STUDY AND APPLICATION
OF CROP HARVESTING MECHANIZATION IN VIETNAM

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An Overview

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I. Introduction

- Production of main crops (rice, maize, sugar cane, etc) has grown significantly in terms of area, productivity as well as output.
- Together with development of the processing technology, many specialized zones have been established.
  - **Maize:**
    - Son La (>40,000 ha)
    - Dong Nai (>60,000 ha)
  - **Groundnut:**
    - Nghe An (>30,000 ha)
    - Tay Ninh (>40,000 ha)
  - **Sugar cane** (many zones with >20-30,000 ha):
    - Thanh Hoa,
    - Can Tho,
    - Tay Ninh…
  - **Rice:** Mekong Delta (4mil. ha)
I. Introduction (cont.)

• Harvesting is an important step affecting the output and the agri-goods directly. It lasts for a short time but needs much labour and is a hard work.

• Manual harvesting methods (per ha): rice 20-25 man-days, maize 15-20, groundnut 65-75, sugar cane 60-70 man-days, etc.

• The shortage of labour from rural regions due to the development of industrial areas and services ⇒ increase 2 – 3 time of harvesting cost of many crops.

• Harvesting mechanization to keep harvest timely and to reduce cost of labor and production more and more imperative.

• Study on crop harvesting mechanization one of the most important tasks of VIAEP.
II. Rice harvesting mechanization

2.1. Rice harvesting technology in Vietnam

- In Vietnam: rice harvesting technology composed of many steps: reaping, gathering, threshing, separating and cleaning. In the Mekong Delta, all these steps take place on the fields; in other areas, after being reaped, rice is transferred and threshed, separated on the yard.

- Step-by-step method contributes to high labour cost and high grain loss:
  - Reaping and gathering: winter-spring crop 3.18%; summer-autumn crop 4.21%
  - Threshing: winter – spring crop 2.34% and summer – autumn crop 2.92%.

- Harvesting mechanization of this method mainly focuses on the study, design, manufacture and application of various reapers and axial-flow thresher.

- One-step method: due to disadvantages of step-by-step method (high labour cost, high grain loss), ⇒ increasing demand on rice combine harvesters.
2.2. Research and application of harvesting mechanization with step-by-step method

- **Reaper**
  - 1990-1994: VIAEP carried out the research, design and manufacture of the GRH-1.2 reaper with vertical upper delivery device (base on the model AR 120 of KUBOTA-Japan). The reaper was divided into two parts: reaping–conveying part (reaping head) and driving, mobile part (motive power).

  - Several mech. firms (Nam Hong, Thai Binh, FUTU) designed and manufactured vertical conveyor reapers with cutting width of 0.9m and 1.2m.

![Vertical conveyor reapers](image)

*Fig. 1. Vertical conveyor reapers with cutting width of 0.9m and 1.2m*
Reaper (cont.):

- Since 1995, many private mech. firms (Mekong Delta) brought onto the market vertical conveyor reapers w. the same features: cutting width 1.5m, upper delivery device in the form of flat belt with lug plates, 7-8 hp diesel engine
- In dry fields with straight, suitable height of rice stalks the reaper can reach high output 2.5 – 3.0 ha/day.

Difficulties of applying reaper: field conditions, many labor for gathering and transferring the grains of rice.
**Thresher:**

- **Horizontal threshing with bar-drum** or **peg-drum** caused high rates of grain breakage, loss and impurities. In the 1985-1990 period, VIAEP did research on the principle of **axial-flow threshing and separating**.

- The best parameters were found out: D & L of drum, distance between board or cover and drum; H, W, v of teeth; dimensions of the feed board, etc. ⇒ Various **threshers** like DLH-0.5, DLH-0.8 and DLH-1.5 has been produced for Northern provinces.

- **These threshers with round teeth** are medium-sized with average output, low grain loss ( < 0.5%, ideal for rice seed) suitable with the field conditions here.

*Fig. 3. Axial-flow thresher DLH – 0.8*
Thresher (cont.):

- Application of axial-flow threshers in Northern regions has improved remarkably. The Viet-Nhat Mech. Company (Nam Dinh) is capturing the Northern market and trying to enter the Southern provinces of China.
- In the Mekong Delta, different threshers with axial threshing, covered drum with flat teeth of private manufacturers have been used widely.
- Axial-flow threshers (with round/flat teeth) in Vietnam: over 100,000 making the mechanization in threshing account for 83.6% on the total harvesting area (Mekong Delta over 98%).

- This is an outstanding achievement in research and application of the principle of axial threshing.

