Integrated Rural Economic and Social Development Programme for
Livelihoods Improvement in the Dry Zone of Myanmar

KNOWLEDGE-SHARING WORKSHOP

Enabling Environment for Custom Hiring of Agricultural Machinery in the Dry Zone of Myanmar

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Outline of Presentation

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Introduction on Agricultural Mechanization

Definition: Agricultural Mechanization

It is the application of animal and machine power to multiply man's ability to perform production operations. Mechanization permits man to multiply his production by the use of animal or fuel power. Mechanization allows the performance of tasks efficiently. (Loyd Johnson, 1964).

The use of hand and animal-operated tools and implements as well as motorized equipment to reduce human efforts, improve quality, perform operations that cannot be done by other means, and improve the timeliness of various operations, thereby increasing yield, quality of product and overall efficiency.
(STOUT and DOWNING, 1974)

Definition: Agricultural Mechanization

It embraces the manufacture, distribution, utilization and provision of after-sales service of tools, implements and machines for land development, agricultural production and primary post-production processes. It includes the use of three main sources of power: human, animal and mechanical. (FAO, 1979)

Definition: Agricultural Mechanization

Agricultural and fisheries mechanization refers to the development, adoption, assembly, manufacture and application of appropriate, location specific and cost-effective agricultural and fisheries machinery using human, animal, mechanical, electrical, renewable and other nonconventional sources of energy for agricultural production and postharvest/ postproduction operations consistent with agronomic conditions and for efficient and economic farm and fishery management towards modernization of agriculture and fisheries (RA 10601, 2013)

Definition: Agricultural Mechanization

Models of Mechanization

High land area to farmer ratio:(example: USA)
Motivated into increasing the level of mechanization in order to cultivate large agricultural lands with limited available manpower and take advantage of favorable agricultural commodity prices.
Thailand, Malaysia and Indonesia follow the USA model

Low land area to farmer ratio: (example: Japan)
Motivated into increasing the level of mechanization in order to increase yields and cropping intensities to meet the growing demands for food and agricultural raw materials.
South Korea, China, Taiwan, Sri Lanka and the Philippines follow the Japanese model.

Potentials of Agricultural Mechanization

Potentials of Agricultural Mechanization

Increased cropping intensity and production

- Tractors, power tillers, irrigation pumps, harvesters and threshers increase cropping intensities
- Irrigation pumps increased yields
- Harvester and threshers/shellers reduced losses which effectively increased yields

Potentials of Agricultural Mechanization

Increased productivity of labor

- Tractors in land preparation reduced 50% of the labor inputs
- Freed family labor can look for alternative work opportunities; children can go to school

Full utilization of farm products and by- products

- Availability of machines allow the processing of farm products and by-products

Potentials of Agricultural Mechanization

Reduction of losses

- Development of harvesting, threshing and processing machines reduced harvest and postharvest losses
- Losses: Rice: 10 – 37%
  Corn: 30%

Increased value added of farm products

- Secondary and tertiary processing open up market potentials and lead to higher retail prices

Potentials of Agricultural Mechanization

Employment and livelihood generation

- Machines designed to increase cropping intensities and production will correspondingly increase labor requirements for production and post harvest operations

Drilling Rig

- Machines designed to diversify farm products and by products open up various livelihood opportunities

Corn Mill

- Use of machines will require the putting up of repair shops in the village areas

Potentials of Agricultural Mechanization

Import substitution

- Local agricultural machinery manufacturing will minimize the importation of agricultural machinery

Export possibilities

- Locally manufactured agricultural machinery can be exported to countries with similar farming conditions

Levels of Agricultural Mechanization

Levels of Mechanization

1. Horsepower per Hectare (hp/ha)

Sum of the contribution of each of the major sources of power multiplied by its assumed hp contribution divided by the total available area

COUN TRY	LEVEL OF MECHANIZATION (Hp/Ha)
Japan	**18.87 (2011)**
Korea	**9.38 (2011)**
China	**8.42 (2012)**
Thailand	**4.20 (2009)**
Philippines	**2.31 (2011) for all crops** **1.23 (2011) for rice & corn**
India	**2.22 (2011)**
Bangladesh	**1.46 (2008)**
Vietnam	**1.20 (2010)**
Source: PHilMech 2011 as presented by Pollido, 2015	

Levels of Mechanization

2. Percent Machine Utilization (% utilization) (Amongo, et, al, 2013)

Level of mechanization by type of technology (manual, man-animal power, man-machine power, combination of types of technology), by type of farm operation

$$= \frac{\text{Number of Farmers using (type of) technology}}{\text{Total No. of farmers responding}} \times 100$$

Levels of Mechanization

2. Percent Utilization of farmers(% utilization)

Farm Operation	Level of Mechanization (% Utilization of Farmer)			
	Manually Operated			
	Camarines Sur (Region V)	Iloilo (Region VI)	Leyte (Region VIII)	Oriental Mindoro (Region IV)
Dike repair	93.75	78.95	88.04	86.32
Planting	100.00	100.00	98.91	98.95
Fertilizer application	100.00	100.00	97.83	100.00
Insecticide application	91.67	74.74	91.30	78.95
Herbicide application	85.42	95.79	35.87[a]	96.84
Harvesting	100.00	98.95	100.00	89.47
Drying	63.64	53.68	78.26	44.21[a]
	Animal-Powered			
Plowing	15.63[a]	12.63[a]	59.78	6.32[a]
Leveling	61.46	49.47[a]	88.04	55.79
	Person-Machine-Powered			
Plowing	73.96	72.63	29.35[a]	61.05
Harrowing	67.71	80.00	84.78	55.79
Threshing/Bagging	86.46	92.63	92.39	89.47
Milling	56.25	32.63[a]	79.35	No data

Note:: [a] % utilization of the available power is not predominant. ***Source of data: Amongo et al. 2013***.

Levels of Mechanization

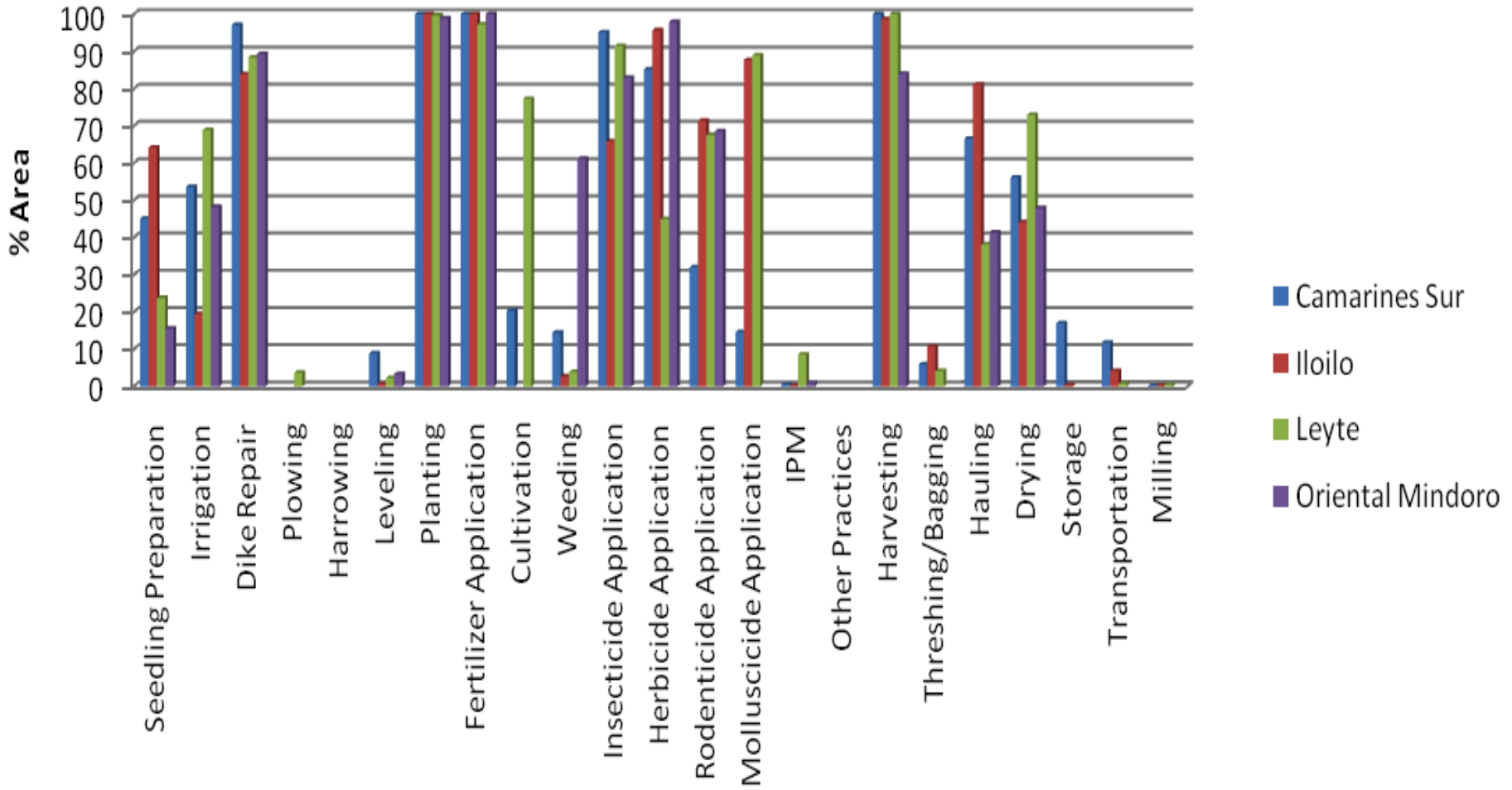
3. Percent Area Covered (% area covered) (Amongo, et, al, 2013)

