Combine Harvesting in South and Southeast Asia: Current Status and Trends

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Our Mission:
To reduce poverty and hunger, improve the health of rice farmers and consumers, and ensure environmental sustainability through collaborative research, partnerships, and the strengthening of national agricultural research and extension systems.

1300 Employees, 120 International Staff
120 ha mechanized experiment station
2t/h rice mill

Research station: Los Baños, Philippines
Offices: Bangladesh, Cambodia, India, Lao, Indonesia, Myanmar, Thailand, Vietnam,
Africa program: 3 countries, Eastern Africa
This Talk

- Challenges in harvesting rice in Asia
- Evolution of harvesting systems
- Examples from countries
  - Thailand
  - Vietnam
  - Cambodia
  - Others: Myanmar, Indonesia, Philippines
  - Harvesting at IRRI

- Trends, support needs
- Conclusions
Rice Terraces, Banaue, Philippines
Rice Estate, Kalimantan, Indonesia

Tidal swamps, Kalimantan
Fresh water swamps, South Sumatra
Deepwater Rice, Cambodia

Straw length up to 4 meters
Intensive Rice Systems, Mekong Delta

Yields of 4-8 t/ha
Very wet grains and straw
Often lodged crop
Challenges in Harvesting in Asia

- Manual harvesting, threshing and collection takes 34 person days per hectare
- Intensive systems, monoculture, 2 seasons / year, 5 seasons in 2 years
  - Little time for harvesting
  - One harvest in during monsoon
- Variation in straw length (0.3-4m)
- Harvest moisture content of 22-24%
- Small farm sizes: 1-4ha
- Difficult field access (roads, topography, canals)
- Lack of support services (financing, after sales services, training)
- Bag handling (>80%)
Evolution of Harvesting Systems

- Green revolution 1960-70s
  - Modern varieties, increase of yields
  - Intensification of cropping systems, 2 crops
  - One additional crop in the wet season
  - Traditional harvest systems could not handle the large additional amounts of very wet crop

- Need for mechanized solutions
Axial Flow Thresher

Introduction in Countries
Philippines, 1969-1972
Pakistan, 1976-1978
Thailand, 1977-1980
Indonesia, 1980-1982
Lao, 1997-1998
Vietnam, 1980s?

Green revolution
Yield increases
Double cropping systems

Axial Flow Threshing Principle
IRRI, 1972

Combine Harvester
Thailand: mid 1990s
Vietnam: since ~ 2000

IRRI, 1972
Mechanical Reaper (1990s)

- **Capacity**: 2-4 ha/d

- **Advantages**
  - Fast cutting

- **Problems**
  - Places crop in windrow back in the field
  - Problem with lodged crop
  - Complex cutter bar and conveying mechanism
Stripper Harvester

- **Source:** Silsoe
- **Capacity:** 1ha/day
- **Advantages**
  - strips and collects grains only
  - less material to handle
- **Problems**
  - problems in wet soils and lodged crop
  - straw treatment
  - does not work well with long straw
  - complex machine
  - skills required

Despite strong promotion in SE-Asia the stripper harvester has not gained wide popularity because of its problems in less favorable harvesting conditions. Only in Indonesia (South Sulawesi and South Sumatra), stripper harvesters are used.

Note: Dr. Caesar Tado did his PhD on the Stripper rotor at Hohenheim University
Thailand: The First Locally Produced Combine in SE Asia

- 1982-1985: Thirty workshops tinkered with combine prototypes
- Axial flow threshers mounted on second hand Caterpillar track drives
- 1991: Kaset Phattana Industry Co. Ltd. introduced first commercial unit
- Five local manufacturers followed
- 2008: 48,000 combine harvesters in Thailand, around 92% of Central Plains harvested by combine
- Successively: Kubota Siam, CLAAS entered the market
Viet Nam

• Major rice exporter
• Mekong River Delta
  – 20% of population
  – 53% of total rice production
  – Avg. farm size 1.2 ha,
    avg. plot size 0.4 ha
  – Some farmers farm 40-70 ha
  – 95% of rice exports
• Six other regions
  – Farm sizes 0.2-0.5 ha
  – Avg. plot size 0.02 ha
• Mechanization: ->
  Mekong Delta
Viet Nam: Piloting before 2000

