Mechanization of rice harvest – lessons learned

Dipl. Ing. agr. Martin Gummert
Senior Scientist, Postharvest Development, IRRI
With inputs from:
Nguyen Van Hung, Phan Hieu Hien, James Quilty

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34 People to harvest 1 ha/day
Harvesting cost: US$ 200-250/ha
Harvesting losses: 4-6%
Partly mechanized harvesting systems
16 People / ha / day
Losses: 4-6%
Combine Harvesting

Why?

- Labor saving
  - 2 instead of 34 persons / day / ha
- Potential to cut harvesting losses to 1-2%
- Cutting harvesting cost up to 50%

Key challenges in Asia

- Small farm sizes (average 2ha)
- Small field sizes (0.1-0.5ha)
- Wet fields during wet season
- Difficult field access
- Poor road network
- Predominantly bag handling
- Poor support services
Technology: Mini Combine

• 1.2m cutting width
• 1ha/day
• 15-40 hp
• Wheels, sometimes rubber tracks
Technology: Axial Flow

- 2-2.5m cutting width
- 4 ha/day
- 40-100 hp
- Rubber tracks

“Small Rice Combine”
Technology: Tangential/axial Flow (TAF)

- > 5 ha/day
- 2-3m cutting width
- 40-300 hp
- Rubber - or steel tracks
Technology: Head-feed Combine

- 2-4 rows
- 0.2-0.4 ha/h
- 60-100 hp
- Rubber tracks
- Leave straw intact
Technology: Adapted Wheat Combine

- 4.3 m
- > 8-10 ha/day
- 140 hp
- Wheels

Bago Division, Myanmar, 2014
Introduction of Combine Harvesting, Vietnam

Public Sector

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

Private Sector

- 1977: Piloting
  - Trading companies import second hand head-feed combines
- 1998: Adaptation
  - 15 local manufacturers produce own designs; Import of cheap Chinese machines
- 2000: Adoption
  - 900 Mini Combines produced, end of production
  - Kubota and Yanmar have >95% market share, Kubota produces locally
  - Only 2 local manufacturers left

Users

- Farmers buy second hand imported head feed combines
- Contractors shift to cheap Chinese axial flow combines with rubber tracks and to locally produced machines
- Shift to better quality machines.
- Around 10,000 combines in the Mekong River Delta

Introduction of Combine Harvesting, Cambodia

Public Sector

2006 - IRRI: Economic assessment, combine harvesting
2007 - IRRI ADB PH project imports Mini Combine from Vietnam; Field week in PV
2008 - Harvesting field day in Battambang
2012 - Exchange visits to Vietnam combine contests
2015 - Combine demo and round table, Battambang

Private Sector

2006 - Participate in events, start import combines from Thailand, China
2012 - Kubota enters market;
2015 - CLAAS multi-crop combine enters market

Users

2006 - Better off Farmers buy cheap machines
2012 - Contractors emerge, shift to better quality machines;
2015 - Contractors prefer Kubota

Monitoring, some promotion

Adaptation

2006 - Monitoring, some promotion
2007 - IRRI ADB PH project imports Mini Combine from Vietnam; Field week in PV
2008 - Kubota enters market;
2015 - CLAAS multi-crop combine enters market

Adoption

2006 - IRRI: Economic assessment, combine harvesting
2007 - IRRI ADB PH project imports Mini Combine from Vietnam; Field week in PV
2008 - Exchange visits to Vietnam combine contests
2015 - One local manufacturer makes copies of Thai machines

IRRI ADB PH project imports Mini Combine from Vietnam; Field week in PV


Rice science for a better world

Around 6,000 combines in around Tonle Sap
Myanmar: Piloting Phase, Experimenting with Different Combine Types (2015)

Similar trends
• Users shift to better quality
• Market consolidating started

Source: IRRI IRRC and CORIGAP projects, 2015
Phases of introduction of combines and support needs
Lesson: We can help countries speed up the introduction of combine harvesting

<table>
<thead>
<tr>
<th>Phase</th>
<th>Characteristics</th>
<th>Major problems</th>
<th>Public sector support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piloting</td>
<td>Import of “cheap” machines; local manufacturers copy/develop combines</td>
<td>Identifying machine for cropping system, field size, climatic conditions</td>
<td>Need assessments, baselines, field demonstrations, pilot testing</td>
</tr>
<tr>
<td>Adaptation</td>
<td>Modifications addressing problems identified in piloting phase; international players discover market; many local manufacturers</td>
<td>Technical problems; economic feasibility, lack of financing, lack of after-sales services</td>
<td>Identification of suitable technologies, testing under local conditions; promotion of combines, financing</td>
</tr>
<tr>
<td>Adoption</td>
<td>Demand established; market leader evolves; local manufacturers consolidate</td>
<td>High losses (business models), soil compaction, effect of land consolidation</td>
<td>Research on effect of introduction of combines and mitigation options for new problems, sustainability issues</td>
</tr>
</tbody>
</table>

Source: Gummert, VDI-MEG Colloquium Landtechnik, Mähdrescher, Tagung Hohenheim, 12-13 September 2013
## Overview, Combine Populations, Southeast Asia

