TKP3501
Agricultural Mechanization

Topic 1:
Introduction, History of Mechanization & Agriculture Tools

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Hunting & gathering

Self sufficient

Modern agriculture

1400 - In Egypt, used a reaper for wheat harvesting
1660 - The use of steel was introduced - plow
1800 - Horse and machinery was intensively utilized to grain production
1916 - Crop copper, harvester, thresher were design and attached to the horses

UNTIL the introduction of the STEAM engine

Why?

Population increase
Demand for food
Increase production rate
Efficiency
Objectives

- To know and to understand the principle of agricultural machineries
- To be able to choose the type of machines, size and the number needed
- To be able to coordinate and to operate the machines in the field
Learning Outcomes

- Ability to identify the different machines
- Ability to compare among the machine
- Ability to comprehend the purpose of the machines
Why we need machineries?
Type of machine available
Traditional vs modern

Introduction

Introduction
to a tractor
Type of tractor
Specification

Tractors’ components & Systems
Main components
Systems;
- Fuel & Intake
- Combustion
- Cooling
- Electric & instruments
- Lubrication
- Hydraulic

Others
- Bearing & seal
- Shaft
- Belt & pulley
- Chain & sprocket
- Gear
- Lubrication (grease, oil)

Filters, oil, lubrication, parts
Compact equipment

Power tiller
Other small equipment

Maintenance

Theoretical Field Capacity
Effective Field Capacity
Field Efficiency
Farm Efficiency**

** = Calculations

How to choose the tractor and implement size**
Tractor & power unit
Type of power available

Crop Production

Land preparation
Crop type;
- Oil palm
- Rice
- Vegetable

Seedling & Planting
Crop type
Planter**

Fertilization & Irrigation**
Spreader
Pump
Sprinkler

Farm maintenance
Grass, road, drainage

Livestock
Feeding system
Milking
Aquaculture

Cost analysis**
Optimization

Forestry
Horticulture

Emerging Technologies
Sensor
Tracking
GPS, GNSS
GIS, Mapping

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Fertilization &
Irrigation
Livestock
Optimization
Emerging Technologies
Crop Production
Planning
Harvesting
Yield, Baller
Transportation

Crop type

Crop type

Field Efficiency

Farm Efficiency**

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What is mechanization in agriculture?

Is it about tools for working the land?
Is it about tractor?
Agricultural mechanization is the use of implements and machines in order to help the production of agricultural outputs.

This definition implies the use of tools and implements correctly, efficiently and at optimum cost. The tools will alleviate loads.
- Cangkul or hoe is a machine, it is a lever. Imagine using the hand to remove weeds around the house.

- Limited area, one hoe cut will upturn approximately 12cm x 15cm soil for the purpose of loosening the soil and delay growth of weeds.

- Hoe and scythe (tajak) is suitable for removing weeds around the tree before applying fertilizer.

- This is an alternative to chemical spray which damage the subsurface feeder roots.
Scope

- Agricultural mechanization covers field works from land preparation, crop establishment, irrigation, crop care, harvesting, infield transportation and primary processing.

- Since this scope is too wide only machineries for the main operations will be discussed.
Power source in the farm

Mechanization and Human Power

Mechanization and Animal Power

Mechanical-electrical Power
1) Mechanization and Human Power

- Hand tool technology - basic and simple
- Time consuming
- Conventional tools without improvement - used throughout the ages and from country to countries.
- Most of the tools is a single purpose
Examples of Conventional tools

- **Soil digger**
  - Hoe (Cangkul) and Spade

- **Weeding**
  - Scythe (Tajak), Hoe

- **Planter/Transplanter**
  - Kuku kambing
  - Stick planter (Penugal)

- **Crop care**
  - Knapsack sprayer

- **Transporter**
  - Wheel barrow
  - Hand held basket (Pungkis)
  - Pole carrier (Pengandar)
  - Bicycle

- **Harvester**
  - Finger held cutter / Ketam (padi)
  - Reaper / Sabit (padi)
  - Hand pruners
  - Pole

- **Thresher**
  - Tub and thresher (Bakul dan alat pembanting)
  - Separator (Pengayak)

- **Paddy processing**
  - Wooden mortar (Lesung hindik)
TONG PUKUL PADI
Untuk memukul padi, merelakan padi dari kedap/jerami
2) Mechanization and Animal Power

- More advanced than sole manual.
- Extra power is needed to increase the work rate and ease out the load.
- More area can be covered compared with man with single tool.
Transportation

- **Sledge**
  Pulled by animal for transporting ag. Input and outputs within the field.

- **Cart**
  Pulled by animal, on wheels.
  E.g. An elephant used for pulling logs in the jungle

- **Irrigation**
  In semi arid countries animals are used for powering up water wheels for distributing water into irrigation canals.
Sledge
Cart
Animal power for irrigation
**TENGGILING**

Untuk pecahkan tanah yang berketul dan meratakan tanah selepas disisir. Proses meratakan tanah tidak begitu baik tanpa menggunakan tenggiling.