Fig. 4. Axial-flow thresher with flat teeth drum
2.3. Results of research and application of rice combine harvester

- **GLH – 0.2 self-propelled combine harvester**


  GLH – 0.2:
  - Cutting width 1.5m,
  - Axial threshing part with mix -teeth drum.
  - 24HP diesel engine
  - Moving system: rubber track-laying conversion enabling working in the swampy field with less than 15 cm depth.
  - Output 0.16ha/h, grain loss less than 2% and the rate of clean grain >96%.
  - Yet, GLH – 0.2 wasn’t durable with minor faults in operation and wasn’t mass-produced because of lack of technology and equipment.

*Fig. 5. Combine harvester GLH – 0.2*
➢ Combine harvester GLH – 0.3 A

- 2001 – 2005: national research project: “Research, design and production of harvesters of main crops, suitable with production conditions”,

- Main features:
  - 35 hp;
  - Cutting width 2m;
  - Rubber track-laying conversion with greater dimensions;
  - Average output 0.25ha/h,
  - Clean grain >97%, grain loss <2%.
GDLH – 1.2 combine harvester

- GDLH – 1.2 three-wheel combine harvester (Nam Hong mechanical firm and the Tractor and Agricultural machines Company): based on the same principle of GLH – 0.2 and GLH – 0.3A.

- 12 – 16 hp diesel engine
- cutting width 1.2m,
- Main drawbacks: Low cleanliness of grains; High loss (> 4%); threshing cylinder clogged when cutting lower; Working only on hard ground.
Combine harvesters manufactured by farmers and private mech. firms

*Bui Huu Nghia’s combine harvester*

Differences with GLH – 0.2, GLH – 0.3:
- Reaping and transferring part of the vertical conveyor reaper ⇒ leaving out reel and gathering screw, decreasing size and weight;
- Transferring part to drum w. 2 paddled chains
- Old gearbox of a Japanese two-wheel tractor
- Home-made chain moving system

The combine is cheap; Suitable with small mech. firm; Works effectively in dry field, straight rice stalks; Output of 0.15 ha/h.

Main weak points: Dependence on working conditions; Low durability of the moving chain.
Nguyen Duc Hoang’s combine harvester (An Giang province)

Main technical features:

• 33 hp; secondhand 4-wheel drive automobile chassis;

• Vertically transferring-reaping part of vertical conveyor reaper width of 1.85m;

• Transferring part to drum: conveyor belt with lug plates width 0.5m;

• Threshing and cleaning part is vertically installed;

• The combine works well in the well-timed dry fields.

Generally, farmers and small mech. firms used secondhand automobile chassis and gearboxes to manufacture harvesters. These ones only work in certain field conditions and are difficult to become goods.
III. Results of research and application of maize harvester

3.1. Sheller

- Since 1990, VIAEP researched and produced various models of shellers: disk sheller TN – 2, sheller TN – 4.0M and lately maize with high moisture content husking – removing combine BBTH – 2.5.
- Picked corn w. moisture content <35% directly transferred to the combine on the fields.
- Output 2.5t/h, undone rate <0.5%, cleanliness >99%. VIAEP has also just studied seed maize combine sheller TNG – 4.0, using electrical engine 4.5kW to meet the demands of seed maize production.

Fig. 11 Husking – removing combine BBTH-2.5

- Generally speaking, there is a wide variety of sheller models, mostly satisfying the production demands. The question is to mass-produce with high quality and reliability for the market to increase the effect in use.
Fig. 12. Seed maize sheller TNG – 4.0
3.2. Corn combine harvester

- Since 2002, VIAEP have deployed the research and experiments to design and produce maize combine harvester TBN – 2. From the corn picker 4 YW – 2 of China, research has been done to improve to suit physical features of Vietnamese corn species by changing the motive power to tractor MTZ – 50. The machine picks corn, cuts the stalks then buries them in the ground, output 0.2 – 0.25 ha/h.

- This way of harvesting is appropriate with new production process, protective and re-fertilize the fields. The current problem stays in design and manufacturing with marked effects.

Fig. 13. Corn on the cob harvester TBN-2
IV. Mechanization for other crops

4.1. Groundnut digging and picking machines

- Current manually multi-step harvesting technology ⇒ much labour and high loss (>5%).

