

# ENHANCING FOOD SAFETY AND SECURITY DURING STORAGE OF PADDY IN MALAYSIA THROUGH THE USE OF AERATION TECHNOLOGY

by

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# Background

- **Malaysian Agricultural Research and Development Institute (MARDI) is a statutory body under the Ministry of Agriculture and Agro-based Industry**
- **MARDI was established in 1969 with the objective of developing indigenous science and technology capabilities in support of the development of the food and agriculture sector**



# ***Core Business***

- ◆ To carry out contract research to generate innovative technologies for the development of the food and agriculture industries
- ◆ To provide consultancy and technical services to support the development of food and agriculture industries
- ◆ To offer joint ventures and licensing arrangements for the commercialization of research results

# MARDI Organisational Structure



**Mechanization & Automation Research Center, MARDI, MALAYSIA**



## MALAYSIAN STATISTICS



**Population: 27.6 millions (2007)**  
**Life expectancy after birth:**  
**Male (71.0 yrs)**  
**Female (76.4 yrs)**

**Country Area: 32,855,000 ha**

**Cultivated area: 6,300,000 ha**

**Irrigated agriculture field Area (9.4)%**



## MALAYSIAN AGRICULTURE

Employment	2007
Total Labor Force ('000)	10,889.5
Employed ('000) Agriculture (1995)	10,538.1 1,500.0
Unemployed ('000) (% of labor force)	351.4 (3.2%)



## MALAYSIAN AGRICULTURE

	Top nine agricultural commodities	Share of agricultural lands, ha (%)
1.	Oil palm	3,950,000 (62.7)
2.	Rubber	1,250,000 (19.8)
3.	Paddy	680,000 (10.8)
4.	Fruits	371,000 (5.9)
5.	Coconuts	153,000 (2.4)
6.	Cocoa	66,000 (1.1)
7.	Vegetables	48,000 (0.8)
8.	Pepper	15,000 (0.3)
9.	Tobacco	15,000 (0.3)
10.	Others	2,000.0



## PADDY PRODUCTION

- Strategic, social, economic and political crop in Malaysia
- Total Production Area = 680,000 ha
- Estimated production about 2.2 million metric tons/year = 1.4 mil tons rice (~70%)
  - \* 800,000 tons rice imported





## FOOD SECURITY AND STORAGE

- ◆ **NO SPECIFIC LAW AND POLICY ON FOOD SECURITY**
- ◆ **1980's NATIONAL PADDY AND RICE BOARD**  
BASED ON UNDERSTANDING - 300,000 TONS; 3 MONTHS CONSUMPTION FOR 13 MIL POPULATION
- ◆ **RECENT FOOD CRISIS EXPOSED THE FLAWS OF OUR FOOD SECURITY/SAFETY SYSTEM**  
-STOCKPILE; STORAGE SYSTEMS; RESPONSE



## FOOD SECURITY AND STORAGE

### PROPOSED STRATEGY INCLUDE

- PLAYERS - MILLERS, WHOLESALERS AND RETAILERS
- IN PADDY AND RICE FORM
- FULLY OPTIMIZE EXISTING STORAGE SPACE AT PADDY MILLS AND RICE GODOWNS



## FOOD SECURITY AND STORAGE

### IMPLEMENTATION PROPOSED:

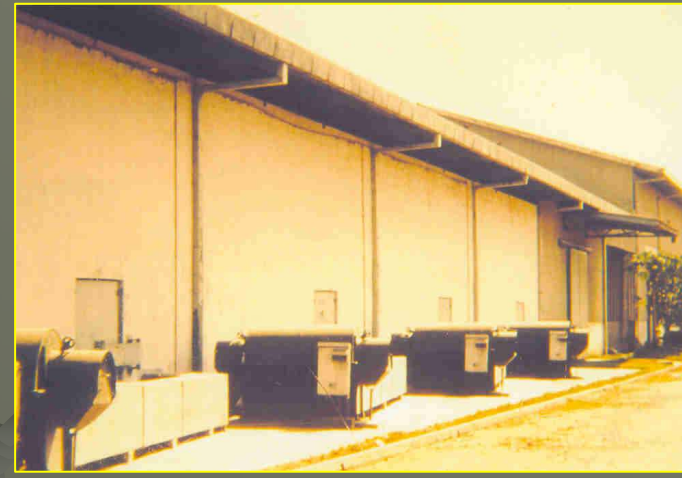
- PADDY : RICE RATIO (500,000 ton rice & 150,000 t pady for a 3-month of consumption)
- PADDY (AND ITS STORAGE SYSTEMS)
  - ❖ < 1 YEAR - **PADDY STORED IN BULK IN SILOS**
  - ❖ < 2 YEARS - PADDY STORED IN BULK IN GODOWNS AND SHELTERS  
(a need to audit the available systems)
- QUALITY MAINTENANCE USING ENVIRONMENTALLY FRIENDLY TECHNOLOGY

