RWANDA POLYTECHNIC

TVET LEVEL II

AGRICULTURE

Small Scale Post-Harvest Operations

TRAINER MANUAL

RWANDA POLYTECHNIC

Approved by: Workforce Development Authority

USAID FROM THE AMERICAN PEOPLE

EDC Education Development Center

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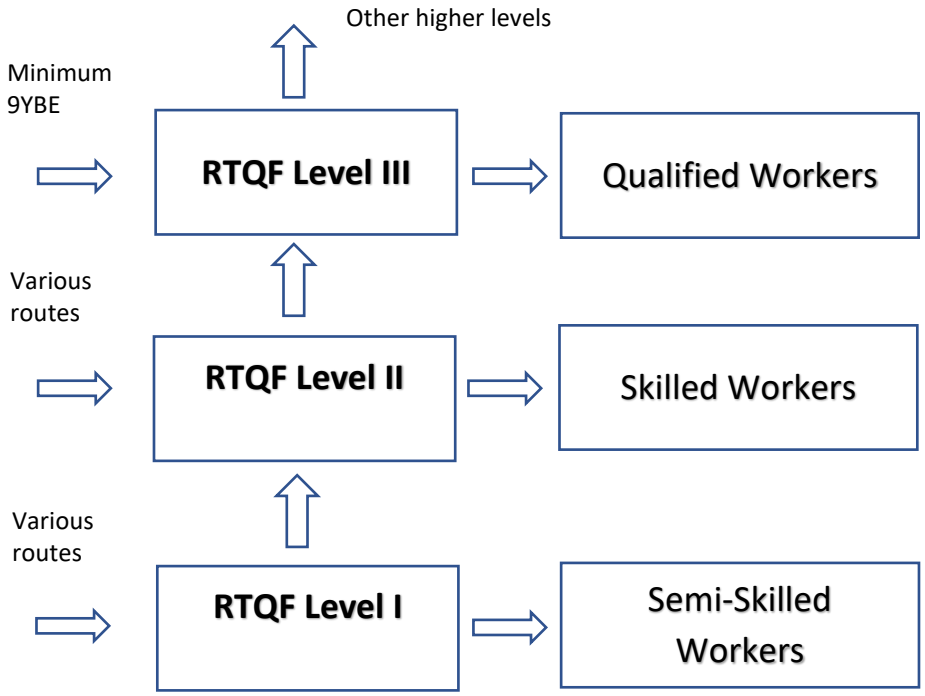
Introduction to RTQF Level II Training Modules

Background

Rwanda Polytechnic, with support of and in collaboration with USAID Huguka Dukore Akazi Kanoze, has developed RTQF TVET Level II programs that combine basic education, soft skills and vocational skills modules. Bridging the gap between Level I and Level III programmes, Level II aims to prepare learners who have a minimum education level of Primary 6 or equivalent to continue with their education or become skilled workers in the labour force.



Following the Workforce Development Authority (WDA) curriculum development process that involved experts from Rwanda Polytechnic, Rwanda Education Board, Ministry of Agriculture, technical vocational institutions, Education Development Center, Akazi Kanoze Access and other technical experts, training modules were developed in basic education, soft skills (work readiness) and, initially, agriculture. Additional vocational areas will be added over time. Trainees will be trained in all Basic Education and Soft Skills modules listed below, as well as in 6 - 8 modules that make up their chosen technical vocational programme.

Module Requirements:

Basic Education	Soft Skills	Vocational Skills
• English • Kinyarwanda • Mathematics	• Basic Entrepreneurship Skills • ICT Essentials • Communication Skills	• Vocational programmes will have a set of 6 – 8 required technical modules.

• Integrated Science (Physics, Chemistry, Biology)	• Safety, Health and Sustainable Environment • Personal Development and Career Guidance	E.g. Food Crop Production and Processing includes the following modules: 1. Food Crop Production 2. Small Scale Post-Harvest Operations 3. Growing Medium 4. Food Safety and Sanitation 5. Food Preservation and Storage 6. Flour Processing

Organization of the Training Manuals

For each module there is a Trainer Manual and a Trainee Manual. These manuals, based on the curricula for each subject, are divided into Learning Units, and each Learning Unit includes 3 – 5 Learning Outcomes. The learning outcomes make up the essential skills, knowledge and attitudes to be acquired by trainees. To make the Trainee Manual more user friendly, Unit and Topic are used respectively for Learning Unit and Learning Outcome. The number of hours per training module varies, ranging between 30 and 120 hours.

Teaching & Learning Methodology of RTQF Level II 2 TVET Materials

The teaching and learning methodology used in the materials is based in experiential and adult learning. Activities are designed to engage trainees, build upon what they know and learn and provide them with opportunities to build their skills in the classroom and in the workplace. More specifically, guiding principles in the development of the manuals include:

- Building on participants' knowledge, skills and experiences
- Facilitating a learning process through active engagement of participants rather than through lecturing
- Providing opportunities to practice – inquiry based and hands on practice, both in the classroom and workplace
- Using simple and clear language
- Connecting to the real world: use local resources and the environment for learning
- Promoting critical thinking through properly debriefing activities and asking questions that get learners to think, analyze, relate issues and topics to their own lives and come up with solutions

- Applying social inclusion principles: Finding ways to include all types of youth (and trainers) – males and females; different cultural/ethnic/religious backgrounds, people with disabilities (PWD); people with different types of health status …

- Encouraging risk taking – promote questioning and being free to explore

- Promoting habits of mind that support life-long learning: curiosity and wonder, open mindedness, creativity

These principles are reflected in the layout and flow of activities in the manuals:

1. **Key Competencies:** Table found at the beginning of each Learning Outcome that describes the main knowledge, skills and attitudes to be gained by the end of the activities.

2. **Self-Assessment:** Conducted at the beginning and end of each Learning Unit to get a sense of trainees' knowledge and skills going into it and what they have gained by the end of the Learning Unit (and steps they need to take to further their understanding and skills).

3.  **Getting Started Activity:** Typically, a quick activity or questions to 1) give the trainer a sense of trainees' existing knowledge and skills; 2) spark the interest of trainees in the topic; 3) introduce the objectives and key competencies of the topic.

4.  **Problem Solving Activity:** A challenging activity to get trainees engaged and to learn through discovery instead of memorization of facts. A variety of teaching and learning methodologies are used, including individual and group work such as reading real life work-based scenarios and answering accompanying questions to activities such as identifying proper tools and equipment from the school workshop to conduct a certain activity. Following the sharing of responses, the trainer guides trainees through the content and processes being introduced.

5.  **Guided Practice Activity:** Building on the concepts and skills gained in the Problem Solving Activity, the trainer guides trainees through practical examples.

6.  **Application Activity:** Consolidates trainees' knowledge and skills through a real-life application of the topic in the classroom, community or workplace. Trainees are given more independence in applying what they have learned.

7. **Key Facts boxes:** Throughout the Trainee Manual, one will find Key Facts boxes. These contain the main information or content for a given Learning Outcome. They are there for the trainees' reference and are used throughout the different types of activities.

8.  **Points to Remember:** List of the top key learning points or "take-aways" from the topic.

9.  **Formative Assessment:** Questions and activities to assess trainees' level of understanding of the concepts introduced.

10.  **Summative Assessment:** Based on the integrated, real life situation approach used in other TVET levels, this is done at the end of every module for agricultural modules and, with some variations, at the end of each Learning Unit for Basic Education and Soft Skills modules.

11.  **Self-Reflection:** Trainees re-take the Self-Assessment given at the beginning of the Learning Unit and identify their strengths, challenges and actions to improve their level of competence.

The Trainer and Trainee Manuals are meant to be used in conjunction with each other and are well coordinated through the headings and labelling of activities. The trainer will always be able to refer trainees to specific activities by the coordinated numbering system. For instance, a specific exercise might be labelled Topic 1.2 Task 2. The Topic is the number of the Learning Outcome and the task is the specific exercise to be done. The Key Facts are also numbered for easy reference. These nor the Self-Assessment tables are in the Trainer's Manual so the trainer should have a copy of both manuals.

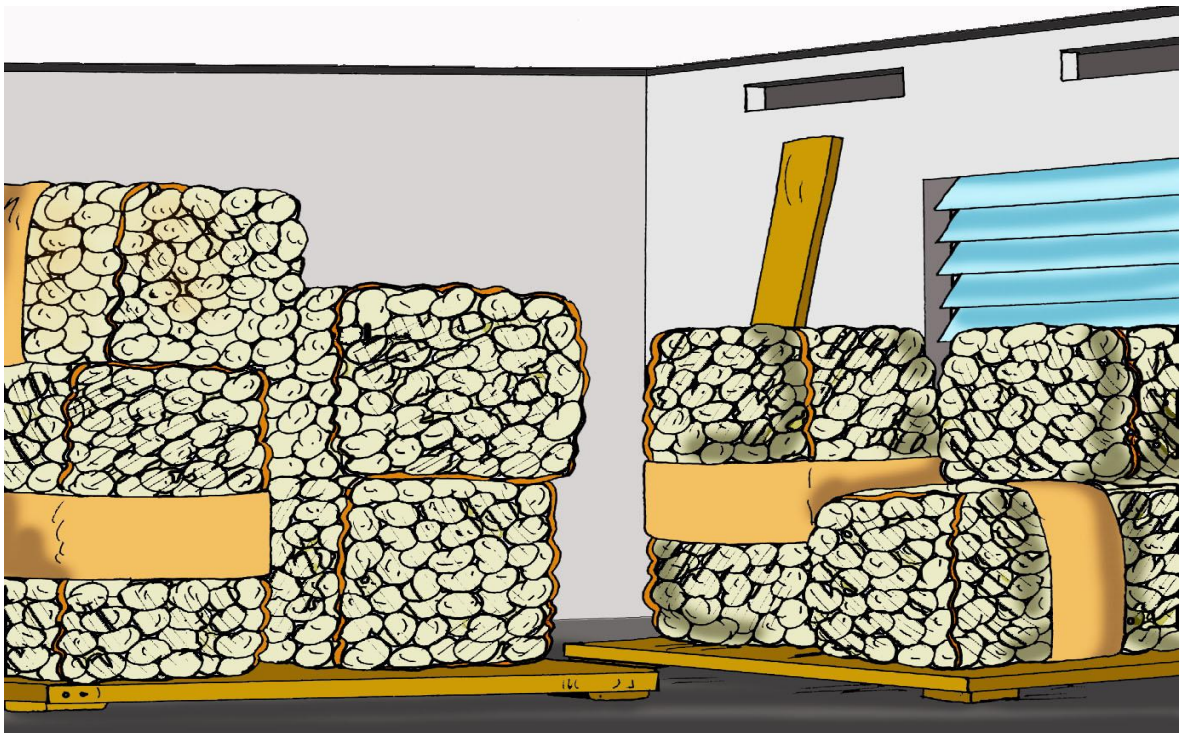
The Trainer's Manual includes answers (or guidelines to the trainer as appropriate) to Formative and Summative Assessments as well as to problems given throughout the activities. Summative Assessments are not included in the Trainee's Manual. These are meant to be used as a guide for those who will be developing a context-appropriative Summative Assessment at the end of the Module or Learning Unit. Basic Education and Soft Skills modules include Summative Assessments at the end of every Learning Unit while the technical modules include it only at the end of the module.

Lastly, there is a section in the Trainer's Manual for additional information to the trainer that includes either specific information or references to information that can help them deepen their understanding of the particular content.

SMALL SCALE POST-HARVEST OPERATIONS

Learning Units	Learning Hours	Learning Outcomes
Learning Unit 1: Perform post-harvest handling	20	**1.1** Cure roots, tubers and bulb crops following requirements
		1.2 Perform postharvest handling operations prior to packaging
		1.3 Sort and grade produce considering market requirements
Learning Unit 2: Perform packaging	25	**2.1** Select and acquire packaging materials following requirements
		2.2 Package produce following requirements
		2.3 Identify cooling methods following instructions and crop requirements
Learning Unit 3: Perform storage	25	**3.1** Clean storage rooms following guidelines and instructions
		3.2 Identify storage methods following requirements
		3.3 Select and acquire storage materials according to the size of store, crop product and recommended storage conditions
		3.4 Store produce following guidelines and requirements

Learning Unit 1: Perform post-harvest handling



Learning Outcomes

By the end of the learning unit, trainees will be able to:

1.1 Cure roots, tubers and bulb crops following requirements

1.2 Perform post-harvest handling operations prior to packaging following requirements

1.3 Sort and grade produce considering market requirements

Learning Unit 1 Self-Assessment

1. Ask trainees to observe the illustration presented in their trainee manuals and discuss what they see. What topics do they think this unit will include based on the illustration? After some brainstorming, share the main topics.

2. Ask trainees to fill out the self-assessment at the beginning of the unit in their trainee manuals. Explain that the purpose of the self-assessment is to become familiar with the topics in the unit and for them to see what they know or do not know at the beginning. At the end of the unit, they will do a self-reflection, which includes re-taking the self-assessment and identifying their strengths, areas that need improvement and actions to take. The self-assessment is not a test!

