

Challenges in Primary Processing of Small Millets

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*Sustainable Food Systems and
Technology with the right politics*

In the Workshop on
*Reducing Drudgery of Women
in Small Millet Processing: Recent Advances*

**Women Empowerment for
Sustaining Development**



In this presentation

- Millets
 - ❖ What are Millets?
 - ❖ Morphology & nutritional content
- Processing of Small Millets
 - ❖ Objectives
 - ❖ Challenges
- Traditional Processing
 - ❖ Design factors
 - ❖ Some Tools Used
 - ❖ Role of women
- Mechanized processing of millets
 - ❖ Machine
 - ❖ Process
- Way forward



Please note slide number
for easy reference during Q&A

What are Millets?

➤ Millets

- ❖ Cereal grains
- ❖ Grasses family (Poacea)

➤ Naked grains

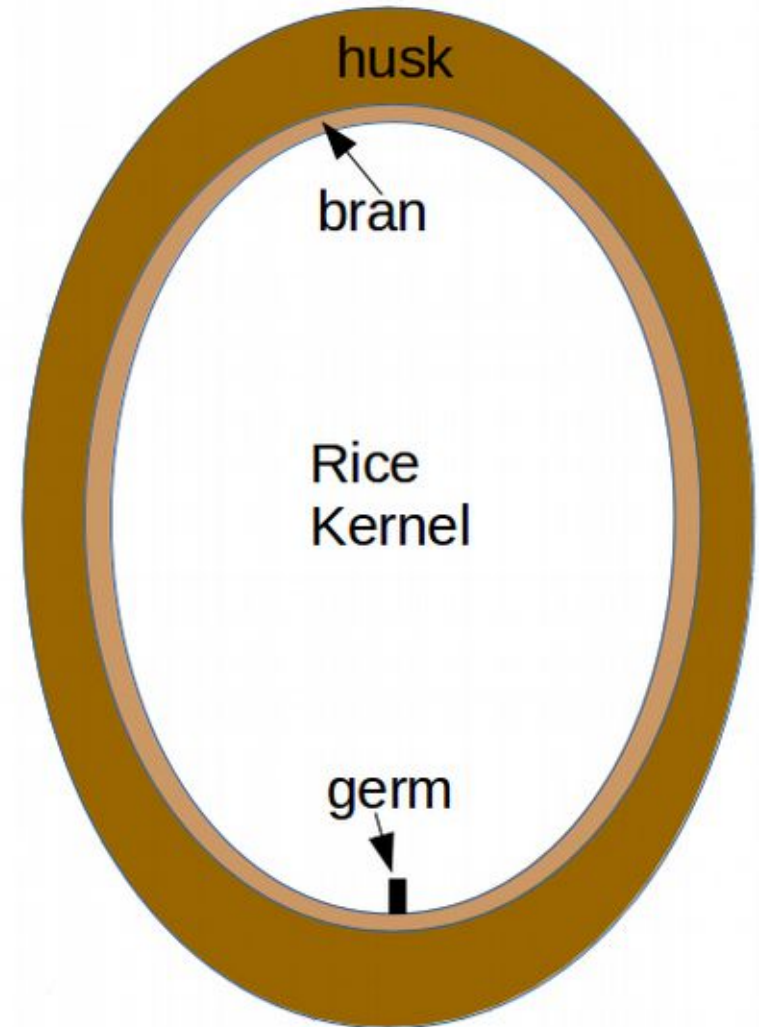
- ❖ Finger M.
- ❖ Sorghum
- ❖ Pearl M., etc.

➤ Husked Millets

- ❖ Foxtail M.
- ❖ Little M.
- ❖ Kodo M.
- ❖ Proso M.
- ❖ Barnyard M.
- ❖ Browntop M., etc.

