Mechanization of Rice Farming across Asia to reduce production costs and improve productivity: Status, lessons and advances

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This talk

- What is Mechanization
- Status
- Some lessons
- Advances
  - In the region
  - At IRRI, with some recommendations
What is Mechanization

IRRI’s draft mechanization strategy document: “Mechanization is the process or system of introducing equipment and/or machines to do work”

- **Technology**
  - Hand tools, animal power, engine driven
  - Different level of complexity and control
  - Common patterns of adoption

- **Delivery**
  - Central or local fabrication; Distribution networks

- **Seed to markets**
  - Includes whole value chain

- **Support services**
  - After sales services, repair, financing, training

- **Supportive policy**
# Stages of Mechanization

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Examples of IRRI technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Application of improved hand tool technology</td>
<td>Cono weeder, drum seeder, pedal thresher, manual transplanter</td>
</tr>
<tr>
<td>2</td>
<td>Draft animal power application</td>
<td>Animal drawn plow / weeder</td>
</tr>
<tr>
<td>3</td>
<td>Stationary power substitution</td>
<td>Rice mills, axial flow pump, axial flow thresher</td>
</tr>
<tr>
<td>4</td>
<td>Motive power substitution</td>
<td>Hydro tiller, hand tractor, 4 wheel tractor</td>
</tr>
<tr>
<td>5</td>
<td>Human control substitution</td>
<td>Laser leveling, dryers, GPS controlled Wintersteiger seeder</td>
</tr>
<tr>
<td>6</td>
<td>Adaptation of cropping practices</td>
<td>Direct seeding</td>
</tr>
<tr>
<td>7</td>
<td>Farming system adaptation</td>
<td>Consolidation of fields e.g. through laser leveling</td>
</tr>
<tr>
<td>8</td>
<td>Plant adaptation</td>
<td>Improvement on digestibility / heating value of rice straw</td>
</tr>
<tr>
<td>9</td>
<td>Automation of agricultural production</td>
<td></td>
</tr>
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</table>

Source: Adapted from Rijk, AG, www.unapcaem.org
Mechanization Stakeholders

- Need for an integrated approach addressing each stakeholders needs
- Stakeholders should stick to their mandates
“Traditional” Rice Production Systems

Mechanization drivers
- Labor shortage
- Cropping intensification
- Yield gains
- Ageing farming population
- Grain quality
- Food safety
- Sustainability
Mechanized Options: Land Preparation

**Laser leveling**
- Dry leveling
- Leveling fields
- Water saving
- Land consolidation

**Land Preparation**
- Two-wheel tractor
- Four-wheel tractor
- Minimum/zero till
Mechanized Options: Crop Establishment

**Transplanting**
- Technology
- Business models: service incl. seedlings

**Direct Seeding**
- Drum seeder
- Drill seeders (wet, dry)
- Option: plus fertilizing
Mechanized Options: Crop Care

Spraying
- Operator safety
- Even application
- Minimize pollution

Fertilizing
- Exact application
- Higher yields
- More even maturing

Weeding
- Needs transplanting
Post production

Harvesting

- Threshers
- Combine harvesters
  - Rice combines
  - Multi crop combines

Drying

- Solar Bubble Dryer for farm level
- Flat bed dryer
- Column dryer for industry
Effect of Mechanization

• Example, straw management
  – Combine use leaves straw in the field
  – Collection difficult, price increased from 20-80$/t
  – Field burning -> GHG emissions, pollution

• Opportunities
  – Value adding: mushroom production, livestock feedstock, bio energy
  – Baling technologies
  – Business models for straw collection
Mechanization Trajectories, Example Japan

- **Rapid mechanization after WW2**
- **Drivers**
  - Land reform
  - High rice price / grain quality
  - Labor shortage, drudgery
  - Convenience
  - Ageing farming population
Status of Mechanization, Countries

• **Fully mechanized**
  – All operations mechanized
  – Japan, South Korea

• **Partly mechanized**
  – Land prep., harvesting, some other operations
  – Thailand (Central Plains), Vietnam (some provinces in the Mekong Delta),
  – Indonesia (South Sumatra, South Sulawesi), Cambodia (Pursat, Battambang)

• **Starting to mechanize**
  – Land preparation by two wheel tractor, harvesting starts to mechanize
  – Myanmar, Lao PDR, ….
Introduction of Combine Harvesting, Vietnam

**Public Sector**

- **1977**: 5 Russian wheat combines with wheels tested.
- **1977**: 1st national combine contest, 2nd hand Japanese head feed combine wins.
- **1998**: 5 national combine contests.
- **2000**: Introduction of Mini Combine to VINAPRO; Price in combine contest.
- **2009**: Monitoring, some programs promote combine harvesting.