## SILO STORAGE OF PADDY

- 40% OF THE MODERN PADDY STORAGE STRUCTURE IS IN BULK
- IN-BIN STORAGE STRUCTURE
- SILO STRUCTURE



Bag



Bulk - horizontal



Bulk - vertical

## Storage system of dry paddy

## SILO STORAGE OF PADDY

- 750 TON CAPACITY; EACH COMPLEX 8 SILOS X 750 T = 6,000T
- SILO STRUCTURE - 11 OUT OF 33 COMPLEXES
- 1/3 OR 1/2 FULL; ABOUT 2 MONTHS PERIOD
- GRAIN TEMPERATURE - 55°C; QUALITY DETERIORATION
- GRAIN TURNING -RM25.50/T; TIME CONSUMING; AFFECT OTHER OPERATION
- NO AERATION FACILITY

## SILO STORAGE OF PADDY

- **Aeration**, a process of bringing fresh ambient air from outside into contact with the stored grain mass, is considered as an alternative technique to grain turning to maintain paddy quality during silo storage.

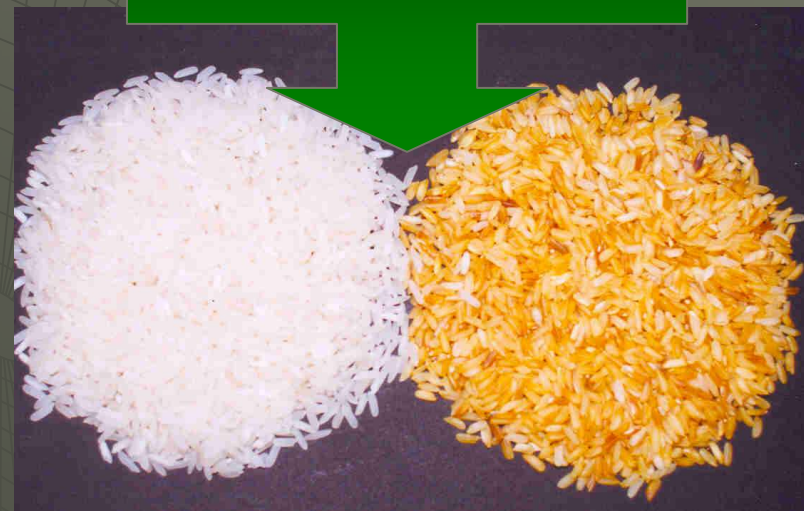
Properly stored paddy



Poorly stored paddy

Milling

High quality milled rice



Low quality milled rice

Milling test of stored paddy



# R&D IN AERATION TECHNOLOGY

- After 6 years of intensive R&D activities, a suitable aeration system was recommended and installed in all concrete tower silos
- This selective aeration technology using good quality ambient air conditions had proven to be practical, suitable and economical in humid tropics like Malaysia

# DESCRIPTION OF THE TECHNOLOGY

The project involves the development of an aeration system and management protocol for dry paddy storage in concrete tower silos

