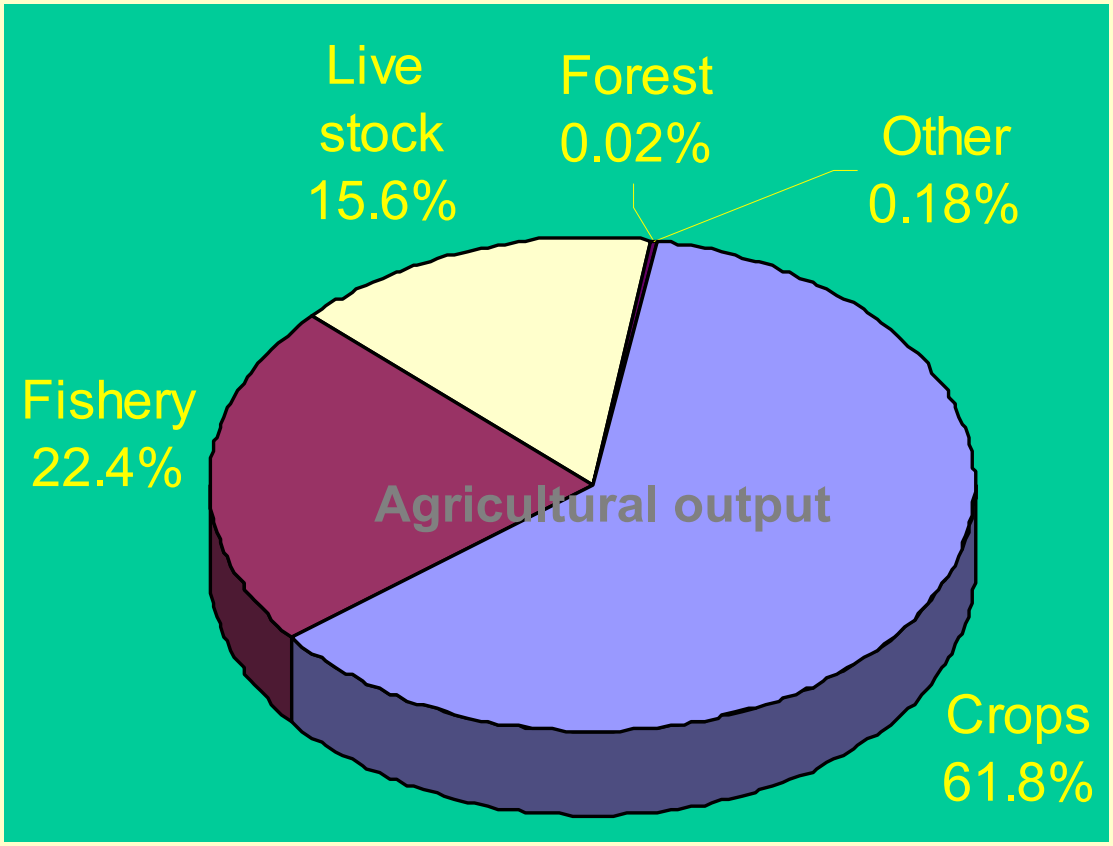
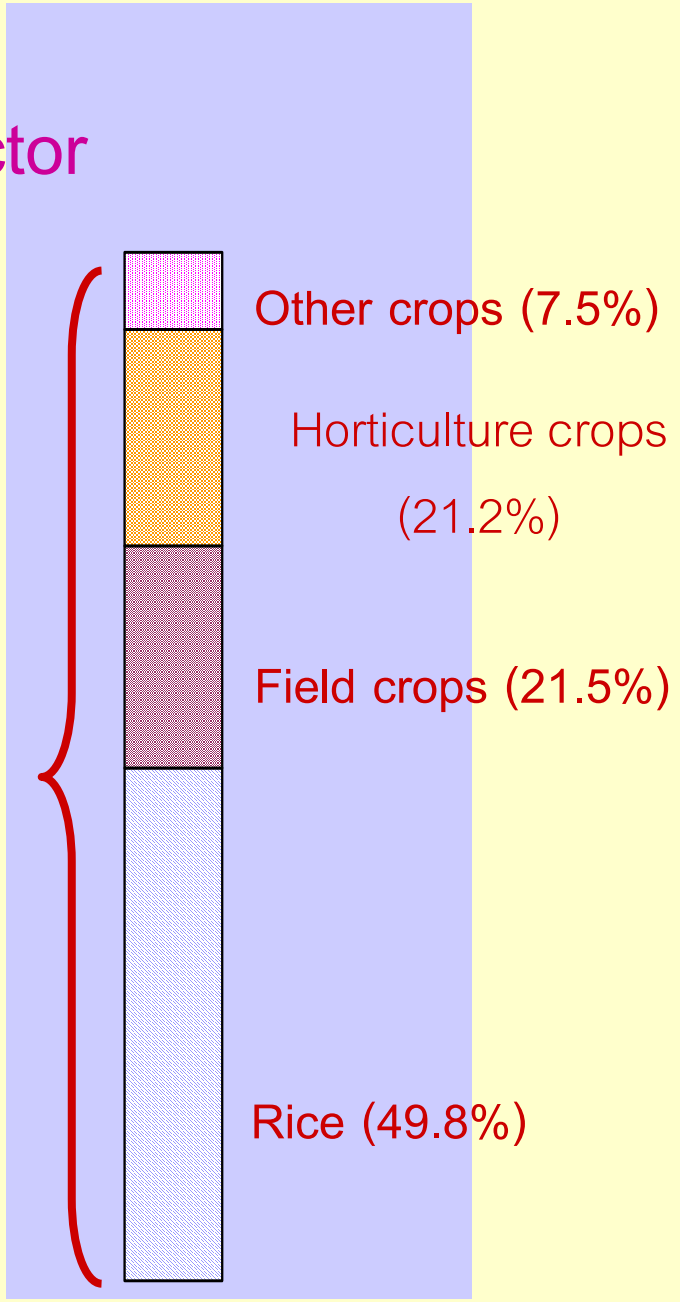
AGRICULTURAL MECHANIZATION DEVELOPMENT IN THAILAND

General Background

Contribution for agricultural sector





General Background

Major crops:

Total agricultural land 20.8 mil. ha.

Crops	Planting area	Production
• Rice	9.5 mil. ha.	20 mil. tons
• Maize	1.2 mil. ha.	4.1 mil. tons
• Cassava	1 mil. ha.	18 mil. tons

