

Crops Production and Marketing Management-Level-IV Based on September 2021, Version 3 Occupational standards



Module Title: Inspecting and supervising agricultural
Crop Harvest

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Table of Contents

LG #69	5
LO #1- Prepare for harvesting	5
Instruction sheet	5
Information Sheet 1- Assessing crop maturity and quality	6
.....	12
Information Sheet 2- Determining and carrying out pre-harvest treatments	13
Self-Check – 2	20
Written test	20
Information Sheet 3- Identifying and complying licenses	21
Self-Check – 3	24
Written test	24
Information Sheet 4- Assessing insurance requirements.....	25
Self-Check – 4	27
Written test	27
Operation sheet 1	28
Identifying the maturity status of crops for harvesting.....	28
LAP Test.....	29
Practical Demonstration.....	29
LG #70	30
LO #2- Determine harvest strategy	30
Instruction sheet	30
Operation sheet 1	32
Estimating and calculating optimum time to harvest.....	32
Self-Check – 1	38
Written test	38
Information Sheet 2- Assessing resource requirements	39
Self-Check – 2	41
Written test	41
Information Sheet 3- Confirming and arranging labor and equipment	42
Self-Check – 3	47
Written test	47
Information Sheet 4- Identifying and arranging fire prevention and control.....	48
Self-Check – 4	51
Written test	51



LG #71.....52

LO #3- Coordinate the harvest strategy.....52

Instruction sheet 52

Information Sheet 1- Implementing effective communication strategies 53

Self-Check – 1 55

Written test 55

Information Sheet 2- Implementing and adjusting harvesting operations 56

- **Harvesting Methods** 56
 - Figure 3.1 Hand Harvesting** 57
 - 2. Harvesting with Hand Tools** 57
 - 3. Mechanical harvesting** 58

Self-Check – 2 61

Written test 61

Information Sheet 3- Coordinating and monitoring equipment operation 62

Self-Check – 3 63

Written test 63

Information Sheet 4- Identifying and controlling existing and potential hazards ... 64

Self-Check – 4 66

Written test 66

Operation sheet 2 67

Implementing and adjusting harvesting operation 67

LAP Test 2 68

Practical Demonstration..... 68

LG #72.....69

LO #4- Complete harvest operations.....69

Instruction sheet 69

Information Sheet 1- Locating storage resources and identifying drying strategies 70

Self-Check – 1 82

Written test 82

Information Sheet 2- Segregating quality of grain and evaluating harvesting operation..... 83

Self-Check – 2 85

Written test 85

Information Sheet 3- Evaluating harvesting operations and outcomes 86

Self-Check – 3 87



Written test 87

Information Sheet 4- Documenting relevant information..... 88

Self-Check – 4 90

Written test 90

References 91



LG #69	LO #1- Prepare for harvesting
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Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Assessing crop maturity and quality
- Determining and carrying out pre-harvest treatments
- Identifying and complying licenses or permits to moving machinery
- Assessing insurance requirements

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Assess crop maturity and quality
- Determine and carrying out pre-harvest treatments
- Identify and complying licenses or permits to moving machinery
- Assess insurance requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.



Information Sheet 1- Assessing crop maturity and quality

1.1. Introduction

Identifying the correct stage of maturity and harvesting at proper time are important pre harvest factors. Maturity indices are important for deciding when a given commodity should be harvested to provide some marketing flexibility and to ensure the attainment of acceptable eating quality to the consumer. Maturity is the stage of development leading to attainment of the consumer for a particular purpose. Physiological maturity: When a plant or plant part will continue ontogeny even if detached. Horticultural maturity: When a plant or plant part possesses the prerequisites for utilization. (Selvakumar, 2014). In physiological sense, maturity refers to the attainment of final stage of biological function by a plant part or the plant. The quality of vegetables can be preserved for a longer duration if it is harvested at an appropriate stage (Kalia, 2011). For instance, in tomato, according to the use of fruits harvesting is done at various stages depending on the purpose. Generally, the tomatoes are harvest at mature green to turning stage for long distance marketing. For fresh local market, pink to light red tomatoes is harvested. Depending on the purpose six maturity stages have been recognized for the harvesting of tomato

1.2. Assessing crop maturity

Maturity: Optimum maturity at harvest is a very important determinant to the final quality of the product. It is advantageous to harvest the crop at physiological maturity. However, it is always not possible to take up harvesting at this stage due to scarcity of lab our and hence harvesting may be taken up calculating the crop duration. The following indicators show us the maturity of the crop in readiness for harvesting:

- Yellowing of the leaves
- Drying of the grain for cereals and stalk grains
- Drying of pods for legume crops
- Bursting of bolls in case of cotton
- Withering of the lower leave for the sugar cane

In case of indeterminate types of crops like sesame, which may have both immature and mature capsule at a time, harvesting can be done when 75% of the capsules are matured.

Some maturity measures of crops

Crop	Criteria for harvest
wheat and barley	Hard dough grain stage
Stalk crop (maize and sorghum)	Seed moisture content 34% for maize and cob dried for both
Legume's crop	Drying of pods, reddish brown leaves, dry up and start to shedding, yellowing of leaves etc.
Oil crops	Back of heads turns to yellows in color, some of the bracts dry up
Sugar cane	Withering of lower leave and brix-20%, sucrose -15%
Fiber(cotton)	Bolls well dried, fully opened and stalk is dried
Jute (like kenaf and sisal)	50% pod stage (120-150days)

Some maturity measures of fruits

Fruit	Maturity indexes.
Citrus, Papaya, Pineapple, Grapes, Mango, Strawberry	Peel color
Mango, Apple	Pulp color
Citrus, Apple, Pear	Size
Banana, Pineapple, Litchi, Mango	Shape
Banana	Drying of plant parts
Melon, Mango	Surface characteristics
Musk melon, Grape, Mango (Tapka stage)	Ease of separation from plants
Watermelon	Tapping
Jackfruit	Aroma
Melons, Apple, Pear	Firmness

Melon, Grapes	Sugars
Grapes, Sweet orange, Papaya	TSS
Citrus, Mango, Pineapple	Acidity
Apple, Pear, Banana	Starch index
Citrus	Juice content

Some maturity measures of vegetables

Vegetable	Maturity indices
Tomato	Seeds slipping when fruit is cut, or green color turning pink
Eggplant, Bitter gourd, Slicing cucumber	Desirable size reached but still tender
Watermelon	Dull hollow sound when thumped
Musk melon	Easily separated from vine with a slight twist leaving clean cavity (full slip stage)
Cowpea, Snap bean, sweet pea, Winged bean	Well, filled pods that snap readily
Cauliflower	Curd compact
Broccoli	Bud cluster compact
Radish and Carrot	Large enough and crispy
Potato, Onion and Garlic	Tops beginning to dry and topple clown
Yams, Bean and Ginger	Large enough

Types of maturity indices:

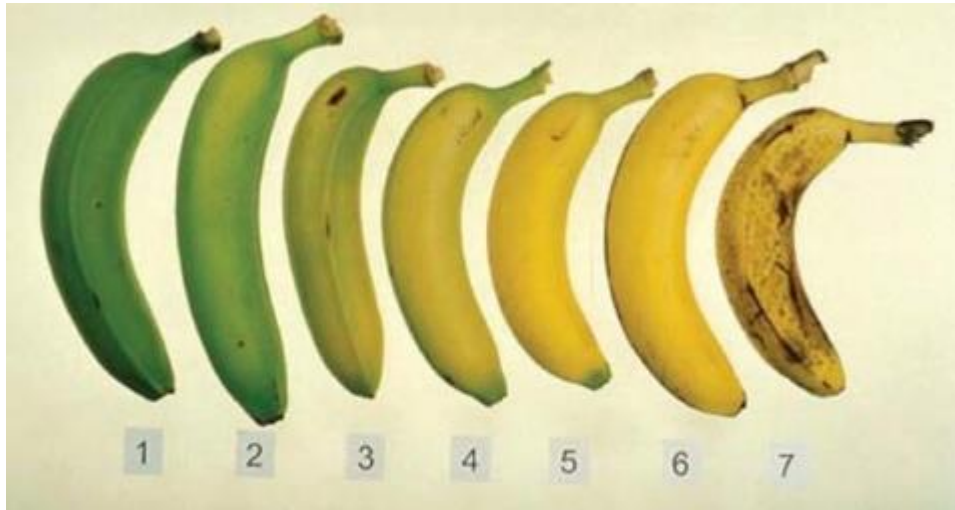
1. Visual indices:

Higher temperature gives early maturity.

a. Size and shape:

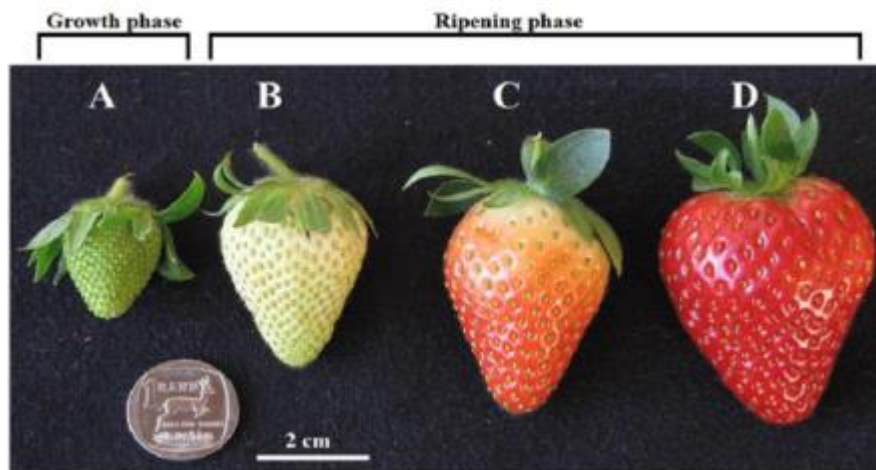
Maturity of fruits can be assessed by their final shape and size at the time of harvest. Fruit shape may be used in

some instances to decide maturity.



b. Color:

The loss of green color of many fruits is a valuable guide to maturity.



2. Physical indices:

a. Firmness:

As fruit mature and ripen they soften by dissolution of the middle lamella of the cell walls.

In many fruits such as apple, pear, peach, plum, guava, kinnow etc. firmness can be used to determine harvest maturity



b. Specific gravity:

As fruit mature, their specific gravity increases.

- This parameter is rarely used in practice to determine when to harvest a crop.
- To do this the fruit or vegetable is placed in a tank of water; those that float will be less mature than those that sink

3. Chemical Measurement:

a. Total Soluble Solids:

It can be determined in a small sample of fruit juice using hand refractometer.

The refractometer measures the refractive index, which indicates how much a light beam will be slowed down when it passes through the fruit juice.





b. Titratable acidity:

Titratable acidity (TA) can be determined by titrating a know volume of juice with 0.1N NaOH to end point. The milliliters of NaOH needed are used to calculate the TA.

4. Calculated indices:

a. Calendar Date/Days after full bloom:

Useful guide to harvest, where seasonal variation in climate is small.

This method works well when the blooming period is short period.

b. Heat Units:

It has been found that a characteristics number of heat unit or degree-days is required to mature a crop under usually warm conditions

It is based on the principle that growth of plant organ is directly proportional with ambient temperature

5. Physiological Method:

Respiration rate: Particularly on climacteric fruits can accurately pin point the most appropriate time of harvest as there is climacteric rise in respiration.

Ethylene production\Like respiration rise climacteric fruits also have ethylene peak

**Self-check 3****Written test**

Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Answer the following questions (20 point)

1. List the indicators of crop maturity in readiness for harvesting (5pts)
2. What are the adverse effects of delaying harvesting crops and harvesting them prematurely. (5 points)
3. Explain the differences between physiological, horticultural and harvest maturities? (5 points)
4. What color changes are observed during the maturities of cabbage and carrot? (5 points)

Note: Satisfactory rating 20 points Unsatisfactory - below 20 points

You can ask you teacher for the copy of the correct answers



Information Sheet 2- Determining and carrying out pre-harvest treatments

2.1. Introduction

Pre-harvest treatments, either physical or chemical, may have a favorable or unfavorable impact upon postharvest quality.

