REFERENCE MATERIAL FOR SESSION ON AGRICULTURE MACHINERY – POST-HARVEST PROCESSING

1 INTRODUCTION

A) **Objective**: Introduce the session and highlight the importance of post-harvest processing in reducing the losses percentage.

B) **Content**: Percent of losses occur after harvesting & significance of post-harvest processing to reduce the same, the table below provides detailed insights into the various types of losses occurring after harvesting for different crops:

Crop	Cleaning losses, %	Drying losses, %	Packaging losses, %	Total losses, %
Paddy	0.5 ± 0.50	0.10 ± 0.15	0.08 ± 0.04	0.23
Wheat	0.40 ± 0.19	0.07 ± 0.09	0.140 ± 0.07	0.19
Maize	0.40 ± 0.65	0.18 ± 0.24	0.16 ± 0.06	0.74
Bajra	0.19 ± 0.09	0.16 ± 0.22	0.20 ± 0.12	0.55
Sorghum	0.47 ± 0.20	0.08 ± 0.05	0.28 ± 0.14	0.83
Pigeon pea	0.41 ± 0.59	0.18 ± 0.18	0.22 ± 0.26	0.81
Chick pea	0.58 ± 0.19	0.40 ± 0.24	0.25 ± 0.08	1.23
Black gram	0.48 ± 0.31	0.26 ± 0.26	0.23 ± 0.04	0.97
Green gram	0.36 ± 0.52	0.33 ± 0.32	0.22 ± 0.03	0.91

Source : *Assessment of Quantitative Harvest and Post-Harvest Losses of Major Crops and Commodities in India by CIPHET, Ludhiana- 2015 Res*

C) Key Insights:

i) Paddy: Total losses are minimal (0.23%), with cleaning losses being the highest contributor. Effective cleaning and drying techniques can minimize these losses further.

ii) Wheat: Losses are significantly low (0.19%), with packaging playing a minor role. Proper storage practices can eliminate these losses entirely.

iii) Maize: High total losses (0.74%) indicate the need for improved drying techniques and better packaging solutions.

iv) Bajra: Moderate total losses (0.55%) highlight the importance of handling practices, especially during packaging.

v) Sorghum: Relatively high losses (0.83%) are primarily due to packaging inefficiencies. Enhanced packaging standards can reduce these losses significantly.

vi) Pigeon Pea: With losses at 0.81%, drying and packaging present areas for intervention.

vii) Chick pea: The highest total losses (1.23%) among the listed crops are attributed to cleaning and drying inefficiencies. Introducing advanced post-harvest technologies is critical.

viii) Black Gram: High total losses (0.97%) can be mitigated with improved drying and cleaning systems.

ix) Green Gram: At 0.91%, drying losses are the most significant. Implementing solar drying or mechanical drying can help reduce these losses.

D) Significance of Post-Harvest Processing:

i. Reduces food wastage and improves profitability.

ii. Enhances the shelf life of produce, making it viable for long-term storage and transportation.

iii. Contributes to food security by ensuring more produce reaches the market or consumers.

iv. Encourages sustainable agricultural practices.

2 OVERVIEW OF INDIAN STANDARDS ON EQUIPMENT USED IN POST-HARVEST PROCESSING

A) Objective: Familiarize participants with key areas of the post-harvest processing where Indian Standards have been developed so far. The list of all the important standards in this area is given at Annex A.

B) Content : Brief of various Indian Standards of the equipment used in various operations e.g. rice milling, pulse & seed processing, millet processing, horticulture produce processing, chaff cutting, and rice fortification etc. is given below. Post-harvest processing equipment plays a critical role in maintaining the quality and reducing wastage of agricultural produce. Below is an elaboration of the key standards available in this domain, categorized by their application areas, and the principles of operation of the equipment.

C) Rice Milling (13 Standards):

Rice milling equipment is designed to enhance the efficiency of paddy processing while ensuring minimal breakage and maximum yield. Key standards include:

- **IS 10048**: Specifies requirements for rice length graders.
- **IS 11531**: Outlines guidelines for rubber roll dehuskers.
- **IS 14846**: Details requirements for paddy separators.