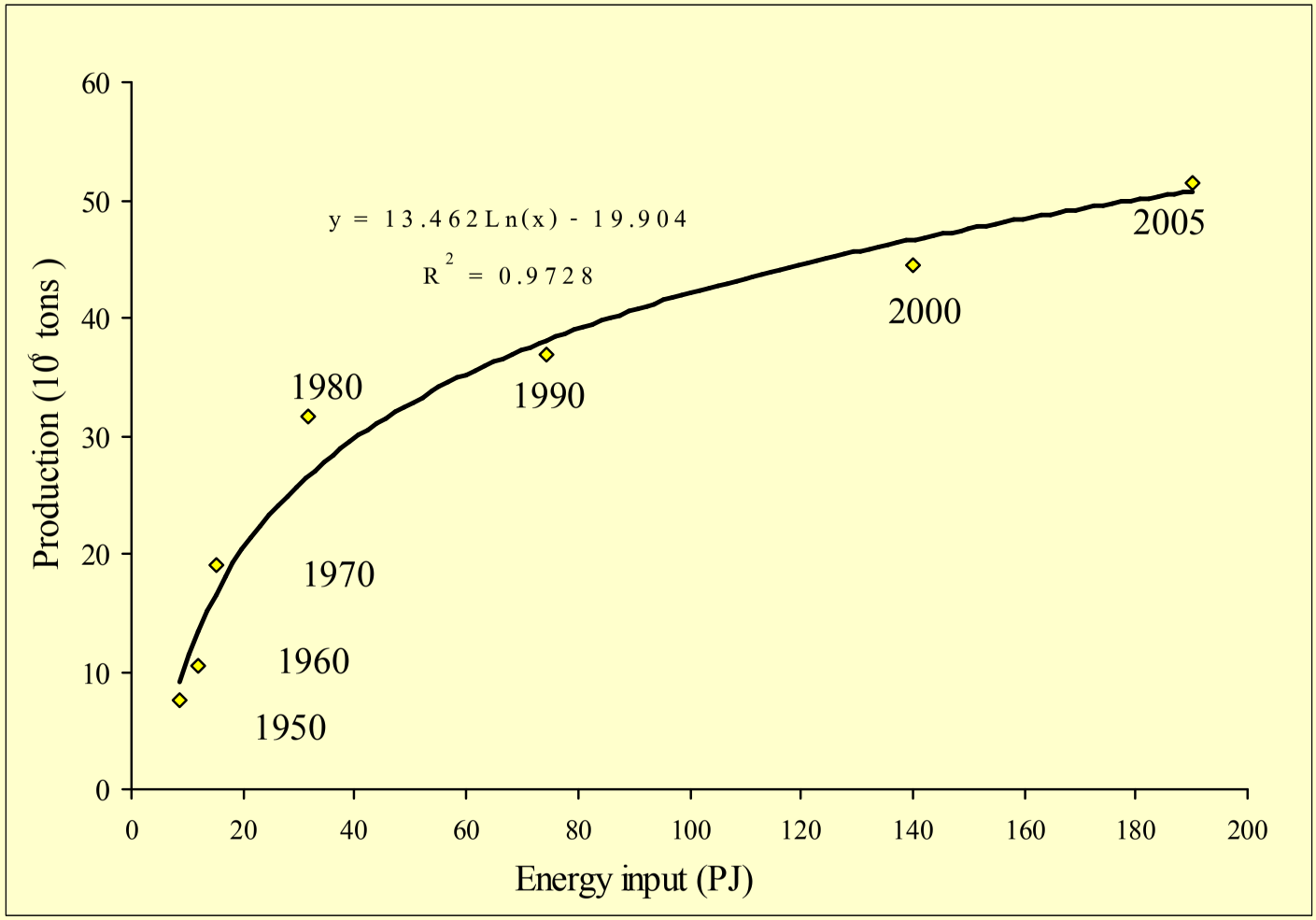
2. Agricultural Machinery Development

Development of agriculture in Thailand can be divided into three stages

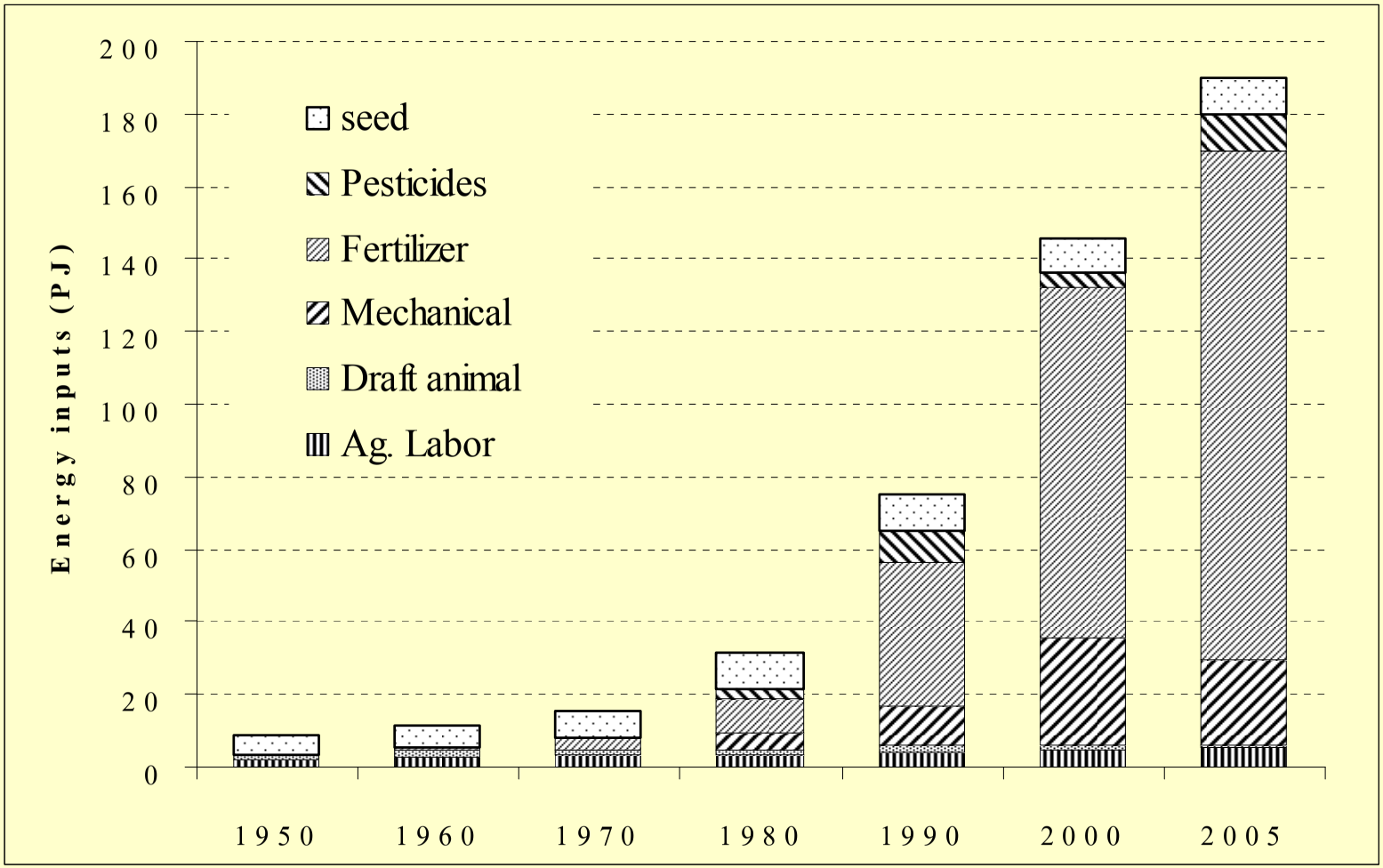
1.Rice monoculture/natural resource-based (Pre-1955),

2. Land-based resource/labor-intensive methods (1955-85) and

3. Structural shift in agricultural production (Post-1985).



Relationship between energy input and crop production in Thailand during 1950-2005

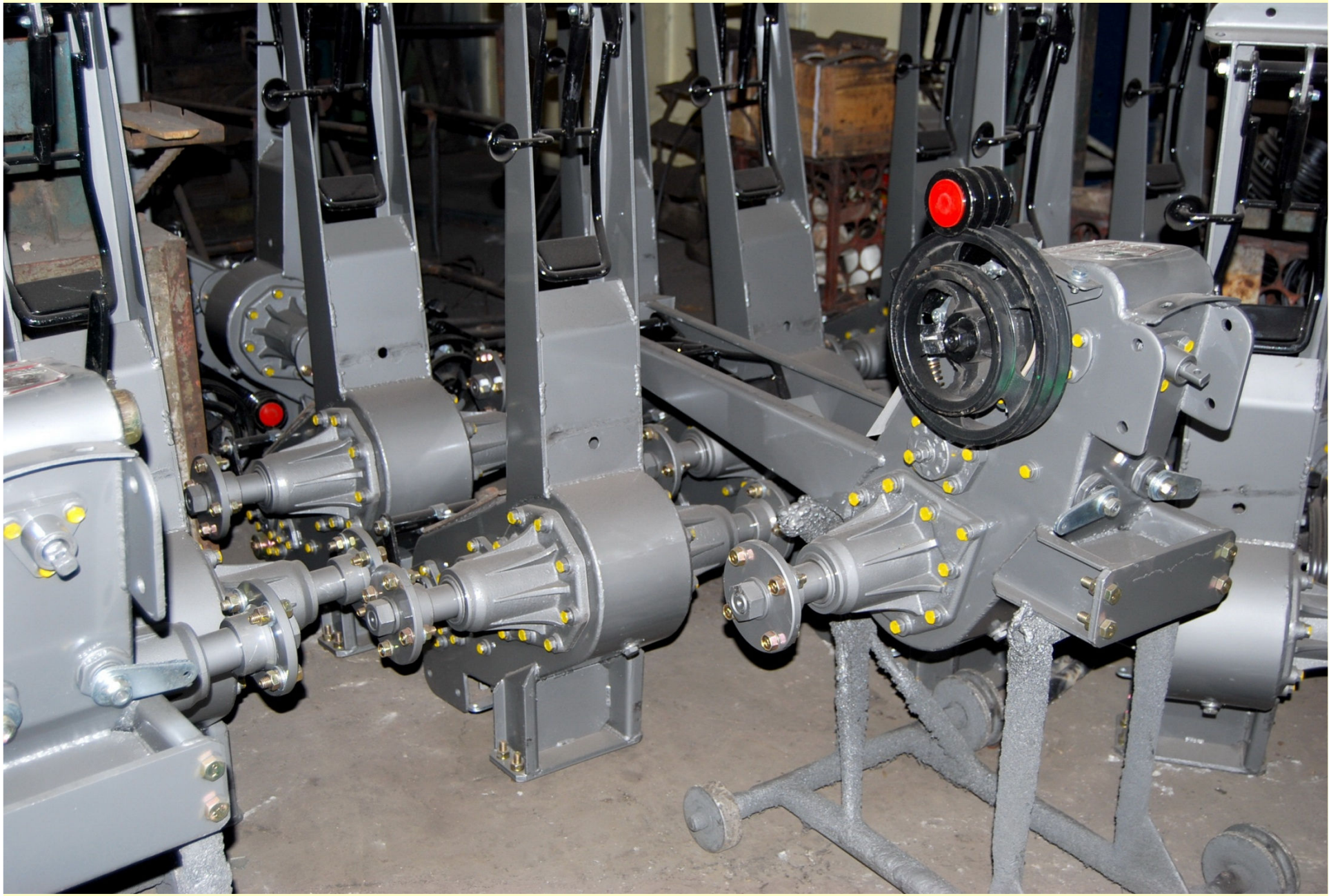


Contribution of different energy inputs in crop production in Thailand during 1950-2005

Success stories in agricultural machinery

In 1964-1965, workshops around the Bangkok area began to modify the design of imported 2-wheeled tractors by trial and error method. Only one workshop succeeded in simplifying the gearbox and other parts of the tractor to suite local paddy field conditions. In 1966, a few firms began producing 2-wheeled tractors.

. The lower price of these tractors relative to the imported tractors and their suitability to local conditions made them popular, and their adoption spread to all parts of the Central plain.