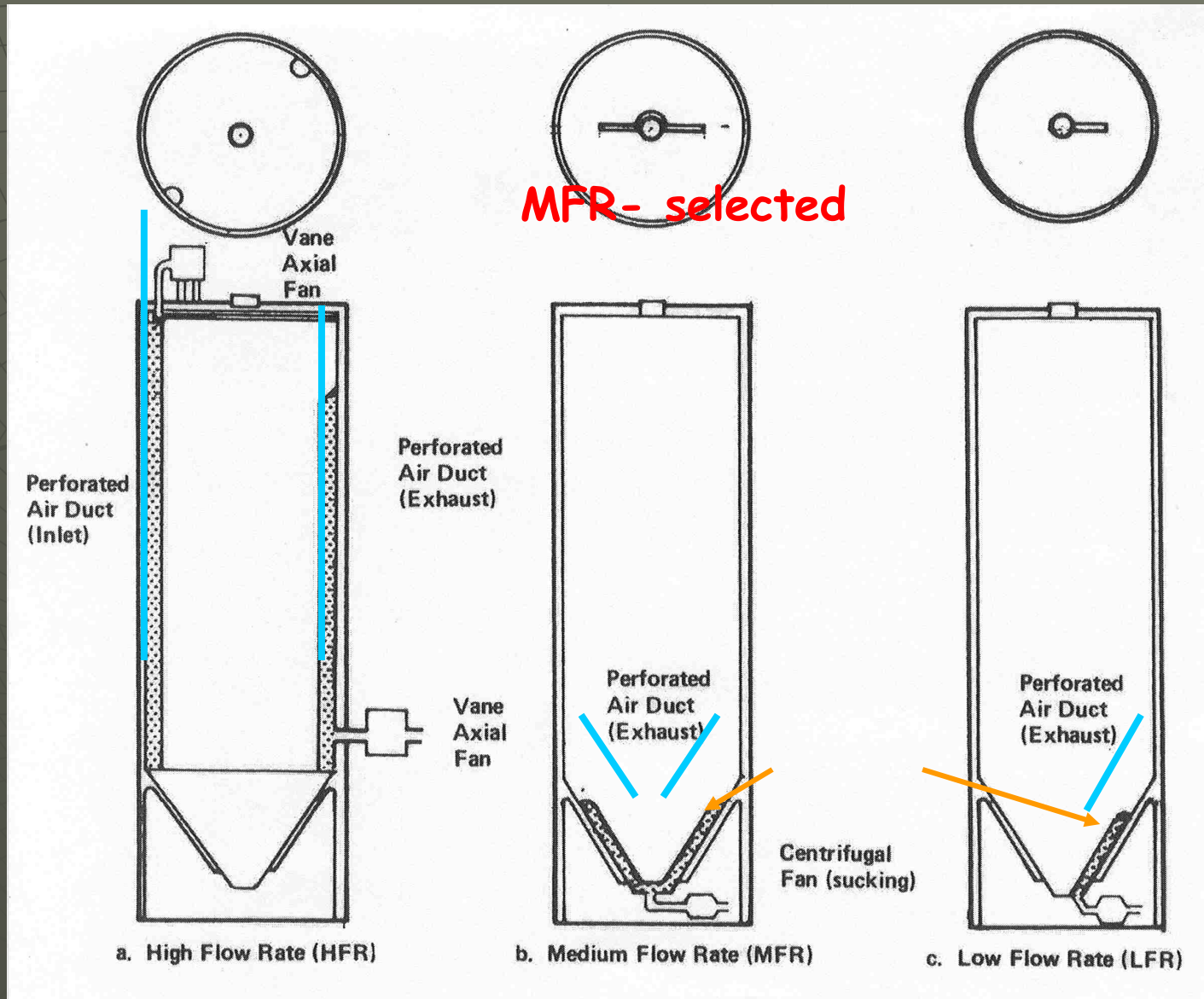
## 1. Air delivery system (Fan)

Establishment of power requirement to facilitate delivery of fresh air through the grain mass to move heat (but not moisture) based on 3 air flow rates namely 1.0 as HIGH, 0.1 as **MEDIUM (recommended)** and 0.03 m<sup>3</sup>/min/ton as LOW

## 2. Ducting system

Establishment of the required length of perforated duct according to the volume to be delivered. The ducting system was of stainless steel semi-circular air ducts between 75 to 80% perforation

# 3 Aeration System Design Evaluated for Silo Structure



## Aeration system installed



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## R&D Commercial trials



Loading of dry paddy into the silo



Paddy sampling inside the concrete silo

### 3. Selective aeration technique

The design enabled the fan to be started even if the silo is not fully loaded

Involves the selection of aeration time based on low relative humidity (RH) of the ambient air (75%) to maintain quality.



## 4. Operation safety guidelines

The temperature and RH of the macro environment has to be monitored from the control room to ensure good storage condition is maintained

If any location in the silo registers a grain temperature of above 35°C in 4 consecutive days, the operator has to be on the alert and aeration period can be extended. However, if the grain temperature surges beyond 39°C, paddy has to be sent for milling immediately

## The technology / innovation

- Has enabled the storage period to be extended from just 2 months (with one third full to avoid losses) to almost 6 months (full capacity), with minimum quality deterioration.

(6 month is the minimum storage period desired for efficient milling operation and year long processing capability)

- The cost of grain turning was about RM25.44/ton of dry paddy. With the innovation, the cost of aerating the grain was only about RM2.83/ton for a 6-month storage period
- Taking into account the initial construction cost of the innovation (RM90,400.00), the investment is almost paid up in just between one to two harvesting seasons

- **Current R&D - incorporating ICT in the storage system for better control and management of storage quality**

## BENEFITS OF INNOVATION

The technology ensure continuous supply of staple food in the country with the following impact:

- Practical, simple to use and time saving
- Productivity improvement in the form of optimum utilization of rated silo capacity
- Minimised quantitative and qualitative losses during storage
- 200% storage extension (from 2 to 6 months)

- Provide choice for suitable storage system, horizontal or vertical
- Economical and low operation costs
- 'Green' technology and environmentally friendly (no chemical use)



**THANK YOU**