Morphology of millet grain

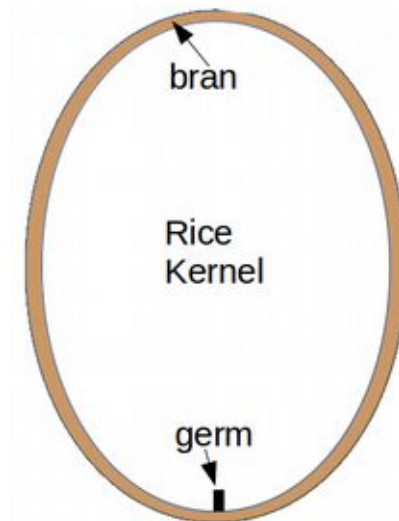
- Husk
 - ❖ Outer most
 - ❖ Hard cellulosic, indigestible
- Bran
 - ❖ Intermediate
 - ❖ Fragile, extremely nutritious
- Germ
 - ❖ F2; point of germination
- Rice Kernel
 - ❖ Inner most
 - ❖ Bulk of the grain & the primary motivation to eat cereal grains



Morphology of millet grain

- Remove the husk
 - ❖ 'cos we cannot digest it !

- Retain the bran (& germ)
 - ❖ 'cos its where the nutrition is



Nutrition in a millet rice grain

- Bran
 - ❖ Fibres
 - ❖ Minerals
 - ❖ Fatty Acids
- Germ
 - ❖ Protein rich
- Rice Kernel
 - ❖ Carbohydrates



Rice with bran removed: *bleached not polished*

Nutritional profile of millets

Nutritional content in 100 gms of dry Grain	Protein (in gms)	Carbohydrates (in gms)	Fat (in gms)	Minerals (in gms)	Fiber (in gms)	Calcium (in mg)	Phosphorus (in mg)	Iron (in mg)	Energy (in kCal)	Thiamin (in mg)	Niacin (in mg)
FOXTAIL	12.3	60.2	4.3	4	6.7	31	290	2.8	351	0.5	3.2
LITTLE	7.7	67	4.7	1.7	7.6	17	220	9.3	329	0.3	3.2
KODO	8.3	65.9	1.4	2.6	5.2	35	188	1.7	535	0.15	2
PROSO	12.5	70.4	1.1	1.9	5.2	8	206	2.9	354	0.41	4.5
BARNYARD	6.2	65.5	4.8	3.7	13.6	22	280	18.6	300	0.33	4.2
BROWN TOP	8.9	71.3	1.9	3.9	8.2	28	276	7.7	338	.	.
SORGHUM	10.4	70.7	3.1	1.2	2	25	222	5.4	329	0.38	4.3
PEARL	11.8	67	4.8	2.2	2.3	42	240	11	363	0.38	2.8
FINGER	7.3	72	1.3	2.7	3.6	344	283	3.9	336	0.62	1.1
PADDY RICE	6.8	78.2	0.5	.6	1	33	160	1.8	362	0.41	4.3
WHEAT	11.8	71.2	1.5	1.5	2	30	306	3.5	348	0.41	5.1
QUINOA	14	64	6	.	7	36	457	4.6	368	0.36	.

Compiled from a study published by National Institute for Nutrition, Hyderabad and other sources for Quinoa and Brown Top millet.

- Each millet has various nutritional highlights
- Used for their medicinal properties in many communities, esp. Kodo
- Fibre content !!
- Nutritionally
 - ❖ far superior to
 - ◆ Paddy Rice
 - ◆ Wheat
 - ❖ Comparable to
 - ◆ Quinoa (an exotic here in India)

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Processing: Objectives

- For use as our food
 - ❖ Remove parts that cannot be digested
 - ❖ Retain the nutritious parts

- For use as feed
 - ❖ Husk for cattle
 - ❖ Immature and smaller grains for poultry



Processing: Staple forms

➤ Husked grains

- ❖ Rice, అరిశి, బియ్యము, చావల, Arisi
- ❖ Grits / Broken, నుజ్జు, నోక, దలియా
- ❖ Semolina / Rava, రవే, రవా, రవా, Nuyi
- ❖ Flour, పిట్టు, పిండి, ఆటా, Maav