Level of mechanization by type of technology (manual, man-animal power, man-machine power, combination of types of technology), by type of farm operation

$$= \frac{\text{Area serviced by (type of) technology}}{\text{Total area of farms surveyed}} \times 100$$

Levels of Mechanization

3. Percent Area Covered (% area covered)



Source : Amongo et al. 2013

Levels of Mechanization

4. Three major levels (UPLB-BAR, 2001):

Low mechanization means that an operation is done with the use of non-mechanical power source such as man and animal.

Intermediate mechanization refers to operations done with the use of non-mechanical power source in combination with the use of a mechanical power source operated by man.

High mechanization involves operations done solely with the use of mechanical power source operated by man.

Levels of Mechanization

4. Three major levels (UPLB-BAR, 2001):

These three levels are further subdivided into three sub-levels indicating advancement in technology through process and strength of the power source.

A fourth albeit minor level is full mechanization wherein the operations are done with the use of mechanical power source with limited human intervention such as computerized machines or robots.

Levels of Mechanization

Levels of Mechanization (UPLB-BAR, 2001)

Operation	Rice & Corn	Vegetables Legumes & Root crops	Coconut	Sugarcane	Fruits	Fiber Crops
Land Prep	Intermediate to High	Low		Intermediate to High	Low	Low
Planting/ Transplanting	Low	Low	Low	Low to Intermediate	Low	Low
Crop care cultivation	Low	Low	Low	Low to High	Low	Low
Harvesting	Low	Low	Low	Low		Low
Threshing/ shelling dehusking	Intermediate to High	Low (Legumes)	Low			
Cleaning		Low				
Drying	Low	Low (Legumes& Rootcrops)	Low			Low
Milling/Village level processing	High	Low	Low		Low	Low

Source: UPLB-BAR, 2001

Levels of Mechanization

5. Number of Tractors per Hectare

Some countries especially the developed countries currently express the level of mechanization based on the number of tractors utilized in a given unit area.

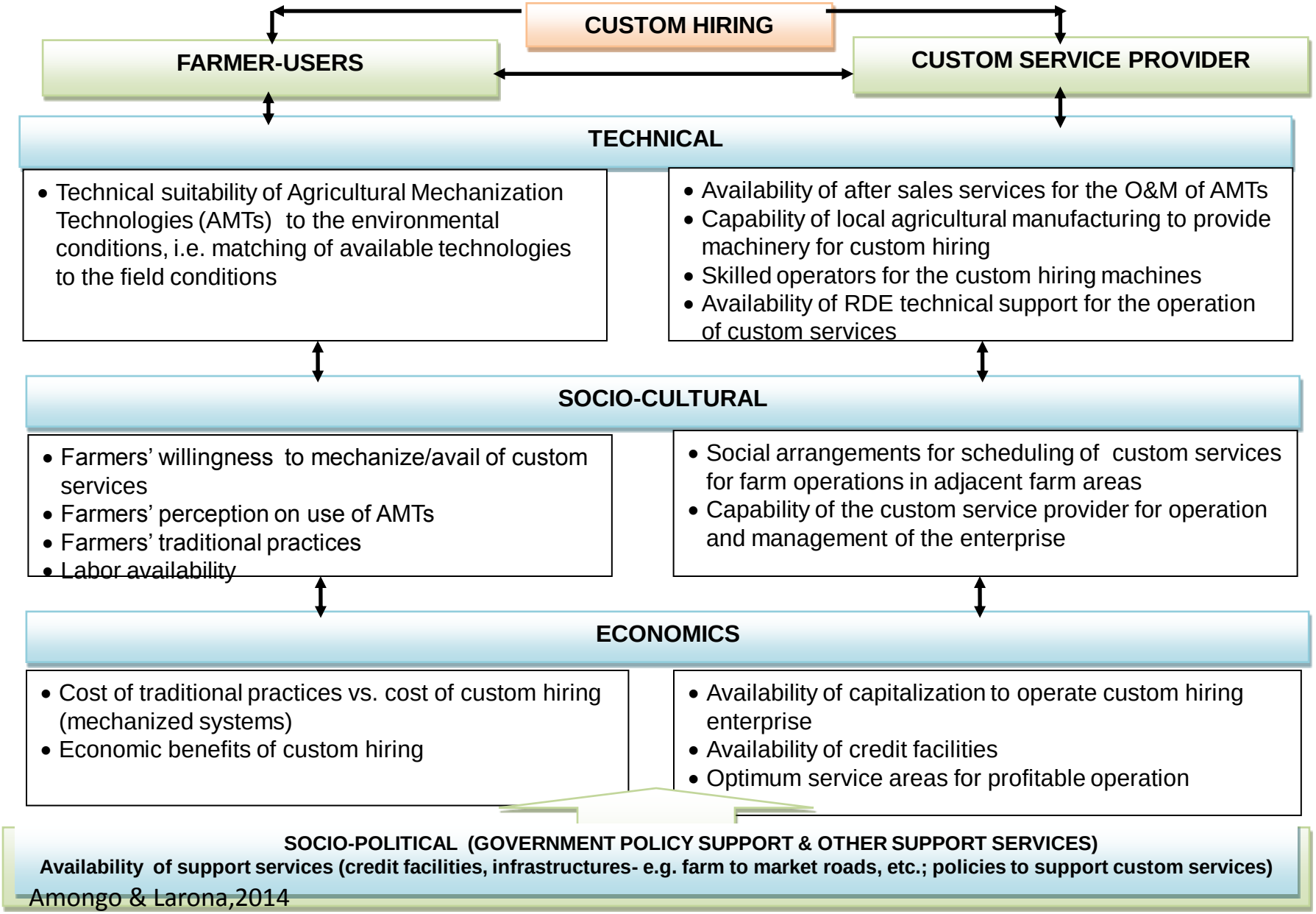
Conceptual Framework on Custom Hiring Services (CHS) of Agricultural Mechanization Technologies (AMTs)

Custom Hiring Services of AMTs

The Custom Hiring Services for Agricultural Mechanization Technologies (CHS for AMTs) shall be operated as business enterprises that will provide the following services:

- After-sales service and warranty for their respective clients;
- Custom plowing, harrowing, harvesting, drying, milling and other farm mechanization services;
- Repair and troubleshooting services of agricultural and fishery machinery and equipment; and
- Training in maintenance and proper use of agricultural machineries and equipment.

Conceptual Framework for Custom Hiring Services of Agricultural Mechanization Technologies



Amongo & Larona,2014

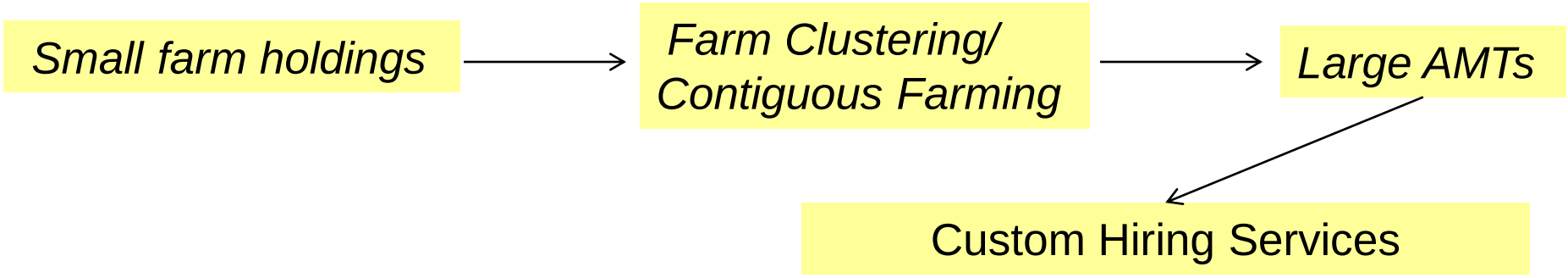
Conceptual Framework for Custom Hiring Services of Agricultural Mechanization Technologies

Farmers as beneficiaries of custom services

Technical suitability of agricultural machines

Location specificity of AMTs

Farm size



Farmers' traditional practices

Social preparation

Conceptual Framework for Custom Hiring Services of Agricultural Mechanization Technologies

Farmers as beneficiaries of custom services

Farmers' preferences on use of agricultural machines

Operations which farmers would like to mechanize (Amongo 2013)

- land preparation
- planting
- harvesting
- drying

Ownership of large agricultural machines was low and farmers opted hiring agricultural machines rather than owning the machines.