Learning Outcome 1.1: Cure roots, tubers and bulb crops

Objectives: At the end of the learning outcome, trainees will be able to:

a. Define curing process
b. Identify crops that can be cured and those that cannot
c. Describe the importance of curing
d. Describe the conditions necessary for curing

Time Required: 10 hours

Learning methodology: Group discussion, brainstorming, practical exercise, field visits and demonstrations.

Materials Needed:

- **Standard training materials -** flip chart, markers, tape, A4 paper
- **Curable vegetables -** Tubers, roots and bulbs of various crops
- **A spacious room** for holding the curing vegetables
- **Articles for curing** – Burlap sacks, or dried grasses or straw and lightweight cloth

Preparation:

- ❑ Prepare students to bring a vegetable of choice for the guided practice activity (do this in the class before).
- ❑ Choose the site for field visit through an organization or personal connection with an agriculturalist who is prepared to demonstrate how to cure crops.
- ❑ List all materials and tools needed to perform curing of tubers, roots and bulbs.
- ❑ Check if all materials and tools are available.
- ❑ Organise how the trainees will safely reach the working place.

Cross Cutting Issues:

- ✓ **Gender:** While forming the groups for group discussion and practical exercise, make sure both females and males are represented. Emphasize that farming can be done by both men and women.
- ✓ **Environment and sustainability:** While curing different crops, emphasize the need to protect the environment through proper disposing of waste materials.
- ✓ **Standardisation Culture:** While curing different crops, emphasize the need to follow set standards or requirements.

Prerequisites:

- Basic reading and writing
- Basic numeracy and arithmetic skills

Key Competencies:

Knowledge	Skills	Attitudes
1. Define curing process	**1.** Perform curing of roots, tubers and bulb crops	**1.** Willing to try
2. Identify crops that can be cured and those that cannot	**2.** Select the crops to be cured	**2.** Self-confidence
3. Describe the requirements and conditions for curing	**3.** Choose appropriate requirements for curing	**3.** Attention to detail

Steps:

Getting Started: What do we know and where are we going?

1. Ask trainees to turn to **Topic 1.1 Task 1** in their Trainee Manuals.

2. Ask each group to have a look at the *images A, B, C, and D* in their trainee's manual and reflect on the following questions:

a. Do you recognize the crops and are they grown in your area?

b. What do you think has happened to the crops in images B and D?

c. Has this ever happened to crops that you have grown?

d. What steps do you need to take to prevent this situation from happening?

3. Conclude by asking volunteers to share their thoughts and then introduce the learning outcomes in the Key Competencies table. Read them together and ensure that everyone understands.

Problem Solving Activity

1. Ask trainees to turn to **Topic 1.1 Task 2** in their Trainee Manuals.

2. Instruct the trainees to read carefully the scenario and respond to the following question with the person next to them:

Bagabo is a potato farmer in Nyamagabe district and in May he had harvested 500 kg of potatoes. Three days later, he found that half of his produce was rotten.

a. What do you think caused the potatoes to rot?

b. What do you think Bagabo should have done to prevent the potatoes from rotting?

c. Why might this be an important problem to solve for farmers in your area?

3. As they are working go around to each pair to ensure the task is understood. If the trainees indicate that they are having difficulties, try to determine what is still not clear and explain accordingly.

4. Ask some pairs to volunteer and share their responses with the rest of the trainees.

5. After all pairs have presented, summarize their responses. Refer trainees to **1.1 Key Facts** in their manuals and review them together.

6. Conclude by informing the trainees prior to the next lesson that they must find a produce item which they will bring to class.

Possible Answer: Bagabo's crops may have rotted because they were infected with either fungus or bacteria that break down the potatoes. Just like other food crops, there are ways to make crops last longer. Bagabo could have used a method called curing to preserve his crops instead of losing them.

Guided Practice Activity

1. Ask trainees to turn to **Topic 1.1 Task 3** in their Trainee Manuals.
   a. Have the trainees present the vegetables to the class. Tell the trainees to divide the vegetables into ones they think are curable and ones which are not.

2. Divide the trainees into small groups.

3. Ask them to discuss the following questions among their respective group:
   a. Can the item of produce that you brought be cured? Why or why not?

   b. If the item of produce can be cured what are conditions and time needed for curing it?

c. What might happen if your item was not cured?

4. Give each group enough time to do the task. As groups are working, guide them where they meet challenges.

5. After the discussions, let each group share their findings and the responses to the questions.

6. After the presentations, have trainees refer to **1.2 Key Facts** in their manual and review them together. Answer any questions that trainees may have.

7. Conclude by explaining to the trainees that their task for the next activity is to prepare for an upcoming field visit by interviewing a farmer in their neighbourhood who grows and cures crops. They should use the "Interview questionnaire" found under **Topic 1.1 Task 4** to guide their interviews and record their findings to the questions.

Application Activity

1. Ask trainees to turn to **Topic 1.1 Task 4** in their Trainee Manuals.

2. Conduct a brief discussion asking volunteers to share their findings from the interview. Consider if this should be done in the classroom prior to leaving for the field visit or could be done while at the field site in order to save time.

3. Explain that the purpose of the field visit is to verify the knowledge they have gained during this learning outcome.

4. Go over any important safety, hygiene, and environmental standards before beginning the practical experience (SHE standards).

5. Facilitate the field visit with a local community farmer or agriculture organization so that the trainees gain real, hands-on, and practical on how to cure crops according to the arrangements already made with the site manager. Each student should be allowed to work with their hands and test out practical curing related techniques under your guidance and the guidance of farm staff.

6. After the field visit have trainees discuss their findings in small groups and then as the entire class using the question below, which is also in their manual:

a. Compare your practical experience with the findings you recorded in your interview. Does your practical experience match the situation described by the farmer?

7. Conclude by summarizing key points and clarifying any uncertainties that arise.

Note: This activity focuses on a field visit to an agricultural job site. Therefore, the manager of the site should be contacted and notified well in advance about the proposed activity. In general, it can be helpful to explain what exactly you as a trainer hope the students will get out of the field visit and agree with the manager upon all of the details. Arrangements to be considered include but not limited to the following setting a date, duration of visit, transportation logistics, safety and precautions, and any follow up items after the field visit is complete.

Adaptation: If there is no job site available or the season is not appropriate for postharvest activities then a demonstration should be arranged at the school using the closest materials and produce available to what would actually be used on the job. This demonstration should allow trainees to gain as much practical knowledge and experience as possible.

Points to Remember

- Curing occurs immediately after harvesting and differs according to the type of crops.
- Curing times depends on humidity, the types of plant involved and the water content of plant.
- Curing is important because it helps crops last longer during storage.

Formative Assessment

1. List three kinds of crops that are curable.
Answers:
a. Tuber crops (e.g. Potatoes)
b. Root crops (e.g. Sweet potatoes, cassava root
c. Blub crops (e.g. Onions, garlic)

Answer the following True/False questions. If true, write “true”. If false, write in the correct answer:

2. Crops are usually cured to make them taste better.
Answer: False, crops are usually cured to increase their storage life.

3. Curing crops is a way to quickly sell your crops after harvest.
Answer: False, curing crops takes some time after harvest but will allow the crops to last longer in storage and may allow for more opportunities to sell in the future.

4. Potatoes should cure at a lower temperature than other crops.
Answer: True

5. All crops cure at a high (i.e. close to 100%) relative humidity.
Answer: True

Learning Outcome 1.2: Perform postharvest handling operations prior to packaging

Objectives: By the end of the learning outcome, trainees will be able to:

a. Identify sufficiently dried crops
b. Explain grain drying systems
c. Perform grain cleaning

Time Required: 5 hours

Learning methodology: Group discussion, brainstorming, practical exercise, and demonstration.

Materials Needed:

- **Standard training materials -** flip chart, markers, tape, A4 paper
- **Various harvested produce -** examples of maize on the husk in both qualities: sufficiently dried, insufficiently dried,
- **Maize drying materials/systems**: various examples which are available and relevant to your area
- **Testing materials for maize-** salt, cups, and teaspoons

Preparation:

- ❑ Procure materials for application activity: corn.
- ❑ Prepare a room for the maize drying and test.

Cross Cutting Issues:

- ✓ **Gender:** While forming the groups for group discussion and practical exercise, make sure both females and males are represented. Emphasize that farming can be done by both men and women.
- ✓ **Environment and sustainability:** While dealing with crop waste, emphasize the need to protect the environment through proper disposing of waste materials.
- ✓ **Standardisation Culture:** While performing postharvest handling operations emphasize the need to follow set standards or requirements.

Prerequisites:

- Basic reading and writing skills
- Basic numeracy and arithmetic skills

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe postharvest handling operations for cereals	**1.** Plan for and perform drying of cereals on various drying systems	**1.** Proactive
2. Explain grain drying testing methods	**2.** Test maize to ensure sufficiently dryness	**2.** Attention to detail
3. Explain how to clean cereals and utilize dumped produce	**3.** Clean cereals by dehusking maize or threshing grain	**3.** Methodical

Steps:

Getting Started: What do we know and where are we going?

1. Ask trainees to turn to **Topic 1.2 Task 1** in their trainee manuals. With the person next to them they should have a look at the illustrations above and brainstorm the following:
   a. What does each illustration represent?

   b. Together, what process do these illustrations show happening?

   c. Has this ever occurred to you or someone you know?

2. Conclude by asking volunteers to share their thoughts and then introduce the learning outcomes in the Key Competencies table. Read them together and ensuring everyone understands.

   Possible Answers: The illustration shows what someone does after they have harvested their crops. In one part of the illustration he has brought his crops to market and they have been accepted, while in the other they have been rejected. At the end of the illustration sequence the farmer is cleaning his rejected grain crop so that he may return to the market and receive payment for his crop.

Problem Solving Activity

1. Ask trainees to turn to **Topic 1.2 Task 2** in their Trainee Manuals.

2. Ask each trainee to pair up with a partner and read the following scenario:

Kagabo is a maize farmer in your district and is preparing to harvest his maize crop. What are some things he can do now to ensure he is prepared to handle his crops after harvesting?

3. After ensuring that everyone has understood the scenario, instruct the trainees to make a list of problems that Kagabo might encounter after harvesting his maize as well as what actions he could take in order to avoid or overcome them.

4. Allow time for trainees to discuss with the partner and generate their list.

5. Re-join the class and ask a few volunteers to share their responses with the large group and discuss.

6. Encourage trainees to ask questions for clarification and provide it where needed, referring to the **1.3 Key Facts**.

Possible Answer: Planning for post-harvest operations is key to producing a good final product. A potential problem when harvesting grains and maize is damage that rain can cause. Therefore, he should create a plan for how the maize will be dried. Planning for transport of crops is also important. Maize should be taken to a homestead as soon as possible after harvesting. Diseased cobs can spread infection to others and should be dumped from the harvest. These can be fed to livestock. Animals such as livestock or small rodents will eat the maize if they have the chance, therefore, measures should be taken to safely store the cereal crops.

Guided Practice Activity

1. Ask trainees to turn to **Topic 1.2 Task 3** in their trainee manuals.

2. Divide the trainees into groups of three or four. In their groups ask them to read the following scenario and prepare a list of helpful recommendations:

Kagabo, the maize farmer mentioned in the previous **Problem Solving Activity**, is looking for help. After he harvested his crop, he delivered it to a nearby mill a few days later because he really needed the money. Surprisingly to Kagabo, his produce was deemed substandard and rejected by the procurement department of the mill. When Kagabo asked why this was the case, the mill inspector answered that his maize was not sufficiently dry and therefore was unacceptable. Now he wants to make sure that the next season's crops do not get rejected by the mill again. He has brought some of the maize still on the husks and wants your help to dry them.

3. Instruct the trainees to make a group list of maize drying recommendations for Kagabo to follow after harvesting.

4. Instruct them to review the information in the **1.3 Key Facts** to supplement their answers.

5. Guide the groups as they encounter questions.

   Possible Answer: Kagabo may have tried to turn in his crops before they had properly dried, therefore, he should pay particular attention to drying his crops according to the following recommendations:
   - Maize drying is most effective in drying racks where maize cobs are hung and suspended.
   - If racks are not available maize can be placed on a mat, tarpaulin, or in a sack during harvesting to dry them as soon as possible.
   - Ethephon can be applied to increase resistance during storage.
   - He should check the moisture level of his crops every few days outlined in the **1.4 Key Facts.**

6. Facilitate a small sharing round where each group presents their recommendations.

7. Once discussions are complete proceed to a demonstration of how maize is dried. Depending on the drying systems available and relevant to your area, demonstrate several methods for drying maize.

8. After the demonstrations, distribute an appropriate amount of dried maize cobbs to each group.

9. Explain to trainees that due to time constraints, they are learning how to use maize drying systems with already dried maize because they will use this in the next lesson. Undried maize can take between four to eight weeks to dry.

10. Instruct the trainee groups to engage in the practical task of drying grains, through various methods, e.g. hanging maize on racks, placing them on a mat, tarpaulin, or in burlap sacks, guiding them when they run into difficulties.