Diperbuat daripada kayu yang berbentuk seperti belimbing segi. Panjangnya antara 5-7 kaki dan garis pusatnya 6 inci. Tenggiling juga memerlukan kerbau untuk menariknya.

**ANUK**

Untuk mengangkut padi dan baja bukit

Satu alat pengangkutan yang ditarik oleh kerbau. Terdiri dari 2 jenis, iaitu anuk buluh dan anuk kayu.
3) Mechanical-electrical Power

- When human + animal = Unsatisfactory, limited time and energy
- Introduction of mechanical power - more easy and faster.
- Engine in combination with wheels (2 or 4) can be used to pull various implements in various combination.
- Like automobile modern tractors have its own beginning. There are many tractor shapes that are configured to suit its main purpose.
Tractor may be regarded as a moving prime mover. The tractor by itself cannot achieve field works.

Implements hitched to the tractor plays an important role as well.

They are either pulled, given rotary motion or pressurized to output spray droplets.

Caution, personal safety, and those nearby especially children.
Mechanization in the west is the shift from animal power to prime movers having external combustion engine like antic locomotive engines. Generated steam power was derived by burning coal.

The engine either static or mounted on chassis in the form of a tractor is more like the train locomotive.

Static engines uses belting to connect output pulley for powering threshing, milling, or separating machines.

These steam engine tractor are well cared by institutions of higher learning in the west.
The success of plow pulled by steam engines occurred in the 1850s.
There was traction problem due to tractor weight.
The tractor engine and shape changed after the emergence of internal combustion engine.
Transmission of power through Power Take Off, drawbar, and hydraulic lift became standard.
Year 1858 steam engine was successful in pulling 8 plows 5km/hr

1889 At least one company in USA made an internal combustion engine tractor

1915-1919 introduction of PTO

1930-1937 Use of diesel engine on large tractors, pneumatic tire for tractors was introduced

1937-1941 use of 3 point hitch for implements

1941-1949 use of hydraulic control for pulled implements

1950-1960 use of better facilities such as power steering, automatic transmission and selection of linear speeds using multiple combination gear box.
Agricultural mechanization has the following aims:

- To increase the output productivity from each worker
- To alter the characteristics of field works, reduce loads, drudgery, field works become more attractive.
- Save the time, more efficient.
Manual power is limited; about 0.1 Hp inefficient and not effective. Unsuitable as the main source of power.

- Even though tractors was available more than a century, its pace of development picked up after the first World War and likewise after the 2\textsuperscript{nd} W W.
- Demand for food and fiber increase but field labor decreased.
- Tractor evaluation is followed by changes in technology and farm size.
- Previously the tractors simply replace the animals now it is multipurpose.
- E.g: output of traction force, force out from belt transmission, power from PTO, hitching implements, remote controlled hydraulic unit, power steering plus air conditioned cabin.
- All this makes the modern tractor useful and efficient
The main functions:

- Field tractors is a mobile prime mover.
- Provides power for various agricultural field works: hitch implements, and provides rotary power.
Tractor Type

Tractors are divided into six main types (according to the running gear)

- 4 wheeled, 2 wheel driven (2WD)
- 4 wheeled, 4 wheel driven (4WD)
- 8 wheeled, 4 wheel driven (8WD)
- 2 wheeled tractor (power tiller)
- Tracked tractor
- Special purpose tractors e.g. self propelled and other farm tractor
Agricultural Tractors: 2 wheeled drive

2WD
Rear driven two wheel drive 4 Wheeled tractor
Agricultural Tractors: 4 wheeled drive

- 25 – 100 Horsepower. Diesel engine
- 2WD or/and 4WD
Industrial tractors
- Housing development, land levelling, mining.
- E.g. excavator, loader, dozer, backhoe, etc

Tracked tractor
- Bulldozer for land leveling and dozing
Agricultural Tractors: articulated type
- 2 W Tractor
- Hp ranging from 5 – 15, for paddy the Hp is 10 – 12.
- Used for vegetable farm and also short term (annual) crops.
- May pull trailer, mostly diesel engine
3 wheeled tractor
For row crops in USA
Self Propelled Machines

- E.g, Combine harvester
- Transplanter
- Transporter
Fig. 1-7—A high-clearance row-crop tractor for special crops.
Fig. 1-8—Different wheel spacings available.
**Implements**

- Eg. Land preparation
- Planter
- Crop care
- Transporters, etc
3 types of power output from tractor: **pulled, lift and rotation**

Methods of attachment to tractor:

1) 3 Point Hitch
2) Power Take Off (PTO)
3) Drawbar
Thank you.