D) Fruit and Vegetable Processing (3 Standards):

This category emphasizes preserving the nutritional value of produce during processing. Key standards include:

- **IS 11615**: Defines requirements for pulping machines.
- **IS 13824**: Provides guidelines for peelers.
- **IS 14611**: Focuses on slicers and dicing machines.

E) Cotton Processing (9 Standards):

Cotton ginning and pressing machinery are standardized to optimize fiber quality and reduce seed damage. Key standards include:

- **IS 5994**: Ginning machines specifications.
- **IS 8563**: Bale pressing equipment.

F) Seed Cleaning and Processing (13 Standards):

Standards focus on equipment that ensures purity and germination capacity of seeds. Key standards include:

- **IS 9025**: Air screen cleaners specifications.
- **IS 11395**: Gravity separators for seed grading.
- **IS 14894**: Seed coating machines.

G) Others (13 Standards):

Covers a diverse range of post-harvest processing equipment, including:

- **Chaff Cutters (IS 7898 & IS 11459)**: Performance and durability requirements.
- **Grain Storage Bins (IS 14482)**: Construction and capacity standards.

H) Millets Processing Equipment (4 Standards):

Millet processing equipment ensures efficient dehusking and polishing to meet consumer demand. Key standards include:

- **IS 19040**: Millet dehusker specifications.

I) Principles of Working:

Below is a summarized view of working principles across various types of post-harvest processing equipment:

Equipment Type	Principle
Disc/Indented Cylinder Separator	Relative length or difference in length
Spiral Separator	Roundness
Destoner/Specific Gravity Separator	Density and specific gravity
Cyclone Separator	Centrifugal force and density difference
Inclined Draper/Velvet Roll Separator	Shape and surface texture
Magnetic Separator	Stickiness and surface texture
Pneumatic Separator	Aerodynamic properties
Fluidized Bed Separator	Size, density, and terminal velocity

- **Disc/Indented Cylinder Separator**: Relies on relative length differences for separating grains.
- **Pneumatic Separator**: Uses differences in aerodynamic properties for separation.
- **Fluidized Bed Separator**: Employs variations in size, density, and terminal velocity for grain classification.
- **Pneumatic Separator**: Differentiates grains based on aerodynamic properties.
- **Fluidized Bed Separator**: Segregates using density and size variations.
- **Destoner/Specific Gravity Separator**: Utilizes density differences for separation.
- **Magnetic Separator**: Removes impurities through stickiness and texture properties.
- **Inclined Draper/Velvet Roll Separator**: Differentiates based on surface texture and shape.

- **Magnetic Separator**: Segregates metallic contaminants using magnetic properties.
- **Spiral Separator**: Separates produce based on roundness.
- **Cyclone Separator**: Uses centrifugal force and density differences for classification.

J) Significance of Standards:

- Ensure uniformity in quality and safety of equipment.
- Enhance operational efficiency and durability.
- Reduce post-harvest losses by optimizing equipment performance.
- Foster innovation and adoption of advanced technologies.

The detailed standards across various domains empower manufacturers and users to adopt best practices in post-harvest processing, thereby contributing to sustainable agricultural development.

3 INDIAN STANDARDS ON EQUIPMENT USED IN RICE MILLING

3.1 Objective: Explaining the requirements of standards meant to ensure performance & durability of the equipment

3.2 Content : Requirements for rice length grader (IS 10048)

A) Summary: The document IS 10048: 2024 outlines the specifications and test codes for rice length graders, detailing material, construction, performance, and other requirements. It includes definitions, types, and constructional details of rice graders, specifying materials for various components and performance criteria. The document also covers marking, packing, and BIS certification, along with methods for testing rice graders. It emphasizes safety, durability, and efficiency in rice grading equipment, ensuring compliance with updated standards and technological advancements.