➤ Naked grains

- ❖ Flour, పిట్టు, పిండి, ఆటా, Maav
- ❖ Semolina / Rava, రవే, రవా, రవా, Nuyi
- ❖ Grits / Broken, నుజ్జు, నోక, దలియా

Processing: Challenges

- Machine / tools
 - ❖ Size of the grains & tolerance of machine parts/sub systems
- Shelf Life
 - ❖ Nutritious for pests not just for humans !!
 - ❖ Rancidity
- Process
 - ❖ Rain fed crops
 - ◆ Variations in material characteristics
 - ◆ Cannot be one process template
 - ❖ Multiple decision points
 - ❖ Batch size limitations
 - ❖ Scale of operations



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Traditional Processing: Design Factors

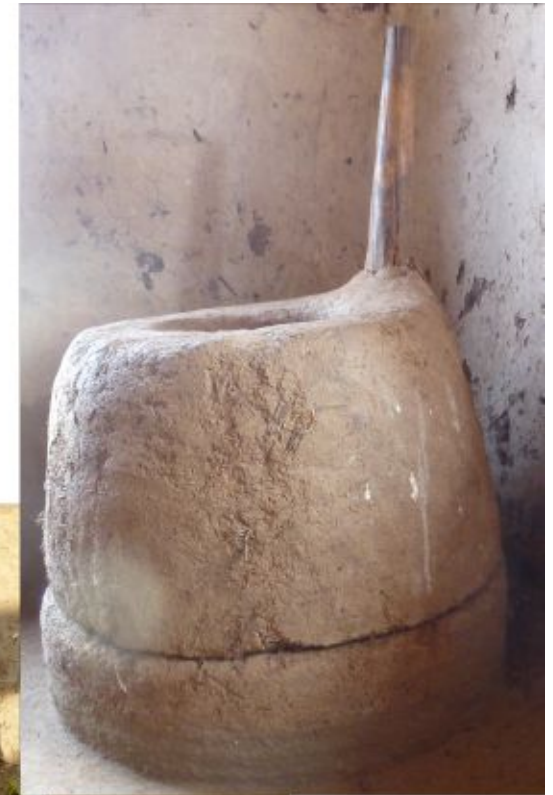
- Small batches
 - ❖ Most nutritious
- Ecologically sustainable
- Completely manual
 - ❖ Definition of drudgery
- Classic example of inequity
 - ❖ Woman's job
 - ❖ Every day, sometimes all day
- ***Socially oppressive***



Traditional Processing: Some of the tools used



Earthenware grinding - traditional set up



Traditional Processing: Role of women

- Invariably woman's work
- Relentless
- Unavoidable
- Not recognized
- Oppressive
- Inequity