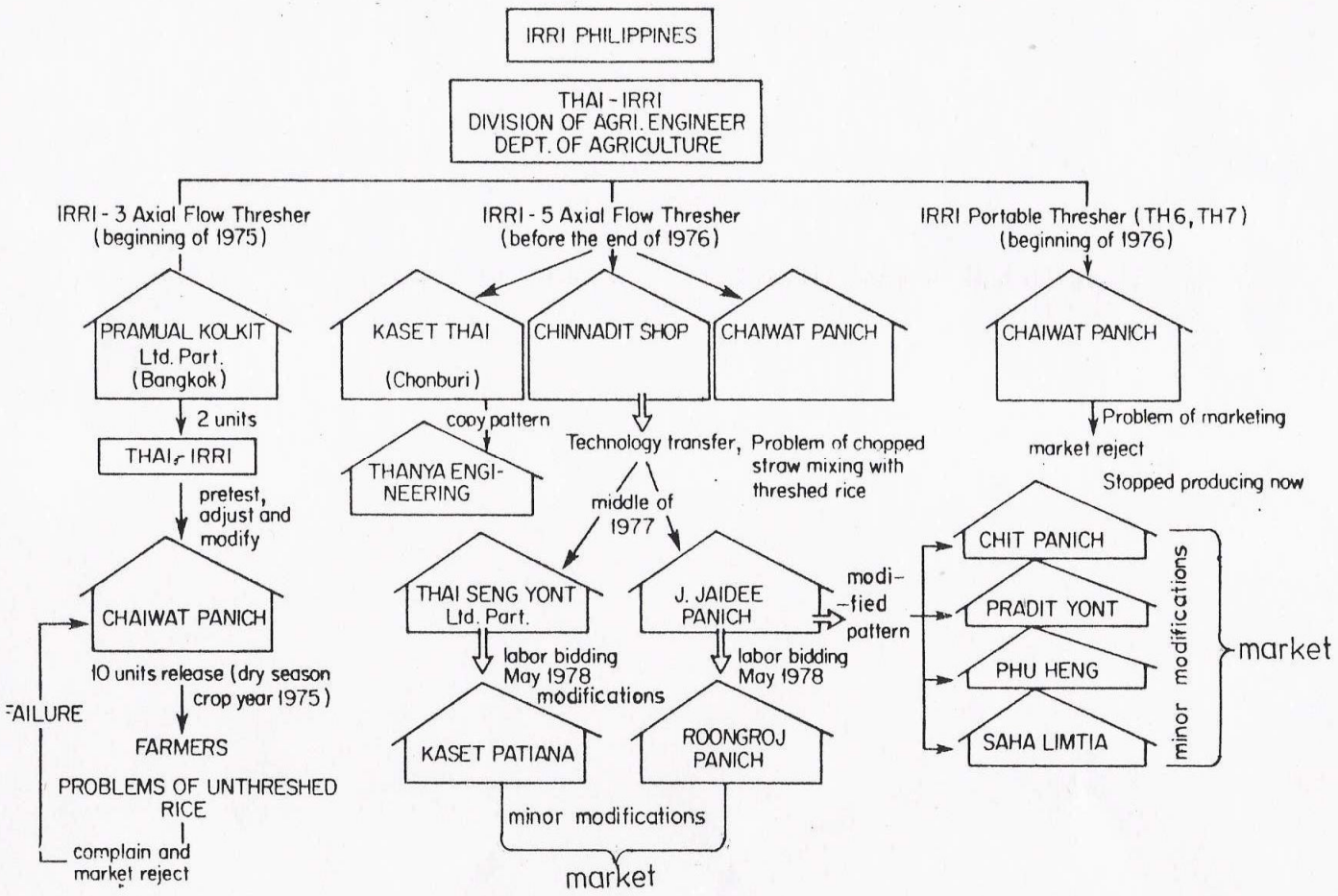


In 1975, the Agricultural Engineering Division constructed the prototype for an axial flow rice thresher, which received its blueprint from the International Rice Research Institute (IRRI)), then released it to a selected firms in Chachoengsao province for commercial production.

Later in 1975, a new blueprint was released to three firms for commercial production, and subsequently it was widely used and developed with very high successfully development.

At present, this machine has still be popular used especially in the North and the North East regions while it was not used in the Central plain region because it was replaced by the using of Thai-made rice combine harvester.

Figure 1. Flow chart of the development of axial flow thresher innovation and adoption (a historical background).



After : Renu Pathnopas, "The Economics of Rice Threshing Machines in Thailand : A Case Study of Chachoengsao and Suphanburi Provinces," a Master's Thesis, Faculty of Economics, Thammasat University, Bangkok, 1980, Table II-7, p. 30.


YAMAHA

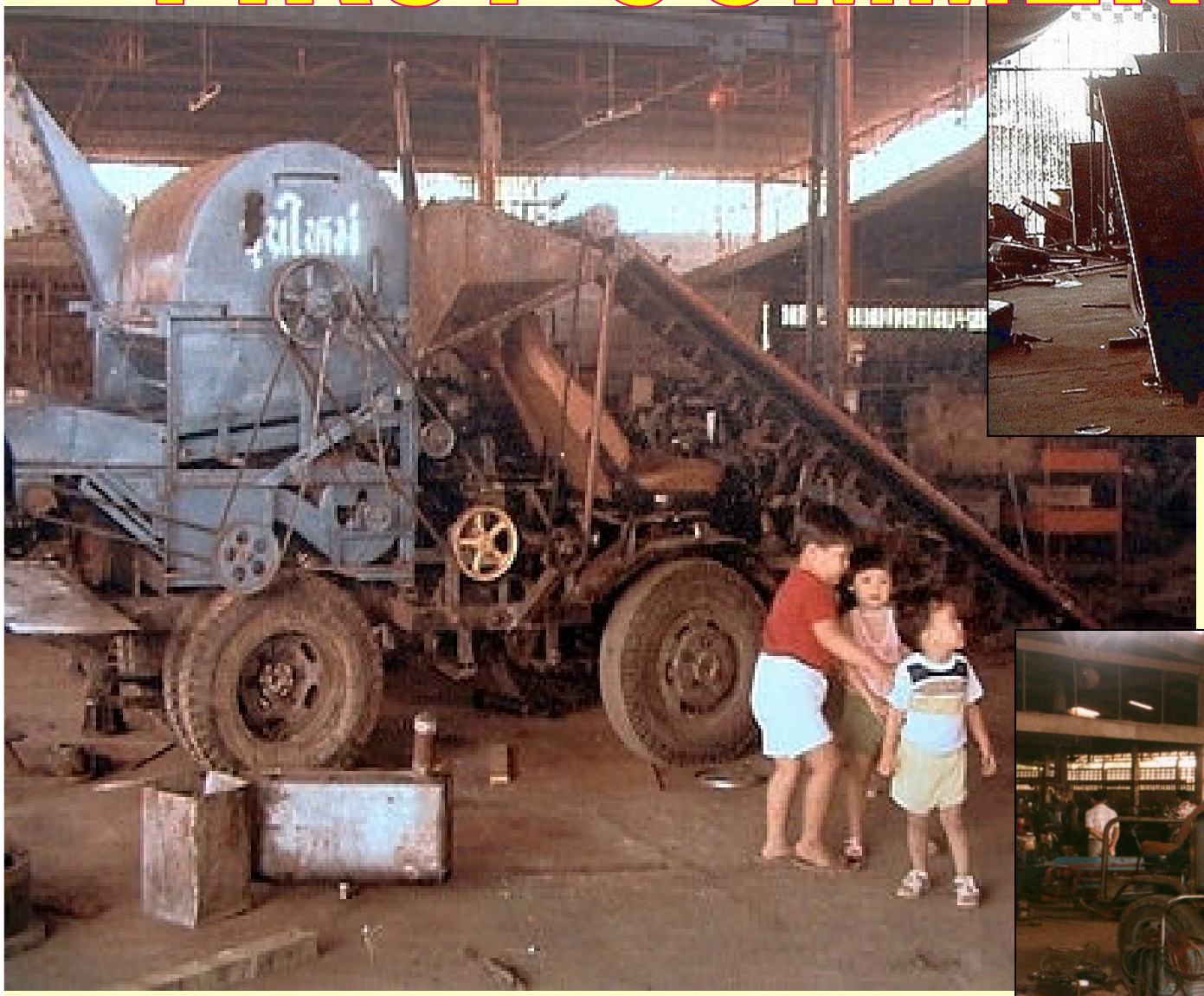

YUEXIN

THAI THRESHER

DEVELOPMENT OF THAI RICE COMBINE HARVESTER

- During the previous Sixth Five – Year National Economic and Social Development Plan(1987-1991), the economic structure rapidly changed from agriculture to industry.
- Labor force from agricultural sector resulting in *shortage of labor for some farming operations.*

FIRST COMMERCIAL



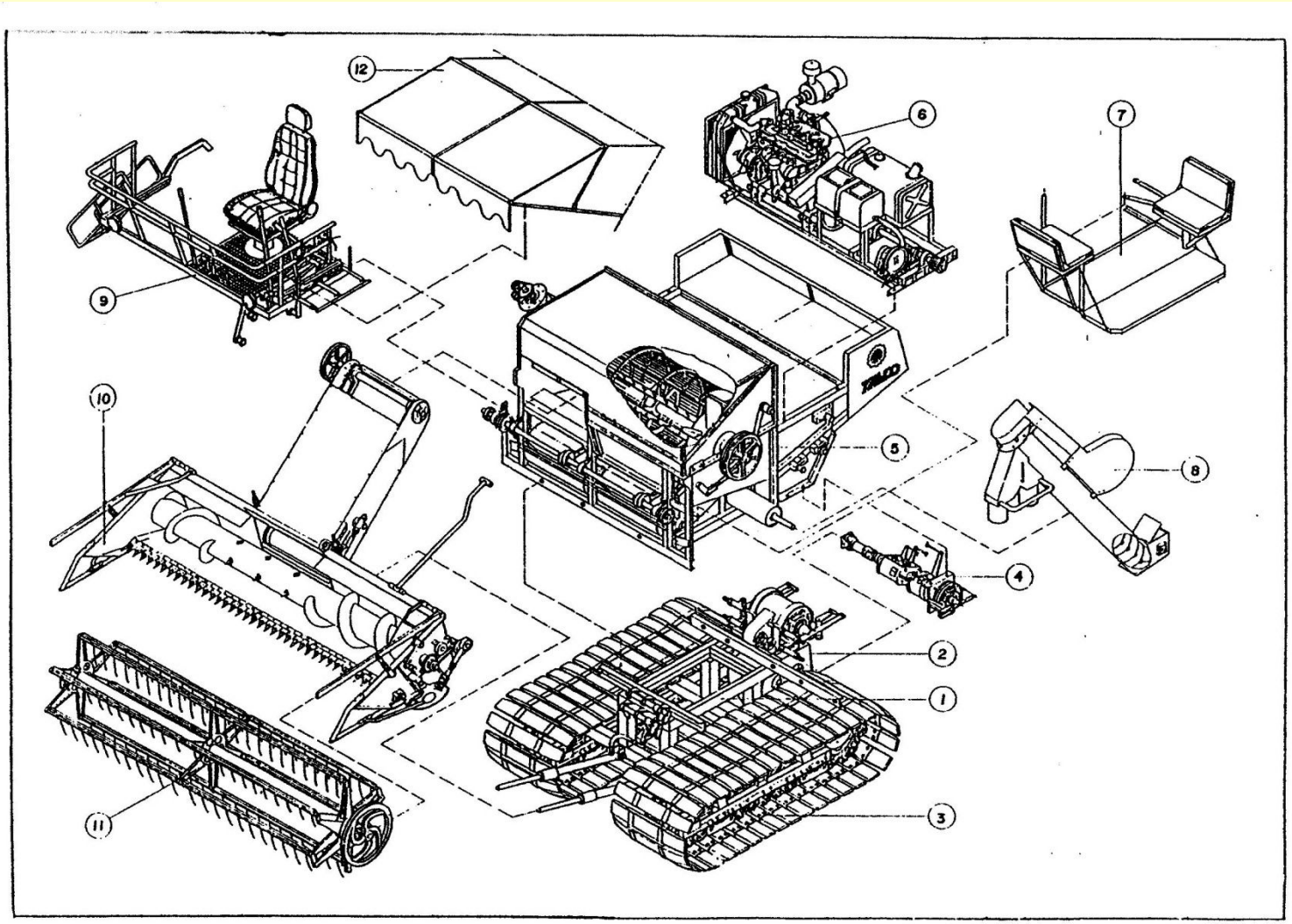
1983

PROTOTYPE


TRAVERSE AXIAL FLOW
NO RETRACEABLE FINGERS


USED DIESEL ENGINE
CRAWLING TRACK
WOODEN SHOES
SACKING TYPE

THAI RICE COMBINE HARVESTER



1. Undercarriage Frame 2. Sprocket and chain transmission 3. Track chain
4. Transmission gear box 5. Threshing unit 6. Prime mover 7. Packing seat
8. Grain auger elevator 9. Lever control 10. Header 11. Reel 12. Roof