B) Key Requirements

i). Material Specifications:

- Feed hopper: Mild steel (IS 2062), Galvanized steel (IS 277), Stainless steel (IS 6911).
- Feed rate/distribution plates: Mild steel (IS 2062), Stainless steel (IS 6911).
- Screens/sieves: Stainless steel (IS 6911).
- Shafts: Mild steel (IS 2062).
- Main Frame: Mild steel (IS 2062), Cast iron (IS 210).
- Pulley: Cast iron (IS 210), Mild steel (IS 2062).
- Plumber block: Cast iron (IS 210).
- Outlets for head rice and brokens: Stainless steel (SS 204/304) (IS 6911).
- Reciprocating box: Wood (IS 399), Mild steel (IS 2062).
- Indented disc and drum/cylinder: Stainless steel (SS 204/304) (IS 6911).
- Belt guard: Mild steel (IS 2062).
- Cam/eccentric: Cast Iron (IS 210), Mild steel (IS 2062).

ii) Performance Requirements:

- Grader must meet specified performance criteria.
- Input capacity per kWh energy used should be at least 1,250 kg.
- Grader must withstand specified tests without defects.

iii) Constructional Requirements:

- Frame: Suitable size mild steel angle section or wood with proper bracings.
- Hopper: Feed regulating device for even distribution.
- Screens: One or two oscillating/rotary screens.
- Blower: Control to regulate airflow.
- Power transmission: V-belt and pulley, gears, or sprocket and chain with guards.
- Guards: Must support 600 N load without permanent set.

iv) Other Requirements:

- Axle shaft: Finished to close tolerances, properly aligned.
- Bearings: Dust-proof, provision for lubrication.
- Controls: Easily accessible, lockable.
- Operational and maintenance manual: Provided by the manufacturer.
- Belt drive: Provision for tightening.
- Screen cleaning: Provision to avoid clogging.

v) Workmanship and Finish:

- Components: Free from defects, smooth welding (IS 816).
- Protective coating: Against rusting for steel components.

vi) Marking and Packing:

- Marking: Manufacturer's details, batch number, power rating, type, model, year, and direction of rotating parts.
- Cautionary notice: Safety instructions in vernacular language.
- Packing: As agreed between purchaser and supplier for safe transit.

C) Test methods

i) Test Material Preparation:

- Use sufficient quantity of polished rice of the same variety.
- Analyze head rice and brokens by taking 5 samples of 100 g each.
- Ensure brokens in the feed range from 25% to 50%.
- Moisture content of test material should be 14% maximum (wet basis), measured as per IS 4333 (Part 2).

ii) Running-In and Preliminary Adjustments:

- Install the grader on a level, hard surface.
- Make adjustments as per the manufacturer's recommendations.
- Attach the grader to a suitable prime mover (preferably an electric motor with an auto-voltage stabilizer).
- Fit an energy meter or transmission dynamometer.
- Run the grader without load for 30 minutes for initial adjustments.

iii) No-Load Test:

- Run the grader at specified speed for 30 minutes without load.
- Ensure no marked vibration, undue noise, belt slippage, unusual wear, or significant rise in bearing temperature.

iv) Load Test:

- Operate the grader at specified speed for 15 minutes at a feed rate slightly below the rated input capacity.
- Collect samples of graded fractions (brokens and head rice) at 5-minute intervals.
- Record main shaft speed and energy meter/dynamometer readings.
- Repeat the test at feed rates covering approximately 90%, 100%, and 110% of the rated input capacity.

v) Sample Analysis:

- Analyze three samples of different fractions for brokens and head rice percentage.
- Energy Consumption Determination:
- Calculate energy consumption per hour using energy meter readings or dynamometer torque readings.
- Adjust for drive type losses (6% for flat belt, 3% for V-belt).
- Rated Input Capacity Determination:
- Select feed rate meeting the following:
- Remove 20% brokens in one pass.
- Head rice in total brokens should not exceed 5%.

vi) Grading Effectiveness Calculation:

Use McCabe-Smith's formula:

$$E = (Xf - Xb) * (Xd - Xf) * (1 - Xb) / [(Xd - Xb)^2 * (1 - Xf) * Xf]$$

Where,

Xf = head rice in feed, Xd = head rice in overflow, Xb = head rice in underflow.

vii) Performance Index Calculation:

$$PI = Capacity * Grading\ effectiveness / Power$$

viii) Long Run Test:

- Operate the grader for a minimum of 20 hours at no load, with at least one continuous run of 5 hours.
- Ensure no breakdown or defect develops during or after the operation.