Conceptual Framework for Custom Hiring Services of Agricultural Mechanization Technologies

Farmers as beneficiaries of custom services

Labor Availability

Social issue in establishing custom services: possible displacement of farm labor.

Lantin *et al.* (2003) noted that agriculture should not be viewed as sink for employment since the gains that could be generated from farming activities (such as farm labor) is not enough to improve the quality of life of landless farm workers.

Other alternative income opportunities: establishment of agro-processing enterprises, training opportunities for possible employment in urban areas.

Conceptual Framework for Custom Hiring Services of Agricultural Mechanization Technologies

Farmers as beneficiaries of custom services

Cost of mechanized system vs. traditional practices

Major reasons of corn farmers for joining clustering and custom services facilities in Cauayan City, Isabela, Philippines:

- reduction in production cost
- improved production performance
- availability of support services from the government
- increase farm operation efficiency.

Net income for a fully mechanized system = PhP 22,210/ha
Net income for traditional system = PhP13,045/ha

Source: Larona (2006)

Conceptual Framework for Custom Hiring Services of Agricultural Mechanization Technologies

Custom Service Provider

Technical suitability of agricultural machines

- Location specificity of AMTs
- Locally fabricated AMTs vs. Imported AMTs

Availability of after sales services

- Training on ORM
- Availability of spare parts

Local manufacturing

- available small to medium scale manufacturers

Conceptual Framework for Custom Hiring Services of Agricultural Mechanization Technologies

Custom Service Provider

Social arrangements for scheduling of custom services

Synchronize farming

Operation and management of custom services

Machinery pooling vs. Custom Services

Enabling Environment for CHS of AMTs

Enabling Environment for Custom Hiring Services of AMTs

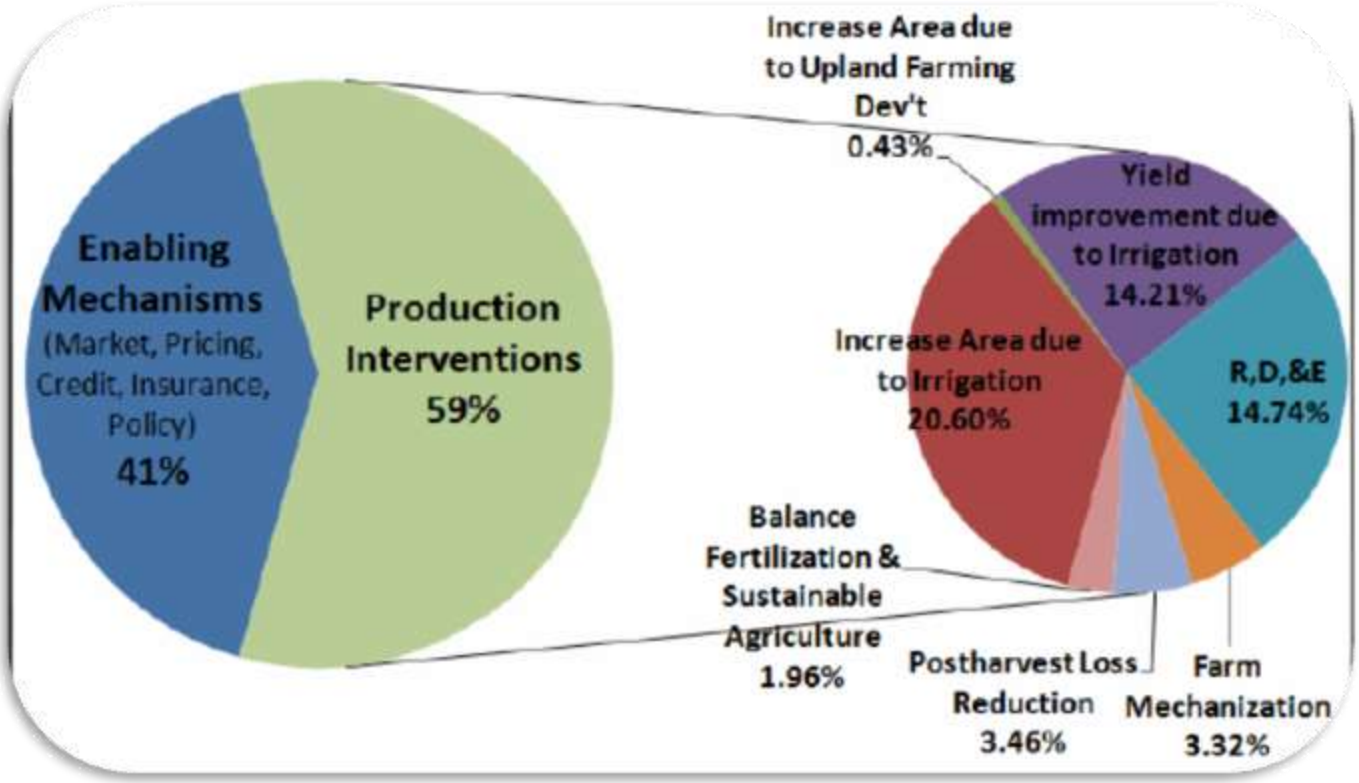
Labor Cost for Land Preparation, Crop Establishment, Harvesting and Threshing (based on Key Informant Interview of Selected ASIAN Countries) 2012

Province, country	Labor cost for land preparation, crop establishment, harvesting, and threshing (In US$/ha)
Nueva Ecija, Philippines	484.50
Zhejiang, China	533.00
Tamil Nadu, India	268.00
West Java, Indonesia	430.50
Suphan Buri, Thailand	192.00
Can Tho, Vietnam	198.00

Source: Regalado, 2015

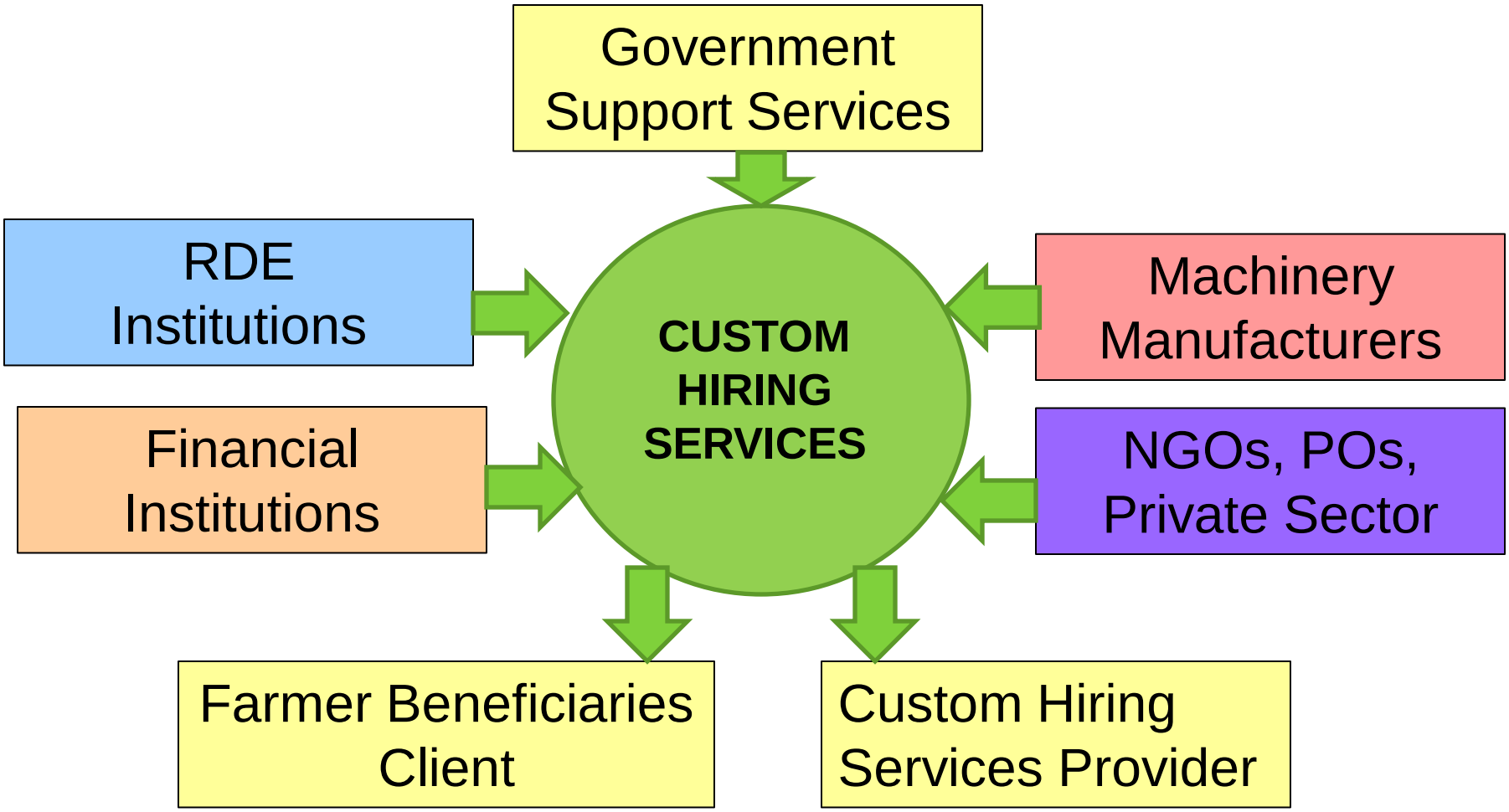
Enabling Environment for Custom Hiring Services of AMTs