1985

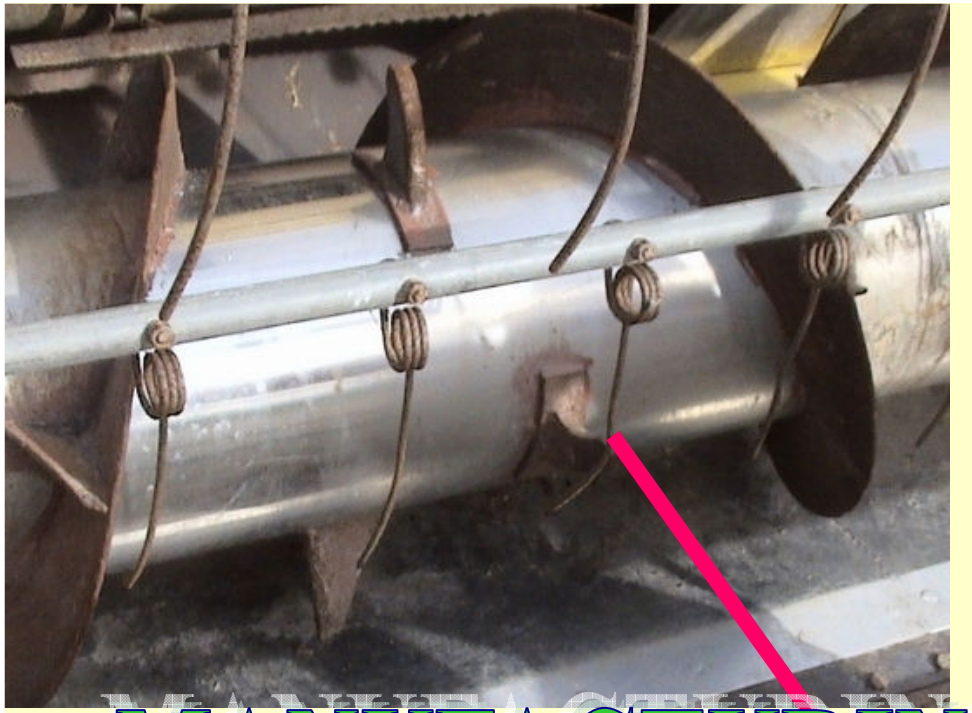
30 WORKSHOPS & MANUFACTURERS

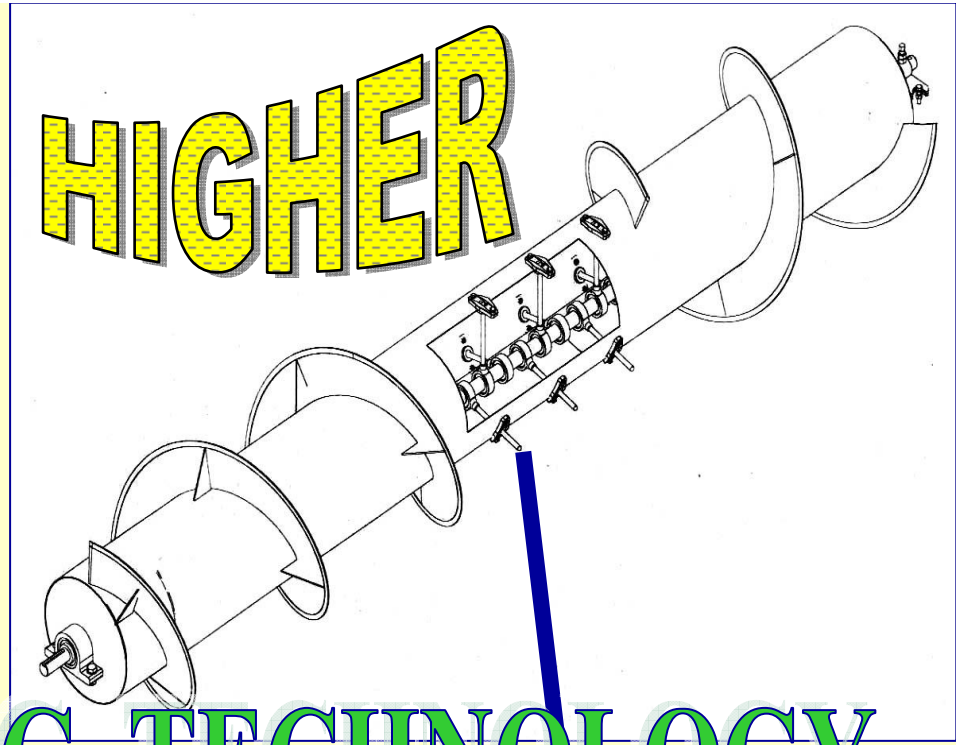
STEP IN

LARGE MANUFACTURERS

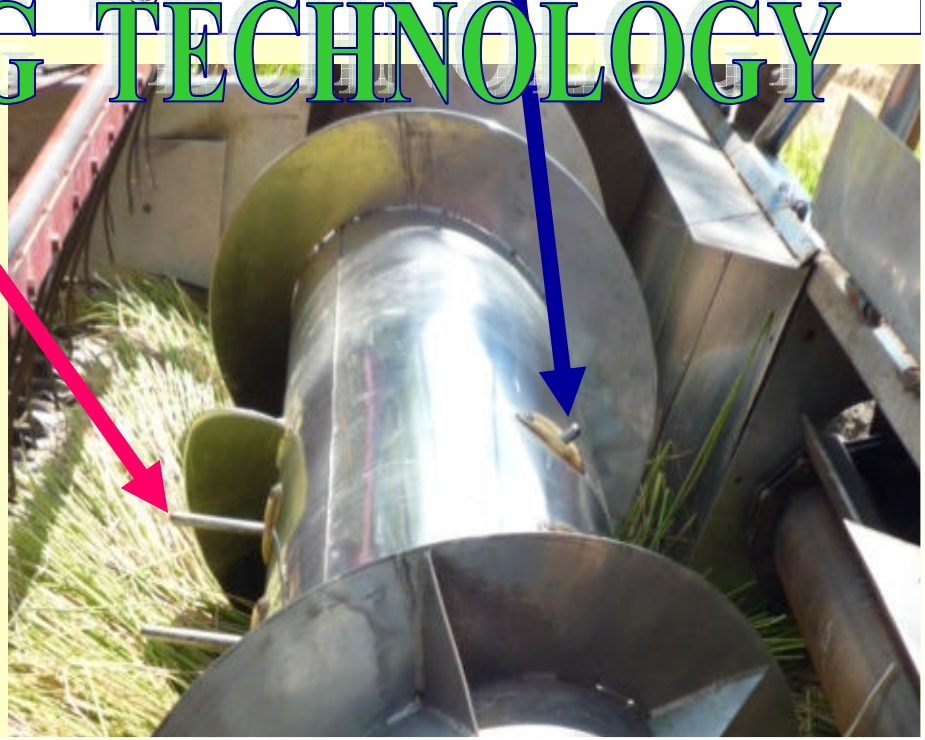
THAI RICE COMBINE HARVESTER

- *Mass production of rice combine started in 1987 when a pioneer workshop joined with a business group to establish a factory.* At the same time *rice thresher manufacturers whose productions were affected by the adoption of the combine* changed some of their production lines to produce *this newly developed machine.*