4 INDIAN STANDARDS ON CHAFF CUTTERS

4.1 Objective: Explaining the requirements of standards meant to ensure performance & durability of the equipment

4.2 Content : Requirements for manually & power operated chaff cutter (IS 7898 & IS 11459)

Importance of Chaff Cutters

Chaff cutters are essential agricultural equipment used for cutting straw or hay into small pieces. These small pieces are easier for livestock to chew and digest, improving feed efficiency and minimizing wastage. They play a vital role in livestock farming by ensuring optimal utilization of fodder resources, which directly impacts animal health and productivity.

A) Types of Chaff Cutters:

1. **Manual Chaff Cutters**:
    - Operated by hand, suitable for small-scale farmers or areas with limited access to electricity.
    - Economical and easy to maintain.
2. **Power-Operated Chaff Cutters**:
    - Driven by electric motors or diesel engines, ideal for large-scale operations.
    - High efficiency and capacity to handle bulk quantities, saving time and labor.

B) Role of Standards in Chaff Cutters

Standards play a crucial role in ensuring that chaff cutters are safe, efficient, and durable. The benefits of adhering to standards are as follows:

i) Safety:

- Standards specify safety requirements to prevent accidents during operation, such as guards to cover blades and emergency stop mechanisms.
- They also mandate proper labeling and operating instructions to ensure user safety.

ii) Performance:

- Performance standards ensure the chaff cutter can process a specified quantity of fodder efficiently.
- They help define quality metrics, such as the uniformity of chopped fodder, which affects feed intake by animals.

iii) Durability:

- Standards require the use of robust materials and manufacturing processes to enhance the lifespan of the equipment.
- They include testing methods for wear and tear, ensuring the machine can withstand long-term use under varying conditions.

iv) Environmental and Energy Efficiency:

- Standards promote energy-efficient designs for power-operated machines, reducing operational costs and environmental impact.

v) Harmonization and Compatibility:

- By standardizing dimensions and designs, spare parts and attachments can be easily interchanged, reducing downtime and maintenance costs.

4.3 IS 7898 for Manual operated chaffcutter

A) Summary:

The Indian Standard IS 7898:2024 specifies the material, construction, safety requirements, and testing methods for manually-operated chaff cutters. This standard aims to ensure uniformity in quality and dimensions across manufacturers, facilitating easier component replacement and user convenience. The standard includes detailed specifications for materials, constructional requirements, safety measures, and test methods to ensure the chaff cutters' performance and safety.

B) Key Requirements:

i)Materials:

- Blades: Carbon steel or alloy steel with specified chemical compositions.
- Other components: Cast iron, mild steel, hard or medium-hard wood, spring steel, etc.

ii) Constructional Requirements:

- Blade: Hardness of 40-45 HRC, specific dimensions, and shape.
- Handle: Minimum diameter of 15 mm, length of 500 mm, and wooden grip.
- Flywheel: Diameter of 900-1350 mm, weight not less than 24 kg.
- Main Shaft: Length of 400 mm, diameter of 30 mm.
- Worm and Worm Gears: Specific dimensions and teeth count.
- Feed Rolls: Length of 207 mm, outer diameter of 75-85 mm.
- Springs, Cover Plates, Shear Plate, Back Plate, Feeding Trough, Stand: Specific dimensions and materials.

iii) Safety Requirements:

- Flywheel locking device, front safety guard, gear cover, warning roller, covered chute, blade cover.
- Cautionary notices for safe operation.
- Workmanship and Finish:
- Components free from defects, non-porous cast iron, rust-free metallic surfaces, sharp and flaw-free blades.

v) Test Methods:

Idle Run Test:

- Operate the chaff cutter for 30 minutes at 50 rpm.
- Check for oscillations, unusual sounds, obstructions, and wear.

Test for Variation in Cut Length:

- Install the chaff cutter on a level surface.
- Use uniform fodder and measure the theoretical length of cut.
- Operate at 50 rpm, feed fodder manually, and measure the cut length of plastic pipes.
- Ensure the variation in length is not more than 5%.

4.4 IS 11459 for Power operated chaff cutter

A) Summary: The Indian Standard IS 11459:2024 specifies the material, construction, safety requirements, and testing methods for power-operated chaff cutters. This standard amalgamates IS 7897:1975 and IS 15542:2005, ensuring uniformity in quality and safety across manufacturers. It includes detailed guidelines on the types of chaff cutters, materials used, constructional requirements, safety measures, and testing protocols to ensure reliable and safe operation.