11. These cobbs will be used in the following lesson.

Application Activity

1. Ask trainees to turn to **Topic 1.2 Task 4** in their trainee manuals.

2. Read the scenario and together as a class:

Kagabo has now handled his harvested crop according to your recommendations and received a premium price at the market. However, he has a friend Bigubi, who also grows maize crops and needs help. Bigubi was in a hurry after harvesting his maize and left most of his in burlap sacks lying in the field. Compare Bigubi's crops to those of Kagabo's which you have helped dry in the previous activity.

3. After ensuring that everyone understands the scenario divide the trainees into groups of three or four people.

4. Instruct the groups to read instructions 2-10 in their trainee manuals as a group and ensure that each group understands their task.

5. Briefly demonstrate how to perform the proper technique of dehusking maize.

6. Distribute undried cobs of maize from Bigubi's harvest to each group.

7. Then distribute Kagabo's dried cobs from the previous lesson instructing the students to keep the samples separate and record which one is which.

8. Instruct the groups to prepare two samples by dehusking the maize from Bigubi's and Kagabo harvest.

9. Have groups randomly label one sample A and the other B.

10. While on a separate piece of paper they should record which samples belong to who, keeping the answers a secret.

11. Instruct the groups to test another groups samples by performing the moisture tests outlined in the **1.4 Key Facts** for both samples of maize.

12. Inform the groups that everyone should get a chance to try the different testing methods.

13. When the testing is finished, inform the groups they are to discuss who they think the samples belong to.

14. Facilitate a class discussion where the groups share their conclusions, record each group's hypothesis on a black board or flip chart. It may help to assign the groups numbers. (e.g. group 1 tested group 3's samples and thought sample A belonged to Bigubi while sample B belonged to Kagabo.

15. Once all groups hypotheses are recorded, have the groups reveal the correct answer from their sheets. (e.g. For group 3, sample A belonged to Bigubi while B sample belonged to Kagabo. Therefore, group 1 correctly identified the maize).

16. Finally conclude the lesson by having trainee reflect on possible places where they could store grain for drying after harvest in the future. Try to connect this reflection to identifying possible income earning opportunities in the future.

Points to Remember

- Keeping cereals dry immediately after harvest is essential for ensuring their quality.
- Damaged grains should be burnt or fed to livestock.
- You can test the dryness of a maize by chewing it in your mouth. A reasonably dry grain of maize will crush without leaving a pasty feel in the mouth.

Formative Assessment

1. Answer the following True/False questions. If true, write "true." If false, write in the correct answer:

a. Harvesting grains should happen on a rainy day so the grains do not get too much sun.
Possible Answer: False, harvesting grains should happen on a sunny day.

b. Damaged or mouldy grains should be removed with the chaff and burned.
Possible Answer: True.

c. Beating the grains with sticks during the shelling process will improve the quality of the grains.
Possible Answer: False, this will damage the grains.

2. Explain one simple way to test the dryness of maize.

Possible Answer: You can test the dryness of maze by chewing some grains in your mouth or by placing them in a clean dry glass and checking for salt after shaking and letting it sit for some time.

3. Think about your own home, make a list of possible places where you could store grain for drying after harvest if you decide to grow grain crops in the future.

Possible Answer: answers will vary depending on the trainee's own living circumstances, however they should reflect an understanding that locations which are dry, in sunlight, away from animals and protected from rain are optimal.

Learning Outcome 1.3: Sorting and grading produce according to market standards

Objectives: At the end of the learning outcome, trainees will be able to:

a. Describe sorting techniques
b. Identify grading methods
c. Define grading standards/ attributes according to market standards

Time Required: 5 hours

Learning Methodology: Group discussion, brainstorming, practical exercise, other possibilities: field visit and demonstration.

Materials Needed:

- **Standard training materials -** flip chart, markers, black/white board, chalk, tape, A4 paper
- **Materials related to grain sorting -** unsorted grains**;** maize, soybean, roots such as cassava roots and, grading table, sorting table, sieve, sacks
- **Materials related to grain grading -** scale, base pan

Preparation:

- ❑ Contact a famer who grows grains and a mill in your neighbourhood in region in order to facilitate a field visit for trainees who do not manage to schedule an appointment independently.

Cross Cutting Issues:

- ✓ **Gender:** While forming the groups for group discussion and practical exercise, make sure both females and males are represented.
- ✓ **Environmental sustainability:** While Sorting and grading produce., emphasize the need to protect the environment through proper disposing of waste materials.
- ✓ **Standardisation culture:** While sorting and grading produce, emphasize the need to follow set standards or requirements.

Prerequisites:

- Basic reading and writing skills
- Basic numeracy and arithmetic skills

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe sorting techniques	**1.** Sort produce with sieve and hand pick grains	**1.** Proactive
2. Identify grading methods	**2.** Identify foreign matter and defects in produce	**2.** Methodical, detail oriented
3. Define grading standards/ attributes according to market standards	**3.** Assess produce according to market standards and test for quality assurance	**3.** Result oriented

Steps:

Getting Started: What do we know and where are we going?

1. Ask trainees to turn to **Topic 1.3 Task 1** in their trainee manuals.

2. Put trainees in small groups.

3. Ask each group to have a look at the illustration above in their trainee's manuals. Each group should analyse the illustrations and answer questions below

a. What are the workers doing in the illustration above and why?

b. What is the difference between the coffee on the table and the coffee entering the sac?

c. In general, what helps us determine the quality of a product?

Possible Answers:

b. the coffee in the sack is sorted while the coffee on the table may contain beans or other matter that is undesirable

c. standards, grades, measuring of qualities, selection processes

4. After the discussions, ask each group to share their work/answers with the rest of the class. As groups present their work, encourage other trainees to ask questions and add anything they have observed.

3. Conclude by introducing the learning outcomes in the Key Competencies table. Read them together and ensuring everyone understands that this learning outcome/session is all about sorting and grading produce.

Problem Solving Activity

1. Ask trainees to turn to **Topic 1.3 Task 2** in their trainee manuals.

2. Ask each trainee to pair up with their partner and read the following scenario:

KOPACA is the cooperative operating in Kirehe district, it has over 4 ha cultivated maize, and it has received an order from MAITECH Flour Processing Co. to supply four metric tons of maize. However, upon delivery to the processing plant, inspectors were not pleased with the product. They claimed that the cooperative provided an uneven and poor-quality grade of maize that would not make good flour. In the end the company paid KOPACA a lower price compared to one they had hoped for.

a. What might the cooperative have done wrong that caused the maize to fetch a lower price than expected?

b. Brainstorm some characteristics of grain that are desirable.

c. Have you ever seen someone sorting grains? Describe how it looked to you.

d. What might be some ways to grade the standards of different grains?

3. Encourage trainees to ask questions for clarification

4. Provide clarification where needed, referring to the **1.5 Key Facts**

Possible Answer: The grain should have been sorted and cleaned for high quality. This means that there is no chaff, broken, or contaminated grains included in the grain stock. By using a sieve broken grain and dust can be separated from the desirable intact grain. The retained grain should have been handpicked to remove discoloured, rotten, and diseased grain. Additionally, sampling and testing could be done before delivering to ensure high quality.

Guided Practice Activity

1. Ask trainees to turn to **Topic 1.3 Task 3** in their trainee manuals.

2. Divide trainees into groups of four.

3. Demonstrate for the entire class the proper technique of sorting grain with a sieve emphasizing key points to keep in mind.

4. Give each group 3 kg of unprocessed grain (i.e. mixed with chaff, foreign matter, and broken grains). Tell trainees to perform the following tasks in their groups while documenting their experience:
   a. Select appropriate sieve
   b. Sort grain
   c. Hand pick for quality assurance

5. Attend to groups as they carry out the tasks and give assistance where needed.

6. Once all groups are finished, call their attention back to you and perform a demonstration of how to calculate amount of foreign matter.

7. Then have each group calculate and determine the foreign matter of another group's grains.

8. Once the foreign matter is calculated have the groups assign a grade to their own grains by referring to **1.5 Key Facts**.

9. Ask groups what they could do to improve their samples.

10. Make sure to highlight working process of the groups which produced the highest grade of grain.

Application Activity

1. Instruct the trainees that they will perform independent interviews with members of their community. Refer them to **Topic 1.3 Task 4** in their manuals.

2. Tell trainees to visit a famer in their neighbourhood who grows cereal crops and discuss with them how they perform post-harvest handling of their produce. Trainees should use their previous experience from sorting cereal grains to focus their discussions around any problems or difficulties the farmers have experienced and ways they have overcome them. Specifically ask about methods they use in order to ensure the quality of their grain they plan to sell.

3. Then, tell trainees to interview a manager at a local mill about how produce is graded there. Specifically ask about the methods they use to ensure the quality of grain they intend to buy.

4. Trainees should prepare a report after the visit which compares the results of their interview with the points discussed during class.

5. Facilitate opportunities for sharing individual findings of trainees with the entire class.

   Note: This activity involves trainees independently interviewing members of their community. Some trainees may need help in reaching out to such members therefore contacts should be arranged and prepared in advance about the proposed activity. In general, it can be helpful to explain what exactly the task of trainees is and agree with the community member upon relevant details. Arrangements to be considered include, but are not limited to, the following: setting a date, duration of visit, transportation logistics, safety and precautions, and any follow up items after the visit is complete.

   Alternative activity: If it is the appropriate time of year, organise a class visit to a farm in order to help with sorting and weighing.

Points to Remember

- Grains always need to be sorted and cleaned for high quality.
- A sieve is used to sort grain.
- Removal of discoloured, rotten and diseased grain will always require hand picking.
- The higher the grain quality the better price it usually receives at market.

Formative Assessment

1. Describe two ways which can improve substandard grains.
Answers: sorting with a sieve, handpicking

2. Have the trainees fill in the correct answer by writing true or false. If the answer is true write "true." If the answer is false, fill in the correct answer

a. Sorting grain often starts with hand picking diseased grain.
Answer: False, sorting grain often starts by running the grain over a sieve.

b. Defects are undesirable matter contained in grain.
Answer: True.

c. The calibre of the grain sieve should be 3.5 mm.
Answer: False, the calibre of the grain sieve should be 4.5mm.

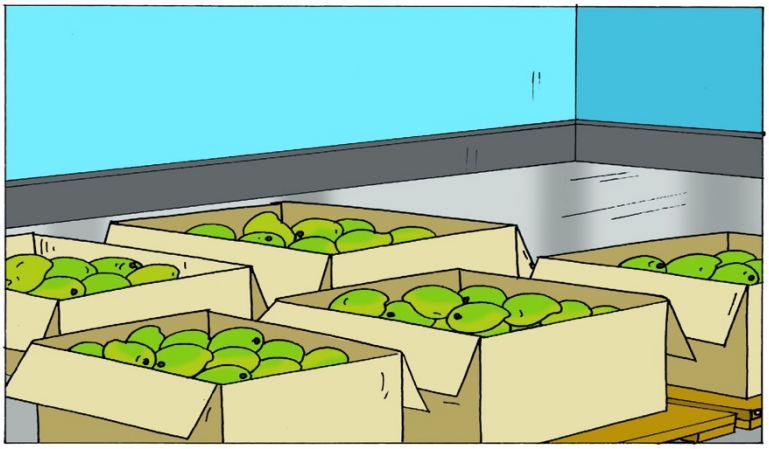
d. Grade 3 grain contains the least amount of defects?
Answer: False, Grade 1 contains the lease amount of defects.

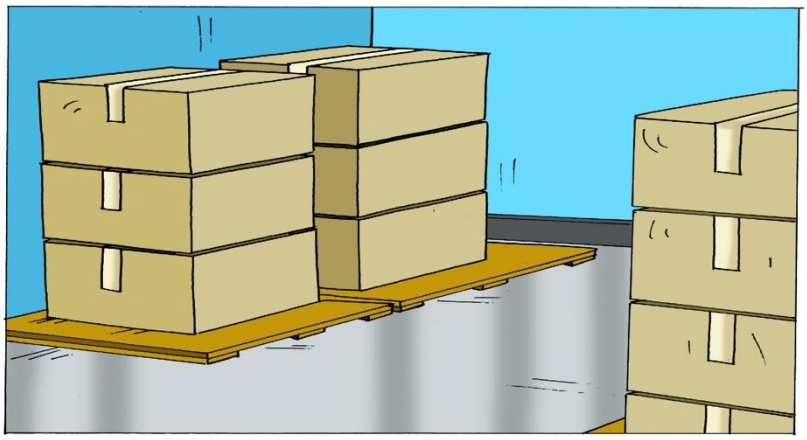
Self-Reflection

1. Ask trainees to re-take the self-assessment from the beginning of the unit. They should then fill in the table in the trainee's manual to identify their areas of strength, areas for improvement and actions to take to improve.

2. Discuss trainees' results with them. Identify any areas that are giving many trainees difficulties and plan to give additional support as needed (ex. use class time before you begin the next learning outcome to go through commonly identified difficult concepts).