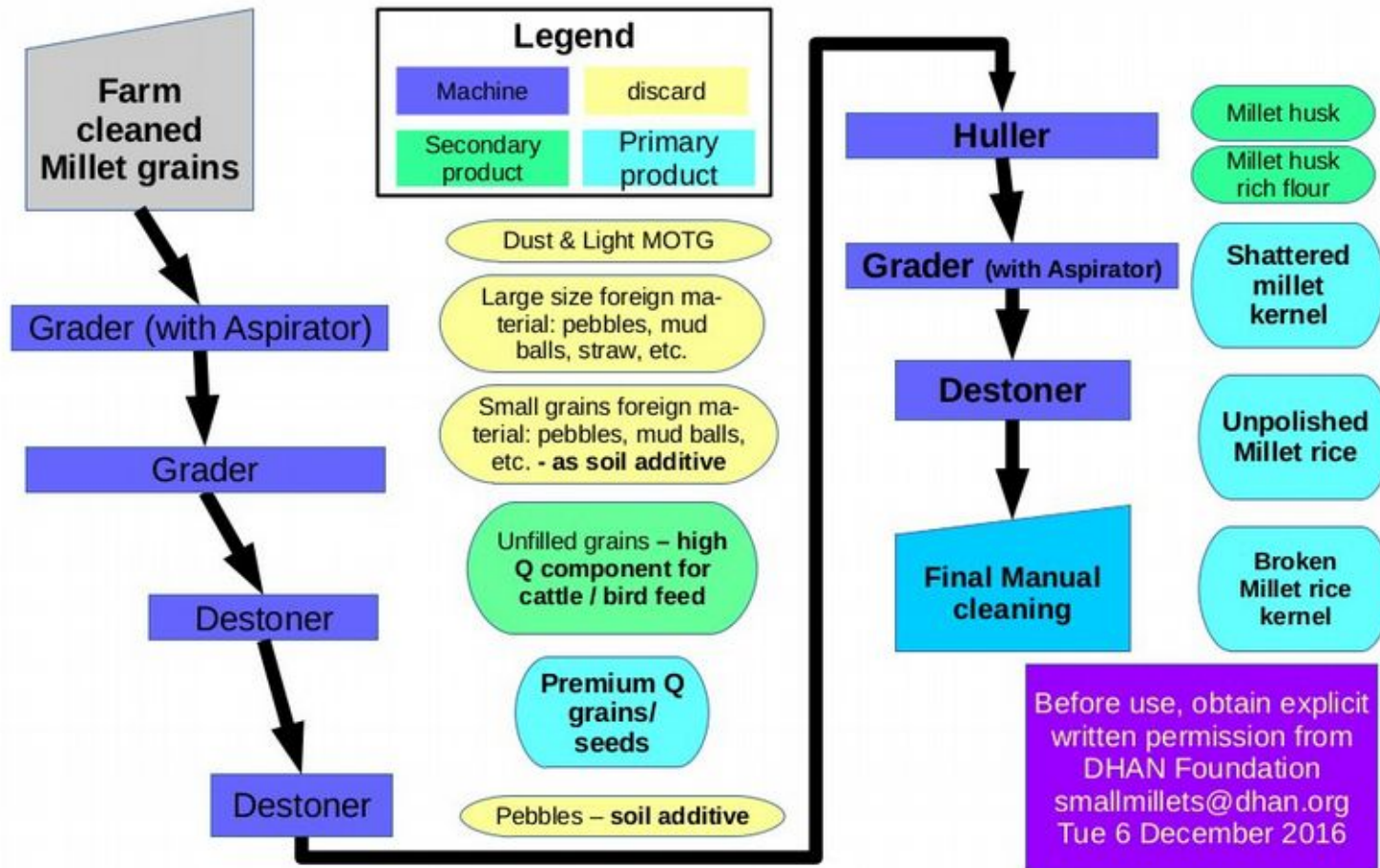
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Process Flow

The IDRC – DHAN Community scale Small Millet Processing Summary of Material Flow



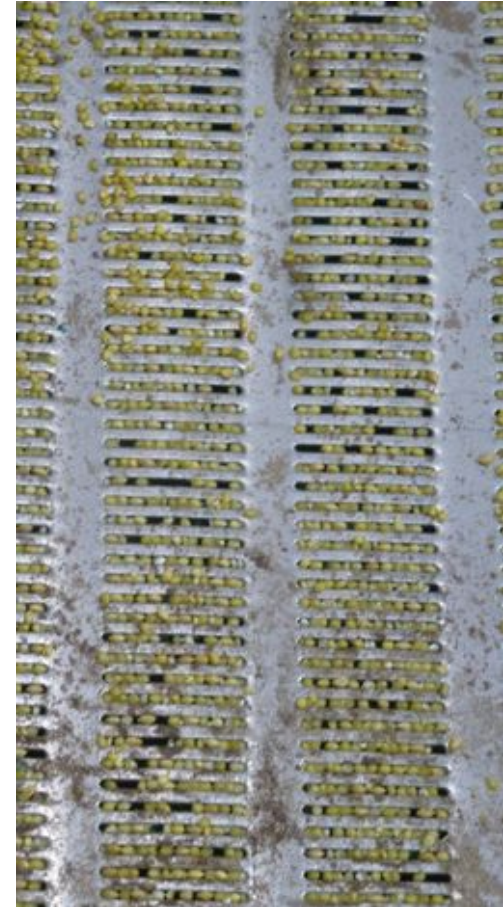
SMP machines - Graders

- Versatile and ubiquitous machine
- Used for
 - ❖ Cleaning
 - ❖ Grading
- Types
 - ❖ Eccentric
 - ❖ Vibrating