B) Key Requirements:

i) Types of Chaff Cutters:

- Based on cutting mechanism: Flywheel type, Cylinder type.
- Based on cut-chaff dropping position: Let-fall type, Throw-away type, Blow-up type.
- Based on feeding system: Chute-fed, Conveyor-fed.

ii) Materials

- Construction materials for various components must conform to specified Indian Standards.
- Blades must be made of carbon or alloy steel with specified chemical compositions.

iii) Constructional Requirements:

Cutter head, blower, transmission system, mounting of power source, cylinder, and other components must meet specific design and material standards.

Allowable deviations for dimensions without specified tolerance must follow IS 2102 (Part 1).

iv) Safety Requirements:

- Blade guard, warning roller, gear cover, file safety guard, feeding chute cover, and other safety provisions must be included.
- Cautionary notices in vernacular language must be displayed on the chaff cutter.

v) Testing Methods:

- Type Tests:

Checking of specifications, material, and visual observations.

Tests at no-load: Power consumption and visual observations.

Tests at load: Short run tests (quality and quantity of cut, power requirement, blowing efficiency) and long run tests.

- Routine Tests: Checking of specifications, visual observations, and tests at no-load.
- No-Load Test: Measure power consumption and observe operational characteristics without load.
- Load Test: Short run tests: Assess quality and quantity of cut, power requirement, and blowing efficiency.
- Long run tests: Evaluate performance over extended operation periods, checking for breakdowns and consistency in cut quality.

vi) Performance Index Calculation:

- Calculate performance index based on quantity of cut, quality of cut, and power consumption.
- This standard ensures that power-operated chaff cutters are safe, efficient, and reliable, providing clear guidelines for manufacturers and users.

5 INDIAN STANDARDS ON MILLET PROCESSING EQUIPMENT

5.1 Objective: Explaining the requirements of standards meant to ensure performance & durability of the equipment

5.2 Content: Requirements for millet dehusker(IS 19040)

Millets are highly nutritious and climate-resilient crops, gaining global recognition for their health benefits and role in sustainable agriculture. Primary processing of millets involves cleaning, dehusking, and grading to make them suitable for consumption and further processing.

- **Cleaning**: Removal of impurities such as dirt, stones, and unwanted seeds.
- **Dehusking**: Removing the hard outer husk to access the edible grain, which is crucial for consumer acceptability.
- **Grading**: Sorting grains based on size and quality to meet market standards and consumer preferences.

Efficient primary processing ensures minimal loss of nutrients and enhances the shelf life and marketability of millets.

Importance of Indian Standards for Equipment

The equipment used for millet processing must adhere to Indian Standards to ensure safety, efficiency, and durability.

- **Safety**: Standards ensure the machinery operates safely, reducing risks to operators. Features like proper guards and safe electrical systems are mandated.
- **Performance**: Standardized equipment delivers consistent results, ensuring high-quality processed millet with minimal wastage.
- **Durability**: Standards ensure robust materials and design, enabling equipment to withstand long-term use under diverse conditions.
- **Hygiene**: Equipment complying with standards ensures hygienic processing, essential for food safety and consumer health.
- **Energy Efficiency**: Standards promote energy-efficient designs, reducing operational costs and environmental impact.
- **Market Compatibility**: Standardized equipment facilitates uniformity in processed products, enhancing their market acceptability.

Indian Standards not only support manufacturers in producing reliable equipment but also empower farmers and entrepreneurs by ensuring efficient, safe, and cost-effective processing solutions. This drives the growth of millet-based industries and promotes millets as a staple for sustainable food systems.

5.3 Indian Standards Developed so far

A) IS 19039 : 2023 Cleaner cum Grader for Millets with Pre-Cleaner — Specification and Test Code

Millet grains straight from the field contain dirt, stones, chaff, and other impurities. Therefore, they cannot be consumed or further processed without proper cleaning. Some millets, such as sorghum, pearl, and finger millets, do not need dehusking. In these cases, grading can be done after pre-cleaning and cleaning. Pre-cleaning, cleaning, and grading processes are crucial to render the grains suitable for consumption or further processing. This standard guides manufacturers in selection of components, fabrication, and safety features when designing and fabricating the equipment. It also outlines test methods, including short and long-run tests under load and no-load conditions, to assess the effectiveness, durability, and proper ergonomic design of equipment.