Examples of treatments include such things as:

- The gathering of cauliflower leaves around the head prior to harvest to prevent yellowing.
- Twisting of cabbage (90 degrees) before harvest to break some roots and induce wilting - this causes the wrapper leaves to tighten, thereby helping to protect head during postharvest.
- Wrapping fruit while still on tree, e.g. apples, carambola (star fruit) and bananas may be wrapped with paper or plastic to prevent attack from birds, fruit flies and other pests or to enhance ripening or fruit color.
- Chemical treatments while in the field to extend postharvest storage life or enhance marketability, e.g., applying sprout inhibitors on potatoes or ethereal on apples to increase the red color.

In some cases chemical application can lead to postharvest residues which create marketing constraints. All physical and chemical pre-harvest treatments which affect the postharvest quality of the commodity under study should be identified.

2.2. Determining and carrying out pre-harvest treatments

Food safety recommendations state raw manure applications must be made a minimum of 120 days prior to harvest for any produce where the edible portion is in direct contact with the soil and 90 days prior to harvest if the edible portion is not in direct contact with the soil. Guidelines differ for composted manure applications. Plant based compost is not considered raw manure.



Food safety is also a concern when flooding occurs in a vegetable garden. Remove and destroy produce if the edible portion is in contact with floodwaters.

2.3. Reasons for pre-harvest treatments: -

- To reduce weight of foliage.
- To facilitate mechanized harvesting.
- To facilitate bulk harvesting sorting, grading and packing by machines.
- To improve post-harvest life of produce.
- To delay harvest date.

Pre-harvest treatments, either physical or chemical, may have a favorable or unfavorable impact upon postharvest quality. Examples of physical treatments include:

- The gathering of cauliflower leaves around the head prior to harvest to prevent yellowing.
- Twisting of cabbage (90 degrees) before harvest to break some roots and induce wilting - this causes the wrapper leaves to tighten, thereby helping to protect head during postharvest.
- Wrapping fruit while still on tree, e.g. apples, carambola (star fruit) and bananas may be wrapped with paper or plastic to prevent attack from birds, fruit flies and other pests or to enhance ripening or fruit color.

2.4. Best practices before harvest

Key areas to focus on are:

- seed quality
- soil fertility
- soil moisture
- pests and diseases.

2.5. Best practices to ensure seed quality include:

- purchasing seeds from good quality input suppliers
- selecting seeds with care, when using seeds from the previous harvest
- treating seeds with ash, or an ash and cow-dung combination, to reduce
- pest infestation



- drying seeds to the correct moisture level before storing
- storing seeds in dry, cool containers, safe from pests
- using zeolite-based drying beads to reduce the amount of moisture in seeds (developed by Rhino Research)³
- testing seeds before storage and planting, whether the seeds were purchased from an input dealer or saved from previous harvests.

2.6. Best practices to improve and maintain soil fertility include:

- using soil and water conservation practices to slow and infiltrate water
- applying organic matter to build soil structure and provide nutrients
- keeping the soil covered (with cover crops or mulch), especially during the off-season, to protect the soil and provide nutrients
- avoiding heavy equipment to limit the amount the soil is compacted
- tilling as little as possible, or not at all, to conserve soil structure.



2.7. Soil moisture

Correct soil water content maximizes plant growth and reduces the probability of disease. It is important to have enough soil moisture and water throughout the crop cycle, but not too much. Too much moisture can increase the risk of aflatoxins in certain crops (for instance, groundnuts and maize) and other crop diseases. Too little moisture can cause crop failure.

2.8. Best practices to ensure correct soil moisture include:

- using raised beds for vegetable production to help control soil moisture, if too much moisture is a concern
- using mulch to reduce the likelihood of the soil drying out, particularly in hot, dry conditions
- constructing berms and basins on contours (boomerang berms) to catch water, slow it down, and spread it out to increase infiltration.

2.9. Pests and diseases

Pests and diseases can have a significant negative impact on yield and can sometimes decimate crops, particularly in tropical environments.

- **Best practices to manage pests and diseases are necessary during the entire production cycle, and include:**

- ✓ identifying pests and diseases
- ✓ learning their life cycle and encouraging natural biological controls
- ✓ (Such as predatory insects that eat pests)
- ✓ using pest-resistant plant varieties
- ✓ using cultivation, fertilization, and irrigation methods that reduce pest habitats
- ✓ removing dead plants and other materials that show signs of disease, which can attract pests to the fields
- ✓ leaving organic matter with no signs of disease in fields to decompose and help fertilize the soil for next season
- ✓ monitoring fields and crops consistently, and acting accordingly (for instance, it is easier to reduce the impact of pests if they caught early in an infestation)
- ✓ using chemical pesticides if necessary, ensuring strict procedures are followed for application and safety.





2.10. Chemicals used for pre-harvest treatment:

- Cytokines - They are used for delaying harvesting dates.
- Growth regulators - Higher concentrations of many phenoxy compounds like 2,4-D; 2,4,5-T and 2,4,5-TP are used for reducing foliage.
- Diquat and paraquat - These are used in root and bulb crops for reduce foliage to facilitate harvesting.

2.11. Precautions in spraying of chemicals:

- Avoiding toxic residual effect at harvesting.
- Reducing the cause of tainting, rendering them unpalatable.
- Restricting use of persistent organo chloride like DDT, BHC and aldrin.
- Determining the date of pesticide spray before harvest.

2.12. Best practices during harvest

- timing
- handling.

Pre-harvest treatments with nutrients, growth regulators and pre-harvest cultural practices have profound influence on yield and post-harvest qualities. These pre harvest treatments influence the fruit yield, fruit firmness, biochemical composition, color development, physiological loss in weight, respiratory rate, enzyme biosynthesis, ethylene production and storage potential.

Organic compounds other than nutrients which in small amount promotes, inhibits or modifies the physiological processes in the plants.

Pre-harvest weed problems are appear in some fields, especially in thin fields and areas with abundant rainfall. Any further delays in harvest will likely exacerbate the problem. Broadleaf weeds can sometimes grow rapidly in crop fields toward the end of the growing season. When this happens, the weeds can grow above the crops canopy for instance cereal crops and small grain crops and the other crops. This not only interferes with harvest, it can also result in dockage problems.



2.13.OHS requirements

- Guarding of exposed moving parts
- Ensuring loads are secure and within working specifications
- The identification and avoidance of obstacles during harvesting operations
- Working within confined spaces
- Hazard and risk control
- Mounting and dismounting
- Handling including lifting and carrying
- Manual handling
- The application of emergency/defensive driving techniques
- Handling, application, and storage of hazardous substances
- Outdoor work including protection from solar radiation, noise, organic and other dusts
- The protection of people in the workplace
- The appropriate use and maintenance of personal protective equipment.



Self-Check – 2	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (20 points)

1. What are the importance's of pre-harvest treatments? (5pts).
2. What are the mechanisms of undertaking pre- harvest treatments? (5pts).
3. Define physical pre-harvest treatments? (5pts).
4. What are the profound influences of nutrients, growth regulators and pre-harvest cultural practices? (5pts).

Note: Satisfactory rating - 20 points Unsatisfactory - below 20 points

You can ask you teacher for the copy of the correct answers.



Information Sheet 3- Identifying and complying licenses

3.1. Requirements for licenses

In order to undertake agricultural crop harvesting the following permits must be considered:

- Crop maturity in readiness for harvest
- Resource availability because harvesting is labor intensive
- Equipment availability
- Favorable weather condition- do not harvest on rainy day
- Staff requirements

Harvest permits are sold to vehicles that will be utilized to haul agricultural products or to service harvesting equipment. A permit is required for each truck or tractor and each grain hauling trailer.

If you drive a larger vehicle, the maximum authorized mass - i.e. the total weight of the vehicle plus the maximum load it can carry - will determine which driving license entitlement you require, for example:

- ✓ 3.5 to 7.5 tones require a category C1 license
- ✓ more than 7.5 tones require a category C license

You must be at least 18 years of age to drive a vehicle weighing between 3.5 and 7.5 tones, and 21 years of age to drive a vehicle over 7.5 tones.

Permit Provisions:

Vehicles Transporting Agricultural Products: Over Axle/Over Gross Weight Tolerance Permit authorizes the operation of vehicles transporting agricultural products with a tolerance of:

- Up to 12 percent above legal axle weight on one single axle or tandem axle, up to 10 percent above legal axle weight on all remaining single axle or tandem axle.
- Up to, but not more than 5 percent above the gross vehicular weight.

NOTE: For agricultural and non-agricultural products, the gross weight should never exceed 84,000 pounds.



- **Examples of agricultural products include, but are not limited to, the items listed below.**
 - ✓ Cottonseed hulls, cottonseed meal, and sugar beet pulp.
 - ✓ Cotton (not baled).
 - ✓ Fresh eggs.
 - ✓ Fresh fruits and vegetables.
 - ✓ Grain, including rice.
 - ✓ Hay.
 - ✓ Live animals, including livestock, poultry and game birds.
 - ✓ Live horticultural products and live nursery stock, including any tree, shrub, vine, cutting, graft, scion, grass, bulb, or bud that is in a growing state and is grown for, kept for, or is capable of propagation and distribution for sale.
 - ✓ Manure produced by livestock, poultry, or game birds.
 - ✓ Nuts.
 - ✓ Oil seed.
 - ✓ Peanuts.
 - ✓ Raw milk.
 - ✓ Seed for planting.
 - ✓ Sugar cane.
 - ✓ Timber.
 - ✓ Wool and mohair.
 - ✓ Wood pulp.
 - ✓ Wood Chips

Vehicle Registration Requirement: Vehicles issued an Over Axle/Over Gross Weight Tolerance Permit must be registered for the maximum permissible weight for the particular vehicle, not to exceed 80,000 pounds. This permit does not increase the registered weight limit, but only allows a tolerance above the maximum registered weight.

Agricultural engines

- Agricultural engines are restricted to purpose-built vehicles that:



- ✓ are designed and used solely for agriculture, horticulture or forestry work
 - ✓ are used on public roads only for going to and from a place of work
 - ✓ if used on a public road, do not carry any load except such as is necessary for its propulsion or for the operation of any machinery built-in or permanently attached to the vehicle
- Examples of agricultural machineries that use agricultural engines include:
 - ✓ combine harvesters
 - ✓ forage harvesters
 - ✓ pea viners
 - ✓ Mowing machines



Self-Check – 3	Written test
-----------------------	---------------------

Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions

1. What are the permissions required for moving machineries? (5 pts.)
2. What are the licensing requirements of agricultural vehicles? (5 pts.)
3. Why harvesting during rainy time is not permitted? (5 pts.)

Note: Satisfactory rating 15 points Unsatisfactory – below 15 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____



Information Sheet 4- Assessing insurance requirements

Crop insurance includes the coverage of crop damaged by fire, hail, and transportation. This policy provides insurance for loss or damage to growing crops caused by hail or other perils. This policy is a concept of combining hail coverage. Coverage for damage before and during harvest and while your crop is in the harvester. This also includes crops in small grain stubble.

In areas of the country where hail is a frequent event, farmers often purchase crop-hail policies to protect high-yielding crops. These policies are not part of the Federal Crop Insurance Program; they are sold by private insurers and regulated by state insurance departments. Many farmers purchase crop-hail coverage as a supplement to MPCl (Multiple peril crop insurance).

Crop-hail policies often have a low or even no deductible. Because, unlike drought or blight, hail can completely destroy a portion of crops in one area of a farm but leave other crops undamaged, a hail claim may be less than the amount of the deductible on an MPCl policy. Crop insurance is purchased by agricultural producers, and subsidized by the federal government, to protect against the loss of their crops due to natural disasters, such as hail, drought, and floods, or the loss of revenue due to declines in the prices of agricultural commodities.