Critical Aspect in Machine Design

- Pest management
 - ❖ Clean-able: no residual material in machine
- Using sieves with the right hole size
 - ❖ To avoid clogging of sieve holes
 - ❖ To improve through put



SMP machines - Destoners

- Used for removing stones & pebbles from the grains
- Very useful to remove unfilled grains – chaff
- Process large volumes
- **Improving seed selection**



kg
er

Critical Aspect in Machine Design

- Pest management
 - ❖ Clean-able: no residual material in machine
- Hole size of bed mesh smaller than the smallest of grains / brokenes that will be put in the destoner



SMP machines - Dehusking / Hulling

- Abrasion milling
 - ❖ Size determined uniformity
 - ❖ Grader iterations
- Examples
 - ❖ Wooden / Earthen grinding mill
 - ❖ Emery mill
 - ❖ CIAE mill
- Advantages
 - ❖ Better viability at large process volumes (tons/hr)
- Impact or Centrifugal hulling
 - ❖ Sp. gravity determined uniformity
 - ❖ Destoner iterations
- Examples
 - ❖ Pounding
 - ❖ Centrifugal / impact huller
- Advantages
 - ❖ Easier to operate once configured

Outputs from Dehusking / hulling of small millets

- Husk
- Hulled millet rice
- Broken Millet grains – coarse grits
- Shattered millet grains – fine grits
- Unhulled grains

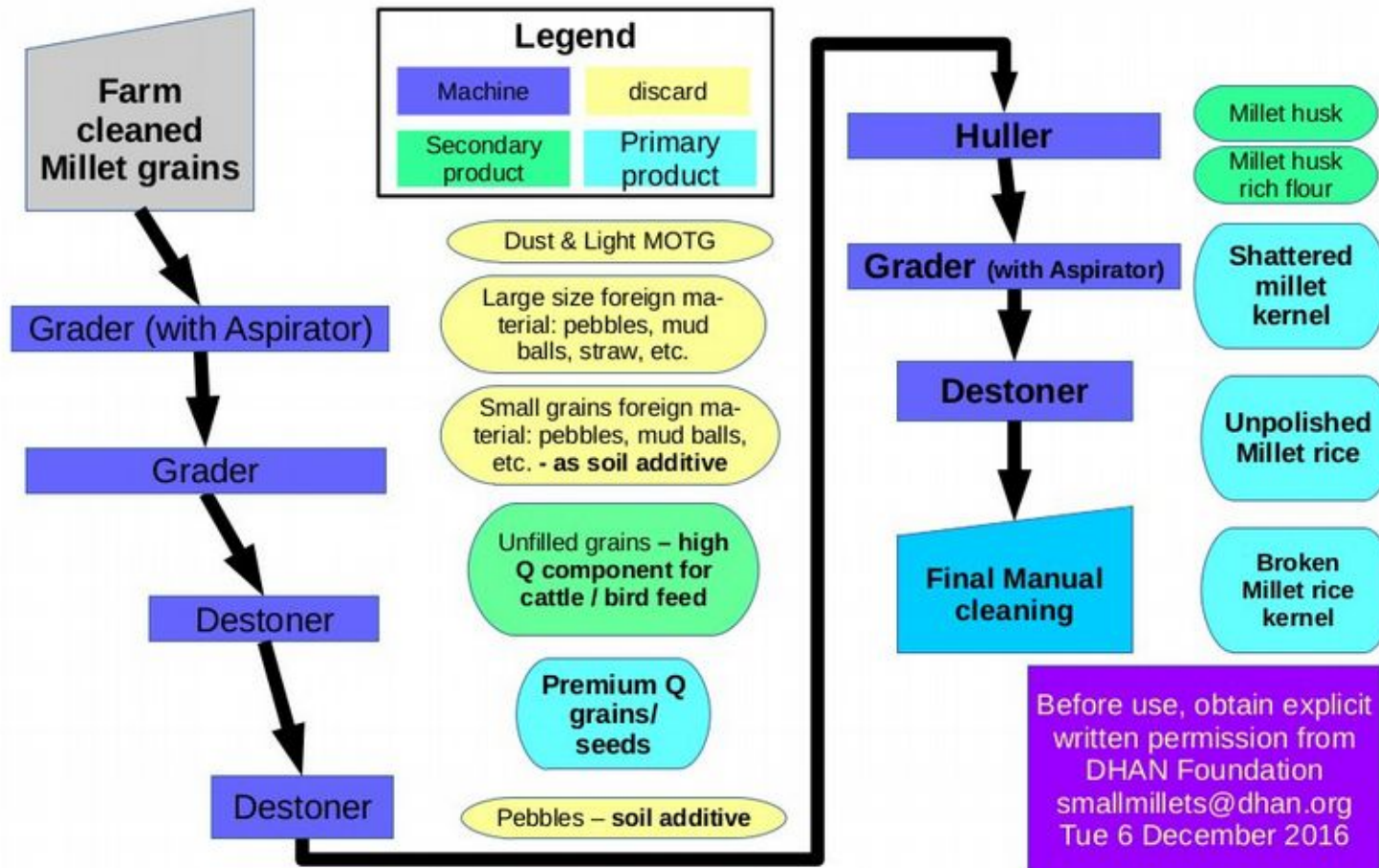
Hulling force	Hulling efficiency	Shattering & bran loss
Too high	↑	↑
Too low	↓	↓