B) IS 19040 : 2023 Millet Dehusker — Centrifugal Type — Specification and Test Code

Some of the millets cannot be consumed directly after pre-cleaning and cleaning like foxtail, little, kodo, proso, barnyard, and brown top millets, as they have a hard cellulosic husk layer that humans cannot digest. The removal of the husk layer thus becomes an important step in the processing of these grains. To remove the husk from the grain, one can use two forces – impact or shear. A stone grinding mill, manual or motor powered, employs the shear force while manual pounding or centrifugal hulling machines use the impact force. This standard is meant for centrifugal type millet dehusker, wherein material, constructional and safety requirements for every component of this equipment are specified. It also outlines test methods, including short and long-run tests under load and no-load conditions, to assess the equipment's effectiveness, durability, and proper ergonomic design.

C) IS 19041: 2023 Destoner for Millets — Specification and Test Code

Prior to dehusking or polishing, it is essential to eliminate all stones to minimize grain damage. A destoner achieves this by utilizing the difference in mass (density/specific gravity) between the stones/mud within the grains and the good grains, segregating them through continuous vibration and air flow. The standard details the material, construction, and safety requirements for each component of this equipment. Additionally, it establishes test methods, encompassing short and long-run tests under both load and no-load conditions, to evaluate the effectiveness, durability, and ergonomic design of equipment.

D) IS 19042 : 2023 Symbols and Flow Diagrams Used in Primary Processing of Millets

Understanding the complete primary processing of millet is crucial when designing the layout for an industrial millet processing setup. The use of symbols in millet processing is essential for fostering a common understanding and facilitating clear communication. To achieve this goal, a standard has been developed. This standard includes a general process flow chart with symbols representing equipment used in cleaning, destoning, grading, dehusking, and other accessories involved in the processing, such as bag filling and loading.

5.4 IS 19040 for millet dehusker

A) Key Constructional Requirements for Dehusker

i) Aspirator/Blower:

- Must be adequately sized with a balanced impeller mounted on self-aligned bearings to minimize vibration.

- The casing must be strong, and the shutter should allow air flow adjustment with a locking mechanism to ensure stable operation.

ii) Dehusking Chamber:

- Made of cast iron, with provisions for rotating the chamber to ensure even wear of rubber linings.

- Can include two chambers for improved dehusking efficiency.

iii) Feed Screw:

- Properly positioned to ensure uniform feeding of the millets into the dehusking impeller.

iv) Frame:

- Constructed from mild steel with channels or angle sections, with access for maintenance and adjustments.

v) Feed Hopper:

- Made of mild steel or stainless steel (SS 304), with a feed-regulating device and a 30°-35° slope for easy grain flow.

vi) Impeller:

- Made of mild steel or stainless steel (SS 304), designed to withstand rotation speeds of 2,000-2,800 rpm.

vii) Outlet/Chute for Grains and Husk:

- Positioned at an appropriate height for easy collection of dehusked kernels and husks.

viii) Rubber Lining and Ring:

- The rubber components (lining and ring) are made from natural or synthetic rubber with hardness between 85 A and 97 A, applied using adhesive.

ix) Shafts:

- Made of mild steel, sized appropriately, and supported by bearings for stable machine operation.

B) Other Operational and Safety Requirements

i) Sheet Metal:

- Minimum thickness of 1 mm for various parts.

ii) . Shaft Tolerances and Alignment:

- Shafts must be finished to precise tolerances, with proper alignment to minimize wear.

iii) . Lubrication and Dust-Proof Bearings:

- Bearings must be designed for lubrication and dust-proof for durability.

iv) . Feed Regulating System:

- Must be included to control the flow of millets into the machine.

v) . Controls:

- Must be easily accessible and lockable in place for safety.

vi). Belt Drive Adjustments:

- A mechanism for tightening belts if a belt drive is used.

vii). Transmission Guards:

- Guards must prevent accidental contact with moving parts, with easy access for maintenance without removing guards completely.

viii) Impeller Balance:

- The impeller must be statically and dynamically balanced for smooth operation.

ix) Rubber Ring and Lining Fixation:

- Rubber ring and lining should be securely fixed with adhesive, with easy replacement and impeller locking mechanisms.

x) Standards Compliance:

- The hardness and type of rubber components should conform to IS 8427 standards, with specific size and type declarations by the manufacturer.