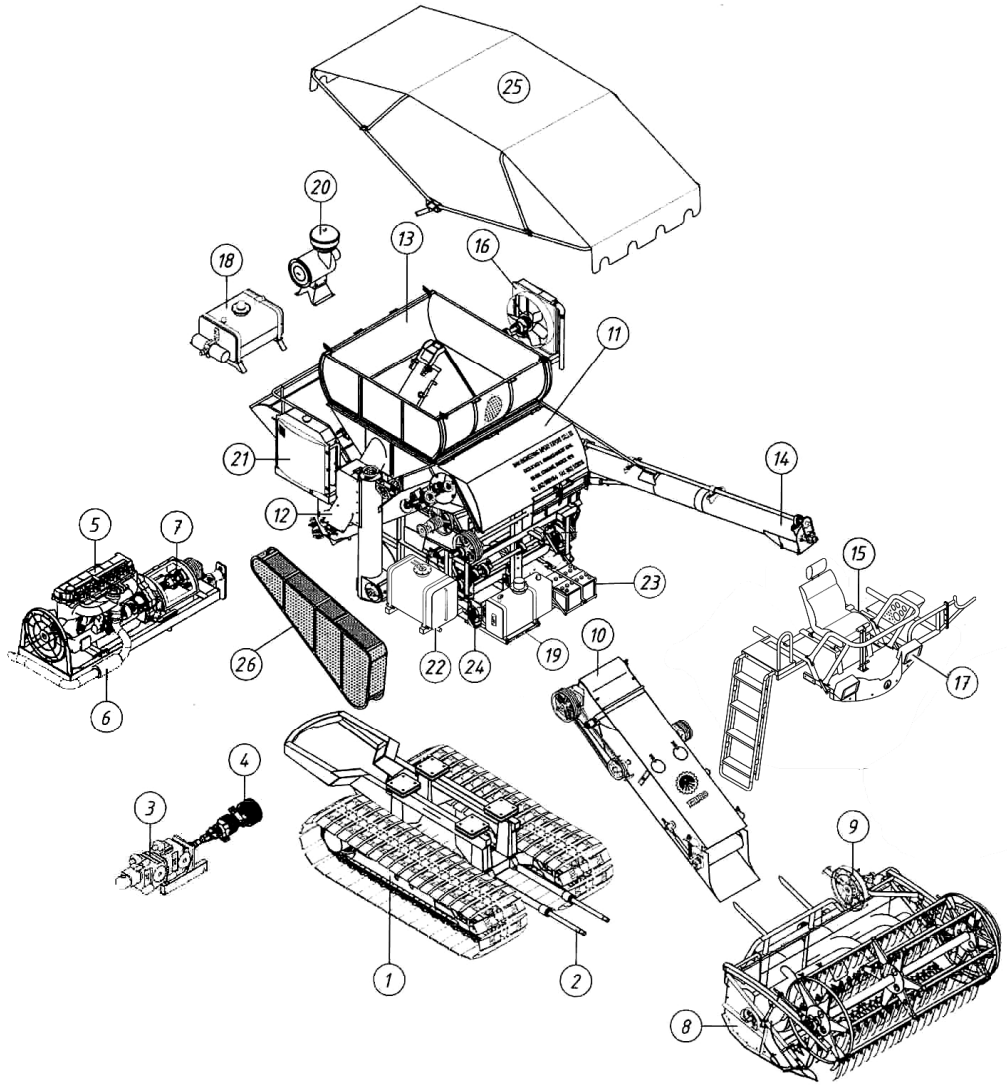


MANUFACTURING TECHNOLOGY




DURABILITY
RELIABILITY
ISO 46

Grain Tank type

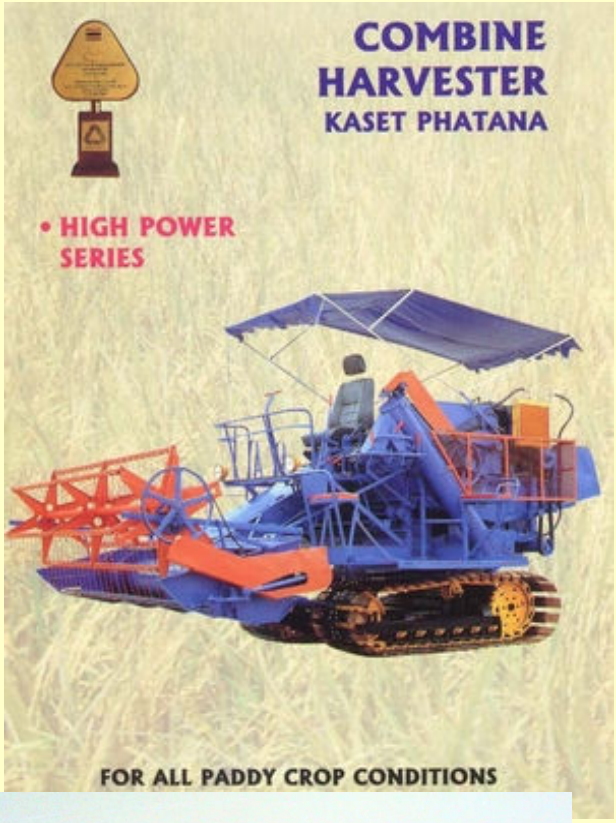


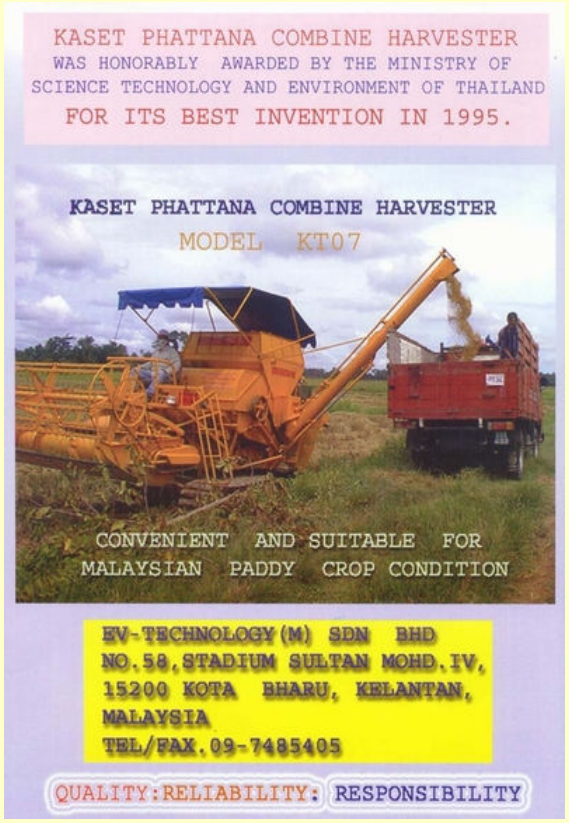
(1) Undercarriage
(2) Harvesting head hydraulic cylinder
(3) Hydraulic double pumps
(4) Universal joint for hydraulic double pumps
(5) Engine set
(6) Exhaust muffler
(7) Main engine idle set
(8) Harvesting table unit
(9) Dust blower
(10) Chain conveyor unit
(11) Threshing unit
(12) Grain tank loading auger
(13) Grain tank
(14) Swinging unloading conveyor
(15) Operator's platform
(16) Hydraulic oil cooler
(17) Front head light
(18) Hydraulic oil tank for main transmission system
(19) Hydraulic oil tank for unloading auger and harvesting head
(20) Air filter
(21) Radiator
(22) Fuel tank
(23) Battery
(24) Reverse rotation gear box
(25) Plastic shelter
(26) Belts guard

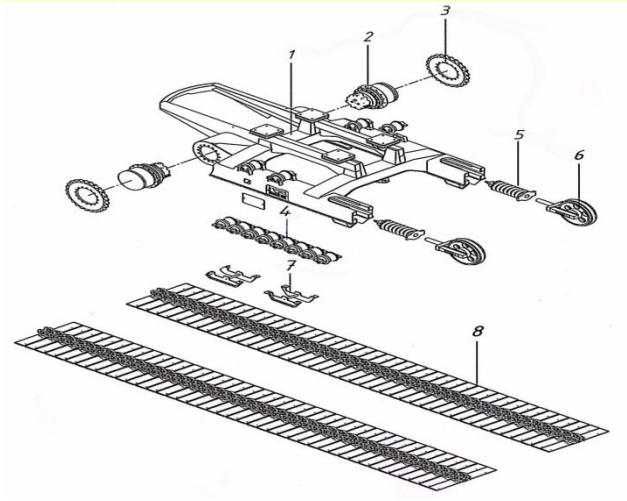
COMBINE HARVESTER WITH GRAIN TANK


ช้างน้อยไวไฟ
ช้างน้อยไวไฟ


POWERFUL WELLKNOWN DIESEL ENGINE
● 6 - Cylinder with 5900 cc. displacement volume
● Maximum rated gross power 120 bhp. at 2500 rpm.
● Maximum torque 389 Newton-metre at 1400rpm.
FULLY HYDROSTATIC TRANSMISSION SYSTEM
● Double separated hydraulic pump and planetary gear drive units
● Manoeuvre rapidly, without time - wasting clutch stamping , gear changing and braking
● Maximum travelling speed about 6 km./hr. both forward and reverse
HIGH QUALITY
PARTS AND COMPONENTS
PLANETARY GEARS
UNDER CARRIAGE
CUTTERS AND GUARDS


COMBINE HARVESTER
KASET PHATANA
• HIGH POWER SERIES
FOR ALL PADDY CROP CONDITIONS


KASET PHATTANA COMBINE HARVESTER
WAS HONORABLY AWARDED BY THE MINISTRY OF SCIENCE TECHNOLOGY AND ENVIRONMENT OF THAILAND
FOR ITS BEST INVENTION IN 1995.
KASET PHATTANA COMBINE HARVESTER
MODEL KT07
CONVENIENT AND SUITABLE FOR MALAYSIAN PADDY CROP CONDITION
EV-TECHNOLOGY(M) SDN BHD
NO.58,STADIUM SULTAN MOHD.IV,
15200 KOTA BHARU, KELANTAN,
MALAYSIA
TEL/FAX.09-7485405
QUALITY:RELIABILITY: RESPONSIBILITY