**Private Sector**

- **1977**: Trading companies import second hand head-feed combines.
- **1998**: 15 local manufacturers produce own designs; Import of cheap Chinese machines.
- **2000**: 900 Mini Combines produced, end of production.
- **2004**: Kubota and Yanmar have >95% market share, Kubota produces locally.
- **2006**: Only 2 local manufacturers left.
- **2009**: Shift to better quality machines.
- **2015**: Around 10,000 combines in the Mekong River Delta.

**Users**

- **1977**: Farmers buy second hand imported head feed combines.
- **1998**: Contractors shift to cheap Chinese axial flow combines with rubber tracks and to locally produced machines.
- **2009**: Shift to better quality machines.
Lessons - Introduction of Combines

• Steep learning curves for all, users, contractors, manufacturers and public service providers

• Government had prioritized local production, but local manufacturers could not compete with the big players
  – Technically: performance, quality
  – Marketing
  – After sales services

• We facilitated frequent exchange for our partners in Cambodia
### Introduction of Combine Harvesting, Cambodia

#### Public Sector

<table>
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<th>Year</th>
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<tr>
<td>2006</td>
<td>IRRI ADB PH project imports Mini Combine from Vietnam; Field week in PV</td>
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<td>2007</td>
<td>IRRI: Economic assessment, combine harvesting</td>
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<td>2008</td>
<td>Harvesting field day in Battambang</td>
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<td>2012</td>
<td>Monitoring, some promotion</td>
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<td>2015</td>
<td>Combine demo and round table, Battambang</td>
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#### Private Sector

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<td>2007</td>
<td>Kubota enters market; Chinese machines increasingly taken out of service</td>
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<td>2008</td>
<td>CLAAS multi-crop combine enters market</td>
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<td>2015</td>
<td>One local manufacturers makes copies of Thai machines</td>
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#### Users

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<td>2006</td>
<td>Better off Farmers buy cheap machines</td>
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<tr>
<td>2007</td>
<td>Contractors emerge, shift to better quality machines; Farmers start asking for better machines</td>
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<td>2015</td>
<td>Around 6,000 combines in around Tonle Sap</td>
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**Combines Demography**

- **IRRI:** Economic assessment, combine harvesting
- **Harvesting field day in Battambang:**
- **Exchange visits to Vietnam combine contests:**
- **Combine demo and round table, Battambang:**
- **Monitoring, some promotion:**
- **Private Sector:**
  - Participate in events, start import combines from Thailand, China
  - Kubota enters market; Chinese machines increasingly taken out of service
  - CLAAS multi-crop combine enters market
- **Users:**
  - Better off Farmers buy cheap machines
  - Contractors emerge, shift to better quality machines; Farmers start asking for better machines
Learnings: Potential to accelerate Trajectories

• The Vietnam experience was confirmed in Cambodia, where combines were introduced along a similar trajectory but in only 7 years instead of 17 (38) in Vietnam

• Countries can learn from each other, avoid costly mistakes

• Need for a regional network for:
  – Verification of new technologies under different conditions and cropping systems
  – Exchange learnings
  – Transfer technologies
Advances – Ongoing Initiatives

• Regional: ESCAP Centre for Sustainable Agricultural Mechanization (CSAM)
  – Asian and Pacific Network for Testing of Agricultural Machinery (ANTAM): Test codes and testing – performance testing of existing technologies
  – Exchange of prototypes

• Bilateral projects: Scaling out of “low hanging fruits”
  – USAID - Mechanization Innovation Platforms
  – GIZ - Better Rice Initiative Asia BRIA
  – Many others

• Many national programs, examples:
  – Philippines: DA Farm Mechanization Program
  – Mechanization included in rice sector development strategies
  – We would like to be more involved and assess whether we can add value to the national programs
IRRI Activities: Mechanization

• Mechanization strategy document
  – Presented at GRiSP Annual Review in October 2014
  – Hired ag. engineers: 1 PDF at IRRI, 1 GRS in Cambodia, 1 NRS in Myanmar, 1 NRS in India

• Cutting across GRISP Programs 3 and 4; Build into RICE Flagship Programs 2 (FSP2) and FSP3

• Mechanization included in bilateral projects
• Multi stakeholder platforms (Learning alliances)
• Capacity building programs, vocational training for agricultural machinery mechanics in Cambodia
New Frontier: Precision Agriculture including..

.. 3-D Printing

• Rapid prototyping
• Printing of spare parts
  – Spare part supply chains often not available
  – 3-D scanning
• Business models

.. Drones

• Remote sensing e.g. level of fields before laser leveling
• Application of agrochemicals
APEC Proposal – Mechanization verification and transfer network

• **Objective:**
  – Multi environment and cropping system verification of mechanized options
  – Technology transfer network
  – Capacity building

• **Supporting APEC Economies**
  – Submitting economy: Philippines through PhilMech
  – Support: Japan, Indonesia, … You are invited to join

• **Concept Note submitted, Two Phases**
  – Phase 1: Need assessments, partnerships, conceptualizing the network (one year)
  – Phase 2: Implementation of the network
Thank You