6 Conclusion (10 Minutes)

6.1 Objective: Recap key points and address participant questions.

6.2 Content: Remaining Key Indian Standards followed by a quiz session (*see* Annex B)

6.3 **Methodology**: Facilitator-led summary and interactive

ANNEX A
LIST OF IMPORTANT STANDARDS FOR THE QUIPMENT USED IN POST-HARVEST PROCESSING

Sl. No.	IS No.	Title
1.	IS 9555: 2024	Rice Polisher — Specification (*Third Revision*)
2.	IS 10048: 2024	Rice Length Grader — Specification and Test Code (*Third Revision*)
3.	IS 12792: 2024	Agricultural Produce Milling Machinery —Mini Rice Mill — Specification (*First Revision*)
4.	IS 17853: 2022	Equipment For Manufacture of Fortified Rice Kernel — Specification
5.	IS 17854: 2022	Equipment For Manufacture of Fortified Rice — Specification
6.	IS 12396: 2024	Paddy Cleaners — Specification (*First Revision*)
7.	IS 12411: 2024	Paddy Dehusker — Centrifugal Type — Specification (*First Revision*)
8.	IS 8440: 2023	Paddy Cleaners —Test Code (*First Revision*)
9.	IS 7051: 2023	Power Operated Maize Shellers — Specification (*First Revision*)
10.	IS 18313: 2023	Dehusker Sheller for Maize — Specification
11.	IS 7898: 2024	Manually-Operated Chaff Cutter — Specification and Test Code (*Third Revision*)
12.	IS 11459: 2024	Power-Operated Chaff Cutter — Specification and Test Code (*First Revision*)
13.	IS 15858: 2013	Cotton Seed Delinting Machinery — Delinting Machine With Electrical Heating And Hydraulic System — Specification
14.	IS 15859: 2013	Cotton Seed Delinting Machinery — Buffing Machine With Air Jet And Nylon Brush — Specification
15.	IS 15860: 2013	Cotton Seed Delinting Machinery — Ammonia Cotton Seed Neutralizer Machine With Ammonia Vaporizer — Specification
16.	IS 15861: 2013	Cotton Seed Delinting Machinery — Pollution Control System With Scrubber, Cyclone, Chimney, Hoods And Ducting — Specification
17.	IS 15862: 2013	Cotton Seed Delinting Machinery — HCL Gas Generation Unit — Specification
18.	IS 11041: 1984	Specification for Air-Screen Seed Cleaner

19.	IS 12576: 1989	Seed Processing Machinery — Indented Cylinder Grader — Test Code
20.	IS 14460: 1997	Seed Processing Equipment — Gravity Separator — Specification
21.	IS 5718: 2000	Agricultural Produce Processing Equipment — Seed Cleaners — Test Code (*Second Revision*)
22.	IS 8108 (Part 1): 2019	Methods of Test for Grain Dryers: Part 1 Selection and Preparation for Test (*Second Revision*)
23.	IS 8108 (Part 2): 1984	Test Code for Grain Dryers: Part 2 Method of Tests for Continuous Dryers
24.	IS 8108 (Part 3): 1985	Test Code for Grain Dryers: Part 3 Methods of Tests for In-Silo Dryers
25.	IS 19039 : 2023	Cleaner cum Grader for Millets with Pre-Cleaner — Specification and Test Code
26.	IS 19040 : 2023	Millet Dehusker — Centrifugal Type — Specification and Test Code
27.	IS 19041: 2023	Destoner for Millets — Specification and Test Code
28.	IS 19042 : 2023	Symbols and Flow Diagrams Used in Primary Processing of Millets
29.	IS 6997 : 2021	Test Code for Sugarcane Crusher (First Revision of IS 6997)
30.	IS 15561 : 2005	Sugarcane Crushers — Safety Requirements
31.	IS 1973 : 1999	Sugarcane Crusher — Specification (Third Revision of IS 1973)