<table>
<thead>
<tr>
<th>Region</th>
<th>Machines</th>
<th>Prevailing machines</th>
<th>Major issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAM</td>
<td>5,000, partial saturation</td>
<td>95% <strong>Kubota</strong>, some <strong>Thai</strong> combines, <strong>CLAAS</strong></td>
<td>Only 20% irrigated rice, low rice price,</td>
</tr>
<tr>
<td>VTN</td>
<td>10,000, 9,000 in MRD</td>
<td><strong>Kubota</strong> 95% market share, <strong>Yanmar</strong>, 2 local manufacturers</td>
<td>Gov. supports mechanization, move to export quality rice</td>
</tr>
<tr>
<td>PHI</td>
<td>1,500-3,000</td>
<td><strong>Kubota</strong>, <strong>CLAAS</strong>, <strong>John Deere</strong>, some <strong>Chinese</strong> brands</td>
<td>Government mechanization programs</td>
</tr>
<tr>
<td>MMR</td>
<td>Several 100</td>
<td>Chinese mini combines, <strong>Kubota</strong>, Indian wheat combines, head feed combines from Korea</td>
<td>Increasing labor shortage, government rice sector development strategy, service provision companies</td>
</tr>
<tr>
<td>INO</td>
<td>200 South Sulawesi, starting in other provinces</td>
<td>Mostly Chinese machines - branded, <strong>Kubota</strong>, <strong>CLAAS</strong> entered market</td>
<td>Labor shortage in outer provinces. Ambitious government program to reach self sufficiency in 5 crops in 5 years</td>
</tr>
</tbody>
</table>

Source: IRRI Trip reports, MyRice, CORIGAP projects
Energy Consumption of Different Harvesting Methods

Harvesting system in Myanmar

<table>
<thead>
<tr>
<th>Stacking of unthreshed crop in field</th>
<th>Paddy loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual, 1 week</td>
<td>8.5</td>
</tr>
<tr>
<td>Manual, 2 weeks</td>
<td>10</td>
</tr>
<tr>
<td>Manual, 3 weeks</td>
<td>11</td>
</tr>
<tr>
<td>Combine (assumed)</td>
<td>5</td>
</tr>
</tbody>
</table>

Sources: Nguyen, HV: IRRI MyRice Project, ACIAR, 2016
IRRI CORIGAP project, SDC, 2016
Cost and Benefits of Different Harvesting System “Business models”

Source: Book Chapter on Combine Harvesting, for publication, IRRI, 2016
Typical Combine Harvesting Business Model

- **Ownership:** Mostly individual, 1 or more machines
- **Operation:** Family member or hired operator. Salary: 150-200 US$/month
- **Harvesting fee:** Cambodia: 70-120 US$/ha, Vietnam: 90-125 US$/ha
  Manual harvesting and threshing – 200-250 US$/ha
- **Annual utilization:** Cambodia: 150 days/year, 90 days WS, 60 days DS; Vietnam: 100 days/year, 8 hours / day (640 h/year); some contractors “follow the harvest”
- **Durability / Lifetime of machine:**
  - “Cheap” combines start breaking during the first season
  - Better quality machine “runs for three years without much problems”
  - After 3,000 hours, major re-built
- **Repairs:** During off season, often by owners and local workshops – modifications

*Source: IRRI combine market study, 2015*
Special business models in Cambodia / Vietnam in 2014

- Cambodian contractor **buys a new Kubota** for US$26,000, **sells it after one year** before major repairs start for $10,000 to Vietnam.
- Vietnamese workshop **invests $5,000 to re-build it** and then sell it with a reasonable margin to Vietnamese combine owners.
- Vietnamese operator might put another 3,000 hours on the clock.
- Nobody seems to earn much money.

One of two Vietnamese manufacturers still making own combines, but also re-building broken machines, mostly Kubota.

Source: IRRI combine market study, 2015
Some Combine Harvesting Problems

• Harvest losses increased, up to 10%
  – Business model favors operators to drive fast
  – Operators don’t know how machine settings affect performance
  – Farmers in a poor negotiating position

• Poor support services
  – Operators get 1 hour of training
  – Spare parts expensive or not available
  – Repair services through local manufacturers

• Logistics
  – Scheduling
  – Right machine for field condition

Source: IRRI combine market study, 2015, CORIGAP, IRRC
Other Effects of Combine Harvesting

Postharvest Loss Assessment, Chainat, Thailand

Harvesting practice has effects on milling outputs.

Source: IRRI Kellogg’s Project, 2016
Collecting the Grains

- Bag handling prevailing in S- and SE-Asia (≈95%)
- Deltas: no field roads, transport on canals
- Slow increase in bulk handling in the intensive systems with farm roads

Unloading of combines with grain in bags into bags in a tank in Cambodia, Prey Veng Province (left), and onto a transportation vehicle in Pursat Province (right).

Bag collector picking up bags in the field (left); unloading at the national highway (right). Vietnam

Source: IRRI CORIGAP project, 2015
Crop Rotation

Trends
• Increase of rice production in all countries
• Over proportional increase in maize production
• Increase in pulses, except Indonesia

Multi crop capability will be more important

Source: IRRI, FAO data
Combine harvesting leads to higher MC and more grain coming to the drying systems in shorter time - need for dryers

Traditional sun drying in Indonesia (top left); flat-bed dryer at rice mill in Myanmar (top right); re-circulating batch dryer in Vietnam (bottom left); Solar Bubble Dyer in Indonesia (bottom right).

Source: IRRC, CORGAP
Effect of Combines on Rice Straw Management

Traditional harvesting, straw collected

Field burning of straw after combine harvesting

See Next Presentation

Source: IRRI BMZ project, 2015; Supergen project 2014
Conclusions

• Viable combine harvesting service business model with clear benefits for operators and farmers
• Combine introduction happening fast - similar trajectories across countries
  • Cheap machines -> Better quality
• Potential for learning from each other
• All seem to move towards the “small rice combine”
  – AF or TAF, tracks, 2-2.5m width, bagging station or grain tank
• New problems: drying, rice straw management soil compaction, etc. need adaptive research in those areas
• Attention needed to optimizing logistics, scheduling, field efficiency, after sales services
Thank You