For Ethiopian farmers dealing with the worsening impacts of climate change, small scale crop insurance can be life saver. But the insurance needs to expand and undergo some tweaks to effectively help them recover from extreme weather. Any decision-making process on crop insurance involves many stages. These stages and certainly the priorities will differ, depending on which type of body is doing the investigation. This may be a government ministry, a farmers' organization, an insurer, a bank or a group of marketing/processing agencies. In any case, some of the more important issues and steps are:

- Demand assessment - ensuring that any initiatives are in response to real risk management needs.
- Identification of the key insured parties; automatic or voluntary cover?
- Determination of key perils - a key factor in insurance design.
- Decision on crops to be covered - another key factor in insurance design.
- Analysis of insurance options, administrative models, and loss assessment procedures, together with determination of associated costs.
- Rating - determining the pure premium required, plus administrative and loss adjustment overheads to derive the initial premium level to be charged.



- Identifying possible complementary roles for the government and for the private sector.

Insurance implications can similarly be summarized in a brief list:

- It is sometimes possible for growers to obtain cover against pests and diseases where there is no generally accepted management control.
- in an attempt to reduce the adverse environmental impact of some well-established chemical spray routines for pest and disease control (e.g. certain chlorinated hydrocarbons) alternative, benign regimes have been developed. Insurance may be utilized in the future in order to provide temporary risk assurance to growers using the new routines.
- Frequently damage to fruit and other crop products provides an entry point for disease organisms. Perforation of the skin due to hail damage is a common example. In this case any hail policy needs to be clear as to whether the consequential loss from disease is also covered.



Self-Check – 4	Written test
-----------------------	---------------------

Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions

1. List the Crop insurance coverage **(5pts)**
2. List the importance's of crop insurance to the farmers **(5pts)**
3. What are the two general categories of crop insurance? **(5pts)**
4. What are decision-making processes on crop insurance? **(5pts)**

Note: Satisfactory rating - 20 points Unsatisfactory - below 20 points
 You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____



Operation sheet 1	Identifying the maturity status of crops for harvesting
--------------------------	--

Basically, identifying the maturity status of a given crop is a very crucial point to undertake crop harvesting. The way of identifying crop maturity depends on different morphological changes and crop maturity parameters that indicate the proper maturity stage of a given crop to be marketed or stored. Therefore, to determine the maturity of a given horticultural crop, follow the following steps one by one.

1. Select the type of Agricultural crop to be identified (cereals, fruit, vegetables, flower, tubers...etc)
2. Prepare materials and tools (like knives, sizing rings, color charts, refractometers, pentameters...etc) available to test the maturity of a given crop depending on the type of crop you have selected.
3. Carefully observe the maturity indices or parameters (like size, weight, length, shape, color, ripeness, texture, skin condition, ease of removal and moisture content, flavor...etc) and the type of maturity (physiological or harvest) depending on the type of crop you have selected.
4. Test the maturity of the crop by either using tools or equipment or through careful observation depending on the type of crop you have selected.
5. Interpret and analyze the results by comparison with specification charts and enterprise/industry maturity standards.
6. Finally, report to your supervisor or other concerned body what you have identified and faced when operating the tasks.



LAP Test	Practical Demonstration
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Name _____ Date _____

Time started _____ Time finished _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **2** hour. The project is expected from each student to do it.

Task 1: Identifying the maturity status of Agricultural crops for harvesting



LG #70	LO #2- Determine harvest strategy
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Instruction sheet
<p>This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:</p> <ul style="list-style-type: none">• Estimating and calculating optimum time to harvest• Assessing resource requirements• Confirming and arranging labor and equipment• Identifying and arranging fire prevention and control <p>This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:</p> <ul style="list-style-type: none">• Estimate and calculate optimum time to harvest• Assess resource requirements• Confirm and arrange labor and equipment• Identify and arrange fire prevention and control
<p>Learning Instructions:</p> <ol style="list-style-type: none">1. Read the specific objectives of this Learning Guide.2. Follow the instructions described below.3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.4. Accomplish the “Self-checks” which are placed following all information sheets.5. Ask from your trainer the key to correction (key answers) or you can request your



trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).



Operation sheet 1	Estimating and calculating optimum time to harvest
--------------------------	---

2.1. Estimating harvest time

Harvesting is the separation of the crop from the site of immediate growth. It is considered as the last step in crop production but the first step in post-production system. Therefore, it is very important to perform the harvesting operation on time and with great care as it influences the subsequent processing and preservation of the crop.

Crops that are immature lose water rapidly and don't store well, in addition to not tasting their best. Crops that are over-matured can be tough and starchy, like beans and corn, or too soft and easily damaged, like plums. Both immature and mature crops are subject to decay. Harvesting during the coolest part of the day is important because high temperatures lead to deterioration in highly perishable crops. The term "field heat" refers to the heat stored in crops from being out in the sun. In harvest and post-harvest handling, you want to manage for reducing/taking out the field heat in your crops.

Harvesting vegetables at the right stage of maturity ensures the best taste and quality. Many vegetables should be picked throughout the summer to maintain plant productivity. The time, frequency, and method of harvesting vary depending on species. Vegetables such as standard sweet corn have a very small harvest period. Others, such as many of the root crops, can remain in the garden for several weeks with little effect on their state. Some vegetables, like summer squash, have to be harvested almost daily. Other plants, such as tomatoes, can be harvested on a weekly basis. Use the table below to determine the optimal time to pick and enjoy your favorite vegetables.

The shelf life of a produce is highly correlated to the physiological/ horticultural maturity at harvesting.

Therefore, understanding the unique characteristics of different produce at physiological maturity is vital in ensuring that only mature produce is harvested.

This greatly reduces the post-harvest losses associated with produce harvested prematurely.

Below are the harvesting indices for different produce:

2.2. Appropriate time for harvest is indicated by:

- The period when at least 80% of the panicles have reached full maturity
- The moisture content of the grains should be between 20 - 22%,
- The grain should have full ripened color (mainly yellow),
- When the grain husk is removed, the grain is white and hard



2.3. Agricultural crop harvest guide

- Color of the skin & seeds (e.g. Tomato, Chili, and Passion Fruits)
- Size of leaves & fruits (e.g. Kale, Banana, and Pineapple)
- The sound when thumped (e.g. Watermelon, Melon, and Cabbage)
- Shape of produce e.g. mature bananas are more rounded

2.4. Points to remember during harvesting

- Timeliness in harvesting paddy rice is important in determining grain quality and yield.
- Harvesting should begin when 80 per cent of the grains (or 8 out of 10 grains) in the main panicles of plants are clear, firm, and straw-colored; the rest should be hard.
- Harvest when paddy rice moisture is less than 25 per cent, about 30 -32 days after flowering.
- If harvesting by hand, grasp the plant about 15 cm-20 cm from the soil or ground level then cut with a sickle 15 cm from ground level.
- If harvested too early, there will be many immature grains which will reduce head rice yield and quality. Immature rice kernels are very slender and chalky, and will result in excessive amounts of bran and broken grains.
- If harvesting is too late, many grains will be lost due to shattering or drying out and cracking during threshing.
- Cracked grains break during milling.
- If moisture content is allowed to vary, grain fissuring (cracking), spoilage through yellowing, and development of odours can occur

2.5. Problems of late harvesting

- Lodging,
- Over drying of grain,
- Shattering,
- Rodent/bird attack,
- Contamination when panicles touch the ground.

2.6. Problems of early harvesting

Page 33 of 93	Federal TVET Agency Author/Copyright	TVET program title- Agricultural crop production Level -IV	Version -1 September 2021
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- Many of immature grains
- Discolored grains,
- Timely harvesting will ensure high paddy yield, a quality product for parboiling
- or milling and high milling recovery with low kernel breakage.

Table.2.1 Days to maturity

Optimal time of harvesting vegetable	
<i>Vegetable</i>	<i>Days to Maturity</i>
Beet	50-70
Broccoli	50-65*
Cabbage	60-90*
Carrot	60-80
Cauliflower	55-80*
<i>Pickling</i>	55-65
<i>Slicing</i>	55-65
Eggplant	75-90*
Garlic	90**
Kohlrabi	55-70
Lettuce (leaf)	45-60
Muskmelon Cantaloupe	75-100
Okra	50-65
Onion	100-120 90-100**
Parsnip	110-130
<i>Snow (Sugar)</i>	55-85
<i>Snap</i>	55-85
<i>Garden (Shell)</i>	55-85
<i>Hot</i>	60-90*
<i>Sweet</i>	70-90*
Potato	90-120
Pumpkin	85-120
<i>Spring</i>	25-40
<i>Winter</i>	45-70
Snap Bean (Green Bean)	50-70
Spinach	45-60
<i>Scallop</i>	50-60
<i>Zucchini</i>	50-60
Sweet Corn	70-105
Sweet Potato	100-125

Tomato	70-90*
Turnip	45-70
Watermelon	80-100
Winter Squash	85-120

Harvest Maturity

It may be defined in terms of Physiological maturity and horticultural maturity, it is a stage, which will allow fruits / vegetables at its peak condition when it reaches to the consumers and develop acceptable flavor or appearance and having adequate shelf life.



Table 2.2: Criteria of maturity for harvesting fruits and vegetables

Fruit	Physical	Chemical
Mango	Olive green colour with clear lenticels, shoulder development size sp. gravity, days from fruit set.	Starch content, flesh colour
Banana	Skin colour, drying of leaves of the plant, brittleness of floral ends, angularity of the fruit, and days from emergence of inflorescence.	Pulp/peel ratio, starch content
Citrus	Colour break of the skin from green to orange, size	Sugar/acid ratio, TSS
Grapes	Peel colour, easy separation of berries, characteristic aroma	TSS 18-12 Thompson seedless, 12-14 for Bangalore Blue, 14-16 for Anab-e-shahi
Apple	Colour size	Firmness as measured by pressure tester
Papaya	Yellow patch or streaks.	Jelliness of the seed, seed colour

Crop Harvesting Criteria

Harvesting is the process of removal of entire plants or economic parts after maturity. The economic product may be grain, seed leaf, root, or entire plant. The remaining portion of the stem that is left on the field after harvest is known as stubble.

Table 2.3. Criteria for harvesting of crops

Crops	Maturity Symptoms and Criteria for harvesting	Harvesting Stage
Rice	<ol style="list-style-type: none"> 1. 32 days after flowering 2. Green grains not more than four to nine per cent 3. Percentage of milky grains less than one per cent 4. Moisture content of grains less than 20 per cent 5. 80 per cent panicles straw coloured and grains in lower portion of panicle in hard dough stage. At least five hills are to be studied at maturity 	
Sorghum	<ol style="list-style-type: none"> 1. 40 days after flowering 2. Grain moisture content less than 28 per cent 3. Yellow coloured ears with hard grains 	
Pearl Millet	28 to 35 days after flowering Compact ears, on pressing hard seeds come out	
Finger millet	Brown coloured ears with hard grains	
Maize	<ol style="list-style-type: none"> 1. Less than 22 to 25 per cent moisture in grain 2. Husk colour turns pale brown 3. 25 to 30 days after tasselling 	
Wheat	About 15 per cent moisture in grain Grains in hard dough stage Yellowing of spikelet's	
Sugarcane	<ol style="list-style-type: none"> 1. The ratio of brix between top and botton part of cane nearly one 2. Brix 18 to 20 per cent 3. Sucrose 15 per cent 	





Red gram	<ol style="list-style-type: none"> 35 – 40 days after flowering 80 – 85 per cent of pods turn brown 	
Black gram Green gram	Pods turn brown or black with hard seeds inside pods	
Groundnut	<ol style="list-style-type: none"> Pods turn dark from light colour. Dark coloured patches inside the shell. Kernels red or pink On pressing the kernels, oil is observed on fingers 	
Cotton	Bolls fully opened	
Sugarcane	Leaves turn yellow, sucrose content more than 10 per cent and brix reading more than 18 per cent	

Table 2.4. Moisture content of grains for safe storage

Crops	Moisture Content (%)
Paddy, raw rice	14
Parboiled rice	15
Wheat, barley, maize, sorghum, pearl millet, finger millet and pulses	12
Groundnut pods, rape and mustard	6



Self-Check – 1	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions

1. What is the effect of premature harvesting on quality? (5 pts.)
2. What is meant by shelf life of horticultural products? (5 pts.)
3. What are the color changes of garlic and carrot when they mature? (5 pts.)
4. List the advantages of timely harvesting of the crop? (5 pts.)