➢ Groundnut digging

- The Sub-Institute of VIAEP (HCM city) studied groundnut digging machine DL – 0.3.
- DL – 0.3 is mounted to the tractor MTZ – 50. The main digging part has a digger blade fixed w. 2 wing rotors. After digging, the gathering step is done manually.
- DL – 0.3 meets the production demands and works efficiently on dry fields, high output 0.3 – 0.4 ha/h, loss <1%.
**Picking machines**

- Groundnut picker BL-2T: stationery; power: 3 kW el./6 hp diesel engine; based on the principle of fruit plucking in the space between 2 drums; groundnut is fed and kept by hand. Output 150 – 200 kg/h, few unpicked and broken fruits (<4% and <0.5% respectively). It can replace 10 – 15 workers.

The machines are simply structured, easily produced with low capital, which permits mass-production. In addition, the Institute have also carried out research and design of one-step groundnut harvester.

*Fig. 15. Groundnut picker BL – 2T*
4.2. Sugar cane harvester

- Sugar cane harvesting is costly and hard because all steps (cutting, whittling, top removing, tying, transferring, etc.) are manual. The cost for cutting, whittling and top removing is 35 – 40 man-days/ha (60% of the total cost).
- 2001 – 2005, VIAEP have studied and produced whole stalk harvester with picking and gathering cut stalk part, 2 blade cutting part, lifting, pulling and spreading drum systems: Self-propelled sugar cane harvester THM – 0.3 with rubber track – laying conversion for one-row harvesting.
- Experimental results show that there are few uncut stalks, crushed root rate 20%, crushed stalk mass 13%, output 10t/h. The model is being studied and improved.
V. Conclusions

- Harvesting mechanization for main crops-an urgent demand of agricultural goods production.

- Main achievements: research, design, manufacturing and wide application of axial-flow threshers, vertical conveyor reapers and corn shellers.

- The study and manufacturing of rice combine harvester with one-step harvesting technology has been carried out by many individuals, mechanical firms as well as scientific institutes. Models like GLH – 0.2 and GLH – 0.3A finished with relatively perfectiveness, but haven't been mass-produced (lack of taking part of manufacturing industry for improving durability, reliability and reasonable price).

- Harvesting mechanization for main crops is a large and complex field of science and technology, the international cooperation is essential to satisfy the increasing demand of production.
Thank you for attention
Vietnam-agricultural country w. nearly 75% of population in rural area. Their main income mostly bases on agriculture and it is also leading sector of Vietnamese economy. But the proportion of households living below poverty line is 37%.

Acceleration of growth by the rural economy ⇒ development of a multitude of non-farm activities (processing, storage, transportation of agricultural raw materials including meat, cereal, root and horticulture crops)

The creation of rural agro-enterprise as a key element of a strategy of rural development. Creation for rural agro enterprise also achieve higher and more stable rural incomes, reduce the flow of migrants from rural to urban areas, create more sustainable long term cropping patterns
Agro-based Entrepreneur Development in Vietnam (Cont’.)

- A key feature of Vietnam’s rural industry base-communities. Yet, despite the success of occupational community villages in a national setting they are ill-equipped to move into higher value (quality) market and don’t have the resources and skills to evolve into small and medium scale enterprises.

- To reduce poverty, the government has set aside 600 billion VND and supported to private sector development as the main impetus for economic growth and job creation.

- Over past ten years, farming economy is set up and developed both in quantity and size at initially household, small scale.
### Quantity, structure and development degree of farms:

<table>
<thead>
<tr>
<th>TT</th>
<th>Different types of farms</th>
<th>Number of farms by years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>1999</td>
</tr>
<tr>
<td>1</td>
<td>Annual crop production farms</td>
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<tr>
<td>2</td>
<td>Long term crop production farms.</td>
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<tr>
<td>3</td>
<td>Animal husbandry farms</td>
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<td>Forestry farms.</td>
<td>-</td>
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<tr>
<td>5</td>
<td>Aquatic production farms</td>
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<tr>
<td>6</td>
<td>Synthetic business farms</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>45.803</strong></td>
</tr>
</tbody>
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*Sources: Statistic Department of Vietnam 2003 and 2005.*
Recommendations

- Necessary to set up project on the orientation of agri-engineering development for agro-forestry and aquatic products processing with the following objectives:
- Evaluation of current situation of engineering for production in different localities.
- Plan and orient the development of engineering for crop production
- Plan and orient the development of engineering for animal husbandry
- Plan and orient the development of engineering for irrigation and transportation in rural areas.
- Plan and orient the development of engineering for agro-forestry and aquatic products processing
- Engineering development for handicraft production
- Establish network of combine machine repairation for agriculture and rural areas.
- Engineering development for the production of agriculture, forestry and fishery meeting with market requirement of agricultural machine and equipment of every locality and of whole country.
Thank you