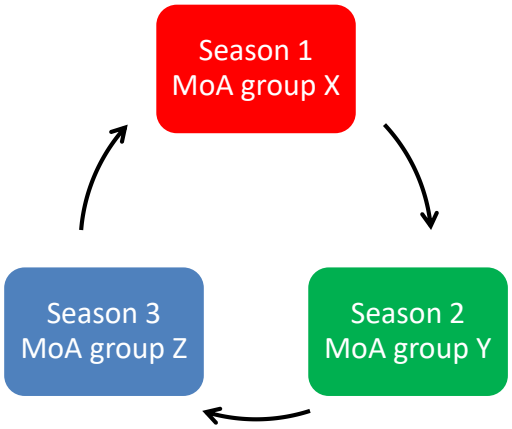
Session 4.2: Resistance Management Strategies

1. Following herbicide application, removing surviving weeds by hand and prior to seeding can be described as a Double-hit strategy. True or False? (2)

Answer: True

2. In your own words describe Mode/Site of Action (MoA) rotation? (4)

Answer: The use of alternations or sequences of pesticides with different MoA over time (per pest generation or season).



3. How to manage resistance in a Bt crop? Fill in the missing words from the table below. (4)

Refuge	part of	surrounding	Express

Planting of _____ the crop area or _____ area, with plants that do not _____ the Bt toxin. This is known as a _____.

Answer: Planting of part of the crop area or surrounding area, with plants that do not express the Bt towin. This is known as a Refuge.

Summative assessment: Unit 4

1. Using weeds as an example draw a diagram to illustrate how resistance develops. (20)

Answer:-

2. What are the main resistance management strategies with pesticides? (8)

Answer:-

- *Integrated Pest Management (IPM)*
- *Use the correct pesticide dose*
- *Calibrate and maintain the application equipment*
- *Good application practices*
- *Double-hit strategy*

- *Preservation of susceptible insects*
- *Use good quality, genuine pesticides*
- *Mode/Site of Action (MoA) rotation*

Total: 28 marks

Study Unit 5: IPM in Action

Session 5.1 Threats and Outcomes

1. The acceptable daily intake (ADI) of a pesticide is the maximum quantity which can be consumed in a year without harm. True or False? (4)

Answer: False. The acceptable daily intake (ADI) of a pesticide is the maximum quantity which can be consumed every day for a lifetime without harm.

2. What are benefits to IPM of accurate record keeping? Mark with an X. (4)

Used to determine whether the action threshold has been reached	*X*
Demonstrate the impact of IPM on crop yields	*X*
Demonstrate the cost of IPM implementation	*X*
Required for income tax returns	
Facilitates auditing for sustainability schemes, such as GlobalGap	*X*
Needed to recommend pest control actions to neighbouring farmers	

3. What does triple rinsing of an empty pesticide bottle do? (4)

Answer: Removes 99.9% of the pesticide from the bottle.

4. What practices help to avoid counterfeit/illegal pesticides? (4)

Answer: 1. Only buy from known, licenced and reputable dealers

2. Do not buy products with poor quality or misspelt labels

3. Beware of products that are cheaper than normal

4. If a call (telephone) number is on the label, call to check whether the product is legitimate

5. Fill in the missing words from the table below. (4)

principles	capacity building	behaviour	Understand

Farmer _____ is essential for IPM to be adopted – farmers need to _____ the _____ and benefits of IPM and how it is implemented. Ultimately this requires training that results in _____ change.

Answer: Farmer capacity building is essential for IPM to be adopted – farmers need to understand the principles and benefits of IPM and how it is implemented. Ultimately this requires training that results in behaviour change.

Session 5.2: Examples of IPM in the field

1. What specific action is undertaken in all the field examples shown? (5)

Answer: Assessment of the pest population (through scouting, trapping or modelling)

2. What do you understand by mass-trapping? (5)

Answer: The management of an insect pest through placement of traps with an attractant in the crop (and outside the crop in some cases) to capture adult (male and/or female) pests

3. List four benefits of using a Spray Service Provider. (8)

Answer: Any of the following:-

- *Professional decision making*
- *Agronomic and pest management advice*
- *Elimination of unnecessary sprays*
- *Improved and safer application (human health and environment)*
- *Improved yields*
- *Proper management of empty containers*
- *Reduced chance of obsolete pesticide stocks*
- *Less use of counterfeit or illegal products*

Coffee farmer game

The aim of the game is to promote adopting sustainable agricultural practices to enhance productivity levels that could lead to an improvement in smallholders' livelihoods. In addition, we intend to provide extension agents with an innovative tool to engage with producers about production techniques.

The game is found here: http://sustainability-farm.basf.jedermann.de/demo/docs-coffee-0.22.0-en

The set up in a glance:

- The game is moderated by an extension agent. The game was designed to be played by a group.
- 2 - 5 teams with maximum 5 players in each team
- Each team has a laptop. Alternatively, if only one laptop is available, the moderator plays the game motivating farmers around her/him to participate in the decisions
- 30-60 minutes of playtime

In this game each player is a coffee farmer trying to make the right agronomic decisions to advance and become a sustainable coffee farmer by learning more about the three pillars of sustainability, economy, environment and society.