INCREASE IN PRODUCTION



Source: Regalado, 2015

Enabling Environment for Custom Hiring Services of AMTs



Enabling Environment for Custom Hiring Services of AMTs

Government Support Services in Selected ASIAN Countries

ITEMS	PROVINCE, COUNTRY					
	Nueva Ecija, Philippines[1]	Zhejiang, China[2]	Tamil Nadu, India[3]	West Java, Indonesia[4]	Suphan Buri, Thailand[5]	Can Tho, Vietnam[6]
Seed Subsidy	No subsidy	Free inbred seeds; free hybrid seeds only to cooperative members.	0.2 $ subsidy per kg of seeds	0.91 $ subsidy per kg of seeds	No subsidy	No subsidy
Price of Urea	27.91 US$/bag	20.83 US$/bag	5 US$/bag (subsidized)	9.10 US$/bag (subsidized)	24.38 US$/bag	26.43 US$/bag
Irrigation/Water	49 $/ha (wet season); 69 $/ha (dry season); Irrigation fee is free if crop is damaged	Free	Free	Free	Free	Free
Land tax	28 US$/ha/year	Free	0.21 US$/ha/year	56 US$/ha/year	0.98 US$/ha/year	Free
Interest on Credit	24% per annum from cooperatives	5% per annum but gov't pays for 80% (4% is paid by the gov't and 1% is paid by the farmer)	0% interest if loan from gov't bank is paid within 6 months	12% per annum from gov't bank	6% per annum from Bank of Agriculture	12% per annum in Agri Bank

Source: Regalado, 2015

Enabling Environment for Custom Hiring Services of AMTs

Government Support Services in Selected ASIAN Countries

Machine Acquisition	85% discount on farm machinery and post harvest facility for qualified irrigator's association and farmer cooperatives.	30% discount on tractors and combine harvester-thresher; 50% on mechanical dryer.	Gov't custom hires combine, leveler, mechanical transplanter, and tractor at 50% lower rental rate. However, gov't can service only 2% of area.	No subsidy	No subsidy	70% of the value of principal have low interest during the 1st year.
Government paddy procurement	Gov't procures less than 5% of production at a support price.	Gov't procures inbred rice production. Gov't offers protection price for inbred rice.	Gov't procures around 60% of harvest. Gov't has minimum support price.	Gov't does not procure paddy from farmers but from traders	Gov't procures all production at a guaranteed price.	Gov't procures through state-owned companies at a price giving 30% profit margin to farmers.

Source: Regalado, 2015

Enabling Environment for CHS of AMTs

Land Consolidation (Contiguous Farming)

RA 10601 Agriculture and Fishery Mechanization Act of 2013
IRR- Section 3- Rule 3.1)

Contiguous farming - shall be defined as a farming system comprising the development and organization of parcels of adjoining or adjacent agricultural lands with a minimum total area of 50-ha for the synchronized production of a particular crop such as but not limited to rice, corn, sugarcane, coconut and high value commercial crops utilizing agricultural mechanization technology. It shall include the necessary physical and institutional infrastructures. Physical infrastructures include the overall design layout of the area (e.g. field plot size, irrigation canal, farm drain, farm ditch, farm roads, postharvest facilities, etc.) while institutional infrastructures consist of the social base by which contiguous farming scheme shall operate.

Land Consolidation (Contiguous Farming)

BENEFITS OF LAND CONSOLIDATION

- development cooperation among farmers
  - for water management
  - synchronized harvesting
  - common warehouse, postharvest facilities, etc.
- developing market channels that demand bulk harvests
- efficient field operations
- efficient use of water and better weed control
- increase land and labor productivity
- increase crop production

Land Consolidation (Contiguous Farming)

Japan

BEFORE

AFTER

Land Consolidation (Contiguous Farming)

JAPAN

-Increase in large scale farms

-Crop diversification thru multi-purpose use of paddies

-Increase in rice production from 4.02 to 4.5 tons/ha

-Irrigation system has flood regulating function

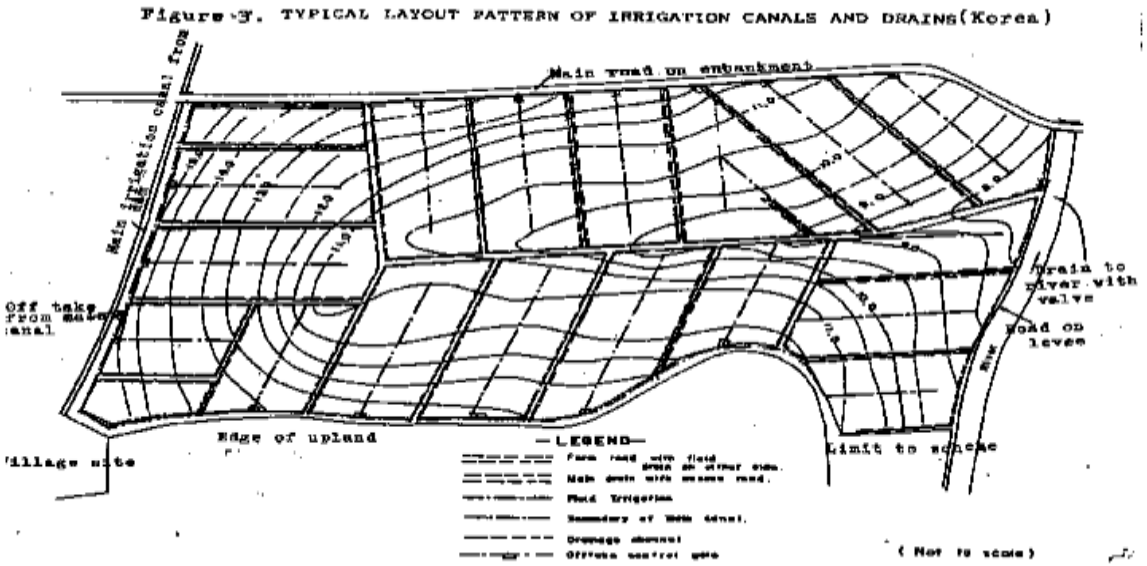
-40% overall work reduction in paddy field from 185 h/0.1 ha (1950s) to 39 h/0.1 ha (1993)

-Reduction in human labor from 1050 h/ha to 300 h/ha

Land Consolidation (Contiguous Farming)