Note: Satisfactory rating 20 points Unsatisfactory - below 20 points

You can ask you teacher for the copy of the correct answers.



Information Sheet 2- Assessing resource requirements

2.1 Resource requirements

Resource requirements for crop harvest are assessed considering the size of the crop which mean the area coverage of the crop to be harvested and estimated timing of harvest to complete area coverage. The resources required will be stated in terms of personnel (these might be temporary, permanent, or contracted workers), machinery and equipment, consumables, and leasing arrangements.

2.1 Harvesting tools

Some fruits need to be clipped or cut from the parent plant. Clippers or knives should be kept well sharpened. Peduncles, woody stems or spurs should be trimmed as close as possible to prevent fruit from damaging neighboring fruits during transport.

Pruning shears are often used for harvesting fruits, some vegetables, and cut flowers. A variety of styles is available as hand held or pole models, including shears that cut and hold onto the stem of the cut product. This feature allows the picker to harvest without a catching bag and without dropping fruits.

Straight bladed hand shears for fruits and flowers:

Using a cutting tool attached to a long pole can aid picking of crops such as mangoes and avocados when the fruit is difficult to reach. Cutting edges should be kept sharpened and the catching bag should be relatively small. The angle of the cutting edge and the shape of the catching bag can affect the quality of the fruit harvested, so it is important to check performance carefully before using any new tools.

Picking poles and catching sacks can be made by hand or purchased from horticultural supply companies. The collection bags illustrated below were hand woven from strong cord or sewn from canvas. The hoop used as the basket rim and cutting edges can be fashioned from sheet metal, steel tubing or recycled scrap metal.

Fruit trees are sometimes quite tall and letting fruit fall to the ground when it is cut from the tree will cause severe bruising. If two pickers work together, one can clip or cut the fruit from the tree, and the other can use a sack to break its fall. The catcher supports the bag with his hands and one foot, catches the falling fruit, then lowers the far end of the bag to allow the fruit to roll safely to the ground.

Unlike most nut crops, pistachio nuts should not be knocked to the ground during harvest because of their open shells and relatively high moisture content. The harvesting practice illustrated below can be used with pistachios and olives with good results.

2.2. Confirming and arranging lab our and equipment required

Harvesting may be done either manual or mechanical.

In agricultural crop harvesting it is important to confirm and arrange lab our and equipment required before implementing harvesting operations considering the size of the field, weather condition and harvesting material availability.

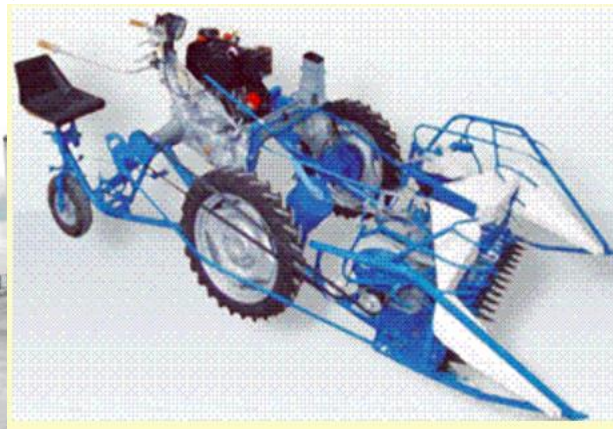
Harvesting tools

In most of the developing countries, harvesting is often done manually. In manual harvesting the following tools are used:

- Sickle
- Scythe
- Knife
- Cradle are most important tools. And they must be sharp, curved serrated for efficient harvesting.

In the mechanical harvesting the following equipment and machinery are used.

It is a chopper harvester with a cleaning system and whole cane harvesters are also available. It can cut one/two rows of cane at a time. The cane is fed between the crop dividers and is cut at the root zone by base cutter blades and simultaneously de-topped from top. The cane is then fed through the roller train and is cut by the chopper drums into small cane pieces of 24.5 to 30 cm. It is then cleaned in the primary extractor before being conveyed on the elevator. The can is then cleaned again with the secondary extractor and loaded onto a vehicle for transportation. In ideal conditions, the harvester can cut nearly 400 tonnes of sugarcane per day.





Uses: Combines are used for cutting, threshing, and cleaning of cereal and other crops in one operation.

jkhcgaskchas

Self-Check – 2	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (15 pts.)

1. What are the resources required for harvesting purposes (5 pts)
2. How can we manage tall fruits during harvesting? (5 pts)
3. What is the purpose of picking poles in fruit harvesting? (5 pts)

Note: Satisfactory rating - 15 points Unsatisfactory - below 15 points
You can ask you teacher for the copy of the correct answers.



Information Sheet 3- Confirming and arranging labor and equipment

3.1 Arranging labor use

Commercial hand harvesting of fruit, nut, and vegetable crops is hard, tedious, and time-consuming work. Hand harvesting 12 million acres annually would require at least 840 million Lh/year (1.05 million workers for 20 weeks/year), and would easily exceed the labor force of workers willing to do seasonal crop harvesting. Fortunately, several of the crops are now already harvested mechanically, and some are harvested using labor-aid machines or devices that make the work easier.

Hand harvest is still the only practical method for many high value products that are either sensitive to bruising or that must be selectively picked. The mechanization of harvesting has proceeded in stages, thus, we may speak of completely mechanized, semi-mechanized, and non-mechanized harvest. In hand harvest, crops picking may use different ways, such as cutting, digging, clipping, pulling or shaking. Those to be done are according the kinds of horticultural crop to be harvested. One advantage of hand harvesting is the ability to pick more small fruit which are often lost during mechanical harvest. The harvest labor requirement of fruit crops is quite high, frequently being more than 50% of the cost of production. The amount of labor required to hand harvest a given field will depend on yield, number of times harvested, and the amount of production.

One advantage of hand harvesting is the ability to pick more small fruit which are often lost during mechanical harvest. The harvest labor requirement of fruit crops is quite high, frequently being more than 50% of the cost of production. The amount of labor required to hand harvest an acre will depend on yield, number of times harvested, and the amount of vine growth. As an example, in prolific fields, an individual can pick 300 pounds (up to 6 bushels) of pickling cucumbers each hour. Approximately 24 hours of labor per acre will be needed for each harvest. Hand labor has not been replaced in the harvest of tomatoes and-until a plant breeding program develops a variety whose fruit will ripen all at one time, so it can be shaken free of the plant-growers will use hand labor. In the last harvest of pear-shaped tomatoes, the plants usually are cut by hand at the ground level and the fruit shaken from the plants, The acceptable fruit is picked up and put in lug boxes. If all or most of the fruit is to meet the state grade, each individual fruit has to be handled. A field with plants that have a high yield potential is an excellent enticement to labor since no one wants to pick from low-yielding plants.



Figure 3.1 Hand harvesting of different crops

Growers should secure picking labor well before harvest. Having sufficient labor is critical to the success of a farm operation. More stringent labor rules have been adopted and enforced in recent years. As labor costs continue to escalate, harvesting aids and mechanical harvesters have attracted more interest. Harvesting aids are often farmer-built or rebuilt from tobacco equipment and are designed to eliminate stoop labor by allowing pickers to work in a more comfortable sitting position. The efficiency of harvesting aids varies widely, but growers usually find recruiting and supervising labor easier when these machines are used. These machines could substantially reduce per-unit harvesting costs of pickling cucumbers, but growers might have to sacrifice some quality because fewer small-sized cucumbers are harvested than with hand-harvested fruit.

3.2 Arranging equipment for harvesting

Equipment required to carry out harvesting operations may include contracted resources, field bins and boxes, grading gauge, knives, platforms, scales, trolleys, trucks, trailers and tractors, waste containers, picking tools, ladder, bags, etc. When hand harvest, the fruits should be carefully picked and avoided any mechanical injuries

from the hand harvesting process. If the product has wounds, it is easily attacked by microbe, and the respiration of fruits will be promoted, and the storage capacity and marketing value will be reduced.

The materials, tools and equipment's needed for harvesting vegetables may include:

- Containers: bags, sacks, cardboards, baskets, plastic sheets, trays, etc.
- Cutting or clipping tools: shears, cutlass, knives, sickles, machetes, etc.
- Digging tools: spades, forks, towels, hoe, etc.
- Treatment chemicals

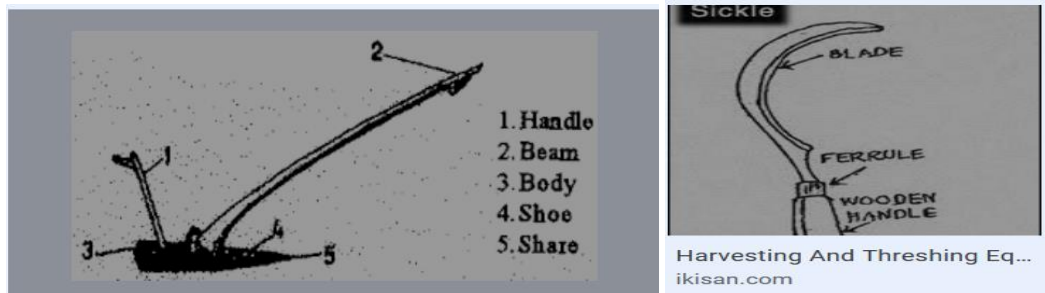


Fig:3.2. materials, tools and equipment's needed for harvesting

Plastic crates are relatively expensive but are durable, reusable, and easy to clean.

- **Harvesting tools-** Some fruits need to be clipped or cut from the parent plant. Clippers or knives should be kept well sharpened. Pruning shears are often used for harvesting fruits, some vegetables, and cut flowers. A variety of styles is available as hand held or pole models, including shears that cut and hold onto the stem of the cut

product. This feature allows the picker to harvest without a catching bag and without dropping fruits.

Straight bladed hand shears for fruits and flowers:



Pole mounted cut and hold picking shears:

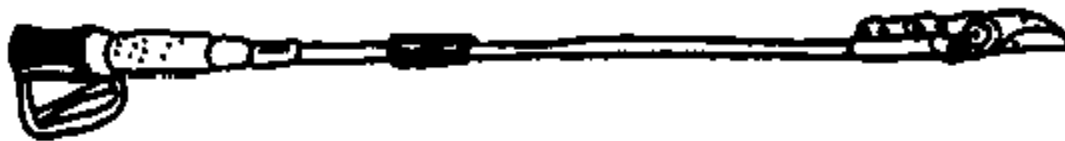


Figure 3.3 Clippers for fruit and flower harvesting

Using a cutting tool attached to a long pole can aid picking of crops such as mangoes and avocados when the fruit is difficult to reach. Cutting edges should be kept sharpened and the catching bag should be relatively small. The angle of the cutting edge and the shape of the catching bag can affect the quality of the fruit harvested, so it is important to check performance carefully before using any new tools.

Using a picking pole:



Figure 3.4 picking pole

Hand woven collection bag

Picking poles and catching sacks can be made by hand or purchased. The collection bags illustrated below were woven from strong cord. The hoop used as the basket rim and cutting edges can be made from sheet metal or steel.

Harvesting containers- Picking baskets, bags and buckets come in many size and shapes. Several examples are illustrated below.