1
2
3
4
5
6
7
8

FIVE MANUFACTURERS

1-2 million Baht

800 - 1000 UNITS/year

1. STEP BY STEP DEVELOPMENT

2. CUSTOM HIRE SERVICE SYSTEM

3. APPROPRIATE FOR THAI PADDY FIELD

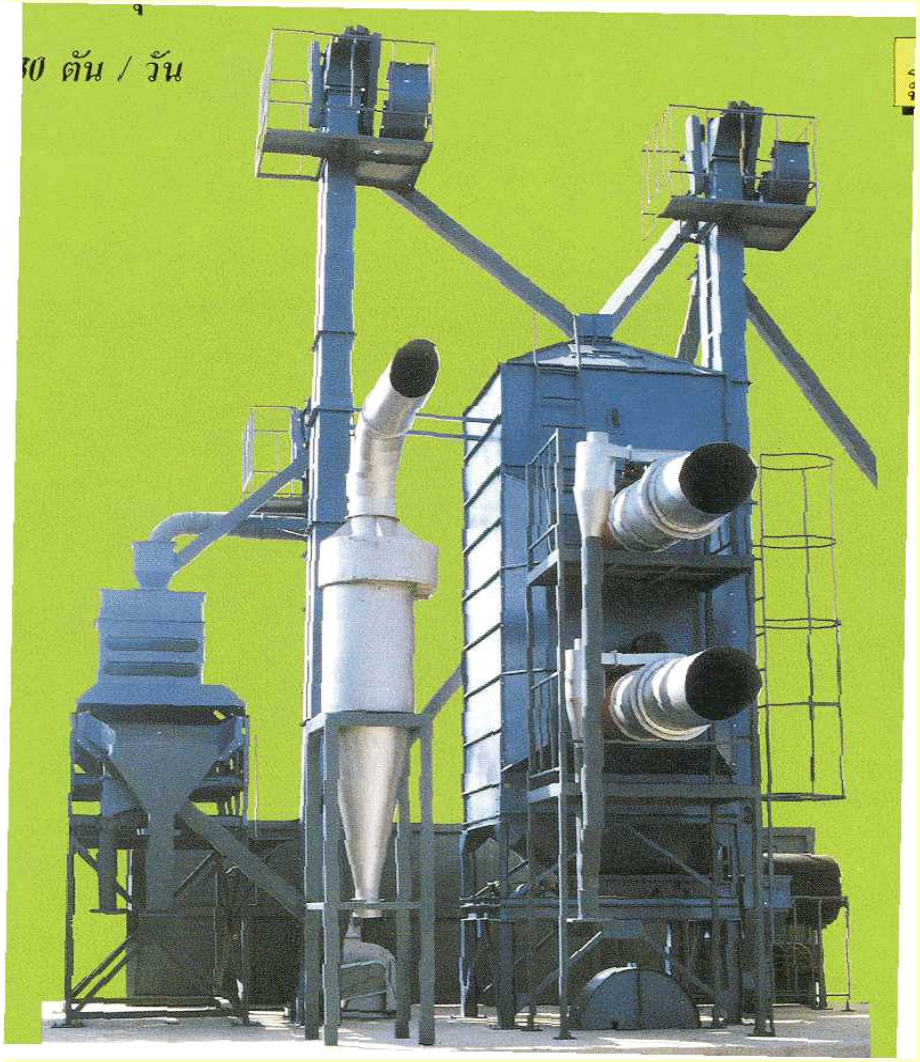
At the beginning of the introduction of the combine harvester, rice is combined at relatively high moisture, sometimes as high as 28%, but the average moisture at harvest is about 24%.

Farmer does not dry his own paddy but sell it to the miller or the collector right away. The high moisture rice is immediately transported to the rice mill or the local collector. Most millers and collector at that time had no mechanical dryer, drying the high moisture rice depend mostly on sun drying.

Rolls of the Thai government

- **Provide small dryers** (30 tons/day) **to Cooperatives and Farmers' group in those areas** (over 300 units existing).
- **Provide soft loan to the millers and the paddy Central Market for dryers installation.**
- **Paddy mortgage plan.**

Farmers' Group and Cooperatives Dryers



Fluidized-Bed Dryer

-Rapid mixing of the kernel

-High heat and mass transfer rates between the air and the kernel

-High specific energy consumption


DR-12F

Rotary Dryers

-shell diameter 1-2 m

length 15-30 m

-slope of the shell 2-4 ^{o}

-drying air temp. 120-280 ^{o}C

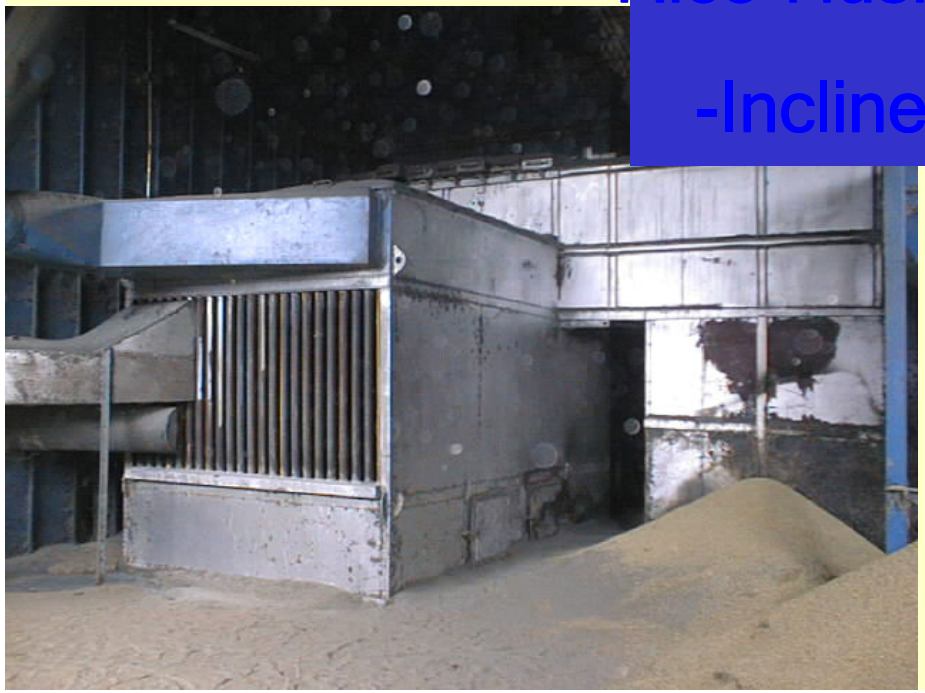
-retention time of grain 10-20 min

Types of Paddy Dryer at Commercial Level

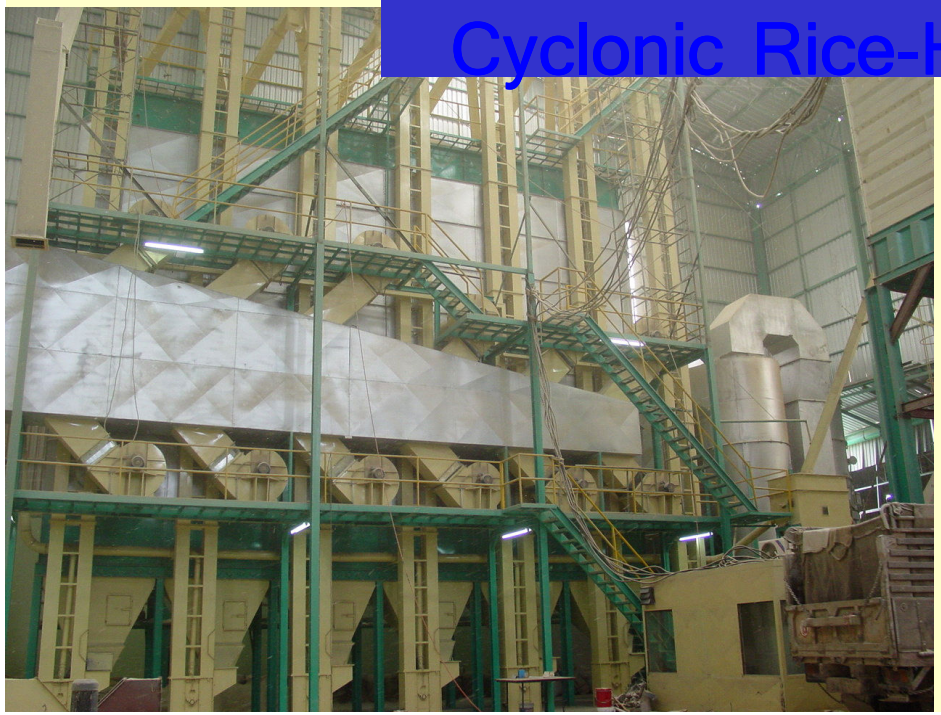
- **Mixed Flow** — **majority (over 60%)**
- **Columnar** — **~27%**
- **Fluidized Bed**
- **Rotary** — **negligible**

Rice-Husk Furnace

-Inclined grate



Cyclonic Rice-Husk Furnace



Development of agricultural machinery testing networks in Thailand

Thai Industrial Standard Institute (TISI), Ministry of Industry is responsible for standardization of agricultural machinery. TISI was established in 1968. It is the official agency with the responsibility in the development of Thai Industrial Standards (TIS), including agricultural machinery standards

The preparation of agricultural machinery standards is undertaken by the Technical Committee (TC). The TC, appointed by the TISI, includes representatives from Agricultural Engineering Research Institute (AERI), manufacturers, the Bank of Agriculture and Agricultural Cooperatives (BAAC), universities. Approved standards are published in the government gazette.

Agricultural machinery standards from various countries have been studied and then adapted to be suitable with Thai agricultural machines and there corresponding working conditions. Research is required to get a basic data for developing standards. Safety standard is one part of each agricultural machinery standard.

Most of agricultural machinery standards are voluntary standards.

Only small diesel engine standard is a mandatory one.

Only a few number of agricultural machinery manufacturers apply for the TISI standard certification.

TIS 768-2531

Thai Industrial Standard
for
Axial Flow Rice Threshers

1. Scope

1.1 This standard specifies components and construction, requirements, mark and label, sampling and criteria for acceptance, and testing for axial flow rice thresher hereinafter referred to as "thresher".

1.2 Threshers in this standard shall use, as power source, engine, electric motor or tractor for threshing crops which are conveyor-fed through the feed board and moved parallel to the axis of the spike-tooth threshing drum. Threshed grains will be separated from foreign materials in a continuous operation.

2. Definitions

For the purpose of this standard, the following definitions apply:

2.1 THRESHING : The separation of grain from straw.

2.2 WHOLE GRAIN : Mature unbroken grain free from earhead.

2.3 UNTHRESHED GRAIN : Whole grain attached to straw after threshing.

2.4 BROKEN GRAIN : Wholly or partially cracked or broken grain.

2.5 GRAIN WITH EARHEAD : Grain attached with grain bearing spike after threshing.

2.6 GRAIN MIXTURE : The mixture of whole, broken, unthreshed grains and grain with earhead coming out of the outlet(s).

2.7 FOREIGN MATERIALS : Materials other than grain such as straw, insect, husk, weed seed, sand, gravel, stone, clay and metal chip.

2.8 NOMINAL FEED RATE : The quantity of crop fed per unit of time at which reasonable threshing efficiency can be attained.

2.9 THRESHING EFFICIENCY : The threshed grain received at all outlets with respect to total grain mixture expressed as percent by weight.