KOREA

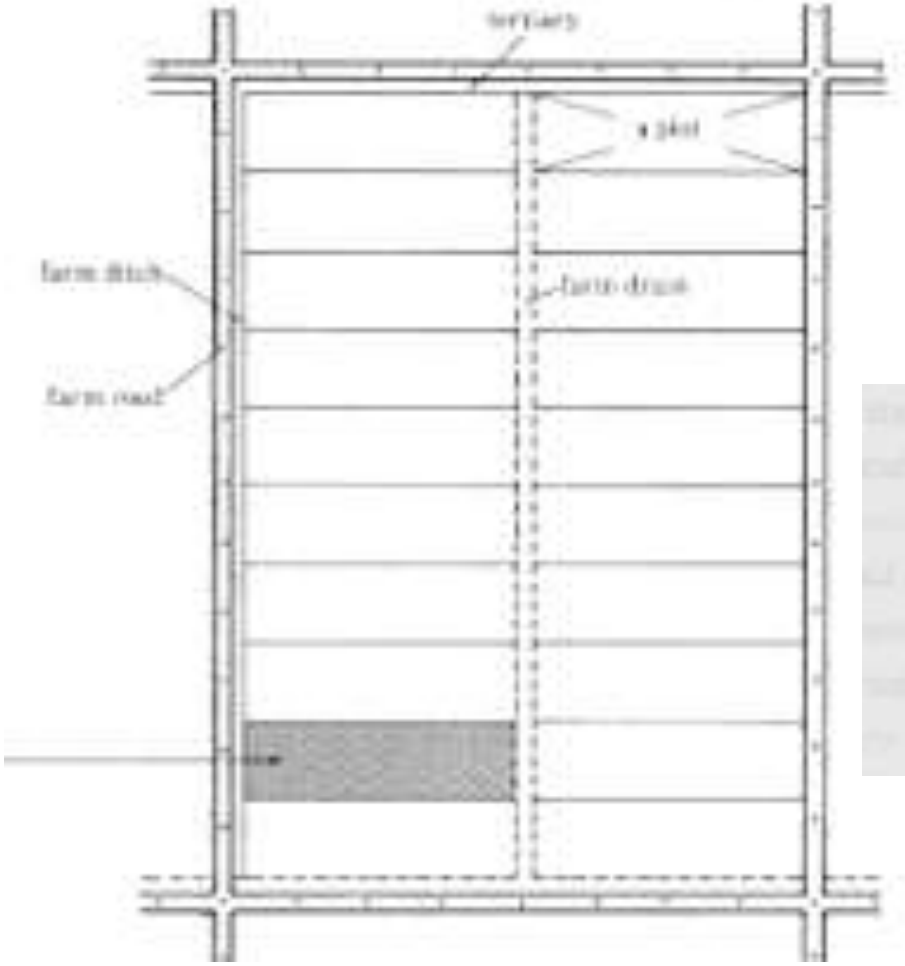
- 94-99% mechanized in 1998
- Around 40 years to finalized the concepts
- 5 years to implement scheme due to objections from landowners/farmers

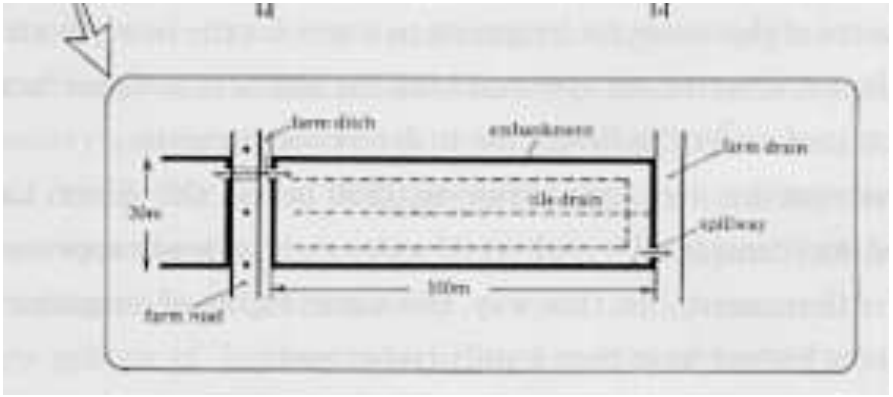


Land Consolidation (Contiguous Farming)

PHASES OF Land Consolidation

1. Farm Layout





Land Consolidation (Contiguous Farming)

2. Site Clearing/Earth Moving

3. Leveling of field

4. Subsurface drainage works

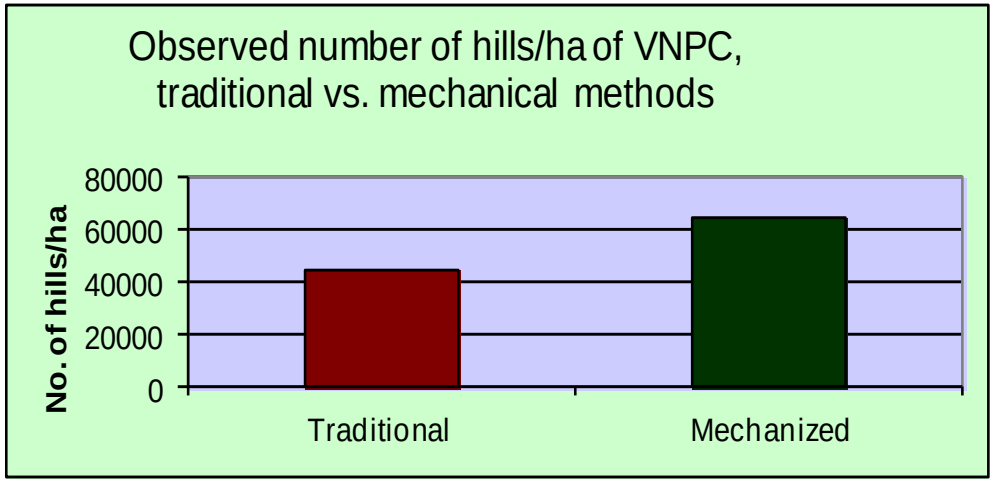
Land Consolidation (Contiguous Farming)

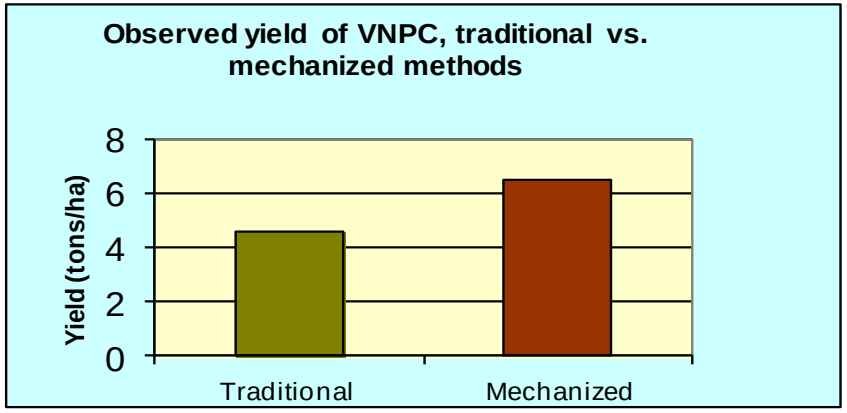
5. Irrigation facilities

6. Construction of farm road, farm ditch, farm drain, other construction activity
7. Installation of power supply
8. Construction of production and post harvest facilities and shed

Land Consolidation (Contiguous Farming)

Significant accomplishments: Villaluna Multi Purpose Cooperative, Isabela Philippines (VLMPC)