Figure 3.2 harvesting containers



Figure 3.5 Collection bag

Fruit trees are sometimes quite tall and letting fruit fall to the ground when it is cut from the tree will cause severe bruising. If two pickers work together, one can clip or cut the fruit from the tree, and the other can use a sack to break its fall. The catcher supports the bag with his hands and one foot, catches the falling fruit, then lowers the far end of the bag to allow the fruit to roll safely to the ground as illustrated below. Some nuts should not be knocked to the ground during harvest because of their open shells and relatively high moisture content.



Self-Check – 3	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (15 pts.)

1. Why growers should pick labor before harvest (5 pts.)
2. What is the advantage of hand harvesting? (5 pts.)
3. Why harvesting aids and mechanical harvesters have attracted more interest now days (5 pts.)?

Note: Satisfactory rating - 15 points Unsatisfactory - below 15 points

You can ask you teacher for the copy of the correct answers.



Information Sheet 4- Identifying and arranging fire prevention and control

4.1 Introduction

In conditions of very low relative humidity and high temperatures, the machinery used for harvesting and gathering cereal crops can cause forest fires, which sometimes lead to serious harm to persons and their safety, to the loss of the crop and of the machinery, to a threat to farm buildings and it may ultimately also affect forest land.

The risk of fire caused by sparks when harvesting cereal crops rises in conditions of low relative humidity (below 50 % there begin to be fires, while a peak in fires occurs with a humidity of below 30 %).

Statistically, the fire curve shifts in terms of time with regard to the relative humidity curve due to the effect of increased fire risk caused by radiation, with a fire peak between 1 pm and 2 pm, and ignitions concentrated between 1 pm and 5 pm; consequently, it is advisable to take the utmost precaution during the times of maximum sunlight.

- Avoid the over-heating of machines or their bearings, as well as the build-up of static electricity with earth dischargers.
- Take extreme care in the maintenance of machines, i.e. clean the exhaust manifold and other points on the machine where the chaff and straw collect every day. Similarly, check the exhaust pipe gas outlet to ensure that the spark arresters are working properly. Provide extinguishers if speedy action for fire in the machinery is required, and water carriers for use on fire in cereal and straw.
- Whenever possible, ensure that there is an observer monitoring the whole of the harvested field in order to detect possible ignitions (the lorry driver or grain tractor driver or any other assistant).
- Ensure discontinuity between the areas already harvested, those not harvested and the forest land. For this reason it is very important that, whenever possible, you leave a strip of field around these areas with the disc ploughs after harvesting.
- On days in a heat wave with relative humidity of below 30%, it is advisable to reduce or, better still, stop activity between 1 pm and 5 pm.



- Schedule the harvest with the concerned body that is defense group (example, ADF) so that the primary action material that the ADF may provide and its volunteers are coordinated and working together at times that the machines are working.
- When harvesting on uneven ground, it is advisable to raise the cutter a little, when turning the harvester between 1 pm and 5 pm (official time) to prevent friction against the ground and any stones. It is also advisable to cover the bottom of the skid with nylon or other non-metallic plates.
- Carry a mobile phone and alert immediately of any incident, and in the event of a fire.
- **Basic principles**
 - ✓ Prevent the occurrence of fire
 - ✓ Provide fire compartmentalization
 - ✓ Provide safe escape routes
 - ✓ Provide fire alarms
 - ✓ Provide extinguishing agents
 - ✓ Provide facilities for the fire brigade
 - ✓ Provide adequate control and maintenance
- **Management tips:**
 - ✓ In case of fire, call 911 first, and then attack with fire extinguishers if it is safe to do so.
 - ✓ A fire can double in size in less than a minute.
 - ✓ Invert and shake the extinguishers once or twice a season to ensure machine vibrations don't compact the powder inside.
- **Methods of extinguishing fire.**
 - ✓ All fires can be extinguished by cooling, smothering, starving or by interrupting the combustion process to extinguish the fire. One of the most common methods of extinguishing a fire is by cooling with water.
- **Classes of fire**
 - ✓ Class A - fires involving solid materials such as wood, paper or textiles.
 - ✓ Class B - fires involving flammable liquids such as petrol, diesel or oils.



- ✓ Class C - fires involving gases.
- ✓ Class D - fires involving metals.
- ✓ Class E - fires involving live electrical apparatus.



Self-Check – 4	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (15 pts.)

1. Why overheating of machines should be avoided? (5pts)
2. What is the importance of raising the cutter a little when harvesting on an uneven ground? (5pts)
3. Why carrying a mobile is good in case of fire emergency? (5pts)

Note: Satisfactory rating - 15 points Unsatisfactory - below 15 points

You can ask you teacher for the copy of the correct answers



LG #71

LO #3- Coordinate the harvest strategy

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Implementing effective communication strategies
- Implementing and adjusting harvesting operations
- Coordinating and monitoring equipment operation
- Identifying and controlling existing and potential hazards

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to:**

- Implement effective communication strategies
- Implement and adjust harvesting operations
- Coordinate and monitoring equipment operation
- Identify and control existing and potential hazards

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.



Information Sheet 1- Implementing effective communication strategies

Harvest is a busy and often hectic time for farmers and agricultural workers because crops ripen on their own time schedule. More workers, more equipment, and a compressed time schedule for harvest increases the potential for accidents and injuries. Employers and workers can increase safety by inspecting the worksite, training employees, and maintaining equipment before harvest work begins.

Implementing effective communication strategies to ensure personnel safety and smooth flow of operations plays a great role in:-

- Solving different problems associated with harvesting operation
- Creating safe working environment
- Minimizing OHS hazards and using the corresponding care
- Facilitating the workers etc...

When your objectives involve communicating with others (when do they not?), the most pertinent environmental conditions consist of the **ideas** that your publics have about you and your objectives. It is sometimes said that "**perception is reality.**" More to the point: Your publics' perception is your reality.

Before starting to harvest operation, communicating ideas and information to work team members, supervisors and other concerned bodies is the most important part of harvesting work. Communicating and sharing of ideas and information to work team members and supervisors regarding the horticultural harvesting operation is important to:-

- ✓ Reduce workload among workers
- ✓ Reduce workplace hazards and risks
- ✓ Successfully complete the harvesting operation
- ✓ Have quality and quantity harvested product
- ✓ Reduce disagreement and biasness among workers
- ✓ Operate the harvesting activities based on crop type, part of the plant harvested, time of harvest, skill level and enterprise work procedures.
- ✓ Solve different problems that may occur during harvesting operation.

One of the best ways to ensure farmer participation is by creating partnerships with telecommunications companies in order to make interactions with farmers through phone and SMS inexpensive for the farmers and organizations. An example of ways to



do this is through utilizing something like a beep system where calls aren't ever actually answered so charges aren't accrued, however some companies will provide certain services at low or no cost.

The rapid advancements in technology are making it easier and easier to reach more farmers, but the large number of technologies out there can also become overwhelming. By tailoring messages and programs to specific groups to ensure they aren't receiving unnecessary information will make tech adoption and agricultural improvements more sustainable in the long run. The best way to do this is by continued engagement with your target group, redefining what your goals are for different segments of your target group, and keeping the costs down for farmers.



Self-Check – 1	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (15 pts.)

1. Explain the importance's of communication in harvesting? (5 pts.)
2. What is the role of technology in easing communication? (5 pts.)
3. What issues are communicated during harvesting? (5 pts.)

Note: Satisfactory rating - 15 points Unsatisfactory - below 15 points

You can ask your teacher for the copy of the correct answer



Information Sheet 2- Implementing and adjusting harvesting operations

During harvesting operation, a high standard of field hygiene should be maintained. It should be done carefully at proper time without damaging the fruits.

During harvesting operation, a high standard of field hygiene should be maintained. It should be done carefully at proper time without damaging the fruits. The harvesting operation includes.

- Identification and judging the maturity of fruits.
- Selection of mature fruits.
- Detaching or separating of the fruits from tree, and
- Collection of matured fruits.

There are many different ways in which fruits and vegetables are harvested. The harvesting method depends on the crop, how it is grown and the resources available. For example, if it is a crop where there is machinery available to do or to help with the harvesting, those methods can only be utilized if the grower or harvesting company can afford to use that machinery to get the crops harvested. Below, the common harvesting methods of fruits and vegetables, and included examples based on the footage I have been able to gather at different harvests.

- **Harvesting Methods**

In general, these are the three different harvesting methods that take place when harvesting fruits and vegetables:

- ✓ Hand Harvesting
- ✓ Harvesting with Hand Tools
- ✓ Harvesting with Machinery

However, it is important to note that it is hard to categorize the different types of harvesting because there can be some overlap.

1. Hand Harvesting

Hand harvesting is just that: produce is harvested by hand, without the use of any tools. When hand harvesting, it is typically done using a picking cart or some sort of container. A common example of a hand harvest with a picking cart is a strawberry harvest. While,

an example of a hand harvest using containers is the hand harvesting carrot operation you have seen previously on the blog. (There are two different types of carrot harvest that can be done: hand harvest for the fresh market or machine harvest for carrots that go on to be processed in to baby carrots or something of that sort.)



Figure 3.1 Hand Harvesting

2. Harvesting with Hand Tools

This harvesting method is typically carried out when harvesting tree fruit, where some sort of clipper (usually specialized for the type of produce being harvested) is used to remove the fruit from the tree, and then the fruit is placed into harvesting containers. Once the harvesting containers are full, the harvested product is transferred to larger bins in the field, of which those are then transported to the facility. Some examples include the harvesting of fresh figs, peaches, and Cuties. Although this is very common in the harvesting of tree fruit, it does also occur for other produce items, such as onion (the non-machine harvesting operation), garlic and row crops.



Figure 3.2 harvesting by hand tool

3. Mechanical harvesting

Mechanical harvesting may be carried out by the use of combine harvesters shown in **Error! reference source not found.** or reapers shown in Figure 4-2. They have the advantage of threshing as they are harvesting. The problem with the combine harvester is the high initial and maintenance costs coupled with its unavailability and lack of spare parts in most areas in West Africa. In addition, when this method is used in fields with well-dried grains, many of the grains fall or are broken by the tines. Generally, the use of combine harvesters is most appropriate on farms that are relatively large with good leveling and water control. The rice variety should be one that matures evenly and should not be of short variety. To perform optimally the use of combine harvesters require the following:

- Large farm sizes,
- Good level and dried surface area (not waterlogged),
- Erect rice plants (not lodged),
- Personnel trained in the use of the equipment,
- Availability of spare parts and machine repairs/maintenance.



a) Harvesting Using a Harvesting Rig – Commonly, the produce items are either hand harvested or harvested using tools and then passed on to the workers working on the harvesting rigs, where the product can be packed; washed and packed; trimmed, washed and packed; etc. The harvesting rigs serve as an aid in the packing process and then once the product is packed, or prepared for the processor, it is transported (typically via a conveyor belt) over to an adjacent trailer that is responsible for transporting the product out of the field. Some examples of this include the harvesting of cauliflower, cantaloupe, and romaine hearts (this is an example of semi-processing activities in the field).



Figure 2.3 use of harvesting rigs



b) Harvesting Using a Mower – The mower harvests have been perfected to rely heavily on the mowers and not so much on actual workers. There is the mower, with a few workers on it or at least one driving it and then an adjacent trailer to capture the harvested product. Some examples include the harvesting of spring mix and basil. Another form of a mower that you have seen is as part of the 3-

step almond harvesting process (which also includes a sweeping and shaking machine).

Figure 2.4 Harvesting using harvesting mowers

c) Harvesting Using a Combine – Combines are used to harvest grain crops. They pass through the fields and mow down the grain crops and remove the desired portion into the machine and spit the rest out the back. An example of this is a corn combine that is used to harvest corn that is harvested to be used in processed products (e.g., corn chips, corn tortillas, etc.).