Learning Unit 2: Perform packaging





Learning Outcomes

By the end of the Learning Unit, trainees will be able to:

2.1 Select and acquire packaging materials

2.2 Package produce following requirements

2.3 Identify cooling methods following instructions and crop requirements

Learning Unit 2 Self-Assessment

1. Ask trainees to observe the illustration above (in their trainee manuals) and discuss what they see. What topics do they think this unit will include based on the illustration? After some brainstorming, share the main topics.

2. Ask trainees to fill out the self-assessment at the beginning of the unit in their trainee manuals. Explain that the purpose of the self-assessment is to become familiar with the topics in the unit and for them to see what they know or do not know at the beginning. At the end of the unit, they will do a self-reflection, which includes re-taking the self-assessment and identifying their strengths, areas that need improvement and actions to take. The self-assessment is not a test!

Learning Outcome 2.1: Select and acquire packaging materials

Objectives: By the end of the learning outcome, trainees will be able to:

a. Explain the requirements of packaging and its functions
b. Describe different types of packages materials for agriculture produce
c. Evaluate criteria for selecting a packaging

Time Required: 5 hours

Learning Methodology: Group discussion, brainstorming, practical exercise, other possibilities: field visit and demonstration.

Materials Needed:

- **Standard training materials -** flip chart, markers, black/white board, chalk, tape, A4 paper
- **Various packaging materials:** jute, plastics, paper, wood, sacks –fibreboard boxes and corrugated fibreboard cases, plastic crates, baskets, tables and gloves.
- **Various local produce:** avocados, bananas, tomatoes, passion fruit, mangos, etc.

Note: You may choose to coordinate with a local agribusiness company that deals with exporting agriculture produce. They may be willing to source the above materials or allow for a field visit in coordination with the role playing activity.

Preparation:

- ❑ Acquire produce and packaging materials.
- ❑ Contact marketing officer to discuss with him/her types of packages they most use and how they do select the packages materials for agriculture produce.

Cross Cutting Issues:

- ✓ **Gender equality:** While forming the groups for group discussion and practical exercise, make sure both females and males are represented. Try to stress gender norm critical perspectives when dealing with traditionally labour roles.
- ✓ **Environment and sustainability:** While selecting and acquiring packaging materials, consider the need to protect the environment by selecting and acquiring degradable materials where possible.
- ✓ **Standardisation culture:** While selecting and acquiring packaging materials, emphasize the need to comply with set standards or requirements.

Prerequisites:

- Basic reading and writing skills
- Basic numeracy and arithmetic skills

Key Competencies:

Knowledge	Skills	Attitudes
1. Explain the requirements of packaging and its functions	**1.** Select appropriate packaging materials according to market requirements	**1.** Self-confident
2. Describe different types of packaging materials for agriculture produce	**2.** Use appropriate packaging materials to maintain the quality of produce	**2.** Attentive
3. List criteria for selecting a packaging	**3.** Apply criteria when selecting packaging	**3.** Accurate

Steps:

Getting Started: What do we know and where are we going?

1. Ask the trainees to turn their training manuals to **Topic 2:1 Task 1** and reflect upon the following:

a. What kinds of horticulture crops and produce i.e. fruits or leafy vegetables are grown in your area?

b. How are they transported? By car, by bike, by foot?

c. Why is some produce transported differently than others?

2. Ask some trainees to share their responses.

3. After the discussion, ask trainees what topic this activity relates to.

4. Introduce the learning outcomes and have trainees turn to the Key Competencies table in their training manual and review the learning outcomes together.

Possible Answer: Certain produce requires different kinds of handling and protection, for example, tomatoes are a delicate fruit and must be handled more gently than passion fruit. Some methods for transporting produce come down to cost and means available, bicycle transport may damage some produce however it may be the only economically viable method.

Problem Solving Activity

1. Have the trainees find a partner and read the following scenario in **Topic 2.1 Task 2** and respond to the questions:
   a. You have just finished harvesting some delicious bananas and they are so good that you want to share them with a friend or family member who is living far away in another province or even another country. What would you do? How could you make sure that the banana arrives to this person while it is still ripe?

   b. Consider other produce that is commonly grown in your area, e.g. mangos, passion fruit, or avocados etc. How might sending these fruits be different? Make a list of things that should be considered when sending different fruits.

   c. Brainstorm with a partner and make a list of your ideas.

2. Call on volunteers to share their ideas.

3. Record the brainstorm on a flip chart or black board.

4. Conclude the session referring by trainees through the **2.1 Key Facts.**

Possible Answers:

a. You could use appropriate packaging to transport the bananas e.g. polyurethane films if transporting bananas to other countries.
b. Mangos, avocados, and passion fruit can be transported in plastic crates if they are being sent within Rwanda, however if being transported outside of Rwanda they will require different packaging.

Guided Practice Activity

1. Divide trainees into different groups of three.

2. Asks trainees to perform the following scenario and instructions found in **Topic 2.1 Task 3:**

   After packaging and sending some of your extra produce to friends, a local fruit buyer notices your work and contacts you about growing your business. She can help sell your fruit to other provinces in Rwanda. You have prepared your farm for the next season to

increase production but first you must also show that you can package your produce according to market standards.

3. Instruct the trainees to answer the following questions:
   a. In your group think of three horticulture crops, i.e. fruits or leafy vegetables grown in your area and decide which ones you could consider growing in the future.

   b. What packaging materials would be best for transporting them and why? (Consider that the packaging may be different depending on the produce.)

   c. Discuss the pros and cons of your packaging selection.

   d. Now consider how your packaging selection may change based on sending the various produce to different locations.

   e. Would you choose a different package for sending produce to another country compared to sending it to another province?

   f. It may help to think about how you prepare differently for different types of longer journeys to different locations. What challenges do you face and how do you prepare to overcome them?

4. Facilitate a group discussion among the different groups identifying potential misunderstanding while highlighting best practices.

5. Conclude the session by taking trainees through the **2.2 Key Facts.**

Application Activity

1. Before the activity, **Topic 2.1 Task 4**, prepare several packaging stations with various packaging materials and produce. Ensure that each station has both examples of appropriate and unsuitable packaging materials for the produce to ensure students can demonstrate knowledge of selection criteria.

2. Divide trainees into groups of three.

3. Read the following instructions together and explain the role playing activity:
   a. There are three roles: the fruit buyer, the farmer, and an observer.

b. Pick one person to play the farmer who will package the fruit, another person to play the role of the fruit buyer, who will buy the fruit (only on the condition that it in the correct packaging). Finally, the third group member observes the process and gives feedback at the end of the role play session.

c. Provide each group with various fruits or vegetables and different types of packages.

d. Role play is as follows: The farmer should select the appropriate packaging for a particular piece of produce and then properly package it. The fruit buyer should inspect the produce to ensure that the correct packaging is selected and will hold up during the journey according market standard. If the packaging is up to market standard the buyer makes an offer to the farmer based on quality standards covered in this learning outcome. If not, the farmer must repackage the produce correctly. The observer should watch the two others in order to make sure both are role playing according to the standards addressed in the unit.

e. Once each group member has played a role the activity is finished.

4. Once everyone understands the task commence the role play.

5. Observe different groups to ensure role playing is done correctly.

6. Once all groups have finished, conclude the activity by discussing any interesting perspectives or issues that arose during the role play.

Points to Remember

- Different produce requires different kind of protection and space when traveling.
- Price, durability, reusability and protection are key factor to consider while choosing the correct packages for different produce.
- For domestic markets, plastic crates provide excellent protection for produce and adequate ventilation during handling, cooling, transport, and storage.

Formative Assessment

Set up a display of several different produce which some of which a properly packaged and some of which are improperly packaged for transportation.

1. From the display of produce, select the incorrectly packaged produce and explain why it is not suitable for transportation.

2. List three of the most important criteria when selecting appropriate packaging for produce:
   a. **Answer:** Availability
   b. **Answer:** Cost
   c. **Answer:** Dimensions are suited for transport

3. Answer the following True/False questions. If true, write "true." If false, write in the correct answer:
   a. Plastic crates are a poor packaging option for the domestic market.
      Answer: False, plastic crates are well suited for transporting produce within Rwanda.

   b. Containers are used to transport large quantities of produce.
      Answer: True.

   c. When transporting containers to distant or international markets, a shipping container is usually used.
      Answer: True.

Learning Outcome 2.2: Package produce following requirements

Objectives: At the end of the learning outcome, trainees will be able to:

a. Recognize conditions of individual packages such as filling capacity
b. Identify hygienic conditions of packages
c. Identify key aspects of labelling

Time Required: 10 hours

Learning Methodology: Group discussion, brainstorming, practical exercise, field visit, and demonstration

Materials Needed:

- **Standard training materials -** flip chart, markers, black/white board, chalk, tape, A4 paper
- **Various packaging materials -** jute, plastics, paper, wood, sacks, fibreboard boxes and corrugated fibreboard cases, plastic crates and baskets, markers, tables and gloves.
- **Bulk quantities of unpackaged coffee**
- **Drawing materials**

Preparation:

- ❑ Arrange a field visit to a coffee packaging site.
- ❑ Set up drawing materials for the label design activity in **Task 3** of this learning outcome.

Cross Cutting Issues:

- ✓ **Gender equality:** While forming the groups for group discussion and practical exercise, make sure both females and males are represented.
- ✓ **Environment and sustainability:** While conducting practical exercise the trainees should always be cautioned on environmental; issues specially while disposing the waste used**.**

Prerequisites:

- Basic reading and writing skills
- Basic numeracy and arithmetic skills

Key Competencies:

Knowledge	Skills	Attitudes
1. Recognize conditions of individual packages such as filling capacity	**1.** Measure and fill accurately the quantity required for package	**1.** Diligent
2. Identify hygienic conditions of packages	**2.** Practice hygienic conditions measures while packaging	**2.** Accurate
3. Identify key aspects of labelling	**3.** Produce appropriate package labels	**3.** Creative

Steps:

Getting Started: What do we know and where are we going?

1. Put trainees into pairs.

2. Ask each pair to observe the illustration above in their trainee's manuals in **Topic 2.2 Task 1**. Each group should analyse the illustration and answer the questions below:

a. What do you think is happening in the picture above?

b. What are the people wearing?

c. Why do you think they are wearing such uniforms?

d. Have you ever seen a scenario similar to this?

e. Describe where it was.

3. After the discussions, have each group share their answers with the rest of the class. As groups present their work, encourage other trainees to ask questions and add anything they have.

4. Conclude by referring the trainees to the learning outcomes in the Key Competencies table in their training manual and review the learning outcomes together.

Problem Solving Activity

1. Ask trainees to read the following scenario carefully in **Topic 2.2 Task 2**.

The Twongere Umusaruro cooperative in Kayonza district wants help training their employees. There are many new employees in coffee packaging who have never been trained in hygiene procedures. They want you to help make a training manual. Identify the images you think best show proper hygiene practices for coffee packaging. Pick five images and prioritize them from most to least important.

2. Have the trainees generate three more ideas of their own for images that would best express proper hygiene on a packaging line.

3. Tell each trainee to turn to his/her partner and share their ideas.

4. Choose some pairs to share to the rest of class their findings.

5. Conclude the lesson by referring the trainees to the **2.3 Key Facts**.

Possible Answers: Will be subjective in nature however, emphasis that students need to justify their choice by explaining why one image was more important than the other.

Guided Practice Activity

1. Inform the trainees that their task is to design and draw a label based on the following scenario found in **Topic 2.2 Task 3**.

Twongere Umusaruro cooperatives in Kayonza district pays an exporter fee when selling their coffee abroad. They have decided that they want to gain more money by exporting their washed unroasted coffee bean product themselves. They plan to use 50kg bags but their buyers are complaining that they have no way of identifying the cooperative's product or to distinguish between different types of coffee beans. For example, beans from the Nyampinga plantation are selling for a price of 600rwf per kg while the Kayonza plantation product only fetches 400Rwf per kilo. All coffee produce is high grade Arabica bean. The cooperative needs your help in designing an appropriate label for their coffee.

2. Once everyone has understood the instructions distribute drawing materials that have been prepared at the beginning of the lesson.

3. Once trainees have finished drawing their label, ask volunteers to present their work.

4. Highlight examples that have effectively included product price, quantity or net weight, best before date, brand name, and/or special handling instructions.

5. Have trainees collect examples of packaging and labels which they think are good. Inform them that they should bring their examples to the next class or take a photo of them using a phone.

Lesson Additions: It could also be good for trainer to show real examples of packaging.

Application Activity

Organise a field visit to a local cooperative which packages coffee. Inform the trainees that as described in **Topic 2.2 Task 4**, they will observe a demonstration by coffee packaging worker.

1. Arrange for a worker in the group to demonstrate the following aspects of coffee packaging related operations.
   a. Hygiene practices: both employee hygiene and package hygiene inspection.

   b. Correctly filling and weighing packaged products.

   c. Seal and label packages correctly (if applicable).