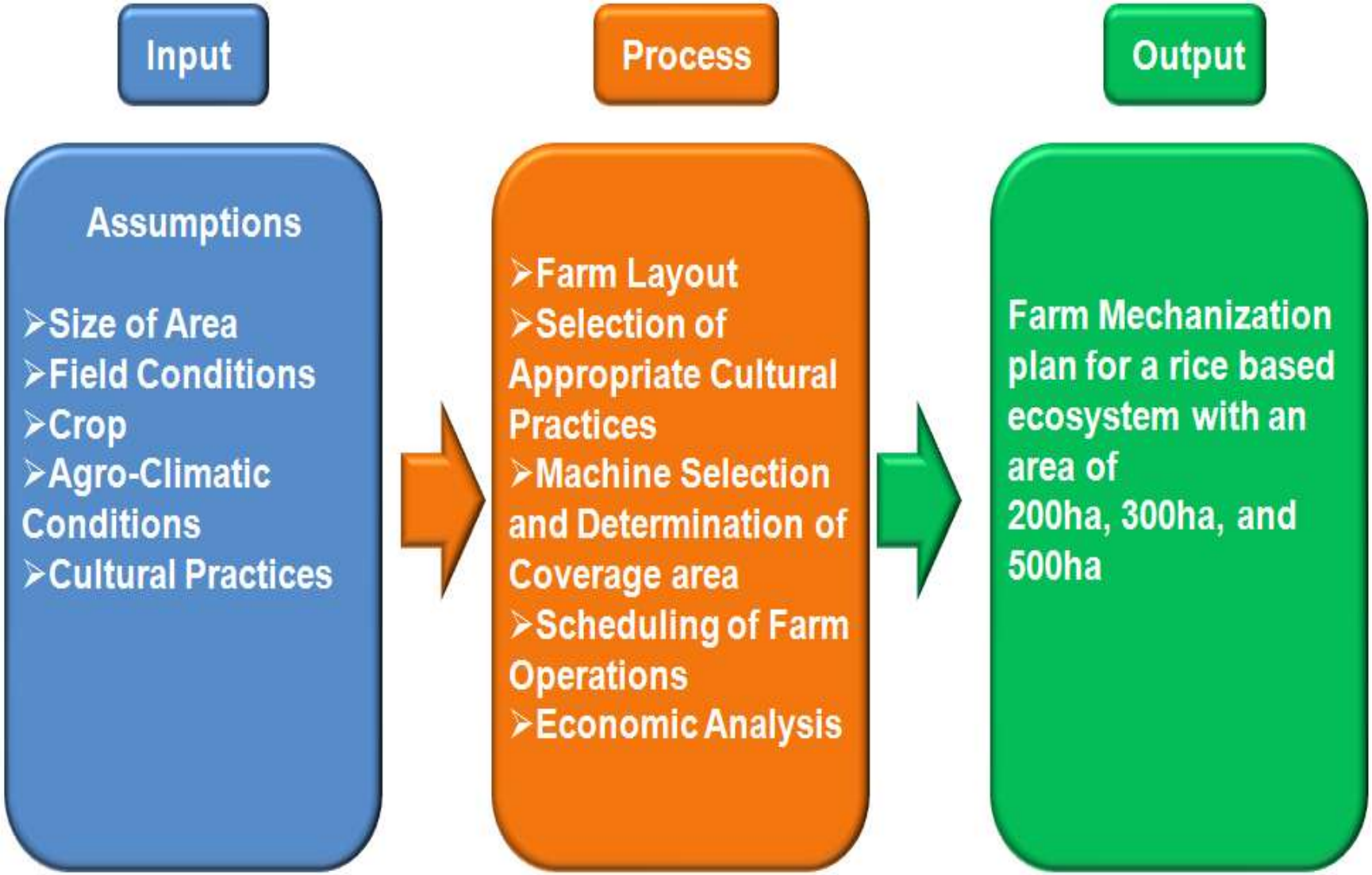


Source: Larona, 2006

Factors in the Establishment of Custom Hiring Services

Technical Aspect

- **Projections of Machinery Requirements**



Technical Aspect

Cropping Calendar

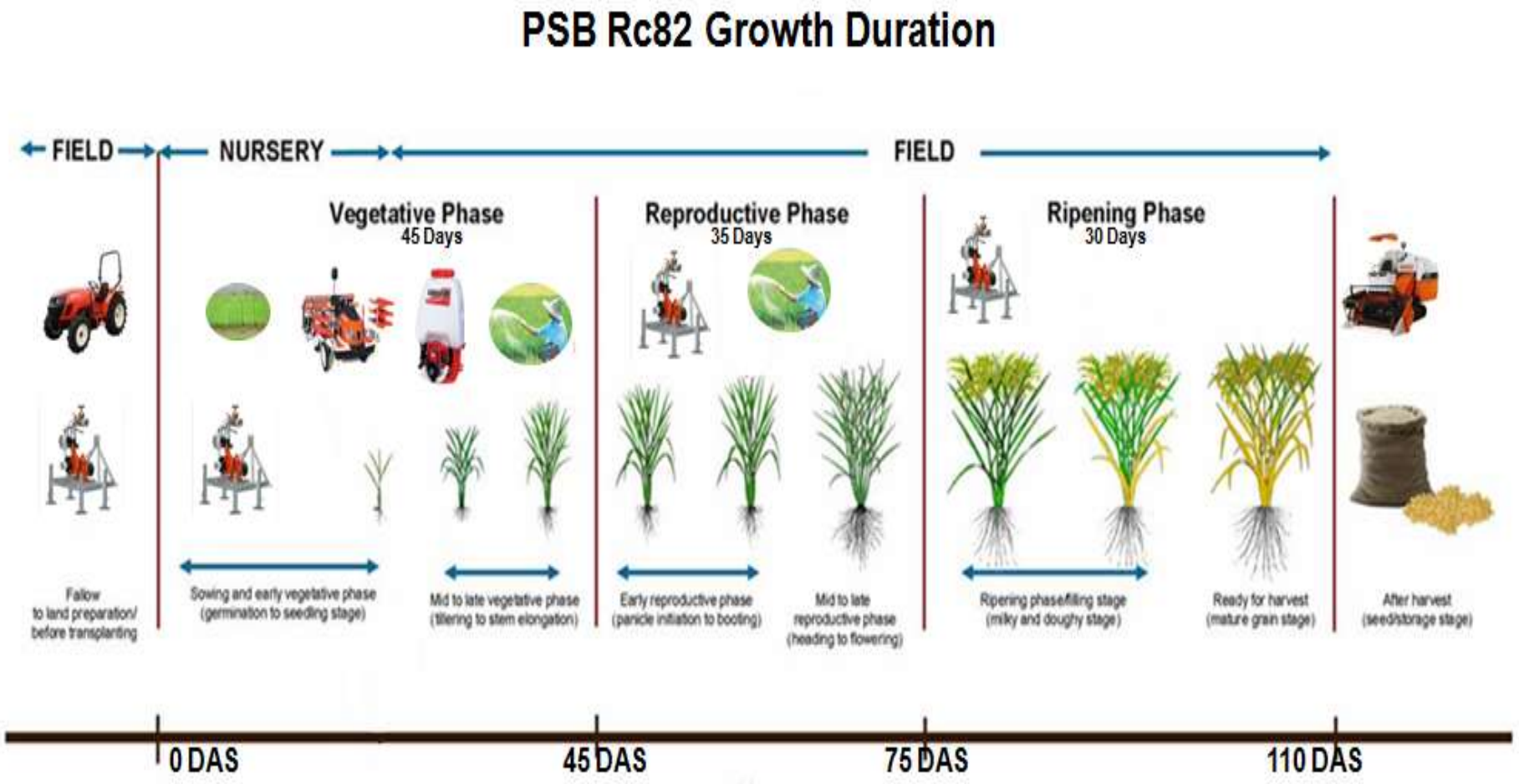


Photo Credits: IRRI

Technical Aspect

Rice Cropping Pattern (Amongo, et. al. 2013)

OPERATION	CAM. SUR		ILOILO		LEYTE		OR. MINDORO	
	Duration	Available Work Day	Duration	Available Work Day	Duration	Available Work Day	Duration	Available Work Day
Seedling Prep	Nov 15-Nov30	12	May 16-May 31	13	Nov 9-Nov 30	18	May 12-May 31	16
Land Prep	Nov 14-Nov 30	13	May 14-May 31	15	Nov 8-Nov 30	19	May 11-May 31	17
Planting	*Dec 1-Dec 31	25	*June 1-June 30	24	*Dec 1-Dec 31	25	*June 1-June 30	24
Chem. App	Dec 8-Jan 13	28	June 9-July 15	29	Dec 12-Jan 5	20	June 6-July 5	24
Harvesting	Mar 1-Mar 31	25	Sep 3-Sep 27	20	Feb 23-Mar 31	30	Sep 18-Oct 17	24
Threshing	Mar 1-Mar 31	25	Sep 3-Sep 27	20	Feb 23-Mar 31	30	Sep 18-Oct 17	24
Drying	Mar 2-Apr 5	28	Sep 4-Sep 28	20	Feb 25-May 2	30	Sep 19-Oct 7	16

Technical Aspect

Rice mechanization technology coverage area

(Amongo, et. al. 2013)

MACHINE	OPERATION	CAM. SUR		ILOILO		LEYTE		OR.MINDORO	
		Coverage Area	No. of Units	Coverage Area	No. of Units	Coverage Area	No. of Units	Coverage Area	No. of Units
Two Wheel Tractor	Seedling Prep	6.93	-	7.51	-	7.80	-	11.55	-
	Land Prep	11.26	22	12.99	19	16.46	13	14.72	19
Four Wheel Tractor	Land Prep	23.40	11	27.00	9	34.20	7	30.60	9
Engine Powered Transplanter	Transplanting	18.90	13	18.14	14	18.90	11	18.14	15
Rice Drum Seeder	Broadcasting	18.75	14	18.00	14	18.75	11	18.00	16
Engine Powered Sprayer	Chemical Application	24.53	10	25.40	10	17.52	12	21.02	13
Combine Harvester	Harvesting	72.60	4	58.08	5	87.12	3	69.70	4
Thresher	Threshing	81.82	3	68.90	4	97.85	3	69.10	4
Dryer	Drying	15.13	17	11.38	18	16.16	13	7.61	36

Technical Aspect

Projected Volume of Rice Mechanization Technologies

(Amongo, et. al. 2013)