ANNEX B
QUIZ TIME

Q 1 What is the main purpose of post-harvest processing?

a) To increase the weight of agricultural products

b) To minimize the qualitative and quantitative deterioration of materials after harvest

c) To change the colour of agricultural products

d) To decrease the cost of production

Q 2 Which IS standard covers the paddy cleaner?

a) IS 9020

b) IS 10488

c) IS 10655

d) IS 12345

Q 3 Which crop experiences the highest total losses during post-harvest processing?

a) Paddy

b) Wheat

c) Chick-pea

d) Sorghum

Q 4 Which material and IS standard is used for the Feed hopper in rice length grading equipment?

a) Mild steel, IS 210

b) Galvanized steel, IS 277

c) Stainless steel, IS 2062

d) Cast iron, IS 6911

Q 5 Which of the following is a key performance requirement for rice flour produced by a micro pulverizer in FRK manufacturing equipment?

a) Average particle size of rice flour shall be less than 300 μm

b) Rice flour shall contain some metal impurities

c) Average particle size of rice flour shall be less than 250 μm (preferably below 150 μm)

d) Rice flour obtained after pulverization shall have varying particle sizes

Q 6 What is the primary criterion used by a disc/indented cylinder separator to sort materials?

a) Roundness

b) Difference in length

c) Density and specific gravity

d) Stickiness and surface texture

Q 7 A magnetic separator operates based on differences in aerodynamic properties, such as drag force coefficient and terminal velocity ?.

a) True

b) False

Q 8 What additional feature should a hopper have to ensure the proper functioning of the micro pulverizer?

a) A large opening for easy access

b) A magnet to trap metal impurities

c) A transparent cover for visual inspection

d) A heater to maintain temperature

Q 9 A cyclone separator relies on centrifugal force and density differences to separate materials ?

a) True

b) False

Q 10 Which of the following is included in the control panel of a micro pulverizer?

a) Temperature controller

b) Feed rate controller and LCD/LED/HMI screen to control process parameters

c) Automatic cleaning system

d) Sound level monitor

Q 11 Which Indian Standard (IS) specifies the requirements for vegetable cutting machines?

a) IS 456:2000

b) IS 18145:2023

c) IS 304:2014

d) IS 12345:2018

Q 12 Manual Acid (H_2SO_4) Delinting is often conducted by farmers in the field ?

a) True

b) False

Q 13 Which Indian Standard is referred for material for the flywheel in a power-operated chaff cutter?

a) IS 4454 (Part 1)
b) IS 2062
c) IS 210
d) IS 4711

Q 14 What is the specified feature of the blower in a power-operated chaff cutter?

a) Axial type blower
b) Centrifugal type blower
c) Radial type blower
d) Mixed-flow type blower

Q 15 According to the requirements, the minimum length for the chute in the feeding system of a power-operated chaff cutter is 900 mm and the conveyor is 200 mm ?

a) True

b) False

Q 16 According to the requirements, what is a key feature of the feed hopper in a millet dehusker?

a) It should have an automatic cleaning system.
b) It should be equipped with a feed regulating device.
c) It should have a built-in heating element.
d) It should be made of transparent material for visibility.

Q 17 What feature is required for the aspirator in a millet dehusker to ensure smooth operation?

a) It should have adjustable speed settings.

b) It should be balanced and mounted on self-aligned bearings to run without vibration.

c) It should be equipped with a temperature control system.

d) It should be made of stainless steel for rust resistance.

Q 18 According to IS 18145, what is a key requirement for the major components of a vegetable cutting machine?

a) They should be made of mild steel.

b) They should be easily removable for inspection and cleaning.

c) They should be permanently fixed to the machine.

d) They should be equipped with an automatic lubrication system.

Q 19 What feature is required for a vegetable cutting machine to ensure safe operation according to IS 18145?

a) It should have a built-in heating element for sterilization.

b) It should be able to run without load with no loosening of fitted parts and minimal excess noise.

c) It should include an external fan to cool down the machine.

d) It should have a digital display for monitoring

Q 20 Which standard specifies the need for strict hygienic conditions in the operation of vegetable cutting machines, as mentioned in IS 18145?

a) IS 2062

b) IS 2491

c) IS 4711

d) IS 513