2. After the demonstration has been performed, instruct the trainees to begin trying to package the coffee by themselves. They should do the following tasks:
   a. Practice hygienic procedures before, during, and after working on the jobsite.

b. Inspect packaging before filling to prevent contamination.

c. Pay special attention to fill capacities and amounts.

d. Practice measuring the correct amount of product and filling the package accordingly to ensure that the correct amount is included.

e. Seal and label the package correctly (if applicable).

3. Observe students to ensure they are following correct practices and procedures.

4. Reconvene trainees to briefly discuss their reflections about the practical experience. Allow them to interview a worker from the packaging house or station. Encourage them to ask as many details concerning packaging as needed.

5. Follow up with the previous label and packaging collection activity by having trainees share their labels and packaging with the class.

6. Be sure to ask trainees why they believe it is a good example.

Note: This activity focuses on a field visit to an agricultural job site. Therefore, the manager of the site should be contacted and notified well in advance about the proposed activity. In general, it can be helpful to explain what exactly you, as a trainer, hope the students will get out of the field visit and agree with the manager upon all of the details. Arrangements to be considered include, but are not limited to, the following: setting a date, duration of visit, transportation logistics, safety and precautions, and any follow up items after the field visit is complete.

Points to Remember

- Practice good hygiene techniques before, during, and after working on a jobsite; washing hands, wearing a hairnet and gloves, and cleaning boots can all prevent package contamination.
- Labels have a variety of functions such as price quantity and brand.
- Labels may require extra information depending on if the produce is being sold to an international market.

Formative Assessment

1. Answers the following True/False questions. If true, write "true." If false, write the correct answer.

   a. Modified atmosphere packaging (MAP) is used for packaging large quantities of wholesale coffee?
   Answer: False, modified atmosphere packaging is used for packaging small quantities of consumer products.

   b. Labels usually indicate the quantity of product included in the package.
   Answer: True.

   c. Labels can help increase the chance that a product is sold.
   Answer: True.

   d. You should always pack as much produce into a package as the label shows, to ensure that consumers feel they are getting a good product.
   Answer: True.

Further Information for the Trainer

1. See page 180 in Small-Scale Postharvest Handling Practices: A Manual for Horticultural Crops
2. https://www.researchgate.net/profile/Lisa_Kitinoja/publication/268296178_Small-Scale_Postharvest_Handling_Practices_A_Manual_for_Horticultural_Crops_4_th_Edition/links/551a98da0cf26cbb81a30605/Small-Scale-Postharvest-Handling-Practices-A-Manual-for-Horticultural-Crops-4-th-Edition.pdf
3. Lisa Kitinoja and Adel A. Kader, 2005. Small-Scale Postharvest Handling Practices: A Manual for Horticultural Crops (5th Edition). University of California, Davis

Learning Outcome 2.3: Identify cooling methods following instructions and crops requirements

Objectives: At the end of the learning outcome, trainees will be able to:

a. Outline and apply possible cooling methods at the small scale farm level to ensure good quality of produce

b. Explain and use Zero-Energy Cooling Chamber (ZECC)) to preserve produce quality

c. Explain and use a room cooling system to maintain the freshness of produce

Time Required: 10 hours

Learning Methodology: Group discussion, brainstorming, field visit, practical exercise

Materials Needed:

- **Standard training materials -** flip chart, markers, black/white board, chalk, tape, A4 paper

Preparation:

- ❑ Think about famers in your neighbourhood using any small scale cooling system. Visit one of them and discuss with the owner the implications and results of the system.

Cross Cutting Issues:

- ✓ **Gender and inclusion:** Ensure the diversity in terms of gender, and ability while forming the groups for group discussion and practical exercise, make sure both females and males are represented.
- ✓ **Environment and sustainability:** While conducting practical exercise the trainees should always be cautioned on environmental; issue specially while disposing the waste used.

Prerequisites:

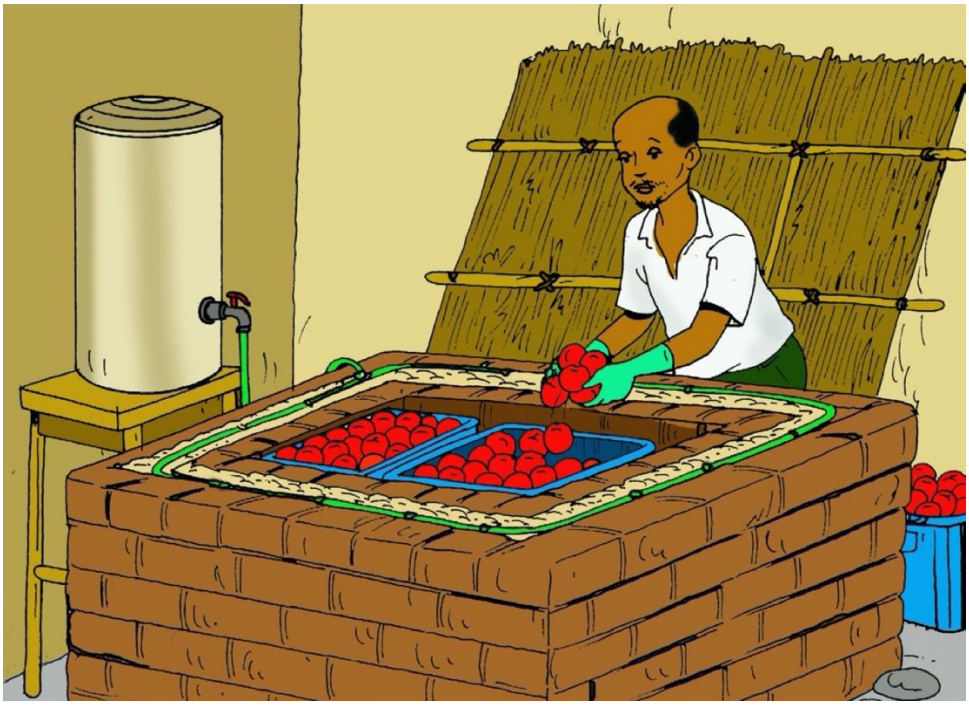
- Basic reading and writing skills
- Basic numeracy and arithmetic skills

Key Competencies:

Knowledge	Skills	Attitudes
1. Outline cooling methods at the small scale farm level	**1.** Apply cooling methods to ensure the good quality of produce	**1.** Methodical
2. Describe a Zero-Energy Cooling Chamber (ZECC)	**2.** Use a Zero-Energy Cooling Chamber (ZECC) to preserve produce quality	**2.** Attentive
3. Explain a room cooling system	**3.** Use a room cooling system to maintain the freshness of produce	**3.** Detail-oriented

Steps:

Getting Started: What do we know and where are we going?



1. Tell the trainees to turn to **Topic 2.3 Task 1** in their trainee manuals and ask them to look at the illustration above and reflect on the following questions:
   a. What do you think is happening in the illustration?

b. Have you ever seen a similar situation in real life?

c. Make a prediction about what this topic will be about.

2. Ask trainees to share their thoughts.

3. After a brief discussion, conclude by introducing the learning outcomes and having the trainees turn to the Key Competencies table. Review it together.

Problem Solving Activity

1. Have the trainees turn to **Topic 2.3 Task 2** in their training manuals and read the following scenario together:

Kamana is a farmer in your neighbourhood who has ventured into farming of tomatoes and his crops have yield a good harvest. However, after negotiating at the market and local restaurants he has only managed to sell off half of his harvest. Now he is afraid that his remaining harvest may be lost if nothing is done.

2. After reading the scenario together, put the trainees in groups of four and ask them to brainstorm what Kamana should do in order to prevent the loss of his unsold tomato harvest.

3. Once the groups have finished brain storming refer them to the **2.4 Key Facts** and instruct them to recommend a cooling system that would be suitable for Kamana.

4. Finally split the entire class into two groups by having them to count off by 1's and 2's.

5. Have the class form two circles asking those who counted number 1 to form the inside circle and the rest of learners to form the outside circle.

6. Instruct the students in the inside circle to share what they think Kamana should do and what type of cooling system would work best to the classmate facing them in the outside circle. When they have done this, ask them to say "pass," at which point their partners in the outside circle will share two things they have learned from the key facts.

7. On your signal, have the outside circle move one step to the left or right and face a new partner. At this point the sharing processes is repeated however the outside student will share what they think Kamana should do while the inside student will share two things they have learned from the key facts.

8. After several rounds of sharing reconvene the class and have the trainees share their answers.

9. Return to **2.4 Key Facts** and review together.

Possible Answer: Tomatoes require immediate and thorough postharvest cooling to remove excessive field heat. Cooling aids greatly in maintaining quality and substantially lengthens the shelf life of the tomatoes. While the optimal cooling method will depend on what Kamana has available to him, forced-air cooling is the most reliable, yet it requires a consistent flow of electricity. Evaporative coolers or using a ZECC is suitable if electricity is not available. Room cooling alone may not provide sufficiently low enough temperatures for cooling the tomatoes.

Guided Practice Activity

1. Have the trainees turn to **Topic 2.3 Task 3** in their training manuals and read the following scenario and determine which cooling system is appropriate for the cured produce and which one is appropriate for the highly perishable produce using the questions bellow:

   Kamana has decided to keep the other half of his tomato harvest by cooling it using a Zero Energy Cooling Chamber or (ZECC). However, when transporting them, the driver has mixed all his tomatoes with other crops and now cannot remember which produce should be placed in the ZECC and which ones can be cooled using a simple room storage method.

2. Ensure that each trainee understands the scenario. Then move onto the questions.

3. Explain to the trainee that their task is to guide the driver by showing him/her which produce should go into which cooling system by writing in the letter indicated next to the photo of a given produce. They should match these letters with the appropriate cooling method.

Answers:

a. All highly perishable produce that should be placed in the ZECC: A. Tomatoes, D. Lettuce, and E. Peppers.

b. All curable produce that should be placed in cool room storage facility: B. Sweet Potatoes, C Onions, F. Irish Potatoes.

Application Activity

1. Arrange a field visit for the trainees on a farm which harvests highly perishable and curable produce and uses both ZECC and cool room storage cooling methods.

2. Have each trainee gain practical, hands-on experience in how to operate the ZECC and cool storage room.

3. Then, tell the trainees to make a list of similarities and differences between the ZECC and cool room storage with the help of a partner.

4. Once each trainee has completed the practical portion and made a list, discuss their findings as a class.

5. Finally encourage students to continuing reflecting on how their new knowledge could help them become employed in the future. Specifically focus their reflections around the following considerations:
   a. Are there any farmers in your area who grow highly perishable crops?

   b. Are they using proper cooling methods to ensure that they are selling the majority of their harvest?

   c. How might your new knowledge about cooling methods help fill a need in the production of crops in your area and create greater value?

   Note: This activity focuses on a field visit to an agricultural job site. Therefore, the manager of the site should be contacted and notified well in advance about the proposed activity. In general, it can be helpful to explain what exactly you as a trainer hope the students will get out of the field visit and agree with the manager upon all of the details. Arrangements to be considered include but not limited to the following: setting a date, duration of visit, transportation logistics, safety and precautions, and any follow up items after the field visit is complete.

Points to Remember

- Zero Energy Cooling Chamber (ZECC) is cooling chamber constructed from bricks and is suitable for highly perishable produce.

- Cool room storage is the simplest cooling method but does not provide adequate cooling for highly perishable produce.

Formative Assessment

1. Answer the following True/False questions. If true, write "true". If false, write in the correct answer:

   a. Potato crops will deteriorate quickly if not adequately cooled directly after harvest.
   Answer: False, highly perishable produce will deteriorate quickly, e.g. tomatoes, cucumbers, peppers, and lettuce.

   b. Highly perishable produce such as tomatoes can be cured in a dry, cool room.
   Answer: False, tubers and bulb crops can be cured in a dry, cool room.

   c. Simplest versions of hydro coolers include a tank of cold water in which produce is immersed.
   Answer: True.

   d. Forced air cooling is the least reliable cooling method
   Answer: False, it is the most reliable.

   e. Night air ventilation storage structures can be cooled using night air if the difference in day and night temperature is relatively low.
   Answer: False, temperature is relatively high.

2. Fill in the blanks:
   a. A ZECC is very practical for places which do not have stable _____.
   Answer: electrification

   b. _____is a method best suited for produce such as such as potatoes, onions, apples, sweet potatoes, and citrus fruits.
   Answer: Cool room storage

Further Information for the Trainer

1. Lisa Kitinoja and Adel A. Kader, 2005. Small-Scale Postharvest Handling Practices: A Manual for Horticultural Crops (5th Edition). University of California, Davis.
2. See pages 105-130 in: https://www.researchgate.net/profile/Lisa_Kitinoja/publication/268296178_Small-Scale_Postharvest_Handling_Practices_A_Manual_for_Horticultural_Crops_4_th_Edition/links/551a98da0cf26cbb81a30605/Small-Scale-Postharvest-Handling-Practices-A-Manual-for-Horticultural-Crops-4-th-Edition.pdf

Self-Reflection

1. Ask trainees to re-take the self-assessment from the beginning of the unit. They should then fill in the table in the trainee's manual to identify their areas of strength, areas for improvement and actions to take to improve.