Figure 2.5 Combine harvesting

• **Key points to be considered during harvesting are:**

- ✓ Whenever possible, ensure that there is an observer monitoring the whole of the harvested field in order to detect possible ignitions (the lorry driver or grain tractor driver or any other assistant).
- ✓ Ensure discontinuity between the areas already harvested, those not harvested and the forest land. For this reason, it is very important that, whenever possible, you leave a strip of field around these areas with the disc ploughs after harvesting.
- ✓ On days in a heat wave with relative humidity of below 30%, it is advisable to reduce or, better still, stop activity between 1 pm and 5 pm.
- ✓ Schedule the harvest with the concerned body that is defense group (example, ADF) so that the primary action material that the ADF may provide and its volunteers are coordinated and working together at times that the machines are working.
- ✓ When harvesting on uneven ground, it is advisable to raise the cutter a little, when turning the harvester between 1 pm and 5 pm (official time) to prevent friction against the ground and any stones. It is also advisable to cover the bottom of the skid with nylon or other non-metallic plates.
- ✓ Carry a mobile phone and alert immediately of any incident, and in the event of a fire.



Self-Check – 2	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (20 pts.)

1. Explain the different ways of harvesting (5 pts.)
2. What are the points to be considered during harvesting? (5 pts.)
3. What are the three types of harvesting machineries? (5 pts.)
4. Compare and contrast hand harvesting and machine harvesting (5 pts.)

· **Note: Satisfactory rating - 20 points Unsatisfactory - below 20 points**

You can ask you teacher for the copy of the correct answers.



Information Sheet 3- Coordinating and monitoring equipment operation

Preparing equipment prior to harvest ensures that it is in good shape for the heavy workload. It should be inspected for proper guarding and all worn parts should be repaired or replaced. Harvesting equipment should not be used unless it is in proper working condition. Agricultural harvesting processes are not evenly distributed over the whole year but are rather subject to very large seasonal fluctuations. External influences such as breakdowns of machine can also interfere with the sensitive structure.

Farm equipment maintenance is not a one season activity. Caring and maintaining of farming machinery is a continuous year-round job. It shouldn't be neglected even during the busiest days within a season.

Failing to perform a series of maintenance and inspections may result into equipment malfunction at a critical time. If equipment fails, it can be devastating to the farming business. Routine inspections or checks and maintenance throughout the year is not time-consuming activity. A routine and quick inspection is enough to catch any awaiting problems that may require immediate fixing. Schedule a comprehensive time-table that will help your preparation prior to harvesting of the yields.

Commercial hand harvesting of fruit, nut, and vegetable crops is hard, tedious, and time-consuming work. The amount of labor needed for harvesting is often well over 50 percent of the total annual labor requirement. Hand harvesting 12 million acres annually would require at least 840 million Lh/year (1.05 million workers for 20 weeks/year), and would easily exceed the labor force of workers willing to do seasonal crop harvesting. Equipment should be made harvest-ready in the off-season, or at least several weeks before use.

- Review operation manuals and follow maintenance guidelines. Cleaning, proper lubrication, replacement of worn parts (belts, chains, springs, hydraulic hoses, etc.), and replacing shields may save valuable time during the short harvest period.
- Remove stumps, stones, or other debris from the field, or clearly mark them to prevent upsets, turnovers, and damage to equipment. Also mark ditches and banks.
- Some banks are undercut. You need to be aware that what appears to be the edge may not be solid, but that there may be an open space below it.
- Plan harvesting so equipment travels downhill on steep slopes to avoid overturns. Space tractor wheels as far apart as possible when operating on slopes.



Self-Check – 3	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (15 pts.)

1. Explain some of the importance's of checking the working conditions of machines (5 pts.)
2. List the mechanisms of equipment coordination before harvesting (5 pts.)
3. Why removing stumps, stones, or other debris from the field? (5 pts.)
4. What is the importance of coordinating harvesting equipment operation?

Note: Satisfactory rating -15 points Unsatisfactory - 15 points

You can ask you teacher for the copy of the correct answers.



Information Sheet 4- Identifying and controlling existing and potential hazards

Permanent accident procedures must be clearly displayed in accessible, and visible location(s). These instructions are available in the predominant language(s) of the workforce and/or pictograms. The procedures must identify, if appropriate the following; e.g.: farm's map reference or farm address- contact person(s) - location of the nearest means of communication (telephone, radio)- an up-to-date list of relevant phone numbers (police, ambulance, hospital, fire-brigade, access to emergency health care on site or by means of transport, electricity and water supplier); - how and where to contact the local medical services, Hospital and other emergency services. - Location of fire extinguisher; - emergency exits; - emergency cut-offs for electricity, gas and water supplies. - How to report accidents or dangerous incidents.

Potential hazards clearly identified by warning signs and placed where appropriated

Permanent and legible signs must indicate potential hazards, e.g. waste pits, fuel tanks, workshops, access doors of the plant protection product / fertilizer / any other chemical storage facilities as well as the treated crop etc. Warning signs must be present.

Safety advice available/ accessible for substances hazardous to worker health, when required

Information (e.g. website, telephone no, data sheets, etc.) is accessible, when required, to ensure appropriate action. Preparing equipment prior to harvest ensures that it is in good shape for the heavy workload. It should be inspected for proper guarding and all worn parts should be repaired or replaced. Harvesting equipment should not be used unless it is in proper working condition.

- **Hazards of falling:** to reduce fall hazards, remember to:
 - ✓ Always keep all platforms free of tools or other objects. Frequently clean the steps and other areas where workers stand to service, mount and dismount, or operate the machine.
 - ✓ Wear well-fitting, comfortable shoes with non-slip soles. Use grab bars when mounting or dismounting machinery.



- ✓ Be sure your position is stable before you perform maintenance.
 - ✓ Recognize that fatigue, stress, drugs or alcohol, and age may affect stability. Harvest season comes with many stresses.
 - ✓ Exposure to dangerous situations can increase the mental pressure, and your risk of injury. Follow safe practices around harvest equipment to make the most of your work time during this important season.
- **Enterprise requirements may include:**
 - ✓ enterprise policies and procedures, including waste disposal, recycling and re-use guidelines
 - ✓ harvesting methods or techniques to be used
 - ✓ industry standards
 - ✓ manager's oral or written instructions
 - ✓ manufacturer specifications
 - ✓ material safety data sheets (MSDS)
 - ✓ operator manuals
 - ✓ processes or actions undertaken to meet customer requirements
 - ✓ product labels
 - ✓ production schedules
 - ✓ productivity rates
 - ✓ quality standards to be achieved
 - ✓ requirements for export markets such as:
 - ✓ standard operating procedures
 - ✓ Work notes and plans.



Self-Check – 4	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (15 pts.)

5. What should be done to reduce fall hazards? (5pts)
6. Why reporting dangerous incidents is important during harvesting? (5pts)
7. What is the consequence of operating mowers at excessive speed? (5pts)

Note: Satisfactory rating – 15 points Unsatisfactory - 15 points
 You can ask you teacher for the copy of the correct answers.



Operation sheet 2

Implementing and adjusting harvesting operation

To undertake harvesting activity of a given Agricultural crop, it is important to practice some procedures regarding the task. Therefore, to undertake a proper crop harvesting practices, follow the following procedures carefully.

1. Strictly identify and select the type of horticultural crop to be harvested (cereal crops, fruit, vegetable, flower...) and the plant organ to be harvested (leaf, root, flower, fruit, bunch...)
2. Carefully identify the maturity status of the selected crop depending on the purpose of harvesting and maturity parameters.
3. Prepare all the necessary tools, materials and equipment associated with the harvesting activities (like knives, machetes, rubber bunds, tractor, containers, buckets, baskets...etc) that aids in crop harvesting and reduces crop damages depending on the type of crop selected.
4. Carefully identify all the OHS hazards and use the correct corresponding PPE to reduce the hazard
5. Understand the nature of the crop to be harvested and prepare temporary storage facility depending on the type of crop to be harvested and parts of the plant to be harvested and adjust the time of harvesting depending on the nature of the crop.
6. Establish suitable weather conditions and carefully identify the major factors that affect the harvesting operation.
7. Determine the method of harvesting depending on the type of crop to be harvested and the availability of harvesting materials and the time of the day suitable to harvest the particular crop.
8. Select suitable harvesting method depending on the type of crop to be harvested and the availability of harvesting materials.
9. Communicate with the concerned bodies on the ways of risk management and mitigation.
10. Now start the harvesting operation carefully by giving highest attention for the quality of products by reducing crop damage, wastage, and contamination.
11. Then start the post-harvest activities (like Grading and sorting) depending on the type of crop you have harvested and carefully transport to the storage area.
12. Finally, complete your work by preparing work documents and reports including the risks and hazards that you have faced when performing the harvesting practices.



LAP Test 2	Practical Demonstration
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Name _____ Date _____

Time started _____ Time finished _____

Instructions: *Given necessary templates, tools and materials you are required to perform the following tasks within 2 hour. The project is expected from each student to do it.*

In store or field make sure that you can identify tool and equipment's of agricultural crop harvest.

Task-1: Implementing and adjusting harvesting operation



LG #72

LO #4- Complete harvest operations

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Locating storage resources and identifying drying strategies
- Monitoring grain moisture content and segregating quality
- Evaluating harvesting operations and outcomes
- Documenting relevant information

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to:**

- Locate storage resources and identify drying strategies
- Monitor seed moisture content and segregating quality
- Evaluate harvesting operations and outcomes
- Document relevant information

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
 - Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).



Information Sheet 1- Locating storage resources and identifying drying strategies

4.1. Introduction

Although in many parts of Africa certain crops can be produced throughout the year, the major food crops such as cereal grains and tubers, including potatoes, are normally seasonal crops. Consequently the food produced in one harvest period, which may last for only a few weeks, must be stored for gradual consumption until the next harvest, and seed must be held for the next season's crop.

Storage is an important marketing function, which involves holding and preserving goods from the time they are produced until they are needed for consumption.

- The storage of goods, therefore, from the time of production to the time of consumption, ensures a continuous flow of goods in the market.
- Storage protects the quality of perishable and semi-perishable products from deterioration.
- Some of the goods e.g., woolen garments, have a seasonal demand. To cope with this demand, production on a continuous basis and storage become necessary.
- It helps in the stabilization of prices by adjusting demand and supply;
- Storage is necessary for some period for performance of other marketing functions.
- Storage provides employment and income through price advantages.

Locating storage resources

Definition of storage

Storage is very crucial post-harvest operation of agricultural products to extend the shelf life of the farm produce in good quality and safety till it arrives on the consumers hand to be consumed.

The rate at which changes occur in harvested products may be influenced by a range of environmental conditions, including temperature, humidity and atmospheric composition.



All may be manipulated by careful management of the postharvest handling system to obtain the best possible results (quality some fruit) has the produce.

The marketable life of most fresh products can be extended by prompt storage in an environment that maintains product quality. The desired environment can be obtained in facilities where temperature, air circulation, relative humidity, and sometimes atmosphere composition can be controlled.

Choosing of **different storage methods** depends on the type of the product, its use and the required storage time.

4.1.1. Underground Storage Structures

Underground storage structures are dugout structures similar to a well with sides plastered with cow dung. They may also be lined with stones or sand and cement. They may be circular or rectangular in shape. The capacity varies with the size of the structure.

Advantages

- Underground storage structures are safer from threats from various external sources of damage, such as theft, rain, or wind.
- The underground storage space can temporarily be utilized for some other purposes with minor adjustments; and
- The underground storage structures are easier to fill up owing to the factor of gravity.

4.1.2. Surface storage structures

Food grains in a ground surface structure can be stored in two ways - bag storage or bulk storage.