MACHINE	OPERATIONS TO BE MECHANIZED	Projected No. of Machines for the Province				
		CAMARINES SUR	ILOILO	LEYTE	ORIENTAL MINDORO	Weighted Average
Two Wheel Tractor	Land Prep	10,780	14,867	3,287	5,774	8,184
Four Wheel Tractor	Land Prep	5,188	7,154	1,582	2,779	3,938
Engine Powered Transplanter	Transplanting	6,423	10,646	2,862	4,686	6,123
Rice Drum Seeder	Broadcasting	6,474	10,731	2,885	4,724	6,172
Engine Powered Sprayer	Chem. App.	4,949	7,604	3,088	4,044	5,128
Combine Harvester	Harvesting	1,672	3,326	621	1,220	1,578
Thresher	Threshing	1,484	2,804	553	1,231	1,429
Dryer	Drying	8,021	16,974	3,348	11,176	9,023

Technical Aspect

Rice Mechanization Technologies



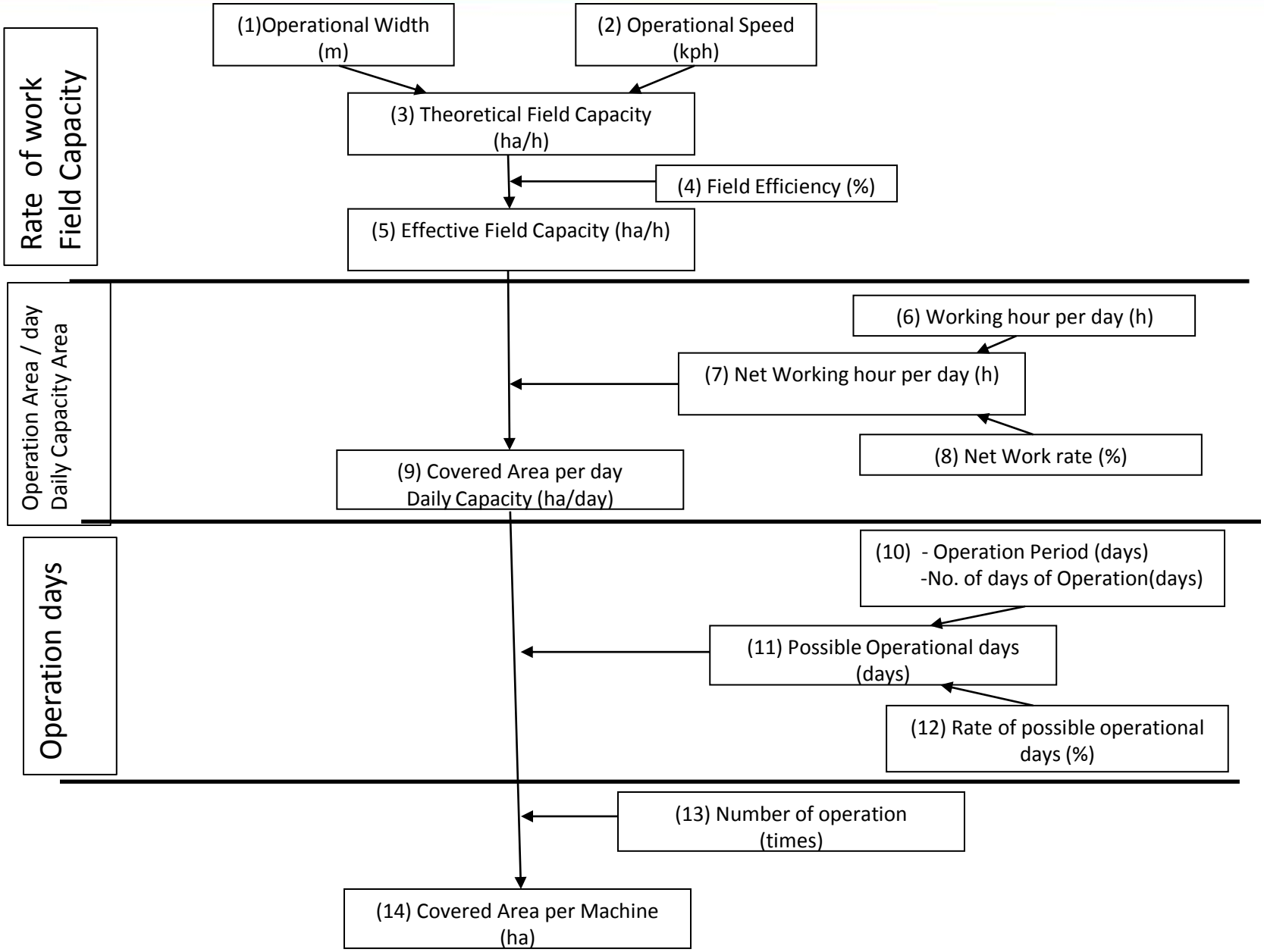




Technical Aspect

Rice Mechanization Technologies

Technical Aspect



Technical Aspect

Name of operation	Equipments	Operation speed (km/h)			Remarks
		Low	Standard	High	
Sowing and Fertilizing	Knapsack power dustor	0.8	1.2	1.6	Use granule blow head
Pest and desease control	Knapsack power applicator	0.8	1.2	1.6	Duster application (boom type blow head)
		1.0	1.2	1.4	Duster application (Single blow head)
		1.1	1.4	1.6	Granule blow head
		0.7	0.9	1.1	Mist blower
	Power sprayer	2.0	2.7	3.4	Horizontal type nozzle
		1.5	2.1	2.6	Swath nozzle
	Power duster	1.1	1.6	2.0	Manual operated type (boom type blow head)
		1.8	2.2	2.5	Pull-type (boom type blow head)
		1.6	2.0	2.3	Mount type (boom type blow head)
	Manual type granule applicator	1.8	2.3	2.9	
Harvesting by reaping & binding	Binder	2.0	2.6	3.3	one row type
		1.8	2.2	2.7	two row type
Harvesting & Threshing	Head-feeding type Combine	1.2	1.6	2.1	0.5~0.7 m cutting width
		1.0	1.4	1.8	0.9~1.3 m cutting width
	Standard Combine harvester	0.7	1.2	1.6	1.5~2.4 m cutting width
		0.7	1.3	2.0	3.0 m cutting width
		1.0	1.5	2.5	4.7 m cutting width

Source: JICA-TBIC2001

Technical Aspect

Name of works	Equipments	Field efficiency (%)			Remarks
		Low	Standard	High	
Plowing	Suki for hand tractor	75	84	94	Pull and dual type power tiller
	Bottom plow	50	62	73	Including Suki with tractor
	Rotary tiller	82	89	96	Dual and power driven power filler
		64	75	86	Above 15p stractor
Plowing & pulverizer	Plow with pulverizer	50	62	73	High-cut plow, plow-rotary etc
Pan-breaking	Sub-soiler	30	35	40	
Pulverizer (harrowing)	Rotary & tiller	82	89	96	Dual and power driven power tiller
		70	82	94	Above 15 ps tractor
	Disk-harrow	65	70	75	
Leveling	Tooth-harrow	70	80	90	
Pressing	Roller	60	65	70	Including culti-packer
Puddling	Paddy harrow	70	82	94	Rotary and leveling plate
Transplanting	Rice transplanter with young seedling	33	54	74	Manual operated one row type
		37	55	74	Power driven two row type
	Rice transplanter with large seedling	39	56	73	Power driven two row type