- 1977: Import of 5 Russian combines (11t, wheels)
- 1980-1999: Research institutes, provincial factories, farmer mechanics make combines
  - Seven contestants, all bogged down except one Japanese head feed combine
  - Led to import of second hand head feed combines, failed after breaking down due to lack of after sales services
  - Best local manufacturers made a few units, frequent break downs
Vietnam, Adaptation 2000-2005

- Period of rapid economic growth – labor shortage
- 15 local combine manufacturers, problems hindering adoption
  - Lodged crop
  - Soft soils
  - Poor machine reliability
- 2004: Introduction of the mini combine
A Breakthrough: The Mini Combine

• Briggs & Stratton, Philippine Rice Research Institute, Nong Lam University, VINAPRO

• Specs:
  – Based on Chinese machine
  – Weight: 0.6t
  – Operators: 5
  – Drive: 3 wheels
  – Prime mover: 16hp gasoline engine
  – Cutting width: 1.3m
  – Capacity: 0.9-1.3 ha/day
  – Losses: <2%
  – Fuel consumption: 15l/ha
Addressing Mobility Issues
Mini Combine, Impact

- Released 2004
- 30 units sold in 2005
- By 2009 around 500 units sold for US$ 4,000
- Two manufacturers produced 900 units
- Phased out after 2009 in favor of larger combines with rubber tracks
Towards Adoption: Combine Contest
Vietnam, Adoption 2006 to Today (1)

- **Catalyst**: 5 annual combine contests in 5 different provinces, increasingly difficult test criteria
- **Results**:
  - All combines now have rubber tracks
  - Low weight allows crossing canals
  - Cutting width 1.5-2m, 3-4ha/day
  - Total losses below 2%, impurities 3-5%
  - Lodged crop problem solved with crop lifters
Viet Nam, Adoption 2006 to Today (2)

- Problems with after sales services / sourcing of spare parts
  - 2006-2009: Chinese machines chosen over Vietnamese ones
  - 2009-now: Kubota became market leader (75% market share in 2013)
  - Number of Vietnamese manufacturers reduced from 15 to 3 with 15% market share
Vietnam: Current Status, Trends, Needs

Status and Trends

• Losses reduced from 5-6% to 2%
• By 2020, 80% of rice harvested by 18,000 combines
• No. of combines anticipated to double in next 7 years
• Afterwards replacement: 3,000-4,000 per year

Needs

• Support services (joint ventures)
• More competition
• Mini combine for unfavorable systems?
Importance of Production, Laser Leveling in Vietnam

**Research Findings:**
- Increases yields (5-15%)
- Lower harvesting losses (10% in lodged crop)
- Reduces water use (10-30%)
- Better milling quality
- Better weed control
- Reduced pesticide use

**Introduction:**
- India: ≈ 10,000 contractors
- China
- Vietnam: Piloting plus national promotion
- Cambodia, Lao PDR: Piloting
Cambodia: The Next Success Story

- Low population density,
  - Cost for manual harvesting 150-250 US$/ha
  - Losses due to delays in postharvest operations
- Ambitious rice strategy, by 2015
  - 4 million t paddy surplus
  - 1 million t milled rice export
- Heavy investment in rice milling
Cambodian farmers adopted IRRI's postharvest technology package, which improved the quality of their rice grains, increased their harvest's milling output, and allowed them to save on labor, time, and money.
February 2012, Prey Veng

Kubota DC68 G
Kubota DC95

Kubota sold around 3,000 machines
How did IRRI Help Cambodia?

• Two one week long **Mini Combine demonstration**, training in 2007, 2008 (collaboration with NLU team from Vietnam)
• Combine harvesting included in **annual training curriculum** at IRRI and in Cambodia
• Cambodian partners participate in **combine contest** in Vietnam in 2011
• **Combine round table discussion** with Cambodian and Vietnamese stakeholders (public and private) in Vietnam, 2011,
• **Round table discussions** with financing institutions in 2012
• Discussions with combine distributors / producers about joint activities e.g. for operators training
Combine Adoption in Cambodia

- Feb. 2013: > 5,000 machines
  - Kubota has biggest market share,
  - Additional machines from Thailand, Vietnam, China
  - In February 2012 John Deere tested a machine
  - Local repair shops
  - Local manufacturer making Thai type machine

- But: Problems at farm level
  - High losses (up to 10%) because of contractor business model, poorly trained operators, and some unsuitable machines
  - Little choice, market dominance by one manufacturer
Myanmar