A. Bag storage

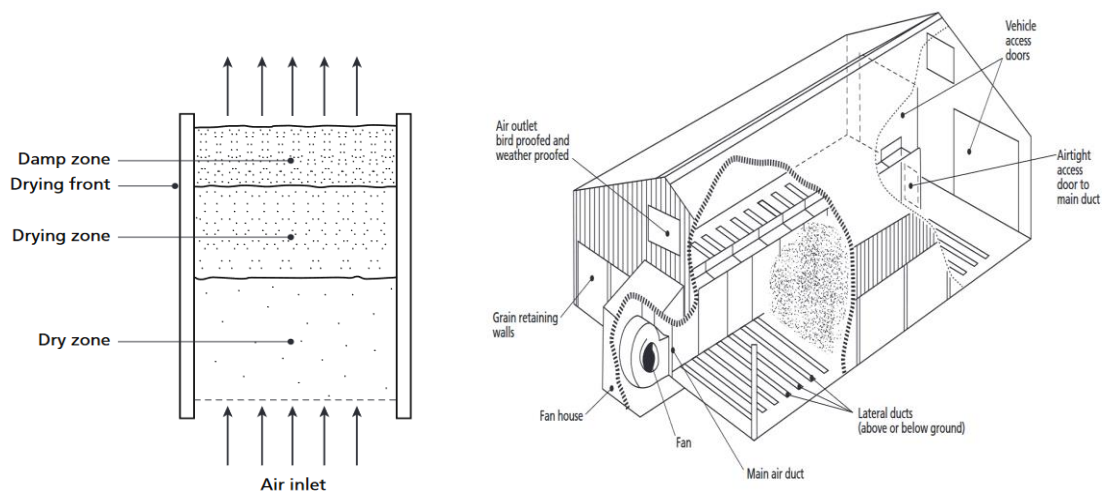
- Each bag contains a definite quantity, which can be bought, sold or dispatched without difficulty.
- Bags are easier to load or unload.
- It is easier to keep separate lots with identification marks on the bags.

- The bags which are identified as infested on inspection can be removed and treated easily; and
- The problem of the sweating of grains does not arise because the surface of the bag is exposed to the atmospheres.



B. Bulk or loose storage [deep layer drying]

- The exposed peripheral surface area per unit weight of grain is less. Consequently, the danger of damage from external sources is reduced; and
- Pest infestation is less because of almost airtight conditions in the deeper layers.



4.1.3. Improved grain storage structures

A. For small-scale storage

- PAU bin
- This is a galvanized metal iron structure. Its capacity ranges from 1.5 to 15 quintals. Designed by Punjab Agricultural University.
- Pusa bin

It is a cylindrical rubberized cloth structure supported by bamboo poles on a metal tube base and has a small hole in the bottom through which grain can be removed.

B. For large scale storage

- CAP Storage (Cover and Plinth)

✓ It involves the construction of brick pillars to a height of 14" from the ground, with grooves into which wooden crates are fixed for the stacking of bags of food grains. The structure can be fabricated in less than 3 weeks. It is an economical way of storage on a large scale.

- Silos storage structure



In these structures, the grains in bulk are unloaded on the conveyor belts and, through mechanical operations, are carried to the storage structure. The storage capacity of each of these silos is around 25,000 tonnes



The purpose of grain storage facility is to provide safe storage conditions for rice grain in order to prevent grain loss caused by adverse weather, moisture, rodents, birds, insects and micro-organisms like fungi.

Grain moisture content should be maintained at 14% w.b. or less.

Don't put rice bags directly on the floor. Those bags should be laid on the rack above 20 cm above the floor.

The longer the grain needs to be stored, the lower the required moisture content will need to be.

Grain and paddy seed stored at moisture contents above 14% w.b. may experience the growth of molds, rapid loss of viability and a reduction in eating quality.

If the moisture content of paddy inside bag is high, open all mouths of bags to release vapor and heat coming from the paddy itself. It's better to spread such

paddy of high moisture content on plastic sheet for room conditions drying.

4.2. Moisture content

The moisture content of a crop is normally given on a

'Wet basis (wb) and is calculated as follows (%mcwb):

$$\frac{\text{Weight of moisture}}{\text{Weight of wet sample}} \times 100$$

Occasionally 'dry Basis' (db) moisture content is given and it is important to know which has been used.

For example, if 100 kg of moist grain is dried and loses 20 kg of water, the moisture content is:



$$\frac{20 \times 100}{100} = 20\% \text{ on wet basis (wb) or}$$

$$\frac{20 \times 100}{80} = 25\% \text{ on dry basis (db)}$$

Grain will normally be harvested at a moisture content of 18–25 percent (wb), although it can be

substantially higher or lower depending on many factors (such as the stage of maturity, season, weather pattern and drying facilities).

Loss of moisture

As grain dries, it releases its moisture into the drying air and consequently loses weight.

The weight of grain after drying may be found using the following equation:

$$W_2 = W_1 - \frac{W_1 (M_1 - M_2)}{100 - M_2}$$

where:

W1 = Weight of undried grain (kg)

W2 = Weight of dried grain (kg)

M1 = Moisture content of undried grain (percent)

M2 = Moisture content of dried grain (percent).

For example, if 200 kg of peas at 32 percent moisture content are dried to 19 percent moisture content, what is the weight of the dried peas?

$$W_2 = 200 - \frac{200 (32 - 19)}{100 - 19} = 200 - 32.1 = 167.9 \text{ kg}$$

When the moisture content of the grain to be dried has been determined, it is possible to check the progress of the drying process by using the following procedure.

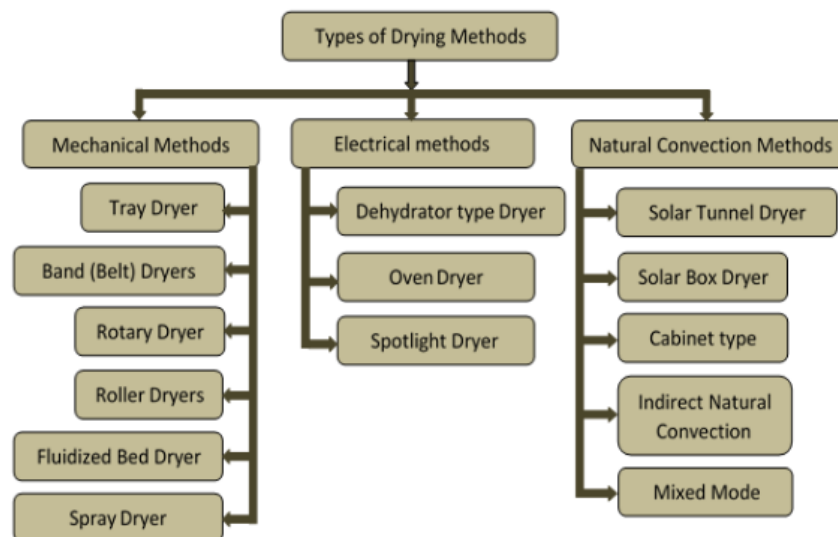
4.2. Drying methods

Drying / Dehydration

The terms drying and dehydration means the removal of water.

Drying - is done by using non-conventional energy sources like sun and wind

Dehydration – means the process of removal of moisture by application of artificial heat under controlled conditions of temperature humidity and air flow



4.3.1. Mechanical methods

A. Tray Dryer: are classified as batch type and band dryer and can dry almost everything. However, because of the labors required for loading and unloading,

they are expensive to operate. They find most frequent application when valuable products like dyes and pharmaceuticals are involved.

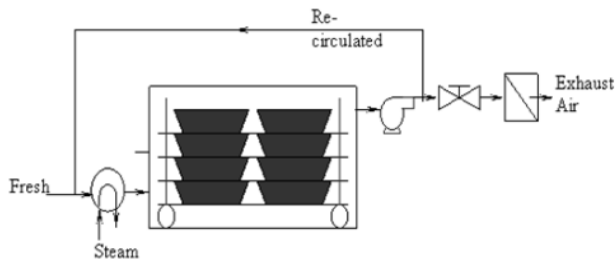


Fig1. Tray Dryer.

This type of dryer is frequently used for drying of wood and various agricultural products.

C. Band (Belt) Dryers:

Band (Belt) Dryers: is preferable if the particles to be dried are rather coarse (i.e. between 5 to 10 mm). The particles spread evenly into slowly moving, e.g. 5mm/s, perforated belt. The belt moves into a drying cabinet and warm gas passes downward through the layer. This type of dryer is chosen when it is not possible to suspend the particles in the drying gas. The dryer must offer a residence time, say 15min, because bound moisture must diffuse through the pellet.

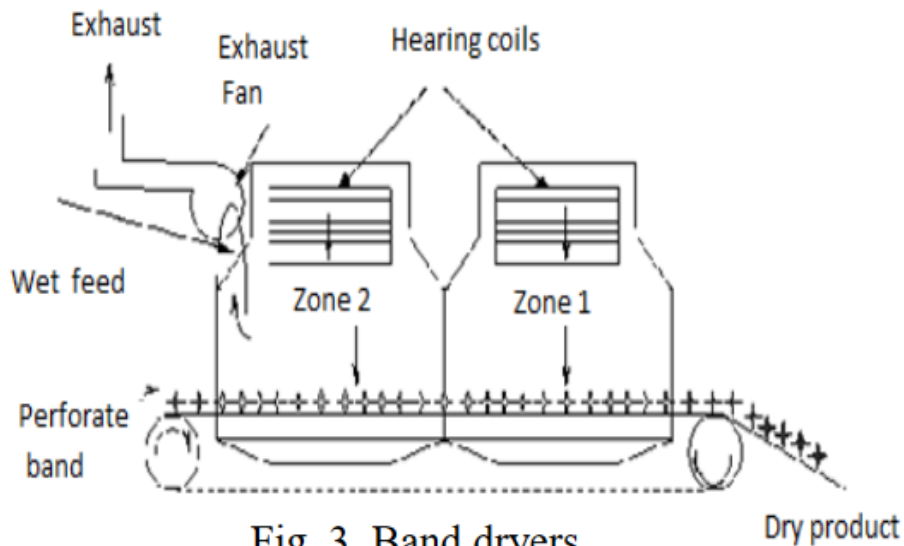


Fig 3 Band dryers

D. Rotary Dryer

Rotary Dryer consist of a cylindrical shell, horizontal or slightly inclined toward the outlet.

They are heated by

- Direct contact of air or gas with the solids,
- By hot gasses passing through an external jacket on the shell, or,
- By steam condensing in a set of longitudinal tubes mounted on the inner surface of the shell.

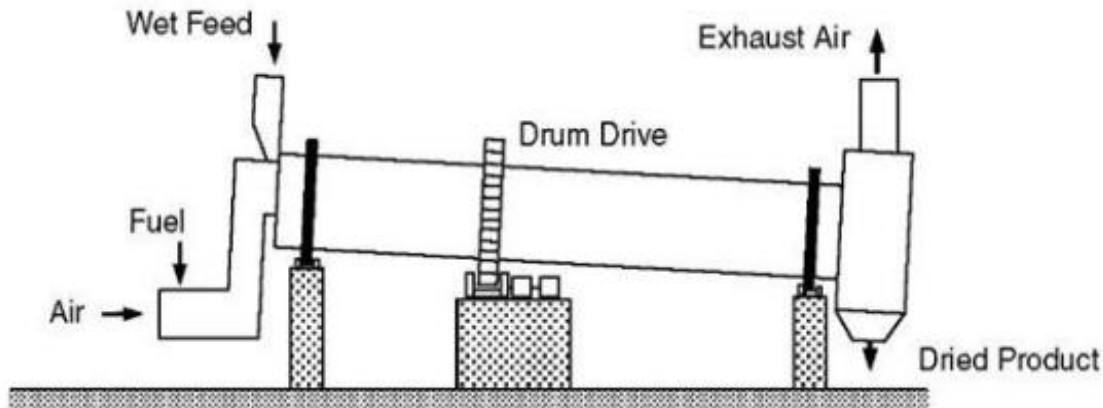


Fig. -----Rotary dryers

The product is fed to the upper orifice and transported during mixing through the cylinder. Regardless of the method of the heating, the water is removed with the air. The disadvantage of rotary dryers is the big power losses, which occur if the product is fine grained.

4.3.2. Electrical methods

2.1. Dehydrator Dryer: is dehydrating food is an ancient method of preserving food. It is a gentle, natural process which removes moisture from food. Using a controlled heat temperature, is dehydrating food is air is circulated from the top of the unit to each of the five trays and base. This method of drying seals in the flavor sand nutrients of the food, leaving a high food nutrient and vitamin content.