In the Menu (upper right corner), the extension agent finds support information to play the game by clicking Help and Rules of the Game. Help describes each of the cards indicating an agronomic practice and economic/social choices and includes messages that the moderator can communicate to smallholders to help them to select the proper activity in the farm.

Objectives

To win the game players must reach 100% in the Asset and Welfare indexes. The overall objective is for players to gain greater insight about sustainable coffee farming. The specific objectives are:

- Provide an interactive educational tool for smallholders to implement best agricultural practices with a focus on IPM and responsible use of crop protection inputs.
- Provide a simple decision simulator about best management practices (economic and social decisions).
- Deliver essential and easy to understand sustainability messages (e.g. soil health)

Setup

The game is divided into three rounds and each of them consist of three stages. In each round, we communicate different messages and prioritize specific agricultural, economic and social practices. The first stage is related to agricultural practices and the second one encompasses

the economic and social decisions. Depending on the players' choices, they will follow a specific path that will lead them to the export market or the local market at the end of the game.

Additional information for the moderator

Each card represents an opportunity for the moderator to discuss with farmers about a specific agronomic practice how is conducted in the field and how it influences productivity and the sustainability of the farm in the long term. Similarly, the social and economic choices help the moderator to discuss how to set priorities.

As in reality, eventualities influence the farming activities and they are reflected in the game. Below some useful information for the moderator to explain eventualities.

Adverse Event	**Information**	**Protective Practices**
Fall in prices (volatility)	A surplus in regional production have drastically reduced coffee prices. Therefore, your income is low this season.	None
Difficulty in reaching the market place	Due to heavy rains in the area, roads are not ready for circulation, so you cannot transport and sell your production.	None
Drought	A strong drought is affecting the region.	If you have selected "Shade Management" or "Mulching", you have protection against water shortage and high temperatures.
Heavy rains	Heavy rains have been registered in the past days in the area.	If you selected "Control Erosion", you are not affected.
Extreme weather	Extreme weather conditions have affected coffee yields in the area.	If you selected "Intercropping", you are not only promoting biodiversity, but you have also ensured another source of income.
Coffee leaf rust (Hemileia vastatrix)	After the last rain, some powdery lesions are visible on the leaves. Coffee leaf rust has infected your crop!	If you have selected "Selection of improved cultivars" or "Chemical and Biological Control", you protected your plantation well!
Coffee berry disease (Colletotrichum kahawae)	It is warm, and the humidity is high. Dark spots appear on the coffee berries and some of the green berries are dropping!	If you have removed "Damaged Cherries" or applied "Chemical and Biological Control", you are protected from the disease.
Coffee berry borer (Hypothemus hampei)	It is warm and humid, and your berries are being attacked by the coffee berry borer.	If you use Biological Control, the natural enemies will control the insects.
Nutrient deficiency	Erosion and a lack of nutrient reposition has resulted in degraded soils which have a negative impact on productivity. Soil quality is difficult to recover.	If you selected "Manure or Fertilizer", you are promoting soil life increasing the resilience of this resource.

Adverse Event	Information	Protective Practices
Environmental risks	Lack of waste management increases the potential for degradation of soil, water and air.	If you selected "Waste Management", you are making efforts to preserve your ecosystem and to secure the long-term sustainability of your farm.

Summative assessment: Unit 5

Practical Assessment

1. Using your own experience describe a pest problem in a defined crop and how you might address it through an IPM strategy along with the benefits of successful implementation.

Answer: Learner`s own answer, but should include Prevention (20), Monitoring (10) and Intervention (20)

Total: 50 Marks

Post-assessment

The students must complete the following post-assessment to determine how much they have learnt of the topic.

	Question	Self-assessment				
		Low				High
1	How well can you explain what IPM and its components?	1	2	3	4	5
2	Do you know the benefits of IPM?	1	2	3	4	5
3	Are you able to explain what prevention of pest attack is and give examples of preventative action?	1	2	3	4	5
4	How well can you explain Responsible Pesticide Use and how this reduces risk?	1	2	3	4	5
5	Can you explain what is Personal Protective Equipment used in pesticide application?	1	2	3	4	5
6	What is your understanding of resistance to pesticides and how to manage this?	1	2	3	4	5
7	Can you describe what are counterfeit and illegal pesticides and their impact on IPM?					
8	Are you able to describe the role that genetically-engineered plants can play in IPM?					
9	Can you give examples of IPM in action?					

Learner's own answer.

Global Forum for Rural Advisory Services (GFRAS) is about enhancing the performance of advisory services so that they can better serve farm families and rural producers, thus contributing to improved livelihoods in rural areas and the sustainable reduction of hunger and poverty. Rural advisory services help to empower farmers and better integrate them in systems of agricultural innovations.