- Farmers are extremely poor, small farm sizes
- Huge rice quality problems, caused by a lack of mechanization options
- Alternative income opportunities (cities, neighboring countries), farmers don’t get labor for harvest
- Opening of the country, support from India, Korea for combine purchases
- Four years ago animal trampling and driving over the spread rice crop still predominant threshing method
Myanmar, 2013
(Piloting phase)

- Chinese machines
- Thai combines
- Kubota machines from Thailand
- Indian wheat combines
- Korean head feed combines
- CLAAS Crop Tiger

During a postharvest survey conducted in May 2013 in 12 villages in Bago Division and the Ayeyarwady Delta most farmers knew somebody who had tried a combine service. 200 Units are used in West Bago
Philippines (Piloting Phase)

- Mini Combine originated at PhilRice, small number of locally produced machines
- Kubota (around 40 units sold in 2012).
- CLAAS has local distributor, a few units sold mostly in the rice bowl Isabella
- New Government Mechanization Policy
  – New bureau for mechanization
  – Heavy support by Government expected
Indonesia

- Only country where the stripper harvesters was adopted by farmers
  - 3 manufacturers in South Sulawesi
  - 5 manufacturers in South Sumatra
- PT Rutan imports Chinese combine and markets it under own name, sold around 200 machines in South Sulawesi
- Huge potential for combine harvesting
South Asia

- **India**: Many local manufacturers - wheat combines, CLAAS Crop Tiger for rice
- **Pakistan**: Imported wheat combines from India with modified threshing drum for rice. Huge losses. ADB and IRRI assessments just conducted early 2013. Project for improvements initiated.
- **Bangladesh**: No combines yet.
Harvesting at IRRI
120 ha Experiment Station

- Different technology options
  - Thai combine from Kaset Phattana since mid 1990s
  - CLAAS Crop Tiger for rice and maize
  - Kubota head feed combine to convert into plot combine
  - Other combines occasionally for testing

- Use of the machines
  - Harvesting of production fields and research plots
  - Used in training (2 week postharvest, short courses)
  - Demonstrations (more than 10,000 visitors per year)
  - Technology evaluation in different cropping systems
  - Research on effect of mechanization on soil structure and fertility, by product management (straw), weeds, etc.
## Trends and Support Needs

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<tr>
<th>Phase</th>
<th>Characteristics</th>
<th>Major problems</th>
<th>Public-sector support needs</th>
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<tbody>
<tr>
<td>Piloting</td>
<td>Import of “cheap” machines by individuals and/or government institutions; local manufacturers copy / develop combines</td>
<td>Identifying/matching machine for/with cropping system, field size, climatic conditions</td>
<td>Need assessments, baselines, field demonstrations, pilot testing, advocacy</td>
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<td>(PHI, MMR, LAO)</td>
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<td>Adaptation</td>
<td>Modifications addressing problems identified in piloting phase; international players discover market, bring in more suitable machines; number of local manufacturers increases</td>
<td>Technical problems with machine performance; economic feasibility, lack of financing, lack of after-sales services</td>
<td>Identification of suitable technologies, testing/performance evaluation under local conditions; promotion of combine harvesting, financing</td>
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<td>(MMR, )</td>
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<td>Adoption</td>
<td>Demand established; market leader evolves; local manufacturers consolidate</td>
<td>Losses from 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>
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<td>(VTN, CAM, THA, Malaysia)</td>
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Summary Outlook

• Rapid adoption of combine harvesters
• Support programs of governments and donors (subsidies, credit)
• Need for tailored assistance in different phases
• Need for objective information about combine performance, side effects
• Need for better support services (financing, repair and maintenance)
Invitation to conduct collaborative research, suggestion for topics

- Effect of combines on soil structure and fertility
- Operators’ training and awareness creation at the end-users’ level about the potential and benefits.
- Equipment testing under different cropping systems and at the national level and dissemination of results to enable potential users.
- Lobbying for consolidation of fields and construction of farm roads.
- Pilot/demonstrate business models that provide incentives for reduction of losses rather than for area harvested.
- Research on energy consumption and greenhouse gas emissions comparing combine harvesting with other harvesting methods in a rice value chain context (plus grain quality issues).
- By product management (straw)
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For better livelihoods for future generations of rice farmers and consumers

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