Fig.---.Dehydrator dryer



4.3.3. convection methods

OYSD (Open Yard Sun Drying Method)

Open Yard Sun Drying Method are simply drying the products in open atmospheric space. Due to this the chances of products getting affected due to rain and dust are more. There is also a possibility fungus formation of the products if they are kept as it is.

Storage resources may include:

- cool rooms and cold storage
- field bins
- other controlled atmosphere storage facilities
- pallets
- racks
- Temporary storage.
- Warehouse diffused light storage etc.

Table 4.1 Storage Requirements for Fruits and Vegetables

Commodity	Storage Temperature* (°F)	Relative Humidity (%)	Average Storage Life
Vegetables			
Artichoke, Jerusalem	31–32	90–95	2–5 months
Asparagus	32–36	95–100	2–3 weeks
Bean & pea, dry	32–40	65–70	1 year
Bean, green or snap	40–45	90–95	7–10 days
Bean, lima	37–41	90–95	5–7 days
Beet (topped)	32	90–95	3–5 months
Broccoli	32	90–95	10–14 days
Cabbage, late	32	90–95	3–4 months
Cabbage, Chinese	32	90–95	1–2 months
Carrot	32	90–95	4–5 months
Cauliflower	32	90–95	2–4 weeks
Celeriac	32	90–95	3–4 months
Celery	32	90–95	2–3 months



Commodity	Storage Temperature* (°F)	Relative Humidity (%)	Average Storage Life
Vegetables			
Corn, sweet	32	90–95	4–8 days
Cucumber	50–55	90–95	10–14 days
Eggplant	45–55	90–95	1 week
Garlic	32	65–70	6–7 months
Leek	32	90–95	1–3 months
Lettuce	32	95	2–3 weeks
Melon, muskmelon (Cantaloupe)	32–40	85–90	5–14 days
Melon, honeydew	45–50	85–90	3–4 weeks
Melon, watermelon	40–50	80–85	2–3 weeks
Mushroom	32	90	3–4 days
Okra	45–50	90–95	7–10 days
Onion, dry	32	65–70	1–8 months
Onion, green	32	90–95	3–5 days
Parsley	32	90–95	1–2 months
Parsnip	32	90–95	2–6 months
Pea, green	32	90–95	1–3 weeks
Pepper, dry	32–50	60–70	6 months
Pepper, sweet	45–50	90–95	2–3 weeks
Potato, late	40–45	90	2–9 months
Pumpkin	50–55	70–75	2–3 months
Radish	32	90–95	3–4 weeks
Spinach	32	90–95	10–14 days
Squash, summer	40–50	90	5–14 days
Squash, winter	50–55	50–75	2–6 months
Sweet Potato	55	85–90	4–6 months
Tomato, mature green	55–70	85–90	1–6 weeks
Tomato, colored, firm	46–50	85–90	4–10 days
Fruits			
Apple	30–40	90	3–8 months
Apricot	31–32	90	1–2 weeks
Avocado	50–55	90–95	3–10 days
Blackberry	31–32	90–95	2–3 days
Blueberry	31–32	90–95	2 weeks
Cherry, tart	32	90–95	3–7 days
Cherry, sweet	30–31	90–95	2–3 weeks
Grapefruit	40–50	85–90	4–6 weeks
Grape	31–32	85	2–8 weeks



Commodity	Storage Temperature* (°F)	Relative Humidity (%)	Average Storage Life
Vegetables			
Orange	32–40	85–90	3–10 weeks
Peach	31–32	90	2–4 weeks
Pear	29–31	90–95	2–4 months
Plum	31–32	90–95	2–4 weeks
Raspberry	31–32	90–95	2–4 days
Strawberry	32	90–95	5-7 days



Self-Check – 1	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (20 pts.)

1. What are the three storage conditions for Agricultural crops? (5 pts.)
2. What are the significance of temperature and relative humidity in the storage of horticultural products? (5 pts.)
3. Discuss on the ways of extending the storage of life of a given harvested horticultural product? (5 pts)
4. Discuss on the ways of extending the storage of life of a given harvested horticultural product? (5 pts.)

Note: Satisfactory rating – 15 points Unsatisfactory - 15 points

You can ask your teacher for the copy of the correct answer



Information Sheet 2- Segregating quality of grain and evaluating harvesting operation

2.1 Segregating quality of grain

Quality of grains segregated to marketing grades and monitored for moisture contain according to classification standards. The grain can be segregated by traditional threshing method (shelling by hand, beating by sticks, bullock threshing) and improved threshing method (shelling by shellers,etc).

2.2.1. Grading – is an important process, of post-harvest handling techniques of crop production to consume better quality products.

The quality is related to morphology, structure and chemical composition of, which influences the nutritional sensory and processing quality.

Factors to be considered in grading: - harvested products are graded into different categories on the basis of following quality parameters:-

- Uniformity in size, shape, color and ripeness.
- Uniformity in appearance.
- Variety.
- Seed content.
- Moisture content.
- Good visual appearance (absence of visual defects).

The importance of grading is:

- To eliminate all unsatisfactory items (defects)
- To increase the quality and storage life of the harvested products
- To attract markets and obtain high sell price
- To minimize contamination of the product from pests and disease.

4.2.2. Dumping: Produce must somehow be removed from the field bin or harvesting container and moved through the packinghouse. This first step is known as "dumping". Dumping must be done gently, whether using water assisted methods or dry dumping. Wet dumping can decrease bruising and abrasions by using moving, chlorinated (100-150 ppm) water to carry delicate produce. When using dry dumping, padded, sloped ramps or moving conveyor belts can decrease injuries to produce.

4.2.3.Pre-sorting: Pre-sorting produce is usually done to eliminate injured, decayed, or otherwise defective produce (culls) before cooling or additional handling. Pre-sorting will save energy in that culls will not be handled. Removing decaying produce items will limit the spread of infection to other units, especially if postharvest pesticides are not being used.



4.2.4.Sorting: Under this operation, injured, bruised, cut, over-sized, under-sized, decayed, shriveled vegetable & fruits are sorted. After sorting, healthy lot is left free from any unwanted subject. Vegetable & fruits are subjected for sorting manually or mechanically placing them on running belt.

4.2.5.Cleaning: Before fresh harvested horticultural products are marketed, various amount of cleaning are necessary. Cleaning typically involve the removal of soil, dust, adhering debris, insects and spray residue. These normally require both spray of water and wet bruising. Chloride is often added to the wash water as a disinfectant. For some commodities, such as kiwifruits and avocados, dry brushing may be sufficient to clean the produce. Other commodities, however, such as bananas and carrots, require washing.

The choice of brushing and/or washing will depend upon both the type of commodity and the type of contamination.

- Wash before cooling and packing: tomatoes, cucumbers, leafy greens
- Wash to remove latex, reduce staining: mangoes, bananas
- Wash after storage: sweet potatoes, potatoes, carrots
- Dry brush after curing or storage: onions, garlic, kiwifruit
- Do Not Wash: green beans, melons, cabbage, okra, peas, peppers, summer squash

Sanitation is essential, both to control the spread of disease from one item to another, and to limit spore buildup in wash water or in the packinghouse air.

4.2.6.Transporting: - The product must be transported as soon as possible to storage facilities by carts, trucks, train or ships.

4.2.7. Storing products: - Ideal storage will ensure minimum losses in quality and preservation of quality for use. Storage involves consideration of climatic and weather, design of the storage equipment, control of the environment in the storage economic and related factors.

The marketable life of most fresh products can be extended by prompt storage in an environment that maintains product quality. The desired environment can be obtained in facilities where temperature, air circulation, relative humidity, and sometimes atmosphere composition can be controlled.



Self-Check – 2	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions

1. What is the role of grading the Agricultural crops? (5 pts.)
2. What is a sorting products? (5 pts.)
3. What is the difference between grading and sorting? (5 pts.)
4. What is the purpose of consuming fresh produce? (5 pts.)

Note: Satisfactory rating – 15 points Unsatisfactory - 15 points

You can ask your teacher for the copy of the correct answer



Information Sheet 3- Evaluating harvesting operations and outcomes

3.1 Evaluating the Harvesting Operations and Outcomes

Harvesting operations and outcomes are evaluated against harvest strategy. This is important because to analysis weather the harvest strategy is good or not and what was the outcomes look like. You can evaluate harvesting operation and outcomes by asking yourself question like:

- Is the harvesting strategy is cost effective?
- Is the harvest strategy save time or not?
- Is the operation is easily is applicable?
- What the effects of operation on personnel safety?

Then, by answering such question you can evaluate harvest operation and outcomes. Formal evaluation of operations will be done by staff of the crops Authority. Self-regulation by logging companies to ensure compliance with the *Code of Practice for horticultural crops Harvesting* and monitoring of performance is recommended.

3.2 Timing of evaluations

- Crops authority officers will evaluate operations at each inspection.
- Maximum time between evaluations should be 3 months. Inspection at 1-month intervals is preferable.
- If the evaluation results in a suspension of operations, a further field evaluation should be carried out to verify that all the work is completed to the required standards before the suspension is lifted.

3.3 Evaluation procedures

- All evaluations require ground inspection.
- The crop authority officer should be accompanied by a representative of the company and other authorities as appropriate.
- Preliminary evaluations may be undertaken from small format photography/satellite images of logging areas which have been flown since the last inspection. Assessments of operations from photography need to be checked in the field.
- Areas inspected and evaluated should include a representative sample of: current harvesting operations, areas completed since the last inspection, areas where the company was directed, at the previous inspection, to do further work.
- During the inspection, all areas of non-compliance with the Code or the harvesting contract are to be explained to the company representative.
- The company representative is requested to sign the evaluation form as a true record of the inspection



Self-Check – 3	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (15 pts.)

1. What are the questions that should be answered during evaluation of harvesting? (5 pts.)
2. At what time evaluation should undertake? (5 pts.)
3. Discuss the roles of evaluation for the final outcome of harvesting? (5 pts.)

Note: Satisfactory rating - 15points Unsatisfactory - below 15 points

You can ask you teacher for the copy of the correct answers.



Information Sheet 4- Documenting relevant information

4.1. Documenting information

As harvesting is completed all data has been under taken during the process has to be documented for future analysis. The following data has to be documented after completing harvesting operation.

- Methods of harvesting
- Resource. Equipment, tools and machinery used
- Man power per hectare
- Any treatment used before harvesting
- Problem encountered during harvesting
- Control measure taken
- Estimation of post harvest yield
- Was the harvest good or fair or poor

Now you have completed implementing harvesting operation. Finally, you have document relevant information you done so far for continual analysis effective planning. Your document may include:-

While the harvest log will be customized to your farm, you may want to incorporate additional recordkeeping requirements here, or maintain them separately. In general, you'll want to maintain at least the following info:

As harvesting is completed all data has been under taken during the process has to be documented for future analysis. The following data has to be documented after completing harvesting operation.

- Harvest date
- Harvest lot number
- Field ID
- Crop/variety
- percentage crop deterioration,
- maturity measurements taken,
- Quantity harvested
- Storage/sale location
- dispatch details and delivery dockets
- total labor required to perform the harvesting operation
- Total cost consumed through the harvesting operation etc...



- Methods of harvesting
- Man power per hectare
- Any treatment used before harvesting
- Problem encountered during harvesting
- Control measure taken
- Estimation of post-harvest yield
- Resource, Equipment, tools and machinery used
- Was the harvest good or fair or poor



Self-Check – 4	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (15pts.)

1. What is documentation in Agricultural crop harvesting? (5 pts.)
2. What are the documentation parameters? (5 pts.)
3. Discuss the roles of documentation for future work? (5 pts.)

Note: Satisfactory rating - 15 points Unsatisfactory - below 15 points

You can ask you teacher for the copy of the correct answers.



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Page 92 of 93	Federal TVET Agency Author/Copyright	TVET program title- Agricultural crop production Level -IV	Version -1 September 2021
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