2. Discuss trainees' results with them. Identify any areas that are giving many trainees difficulties and plan to give additional support as needed (ex. use class time before you begin the next learning outcome to go through commonly identified difficult concepts).

Learning Unit 3: Perform storage

Learning Outcomes

By the end of the Learning Unit, trainees will be able to:

3.1 Clean storage rooms

3.2 Identify storage methods

3.3 Select storage materials

3.4 Store produce

Learning Unit 3 Self-Assessment

1. Ask trainees to observe the illustration above (in their trainee manuals) and discuss what they see. What topics do they think this unit will include based on the illustration? After some brainstorming, share the main topics.

2. Ask trainees to fill out the self-assessment at the beginning of the unit in their trainee manuals. Explain that the purpose of the self-assessment is to become familiar with the topics in the unit and for them to see what they know or do not know at the beginning. At the end of the unit, they will do a self-reflection, which includes re-taking the self-assessment and identifying their strengths, areas that need improvement and actions to take. The self-assessment is not a test!

Learning Outcome 3.1: Clean storage rooms

Objectives: By the end of the learning outcome, trainees will be able to:

- **a.** State tools and materials using while cleaning and maintain storage rooms
- **b.** Describe how to clean and maintain the storage rooms
- **c.** Describe how to maintain the storage structure

Time Required: 4 hours

Learning Methodology: Group discussion, brainstorming, field visit, practical exercise, role play

Materials Needed:

- **Standard training materials -** flip chart, markers, black/white board, chalk, tape, A4 paper
- **Materials for making rat traps**- tin cans, plastic, sheet metals, metal cutters

Preparation:

- ❑ Choose one facility in your neighbourhood and fix an appointment with the farm manager or cleaner focusing on cleaning storage rooms. Ask permission to assist the cleaner.

Cross Cutting Issues:

- ✓ **Gender equality**: while forming the groups for group discussion and practical exercise, make sure that both females and males participate
- ✓ **Environment and sustainability:** While cleaning room you be mindful of not polluting the environment when disposing of wastes.

Prerequisites:

- Basic reading and writing skills
- Basic numeracy and arithmetic skills

Key Competencies:

Knowledge	Skills	Attitudes
1. State tools and materials used for cleaning and maintaining storage rooms	**1.** Use different tools and materials to clean and to maintain storage rooms	**1.** Methodical
2. Describe how to clean and maintain the storage rooms	**2.** Remove trash and infected produce from storage room	**2.** Precise
3. Describe how to maintain the storage structure	**3.** Produce rat guards, check screens, and floors	**3.** Detail-oriented

Steps:

Getting Started: What do we know and where are we going?

1. Tell the trainees to turn to **Topic 3.1 Task 1** and reflect upon the following questions individually:
   a. Think of a storage facility in your neighbourhood or area.

   b. Have you ever been inside of it? What did it look like?

   c. What was it used for and what products did it store?

   d. List some reasons why produce might be kept in storage facilities.

2. Ask trainees what they think this learning outcome is about. Then, introduce the learning outcome and have trainees turn to the Key Competencies table. Review it together.

Problem Solving Activity

1. Ask trainees to turn to **Topic 3.1 Task 2** and think of a time when they had to clean up their house or another place and briefly discuss with a partner the following:
   a. What steps did you have to take to make sure the house was clean?

   b. What tools or cleaning supplies did you use?

   c. What kinds of things did you have to remove from the house to make sure it stayed clean?

2. Later ask the trainees to, brainstorm a list of potential problems that could occur when storing large amounts of grain in one room. Encourage them to generate at least five problems and ways they could be overcome.

3. Conclude the activity by calling on some volunteers to share their ideas with the rest of the class and discussing how these problems could be overcome.

4. Then, refer all the trainees to **3.1 Key Facts.** Read the information together.

Guided Practice Activity

1. Explain to the trainees that this activity, **Topic 3.1 Task 3**, will have them create rat guards and inspect the classroom according to the following scenario:

A grain storage room in your neighbourhood has an infestation of rodents and they need your help! You and your fellow trainees should take measures to rat proof the structure.

2. Read the following instructions out loud ensuring that all trainees understand the activity:

a. Make several rat guards and place them on the table legs of your training centre to ensure that no rats can access the grain stored on the tables.

b. Check all other entry points in your classroom to ensure that no rats can enter from any other points.

c. When you have completed your list of potential entry points, make recommendations on how rat infestation could be reduced.

3. Refer to **3.1 Key Facts** to supplement the trainees' knowledge and perform a demonstration of how to make a rat guard from a used can, sheet metal, or plastic and how it can be attached to a table leg.

4. After, instruct the trainees to go around the room inspecting for and recording points of possible rodent entry.

5. Once all trainees have completed compiling their list, reconvene the class and ask volunteers to share their findings. Have trainees go from point to point indicating each point they found.

6. In the end highlight any points of entry that were missed by students.

Application Activity

1. Prepare trainees to conduct a field visit according to the following prompt found in **Topic 3.1 Task 4**:

   Visit a storage facility in your neighbourhood or surrounding area to verify the knowledge you have gained from the previous practical experience. Your tasks it to carefully observe how the storage room is maintained by staff. You may need to ask questions to staff when they are available. Take special note of any details that may arise.

2. Their observations should be structured around the following points:
   - **a.** What is the size of the storeroom?
   - **b.** How is waste removed?
   - **c.** Locate any points of entry such as windows, drains, and screens. Are they protected?
   - **d.** Are rat guards in use?
   - **e.** Do the staff disinfect the storage room? How?
   - **f.** How do the staff start their work each day and how do they end it?
   - **g.** How are staff certain that their work or task is finished for example cleaning floors or fumigating grain?
   - **h.** How often do staff clean the surrounding area of the storage facility?

3. After the trainees have completed their field study, ask them to share their findings with the entire class.

4. Encourage the students to reflect on how these observations could help them one day work at a storage facility in the future.

5. Additionally, highlight how their newly gained knowledge can lead to identifying and exploiting new possible opportunities. For example, if the storage facility did not use rat guards, could the rat guards be sold and installed for a profit?

Note: This activity focuses on a field visit to a job site. Therefore, the manager of the site should be contacted and notified well in advance about the proposed activity. In general, it can be helpful to explain what exactly you as a trainer hope the students will get out of the field visit and agree with the manager upon all of the details. Arrangements to be considered include, but not limited to, the following: setting a date, duration of visit, transportation logistics, safety and precautions, and any follow up items after the field visit is complete.

Points to Remember

- When inspecting stored produce, any spoiled or infected produce should be removed and destroyed.
- Do not mix new grain with old; old material that must be kept should be thoroughly fumigated.
- Take control measures early to prevent infestation of crops maturing in the field.

Formative Assessment

1. True or false: Answer the following True/False questions. If true, write "true." If false, write in the correct answer:

a. Do not mix new grain with old; old material that must be kept should be thoroughly fumigated.
Answer: True.

b. Inspecting stored produce, cleaning the storage structure, and the surrounding area on a regular basis will help spread disease.
Answer: False, inspecting stored produce, cleaning the storage structure, and the surrounding area on a regular basis will help *prevent* disease.

2. Fill in the blank:

a. Large structures usually require _____.
Answer: chemical treatment

b. Small rural structures can be cleaned by using _____ and making use of the sun.
Answer: smoke

Learning Outcome 3.2: Identify storage methods

Objectives: At the end of the learning outcome, trainees will be able to:

a. State criteria for selection of storage methods
b. Describe different storage methods for different crops
c. Explain bulk and field storage

Time Required: 6 hours

Learning Methodology: Group discussion, brainstorming, field visit, practical exercise, role play

Materials Needed:

- **Standard training materials -** flip chart, markers, black/white board, chalk, tape, A4 paper
- **Map making activity materials**- (if available): recent physical maps of local areas; laptop, tablets, or smartphone with access to google maps; large sheets of paper, makers,

Preparation:

❑ Contact farmers using different storage methods mentioned here and prepare field visit to a storage facility or field storage site.

Cross Cutting Issues:

✓ **Gender equality:** Consider gender while forming the groups for group discussion and practical exercise, make sure both females and males are represented.
✓ **Environment and sustainability:** While conducting practical exercise the trainees should always be cautioned on environmental issues, especially while disposing of waste.
✓ **Standardisation culture:** While identifying storage methods emphasize the need to comply with set standards or requirements.

Prerequisites:

- Basic reading and writing skills
- Basic numeracy and arithmetic skills.

Key Competencies:

Knowledge	Skills	Attitudes
1. State criteria for selecting storage methods	**1.** Select storage methods based on criteria	**1.** Precise
2. Describe different storage methods for different crops	**2.** Select storage methods for different crops	**2.** Self-confident
3. Explain bulk and field storage	**3.** Distinguish between when to use bulk storage and field storage	**3.** Precise

Steps:

Getting Started: What do we know and where are we going?

1. Ask each trainee to turn to **Topic 3.2 Task 1**. In their trainee manuals. Instruct them to find a partner and reflect upon the following question:

a. Have you ever had to keep something safe and secure, for example money, a possession, or maybe a bit of food? If so, how did you do it?

b. Now imagine if you were paid to keep a large amount of such items safe. How would you go about doing this?

c. How would different items determine what you would do to keep them safe?

2. Introduce the learning outcome. Tell trainees to turn to the Key Competencies table and review it together.

Problem Solving Activity

1. Ask each trainee to turn to **Topic 3.2 Task 2** and inform trainees that this activity involves performing a role play with a partner.

2. After the trainees have partnered up, explain the roles of the role play:

a. One small scale farmer producing bulb crops, who is not totally familiar with various storage systems or the cost of storing produce.

b. One bulk storage facility manager at Matima Store Warehouse who wants to sell storage space to local famers.

3. Then, explain the objectives:

a. The small scale farmer wants to store their crops but is not sure if the storage facility will meet their needs. The farmer should ask the manager as many relevant questions as they possibly can to see if the manager's storage facility can adequately store the farmer's harvested crops.

b. The storage manager wants to store the farmer's crops and be paid. However, they must present their facility as having the capacity to meet the needs of the farmer's harvest. The manager must think of how they would present their storage facility so that the farmer agrees to pay for storage.

4. The trainees should role play the scenario until an agreement is met or it is determined that the storage facility does not meet the needs.

5. After the pairs have finished their role play, put each pairs of partners with another pair making a group of four and assign each group a section of the **3.2 Key Facts** below. Divide the Key Facts by how many groups there, while considering that there may be several groups which review the same sections. The Key Facts could be divided into different sections by produce, criteria, and methods.

6. After each group has finished reading the **3.2 Key Facts**, instruct them to discuss how they might make a different decision in light of the new information they have read.

7. Finally facilitate a discussion where each group presents their section of the **3.2 Key Facts** and a brief reflection on how it affected their role playing decisions.

6. Conclude by synthesizing responses and discussing some common storage related problems and issues that this role play helped identify and uncover.

Guided Practice Activity

1. Divide the trainees into groups and ask them to turn to **Topic 3.2 Task 3** in their trainee manuals.

2. Instruct the trainees that they will perform a community mapping activity to help identify different storage methods used in their area.

3. Have the groups choose an area that they are all familiar with and brainstorm a list of as many farms and storage facilities as they can, keeping in mind where they are located.

   Note: You may want to make sure that everyone is familiar with the areas selected if trainees come from a range of different areas.

4. Encourage them rely on their previous field visits and note what produce that is grown at each farm, as well as what methods are used to store the produce.

   Note: You may want to start by demonstrating for the entire class how to begin drawing the map and what things they should consider.

5. Once you feel the trainees have a good idea of what the task involves, instruct them to beginning with one of the locations they have listed, and draw the important features of the surrounding community such as:
   a. Infrastructure: roads and building
   b. geological features: rivers, hills, valleys
   c. Agricultural sites: fields, plantations
   d. The school (if in the area)
   e. Your home (if in the area)

6. Have the trainees add the farms and storage locations from their brainstormed list, indicating where the produce is grown and what methods are used to store them.

7. Once all the groups have finished, have the entire class take turns sharing their maps.

8. After each group has shared their map, conduct a discussion around the following points:
   a. How many farms and storage facilities are present on your map?

   b. What relationships did you notice between where the farms and the storage facilities are located?

   c. How many of each method of storage facility were identified on your map?

   d. What relationships did you notice between what the farms grew and what storage method was used in the area?

9. Keep a summative total of the farms and storage facilities as each group shares their inputs.

10. Encourage the trainees to share different relationships that they observed while pointing out ones that were overlooked.

11. Once the discussion is concluded, encourage the trainees to reflect individually on how the community mapping activity could help them identify potential existing workplaces or an opportunity to create a new storage site that would meet farmers' needs, where there currently is none.