2.10 CLEANING EFFICIENCY : The whole grain with respect to grain mixture including foreign materials at main grain outlet expressed as percent by weight.

2.11 PERCENTAGE OF SPILLED GRAIN : All the grain received at all outlets other than the main grain outlet with respect to total grain mixture, expressed as percent by weight.

2.12 PERCENTAGE OF BROKEN GRAIN : The broken grain from all outlets with respect to total grain mixture expressed as percent by weight.

2.13 OUTPUT CAPACITY : The grain mixture received per unit of time at main grain outlet.

2.14 SPECIFIC OUTPUT CAPACITY : The output capacity per unit power of the power source used.

2.15 STRAW AND GRAIN RATIO : The ratio by weight of straw to grain.

2.16 POWER CONNECTIONS : Points for the installation of devices by which the motion of a power source is transmitted to or disconnected for all systems.

2.17 LENGTH OF THRESHING DRUM : End to end length of the threshing drum excluding the axle as shown in Figure 1.

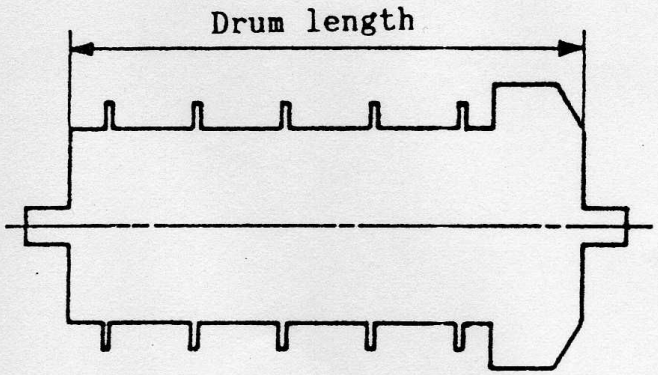


Figure.1 Length of threshing drum
(clause 2.17).

3.1.1 Threshing system for threshing and for discarding straw through the straw outlet.

3.1.2 Cleaning system for separating foreign materials from threshed grain.

An example of crop flow diagram of the thresher is given in Figure 3.

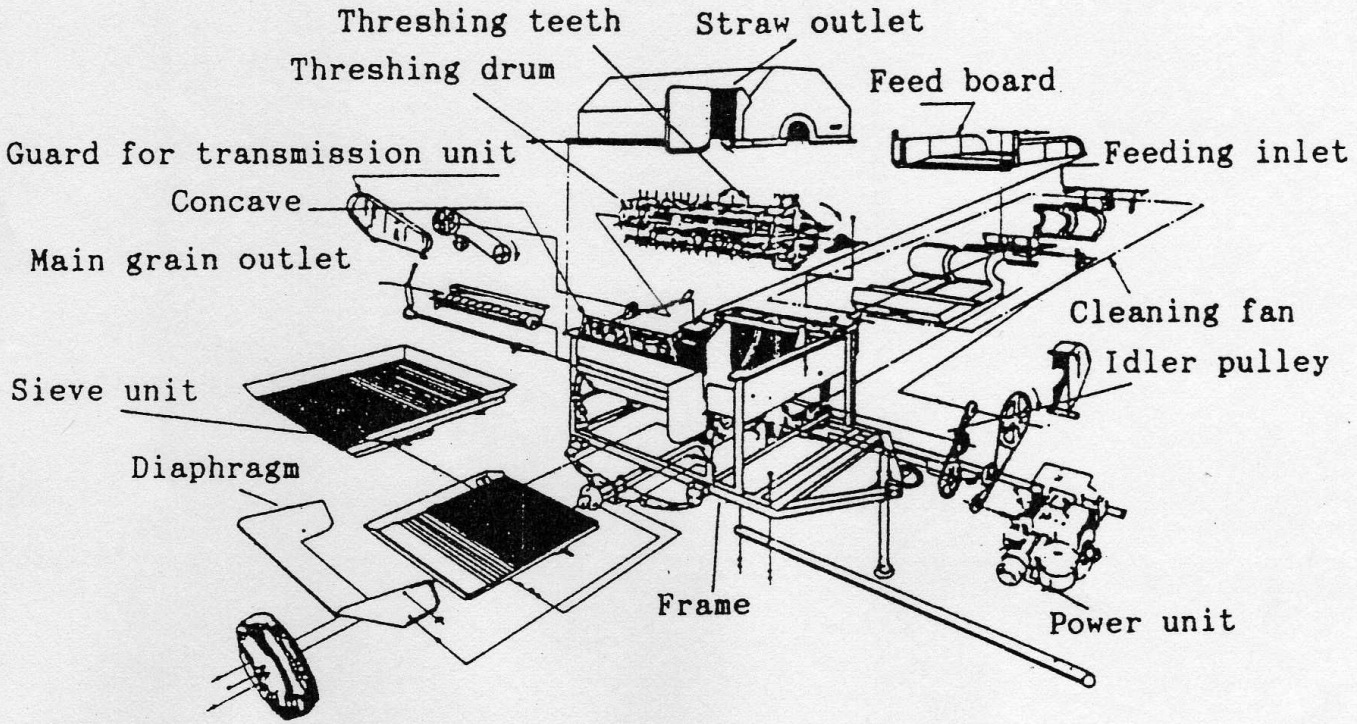


Figure 2 : Example of thresher components
(clause 3.1)

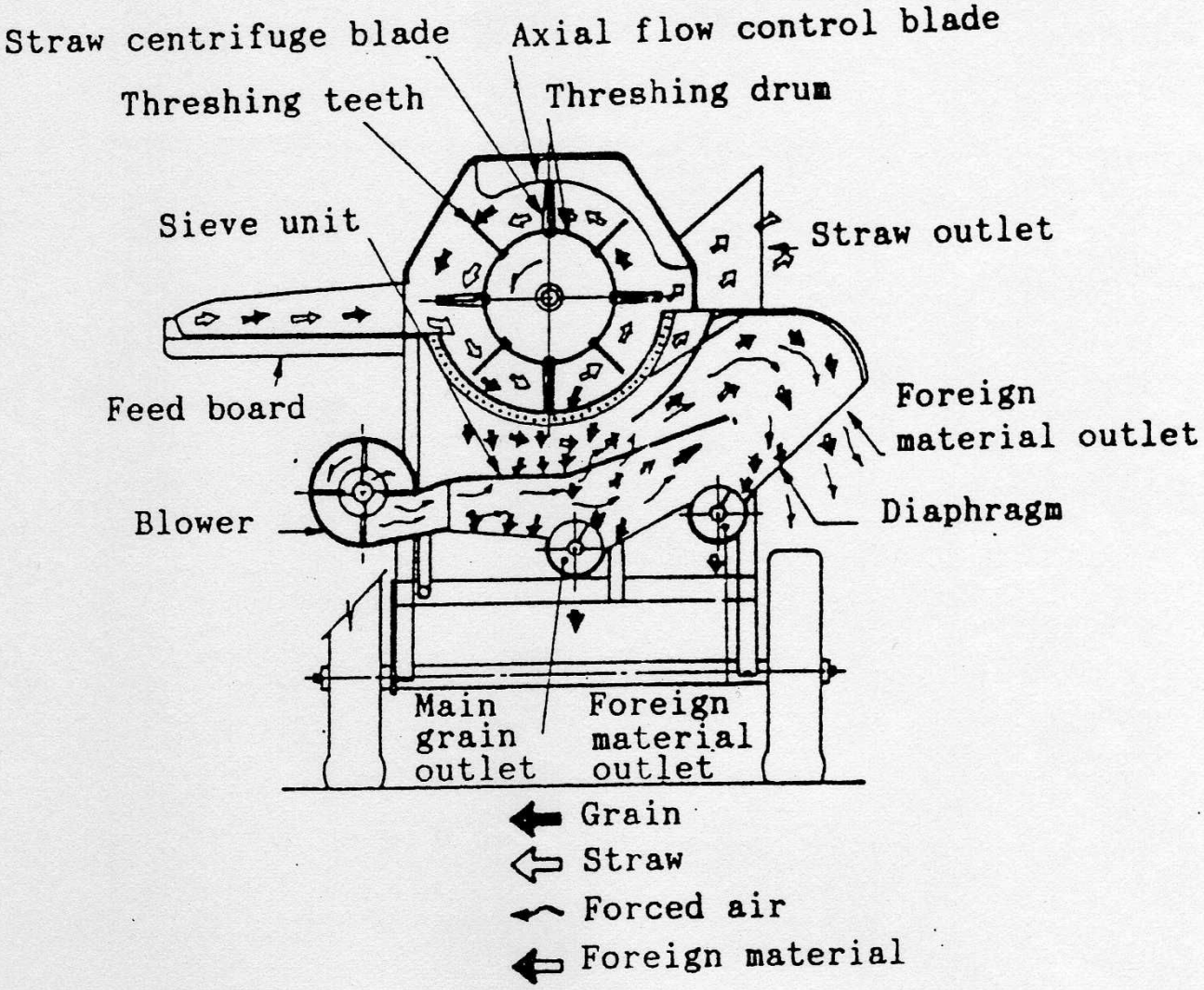


Figure 3 : Crop flow diagram of thresher

(clause 3.1)

3.2.1.2 Means of lubrication for moving components and points of contact between metal parts shall be provided.

3.2.1.3 All points requiring frequent lubrication and cleaning shall be easily accessible.

3.2.2 All metal components except the threshing drum, the inner surface of concave, and transport instruments shall be painted or finished for protection against rust.

3.2.3 Safety for operator of the thresher shall be ensured as follows :

3.2.3.1 Protruding fasteners shall be avoided.

3.2.3.2 Any sharp corners shall be avoided.

3.2.3.3 Guards shall be provided to prevent accidental contact of operators in the transmission system. They shall be so designed as not to hinder in the adjustment, servicing and operation of components, and shall not be easily removed without the aid of tools.

4. Requirements

4.1 Components and instruments shall comply with the following :

4.1.1 Feed board

The feed board shall be made from steel sheet of at least 1.2 mm thickness.

The shortest normal distance measured in a horizontal plane from the tip of the threshing teeth to the outer edge of the feed board (a) shall not be less than 750 mm, as shown in Figure 4.

