1. MEANING AND PURPOSE OF MECHANIZATION

1-1. Effect of Mechanization

1) Saving cost in labor shortage

2) Stabilization farm system by work timeliness

3) Improvement of farm work by high efficiency of machine

4) Increase yield by working precisely

5) Make multi-crop system feasible for farm management etc.

6) Improvement of health by release from heavy work and improvement of living conditions

7) Release from gender gap by saving time spent to farm work of woman

8) Level up rural development by spreading of engineering knowledge

1-2. Objective of Farm Mechanization

Farm mechanization is based on total agricultural system, which is deeply connected to socio-economic environment of each country. So farm mechanization problem should be discussed from the point of view of, not only farm mechanization itself, but also socio-economic background.
For establishment of better farm work system, it is necessary to analyze and make a plan of them.

Systems engineering is one of the most powerful techniques how to apply the farm machinery for taking optimal actions to solve these complex and difficult mechanization problems.

First, the mathematical models should be built in from the original prototype systems, which are, in these cases, the farming systems.

$$Z = g(Y1, Y2, Y3, ---) \qquad \text{Eq. 1-2-1}$$

where,

symbol	term	unit
Z	Total model	-
Y1	Economical part	-
Y2	Ecological part	-
Y3	Cultural part	-
Y4	Social part (Gender, rural development etc.)	-

Refer to appendix\fm-13target.xls

1-2-1.Target of Farm Mechanization Planning

On Farm Mechanization Planning, it is essential that the fundamental idea of farm mechanization is to find the conditions to make the objective function, that is, “total benefit” maximum in certain farming system.

$$B = M - D \qquad \text{Eq. 1-2-2}$$

where,

symbol	term	unit
B	Total benefit	-
M	Merit, something plus	-
D	Demerit, something minus	-

Generally in farm mechanization planning problem, we discuss to make the economic benefit maximum by increasing the production income and by decreasing the cost.

It is important to make economic benefit maximum, but we should also consider the total benefit from the point of wide view of other factors by evaluating of energetic benefit, healthy benefit and social matter etc. at same time.

Another point is to make clear that in what area we want to optimize the system. At the beginning we should define to plan the optimal system for the world level, or for the country level, or for farm enterprise, or for land owner, or for tenant farmer, or for farm laborer.

1-2-2.Economic Analysis

$$PR = PS - TC \qquad \text{Eq. 1-2-3}$$

where,

symbol	term	unit
PR	Economic profits (benefit or net return)	$
PS	Gross return or income (amount of production)	$
TC	Total cost or expenses for production	$

$$GS = P * Y * A \qquad \text{Eq. 1-2-4}$$

where,

symbol	term	unit
GS	Gross return or income (amount of production)	$
P	Price per unit weight	$/kg
Y	Yield	kg/ha
A	Area of farm	ha

Amount of production S is calculated by multiplying the price P of a unit weight and the yield Y and the total area A. Therefore, the higher price, the more yield and the wider area, then the larger income.

$$TC = FC + VC \qquad \text{Eq. 1-2-5}$$

where,

symbol	term	unit
TC	Total cost	$
FC	Fixed cost	$
VC	Variable cost	$

Fixed cost is constant and variable cost increases, when annual working area increases.

1-2-3.Energy consumption or Work intensity Analysis

Energy consumption of machinery Refer to FS-plan-2005.xls

RMR: Energy Metabolizability Refer to RMR.xls

(Measuring of CO2 gas of human respiration)

1-3. Exercise

Exercise 1-1.

List up your feeling of farm mechanization target.

Term of benefit	weight example	%	your data	%
Economic	70	45.2		
Ecological	20	12.9		
Cultural	10	6.5		
Political	10	6.5		
Social	10	6.5		
Energetic	15	9.7		
Human healthy	20	12.9		
Total	155	100		

Refer to appendix\fm-13target.xls