Application Activity

1. Ask trainees to prepare for a field visit to a nearby storage facility and/or field storage site.

2. Explain that their task from **Topic 3.2 Task 4** is to carefully identify which storage methods are being used.

3. Encourage them to ask questions to staff when appropriate and take special note of any details that may arise around the following questions:

a. What are the methods of storage?

b. What produce is being stored?

c. What is the temperature of the facility (or each room if multiple rooms)?

d. How is the air circulated?

e. What is the total capacity of the storage facility?

f. What is the storage capacity for each particular crop?

g. How much does it cost to store produce at the facility?

h. Raise any other relevant questions.

4. Facilitate a discussion which allows trainees to share their observations from the field visit.

Note: This activity focuses on a field visit to an agricultural job site. Therefore, the manager of the site should be contacted and notified well in advance about the proposed activity. In general, it can be helpful to explain what exactly you as a trainer hope the students will get out of the field visit and agree with the manager upon all of

the details. Arrangements to be considered include but not limited to the following: setting a date, duration of visit, transportation logistics, safety and precautions, and any follow up items after the field visit is complete.

Points to Remember

- Storage methods should be determined by cost of storage, the quantity of crop needing to be stored, and the requirements of each crop.
- Underground field storage is an inexpensive and effective way to store crops if transportation is not immediately available or practical after harvest.
- For bulk storage of produce in cartons or bins, stacks must allow free movement of air.

Formative Assessment

1. List three criteria for selecting a storage method.

Answers:

a. cost of storage

b. requirements of each crop

c. quantity of each crop

2. True or false: Answer the following questions. If true, write "true." If false, write in the correct answer:

a. Bulk stored crates of produce should be packed close together to save space and avoid contamination.

Answer: False, bulk stored crates of produce should be spaced 15cm to 17cm apart to allow free movement of air.

b. Potato clamps are a low cost technology that can be designed using locally available materials for ventilation and insulation Inspecting stored produce.

Answer: True.

c. Hermitage storage is suitable for storing bulk grain.

Answer: True.

Further Information for the Trainer

1. For extensive list of storage temperatures for different produce: http://www.fao.org/3/ae075e/ae075e15.htm#storage_temperatures

Learning Outcome 3.3: Select and acquire storage materials

Objectives: By the end of the learning outcome, trainees will be able to:

- **a.** List and select the main materials available in storage
- **b.** Describe materials used in storage
- **c.** Use storage materials
- **d.** Explain the use of storage material
- **e.** Handle storage materials

Time Required: 3 hours

Learning Methodology: Group discussion, field visit, brainstorming, other possibilities: role play and practical exercise

Materials Needed:

- Pallet, sacs, storeroom, Sacks, Wooden crates, Carton or fibreboard boxes, Plastic crates, Baskets, Weighing scale, A sampling spear, Brooms, Tarpaulins
- A real floor plan of a storage room which shows different storage materials (**Note:** if not available then design one)

Preparation:

- ❑ Help students contact storage facilities owners and notify them about visit when needed.
- ❑ Prepare a floor plan of a storage room if a real one is not available.

Cross Cutting Issues:

- ✓ **Gender equality:** While forming the groups for group discussion and practical exercise, make sure both females and males are represented.
- ✓ **Environment and sustainability:** While conducting practical exercise the trainees should always be cautioned on environmental issue especially while disposing the waste used.
- ✓ **Financial education:** Consider reasonable price while selecting and acquisition storage materials for financial.

Prerequisites:

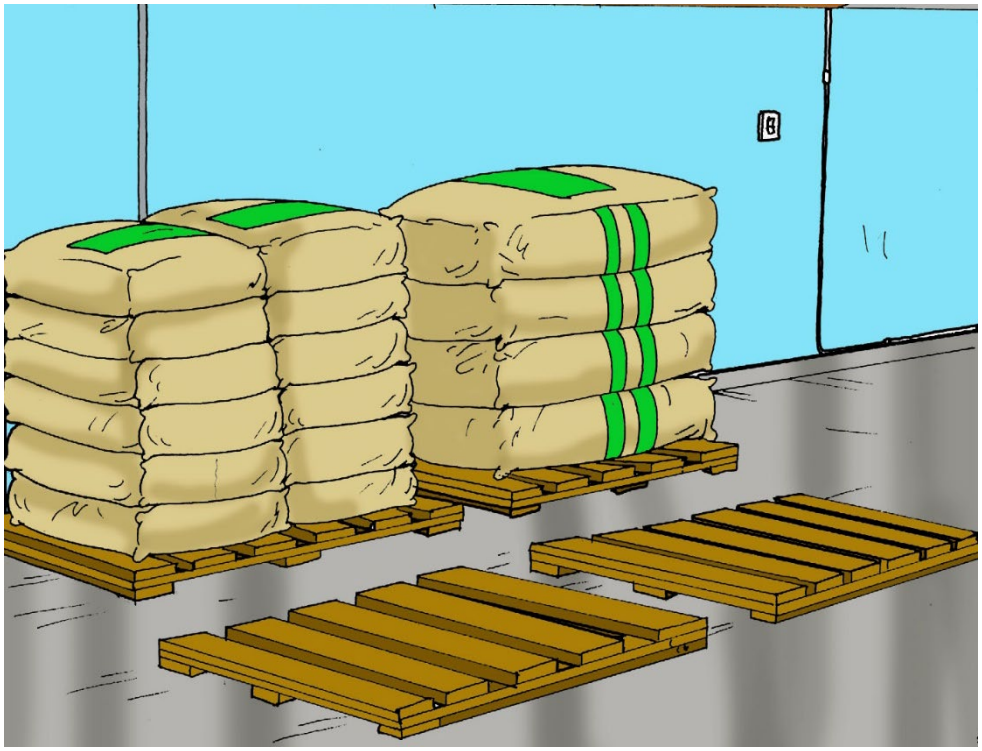
- Basic reading and writing skills
- Basic numeracy and arithmetic skills

Key Competencies:

Knowledge	Skills	Attitudes
1. List main materials available in storage	**1.** Select storage materials	**1.** Self-confident
2. Describe materials used in storage	**2.** Use storage materials	**2.** Attentive
3. Explain the use of storage material	**3.** Handle storage materials	**3.** Respectful

Steps:

Getting Started: What do we know and where are we going?



1. Ask trainees to observe the illustration in their training manual in **Topic 3.3 Task 1** and respond to the following questions:

a. What kinds of agricultural products might be stored in the illustration?

b. Can you think of alternatives ways of storing agricultural products that are not show in the illustration (think back to previous unit)?

c. Brainstorm possible items and materials that may be found in this setting and others.

d. How are agricultural products affected by the materials used for storage and how those materials are used?

2. Ask volunteers to share their responses to the rest of the trainees.

3. After the discussion, ask trainees what topic they this activity relates to.

4. Conclude by introducing the learning outcomes and having the trainees turn to the Key Competencies table. Review it together.

Problem Solving Activity

1. Ask the trainees to open to **Topic 3.3 Task 2** and ask them to read the following scenario:

The new Matima Store Warehouse has a new manager who is not sure what materials she will need in order to properly store the produce which will soon arrive to the storage facility. She does know however, that she plans to receive the following:

- 100 sacks of cassava flower weighing 50k each
- 2 truckloads of unpackaged load potatoes
- 300kg of avocados
- 5 sacks of coffee weighing 25kg each
- 20 boxes of tomatoes
- 1000kg of unpackaged grain
- 500kg of unpackaged onions

She is not sure when these deliveries will arrive so it will be important to keep in mind that each commodity can be moved as easily as possible within the warehouse while at the same time adequately protecting the produce and providing any other needs such as humidity and temperature.

2. Read the scenario together as a class and ensure that each trainee understands, repeating or explaining parts as needed.

3. Ask the trainees to work in pairs to try to answer the following prompt: Help the manager of Matima Store Warehouse select the correct storage materials so that her business can thrive.

4. After they have done some initial brainstorming instruct the pairs to use the information included in the **3.3. Key Facts** to enhance their answers.

5. Facilitate a discussion of the trainee's thoughts and their inputs.

6. Conclude by reviewing **3.3 Key Facts.**
   - 100 sacks of cassava flower weighing 50k each.
     Answer: Pallets

   - 2 truckloads of unpackaged load potatoes.
     Answer: Large crates and pallets, bulk storage, alternatively potato clamp-field storage

   - 300kg of avocados
     Answer: Net bags

   - 5 sacks of coffee weighing 25kg each
     Answer: Pallets

   - 20 boxes of tomatoes
     Answer: Trays

   - 1000kg of unpackaged grain
     Answer: Synthetic sacks

   - 500kg of unpackaged onions
     Answer: Net bags

Guided Practice Activity

1. Ask the trainees to turn to **Topic 3.3 Task 3** in their trainee manuals.

2. Instruct them to read the scenario and follow instructions after:

   Matima Store Warehouse has been so successful that they plan to expand by building a new warehouse and they want to hire you to design the floor plan and acquire the correct materials.

3. Indicate to the trainees that using the space in their manual below, they should draw a floor plan of a storage facility that they themselves could see managing one day in their own neighbourhood.

4. Challenge them to clearly draw what kinds of produce they plan to store and what storage materials they would select to store them.

5. Also, have them consider the size available for their storage area based on how much and what kind of produce they intend to store.

6. Have them draw a plan that would allow for easy movement throughout the warehouse.

7. Remind them to include tools for maintaining hygiene standards, checking quality and recording deposits and withdrawals.

8. Once every trainee has understood the task and begun their work, visit with each trainee to help where needed.

9. After all of the drawings have been completed, have students go around and share their work with others.

10. The floor plans should be saved by either you or the trainees because they will be used in the next Learning Outcome in **Topic 3.4 Task 3.**

    Adaptation: If the drawing activity is too challenging for trainees, adapt the guided practice to have trainees make a list of advantages and disadvantages for the storage materials that they would use according to produce which is commonly grown in their area.

Application Activity

1. Instruct trainees to plan and perform an individual field site visit to a storage facility in their neighbourhood and note the following aspects:
   a. Identify which crops and produce are being stored.

   b. Make note of what storage materials are used and how they are placed within the warehouse.

   c. Record any differences that you notice between what you have learned in your class and what you observe in the workplace.

   d. Reflect on how you might use your new knowledge in the future to work in a storage facility.

2. After students have completed the site visit facilitate a discussion so that they can share the observations

Note: This activity focuses on a field visit to an agricultural job site. Therefore, the manager of the site should be contacted and notified well in advance about the proposed activity. In general, it can be helpful to explain what exactly you as a trainer hope the students will get out of the field visit and agree with the manager upon all of the details. Arrangements to be considered include but not limited to the following setting a date, duration of visit, transportation logistics, safety and precautions, and any follow up items after the field visit is complete.

Points to Remember

- There are various materials that can be used to store different types of produce based on space available.
- Materials for quality control hygiene and maintenance must be included in a warehouse plan.
- When the product is stored in sacks these should preferably be stored on pallets.
- When the sacks are stacked on the pallets, they should always be neatly stacked, in such a way that air can pass through the sacks to dry and cool the grain.

Formative Assessment

1. Complete the missing table to indicate the advantages and disadvantages of each storage material:

Materials:	Advantages	Disadvantages
Wooden crates	**Answer**: can be manufactured and repaired locally.	may be too hard or rough for produce
	Have a higher capacity for larger fruits	**Answer:** Can easily become contaminated with fungi and bacteria
Plastic crates	**Answer:** Higher impact strength and a low degradation by ultra-violet radiation.	Can be stolen
	Longer life span	**Answer:** Expensive

True or false: Answer the following questions. If true, write “true.” If false, write in the correct answer:

2. A set of weighing scales to weigh grain on should never be recalibrated.
Answer: False, should often be recalibrated.

3. Sacks are inexpensive but offer low protection against puncturing, compression, vibration and impact injuries, and often times they must be hung when stored.
Answer: True.

Learning Outcome 3.4: Store produce

Objectives: At the end of the learning outcome, trainees will be able to:

a. Describe general requirements for good storage
b. Recognize need for quality control
c. Explain procedures for receiving, storing and withdrawing produce from storage

Time Required: 10 hours

Learning Methodology: Group discussion, brainstorming, field visit, demonstration, practical exercise, other possibilities: role play

Materials Needed:

- **Standard training materials -** flip chart, markers, black/white board, chalk, tape, A4 paper
- **Materials for role playing -** Variable cards for the application activity

Preparation:

- ❑ Contact storage facilities owners to notify them about a visit. While on the visit walk around checking the best practices they have exercised and discuss with storekeeper.
- ❑ Prepare materials for role playing for **Topic 3.4 Task 4**:
  - Produce three decks of "variable cards" on small 10x10cm cards.
  - Create one deck with a single produce written on the face of the card.
  - On the other deck write the normal storage durations periods on the face of the cards (e.g. seven day, 20 weeks etc.).
  - On the final deck write the normal stored quantities of produce (e.g. 1000 kg, 20 sacks, 20x50kg bags, 500kg loose/non-packaged etc.).

Cross Cutting Issues:

- ✓ **Gender equality:** While forming the groups for group discussion and practical exercise, make sure both females and males are represented.
- ✓ **Environment and sustainability:** While conducting practical exercise the trainees should always be cautioned on environmental issue especially while disposing of waste.
- ✓ **Standardisation culture:** While storing produce emphasize the need to comply with set standards or requirements.