Compliance is checked by measurement.

4.1.2 Threshing drum and teeth

4.1.2.1 When tested as in clause 7.1.2.1, threshing drum shall statically balance.

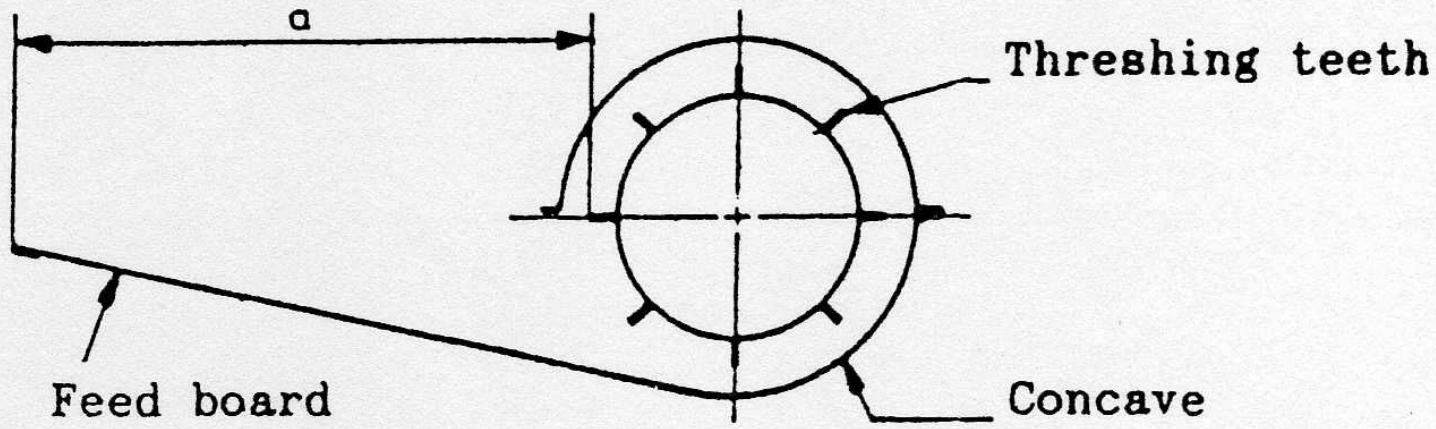


Figure 4 Normal distance from threshing teeth to feed board (clause 4.1.1)

4.1.2.2 Threshing drum shaft shall be made from steel having a tensile strength of 451 to 755 MPa and a hardness of 69 to 100 HRB.

Compliance is checked by the test of clause 7.1.2.2.

4.1.2.3 Threshing teeth shall be made from hardened low alloy steel averaging 32 to 40 HRC in hardness.

Compliance is checked by the test of clause 7.1.2.3.

4.1.2.4 One end of the threshing tooth shall be fastened to the drum by means of screw thread conforming to TIS 159, "General purpose ISO metric screw threads and selected sizes for screws, bolts and nuts", having a pitch of not less than 1.75 mm and a screw length not less than 25 mm. Where the threshing drum is not threaded, a spring lock washer shall be attached to all threshing teeth.

Compliance is checked by visual inspection and by inspecting the diameter and pitch using a go and no-go gauge.

4.1.3 Bearing

Bearing shall be of a type provided with seal for adequate protection against the ingress of dust.

Compliance is checked by visual inspection.

4.1.4 Power transmission V-belt

TIS 146,"Power transmission V-belt" shall be complied with.

ฟันลูกนวด

ตัวอย่างที่	ความแข็งรอกเวลล์สเกล C		
	1	2	3
1	37.7	37.7	35.3
2	37.7	34.5	38.0
3	29.0	30.5	29.0
4	26.0	29.0	31.3
5	26.0	24.3	24.5
6	34.0	38.7	35.0
7	36.7	38.7	42.3
8	29.0	32.3	31.5
9	36.0	40.3	40.0

เกณฑ์มาตรฐาน : ความแข็งของฟันลูกนวด 32 - 40 HRC

การทดสอบ/วิเคราะห์ : เพลากลม

วิธีทดสอบ/วิเคราะห์ : ความต้านทานแรงดึง และความแข็ง

ภาวะการทดสอบ : อุณหภูมิ 29°C ความชื้นสัมพัทธ์ 65 %

ผลการทดสอบ/วิเคราะห์:-

เพลากลมลูกนอก

ตัวอย่าง	ขนาด mm.	ความต้านแรงดึงที่จุดคราก kgf/mm^2 (MPa)	ความต้านแรงดึงสูงสุด kgf/mm^2 (MPa)	ความยืด (%)
1	Ø 18.84	54.12 (541.2)	63.72 (637.2)	2.44
2	Ø 18.92	52.73 (527.3)	63.71 (637.1)	3.56
3	Ø 19.00	38.96 (389.6)	49.13 (491.3)	8.80

หมายเหตุ ขาดนอก Gauge

เกณฑ์มาตรฐาน : ความต้านแรงดึงของเพลาลูกนอก 451-755 เมกกะพาสคัล (MPa)

เพลาลูกนวด

ความแข็งของรอกเวลส์สเกล B

ตัวอย่างที่	HBR		
	1	2	3
1	91.5	91.3	92.7
2	91.5	92.5	92.3
3	81.0	81.5	81.5

เกณฑ์มาตรฐาน : ความแข็งของเพลาลูกนวด 69-100 HRB

ผู้ทดสอบ/วิเคราะห์ ----------

(นายสนั่น โชติยะมาลา)

ผู้ตรวจสอบ ----------

(นายสุชาติ แก้วทอง)

ผอ.ห้องปฏิบัติการทดสอบทางฟิสิกส์

ผู้รับรอง ----------

(นายสรพล วัฒนวงศ์)

ผู้อำนวยการ

ศูนย์ทดสอบและมาตรวิทยา

Ref. 11242410210003010O1

วันที่ 19 กุมภาพันธ์ 2541

4.2 Efficiency

4.2.1 No-load condition

When tested in accordance with clause 7.2.3.1, the following shall be ensured.

4.2.1.1 The thresher shall operate without shock or blockage in the threshing and the cleaning systems;

4.2.1.2 Rotating or oscillating components shall operate smoothly without undue knocking or rattling sound as a result of abrasion or imbalance;

4.2.1.3 None of the components or instruments shall be damaged. Fastening connections between different components by means of rivets, bolts or welding shall be such that they will not get separated or loosened.

4.2.2 Load condition

When tested in accordance with clause 7.2.3.2,

4.2.2.1 Threshing efficiency shall not be less than 99% ;

4.2.2.2 Cleaning efficiency shall not be less than 97% ;

4.2.2.3 Percentage of spilled grain shall not exceed 4 ;

4.2.2.4 Percentage of damaged grain shall not exceed 2 ;

4.2.2.5 Specific output capacity shall not be less than 120 kg/hr/kw ;

4.2.2.6 The running of the thresher as given in clauses 4.2.1.1, 4.2.1.2 and 4.2.1.3 shall still be maintained.

7.2 Efficiency

7.2.1 General requirements for calculations and measuring devices used for the tests shall be as follows :

7.2.1.1 Revolution speed

Apparatus for measuring revolution speed shall be accurate to within 2 %.

7.2.1.2 Weight

Weighing apparatus shall be accurate to 0.1 g.

7.2.1.3 Straw and grain ratio

Take five samples of the crops each weighing about one kilogram. Separate the grains from stalks manually for each sample. Take the mass of grain and straw separately for each sample, and calculate their ratio. The average of the five samples shall be taken as the straw and grain ratio.

7.2.1.4 Weight of crop bundle and length of cut crop

Ten bundles of cut crop shall be used. Weigh each bundle, and obtain the average length of cut crop from a number of these samples.

7.2.1.5 Moisture content of grain

Use the samples as of clause 7.2.1.3. Determine its moisture content in accordance with the method specified in ISO 712.

7.2.1.6 Sampling of threshing output

Use a container of a size sufficient to permit single collection of all samples within the specified time. Sampling at straw outlet and foreign material outlet should be carried out using a sack or any other apparatus that permits the air to pass through.

7.2.1.7 Analysis of samples

Manual separation or standard analysis instrument shall be applied.

ฟนธ์ พันธุ์เปลือก : ~~กข~~ กข 78.6 (RD-6)

7.2.1.3 อัตราฟางต่อข้าวเปลือก

1. ต้นข้าว 1 กิโลกรัม

	ข้าวเปลือก GRAIN	ฟาง STRAW	อัตราส่วน	ความชื้น % (w.b.)
1	685.9	314.1		20.4
2	639.2	360.8		22.6
3	701.0	299.0		20.6
4	643.2	356.8		20.7
5	641.5	358.5		20.2
เฉลี่ย	662.16	337.84	66.21	20.9 *

7.2.1.4 น้ำหนักฟ่อนข้าวและความยาวของต้นข้าว

* ไม่เกิน 20% w.b.

	น้ำหนักฟ่อนข้าว(กิโลกรัม) WEIGHT (kg.)	ความยาวของต้นข้าว(มิลลิเมตร) LENGTH (mm.)
1	2.9	56.8
2	2.9	77.0
3	2.3	71.2
4	2.0	75.5
5	2.7	84.6
6	1.8	78.7
7	1.9	65.4
8	2.3	74.3
9	2.6	69.4
10	2.6	72.0
เฉลี่ย (Avg.)	2.40 ↓	72.49 ↑
(STD)	3.5 - 4.5 กิโลกรัม	500 - 700 มิลลิเมตร

The National Agricultural Machinery Center (NAMC) was established in 1979 organized under Research and Development Institute at Kamphaengsaen, Kasetsart University.

The main functions of the center was

1)Testing and Standardization

2)Responsibilities to testing of agricultural machines either locally fabricated in Thailand or imported from abroad and collaborating with the Thai Industrial Standards Institute in standardizing agricultural machinery testing.

Future collaboration

Establishing a regional network for testing agricultural machinery will be useful among national agricultural machinery testing agencies

and institutes of member countries for efficient use of agricultural machinery and promotion of green agricultural technology.


THANK YOU