Critical Aspect in Huller Design

- Pest management
 - ❖ Clean-able: no residual material in machine
- Aspirator control
 - ❖ Appropriately sized dampner windows on the aspirator / fan box
- Good control on feed rate
 - ❖ Non-linear effect on hulling efficiency
- Longevity of active components
 - ❖ Impact surface
 - ❖ Impeller

Process Flow

The IDRC – DHAN Community scale Small Millet Processing Summary of Material Flow



Critical Aspect in Operations

- Ability to identify if material is sufficiently cleaned and graded for hulling
- Identifying optimal feed rate for max. hulling efficiency
- Identifying optimal dampening of aspirator to separate husk from the huller output

Trained and alert operators

Way Forward : Technology Challenges

➤ Producer side

❖ Machines

- ◆ Pest Management
- ◆ Nutrition conscious

❖ Trainings

- ◆ Skill development

➤ Consumer side

❖ Nutrition

- ◆ Recognizing it
- ◆ Confidence to ask for it

❖ Managing variability



Way Forward : Systemic Challenges

- Small scale
 - ❖ Should be able to process 20 kg of grains, giving ...
 - ◆ 9 to 11 kg of millet rice
 - ◆ 1 to 2 kg of millet grits
 - ◆ 1 to 2 kg of chicken feed
 - ◆ 5 to 6 kg of cattle feed
- Sustainable, Community centric SMPU
 - ❖ Part of a multi grain/commodity agro-processing center
 - ❖ Season & Local appropriate
 - ❖ Multi – modal (Energy)
 - ❖ Financially viable
- Equitable & Accessible
 - ❖ Food as a basic human right
 - ❖ Gender and Disability conscious



Way Forward : Praxis

- Community scale units
 - ❖ Machines (re)designed
 - ❖ Skill Development
- Sustainability
 - ❖ Consumer education
 - ❖ Energy research
- Equity & Access
 - ❖ Policy framework
 - ❖ Behavioural changes



Thank you !

For more info ...

<http://themillet.org>

<http://millets.wordpress.org>