Prerequisites:

- Basic reading and writing skills
- Basic numeracy and arithmetic skills

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe general requirements for good storage	**1.** Apply requirements for good storage	**1.** Precise
2. Recognize need for quality control	**2.** Perform quality control for different crops	**2.** Attentive
3. Explain procedures for receiving, storing and withdrawing produce from storage	**3.** Apply guidelines for storing produce	**3.** Teamwork spirit

Steps:

Getting Started: What do we know and where are we going?

1. Ask the trainees to open their trainee manual to **Topic 3.4 Task 1** and look at the illustrations. With a partner, they should discuss the following:

a. Have you ever stored something and it ended up going bad?

b. What do you think caused the item to go bad?

c. How do you think this could be related to storing produce?

2. Ask some volunteers to share their responses.

3. Introduce the learning outcome and have trainees turn to the Key Competencies table and review it together.

 Problem Solving Activity

1. Divide the trainees into groups of three or four people and ask the trainees to open their trainee manual to **Topic 3.4 Task 1**.

2. Present the following scenario:

With the help of your floor plan drawing, Matima Store Warehouse has expanded its operations and can now store many varieties of grains, cured produce, and even fresh produce. Word has spread around and last week the manager took in the following produce:

- 100 bushels of bananas
- 50kg avocados
- 100kg of lemons
- 20kg of limes
- 100kg sweet potatoes

The manager decides to store the produce together, since they all require the same temperature of 13-18°C and similar relative humidity, in a smaller room which has been sealed off to prevent infestation. However, after several days the farmer returns to collect her harvest, they find the produce has over ripened and will be difficult if not impossible to sell at market.

3. After reading through the scenario and ensure each student understands the task instruct them to work through the following questions within their groups:

a. Brainstorm what may have caused the produce to overripen.

b. Make a list of other problems that could occur at storage facilities like Matima Store Warehouse, which need to carefully receive new produce, store it, and manage how it is withdrawn.

4. After the trainees have formulated their answers refer them to the **3.4 Key Facts** to strengthen their responses.

5. Ask trainees to find a new partner and have them explain their answer and the three Key Facts that they think are most relevant.

6. Reconvene the class and facilitate a discussion.

Note: This may be a particularly difficult task for the trainees. Explain that some fruits can cause other fruits to become over-ripened if they are placed in near proximity and a closed environment. The cause for this is a gas called Ethylene, which plants like bananas release after harvest. Therefore, it is important to know which plants release this gas and which ones are sensitive to it.

Guided Practice Activity

1. Put trainees into groups of three or four people and inform that they will be role playing according **Topic 3.4 Task 3** in their trainee manuals, which outlines the following scenario. Explain the roles to the trainee: the store manager, store labourer and sector food inspector.

a. The storage manager is in charge of:
- deciding where to store the produce
- what to store
- keeping records of what is coming in and out of the store
- ensuring the labourer is working to minimize handling steps

b. The labourer is in charge of:
- checking quality and moisture of the produce
- handling the management
- ensuring that the managers decisions result in the best storage practices and preventing loss
- controlling pests

c. The inspector is in charge of:
- ensuring the produce and grains being stored are up to standard and free of contamination.

2. Explain the rules of the role play:

a. Each turn begins by getting a new set of three variable cards from the trainer which indicate the kind of produce, the quantity, and how long it is being asked to be stored for.

b. The manager then has to decide where this commodity will be stored in their warehouse, using the floor plan they drew up in **Topic 3.3 Task 3** which now serve as the imaginary warehouse.

c. The store manager should look at the cards first and assess the needs of the produce and status of the warehouse. Then decide how and where to put the produce and properly record it.

d. Next, the labourer explains what should be done in terms of quality control, pest control, and receiving procedures.

e. The inspector takes notes on any complications they see.

f. After three rounds of "simulated storage" each member should have a chance to debrief by explaining what they observed, highlighting both what was properly and poorly executed

g. After the debriefing has occurred, switch roles.

h. Once everyone has played the different roles, the role play is over.

3. Explain the variable cards used:

- Deck 1 contains 10x produce cards e.g. 1x1m cases tomatoes, bags of grain, sacks of avocados (**Note**: make the cards relevant to produce grown in your area).
- Deck 2 contains 10x cards with a typical time duration of storage, e.g. 2 weeks, 5 days, 10 months (**Note**: create cards have relevant times for the produce cards).
- Deck 3 contains 10x cards indicating a typical quantity of produce. 10x, 100 kg, loose and unsorted (**Note**: create cards have relevant quantities for the produce cards).

4. After explaining the roles, rules, and cards initiate the role play by handing every groups storage manager three variable cards from each deck.

5. Follow debriefing sessions to ensure that the role play is understood.

Example of a possible debriefing: Variable cards= 10x 1x1 crates of tomatoes store for 10 days; 100 x 50k sacks of grain store for 2 months; 300 sacks of 20kg avocados store for 7 days.

The food inspector could note that while the tomatoes were stored in the correct cold temperature, they were perhaps blocked by the grains which were placed in front of cold storage room door and being stored for two months. Therefore, the tomatoes would have either rotted or the grains would have to be moved twice. The manager could note that the labourer forgot to check the quality of the grains while the labourer

could tell the issue that the manager decided to take in the grains putting them in front of the tomatoes.

6. Clarify that after each member has had the chance to play a role, the trainees should reflect on their experience and prepare to share your conclusions with the rest of the class.

7. Once all groups have concluded the role play, engage trainees in a group discussion.

Application Activity

1. Inform the trainees that they should arrange a field visit to one of the larger warehouses in the surrounding area with the same group they performed the previous role play activity. Refer them to the Community Mapping activity in **Topic 3.2 Task 3** for ideas. Stress that, if possible, they should visit a facility that stores a wide variety of produce.

2. Instruct the trainees to use the questions in order to interview the store manager and guide their observations. They should record the responses for later discussion with the class.
   a. What kinds of problems do you encounter regularly?

   b. How are decisions made and problems solved in the warehouse/storage facility?

   c. What do you consider to be best practices for storing each crop type (when applicable): grains, leafy vegetables, fruit, bulb crops, roots, and tuber?

   d. What other procedures do you recommend for maintaining the warehouse?

3. Interview another employee(s) (if applicable):
   a. How do the employees of the warehouse work together?

   b. What tasks and responsibilities are shared? Which ones are not?

4. Once they have completed the field visit, dedicate time to hold a discussion and share important observations.

   Note: This activity focuses on a field visit to an agricultural job site. Therefore, the manager of the site should be contacted and notified well in advance about the proposed activity. In general, it can be helpful to explain what exactly you as a trainer hope the students will get out of the field visit and agree with the manager upon all of

the details. Arrangements to be considered include but not limited to the following: setting a date, duration of visit, transportation logistics, safety and precautions, and any follow up items after the field visit is complete.

Points to Remember

Tell trainees that the following is a take home message that they are not allowed to forget in their walk of life

- All produce should be stored and handled with the ultimate goal of reducing damage and waste. Samples should be taken at random from anywhere in the sack.
- Removal all the old produce and grain from the store regularly.
- Keep accurate records of all incoming and outgoing produce.

Formative Assessment

1. List the four factors that limit post-harvest produce lifespan:
Answers:
- Temperature
- Water loss
- Mechanical damage
- Decay storage

2. True or false: Answer the following questions. If true, write "true." If false, write in the correct answer:
a. Grains should be checked for moisture content after they have been received and stored.
Answer: false, grains should be checked for moisture ***before***….

b. Bananas should be stored close to sweet potatoes to prevent early ripening.
Answer: false, bananas should ***not*** be stored close to the sweet potatoes.

3. According to you, what is the most important guideline to remember when practicing storage of various crops and produce? Why?

Self-Reflection

1. Ask trainee to re-take the self-assessment from the beginning of the unit. They should then fill in the table in the Trainee's Manual to identify their areas of strength, areas for improvement and actions to take to improve.

2. Discuss trainees' results with them. Identify any areas that are giving many trainees difficulties and plan to give additional support as needed (e.g. use class time before you begin the next learning outcome to go through commonly identified difficult concepts).

Summative Assessment

Integrated situation	Resources
The assessor will set up different "stations" that represent the main processes of post-harvest operations. The trainee will complete the following summative assessment according to the following scenario: "Gashayija is a maize farmer in Gatsibo district. He has been growing maize and anticipating selling maize grains when they are out of market. However, he was seriously disappointed because he lost more than 60% of his maize grains due to poor postharvest operations and management. As a lead farmer in the neighbourhood, he invited you to demonstrate to him how he should have handled and stored his maize grains and reduce spoilage. You are requested to perform post-harvest operations for his most recent harvest." **1. At the drying station the trainee must:** **2.** Draft a plan for transport and drying of the maize, detailing each step to be taken from initial harvest to the maize being ready for cleaning and sorting. **3.** Demonstrate how maize can be dried using several drying methods **4.** Explain how other crops such as tubers and a fresh produce would be handled differently comparted to the maize. **5. At the cleaning station the trainee must:** **6.** At the maize cleaning, sorting, hand picking station, perform maize cleaning and sorting and weigh each to measure defects and foreign matter. **7.** Grade the maize. **8. At the packaging station the trainee must:** **9.** Select correct packaging materials for maize. **10.** Package the maize correctly following hygiene standards. **11.** Explain correct hygiene packaging procedures. **12.** Describe any additional considerations and action you would need to take for other produce that require cooling. **13. At the storage facility station the trainee must:** **14.** Perform an evaluation of the storage room facilities both inside and out and identify possible problem related to storing the maize and how to overcome identified problems. **15.** Select correct storage materials for the maize. **16.** Perform storage and describe how quality can be checked. **17.** Describe any additional considerations and action you would need to take for storing tubers, bulb crops, fruits and leafy vegetables. **18. The task should be performed within 3 hours.**	**Produce:** Dry maize cob **Processing Equipment:** Drying space Wheelbarrow PPE Maize cob dehusker Maize sieve or sorting table Weighing balance Bottom pan **Packaging materials:** Hygiene items Several varieties of maize packaging Blank labels **Materials for storage facility:** Room to serve as storage facility: Pallets Burlap bags Other objects to represent items commonly found in a storage facility

While trainees are carrying out tasks as per integrated situation above, tick appropriately as he/she move further

Assessment Criterion 1: Quality of Process

Checklist	Score	
	Yes	No
Indicator 1: Handling operations prior to packaging are properly performed following requirements		
Post-harvest handling operations		
Threshing grains		
Drying grains		
Drying systems		
Natural drying		
Artificial drying		
Chemical control including fumigation		
Post-harvest handling operations		
Threshing grains		
Indicator 2: Produce are correctly sorted and graded considering market requirements		
Sorting/winnowing		
Grading		
Grading standards/ attributes		
Market requirements		
Indicator 3: Packaging materials are correctly selected and acquired following requirements		
Package requirements and functions		
Types of containers		
Field containers		
Consumer packages		
Bags (sacks)		
Types of packaging materials		
Plastics		
Paper and board		
Criteria for selecting packaging materials		
Easy transport		
Easy to fill, assemble and close		
Ventilation		
Dimension suited for transport		
Availability		
Cost		
Suited for market demands		
Indicator 4: Produce is suitably packaged following requirements		
Hygienic conditions		
Considerations in packaging		
Minimum and maximum fill weight		

Conditions of the package		
Sealing packages		
Labelling		
Modified atmosphere packaging		
Indicator 5: Cooling methods are suitably identified following instructions and crop requirements		
Cooling methods at small scale farm level		
Room cooling		
Night air ventilation		
Indicator 6: Storage rooms are properly cleaned following guidelines and instructions		
Clean and maintain the storage structure		
Remove trash and weeds		
Rat guards		
Maintenance of screens and floors		
Indicator 7: Storage methods are properly identified following requirements		
Criteria of choice of storage method		
The crop and its requirements		
Cost		
Quantity of produce to be stored		
Advantages of storage		
Storage methods for grains		
Bags storage		
Indicator 8: Storage materials are properly selected and acquired according to the size of store, crop product and recommended storage conditions		
Storage materials		
Bags (sacks)		
Pallets		
Cleaning equipment		
Indicator 9: Produce is suitably stored following guidelines and requirements		
Requirements of a good store		
Guidelines for storage of maize grains		
Observation		

Assessment Criterion 2: Quality of product

Checklist	Score	
	Yes	No
Indicator 1: Plan for drying is adequate		
Transport and methods minimize chance of losses		
Indicator 2: Maize is well sorted and graded		
Absence of foreign matter in grains		
Maize of uniform grains		
Indicator 3: Store is cleaned appropriately		
Absence of weeds		
Tidy store		
Minimized risk of infestation		
Observation		

Assessment Criterion 3: Relevance

Checklist	Score	
	Yes	No
Indicator 1: Time is effectively managed		
Duration (3 hours)		
Indicator 2: Understanding of different produce		
Other measures are detailed for different produce at each step		
Indicator 3: Maize of grains packaging done as required		
Maize packed and stored correctly		
Observation		

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