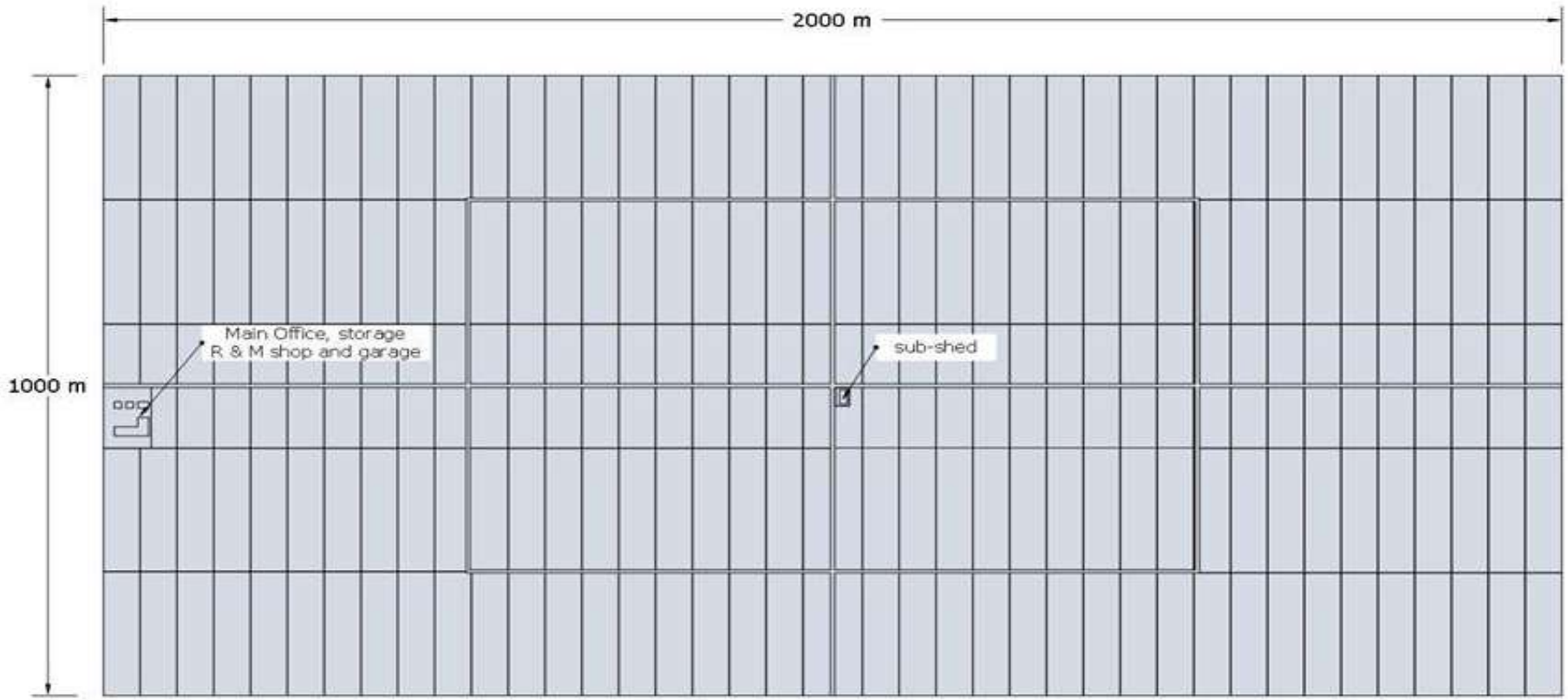
Source: JICA-TBIC 2001

Technical Aspect

Name of works	Equipments	Field efficiency (%)			Remarks
		Low	Standard	High	
Fertilizer application	Manure spreader	20	30	40	Including the feeding and transporting
	Lime sower	40	50	60	
	Broad-castor	45	55	65	
Sowing & fertilizing	Grain drill (Drill seeder)	54	65	76	Power driven (worlking type)
		30	45	60	Direet mounted type
		38	52	66	Traction type
Pest and desease control	Knapsack type power duster	35	50	65	Dusting
	Power sprayer	35	50	65	Used horizontal nozzle
		24	35	46	Swath-nozzle
	Power duster	35	50	65	
	Manual hand sprayer	37	54	71	
Reaping & binding	Reaper binder	47	65	83	
Threshing	Self-propelled power thresher	47	65	83	
Harvesting & threshing	Head-feeding type Combine	34	50	66	Including harvesting by hand in cornner
		51	65	79	Not including by hand harvest
	Standard type Combine	43	55	66	

Source: JICA,-TBIC, 2001

Technical Aspect



Size of Farm roads should be based on the type of machine and PAES 421 Farm to Market Roads (Source: Ruzgal et. al.)

Machinery Coverage Determination

1. Condition of Farm Area

a. Field Condition:

    1. lowland field – flooded condition, transplanted
    2. upland field – dry, un-bunded, directly seeded

- Machinery utilization would depend on the condition of the field/farm.

Machinery Coverage Determination

b. Soil hardness estimation using human foot

(JICA, 2001)

Standard Judgment	Tractor with attachments			Combine (Minimum height from ground)		
	Rotary	Bottom plow	Bottom plow with girdle	< 10 cm	10-20 cm	>20cm
Limits of ease of operation	< 2cm	0	< 1cm	< 2cm	< 3cm	< 4cm
Limits of possible operation	2-5cm	0-2cm	1-5cm	2-5cm	3-7cm	4-10cm
Limits of impossible operation	> 5cm	> 2cm	> 5cm	> 5cm	> 7cm	> 10cm

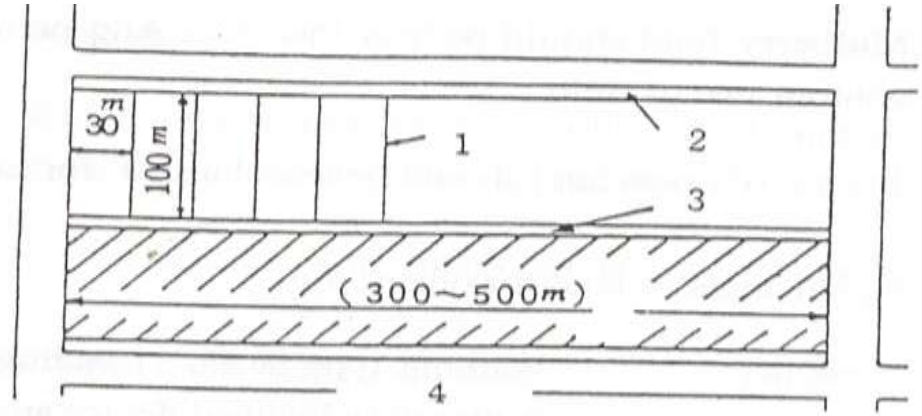
Machinery Coverage Determination

c. Hard pan and soil moisture

Mechanized operation in lowland field condition requires the presence of hardpan.

d. Size and shape of field

Preferably rectangular in shape



1. levee (fixed)
2. irrigation canal
3. drainage canal
4. farm road

Machinery Coverage Determination

e. Inclination of field

1) In case of contour line operation in upland field:

ridging- 6^o

broadcasting, flat ridging or standard cultivation – 10^o

operation of maximum contour line direction – 10^o

Machinery Coverage Determination

f. Inclination of field for other crops

3) Combine :

operation along the contour line - 3^{o}

maximum inclined direction - $< 5^{o}$

Machinery Coverage Determination

g. Length of headland

kind of machine		length of head land
Tractor	fruit garden	about 4 m
	mulberry garden	2–3 m
Trencher	self propelled type (walking type)	about 2 m
	loading type	about 5 m
	self propelled type (riding type)	about 5 m
Power sprayer	loading type	3.5 m
	pulling type	4.5 m
	self propelled type	4.0 m

Source: JICA, 2001

Machinery Coverage Determination

Tractor

Trencher

Machinery Coverage Determination

Power operated sprayers

Self Propelled Power Sprayer
Source:agrio-sprayers.eu

Tractor Mounted Power Sprayer
Source: ycbestmachine.en.made

Tractor Trailer Type Power Sprayer
Source: farmsandequipment.com

Machinery Coverage Determination

h. Farming area measurements

Paddy field	Hight between paddy field to road	(1) 30 cm: Tractor. (2) < 20 cm: head feeding Combine (cutting width 0.8~1.2 m) < 25 cm: conbine (cutting width 1.2~3.5 m) < 40 cm: combine (< 3.5 m cutting width)
	Go into field from road	(1) In case, if there is more than 30 cm hight between paddy field to farm road, and also there are canal between paddy field to farm road, the width should be more than tractor or equipment width, and inclined angle should be less than 12 degree.
Up-land field	Inclination angle	Less than 8~10 degree.
	Radius of curvature	more than 6 m
	Head land	In case of, if you use farm road for head land, the width of farm road should be more than 3.5 m.

Source: JICA, 2001

Machinery Coverage Determination

FARM OPERARTION	AGRICULTURAL EQUIPMENT AND MACHINERY	FIELD CAPACITY					DAILY COVERED AREA			
		Working Width (m)	Operating Speed (kph)	Theoretical Field Capacity(ha/hr)	Field Efficiency (%)	Actual Field Capacity (ha/hr)	Working Hours per day (h)	New Work Rate (%)	Net Working Hours (hr/day)	Daily Capacity (ha/day)
Land Preparation	Four-Wheel Tractor	-	-	-	-	-	-	-	-	-
	Disc Plow	1.0	5.0							
	Rotary Tiller (1st Pass)	1.6	5.0							
	Rotary Tiller (2nd Pass)	1.6	6.0							
Transplanter	Self-propelled Rice Transplanter	1.8	5.0							
Crop Protection	Knapsack Power Sprayer	8.0	1.2							
Harvesting and Threshing	Combine Harvester	1.9	4.4							

Economics of Agricultural Machinery

Economics of Agricultural Machinery

Economics play a vital role in agricultural machinery management.

Selection of the size and capacity of a machine for a particular job requires careful evaluation of all cost items.

Oversized machines require higher investment and may be too large for economic operation with the rest of the machines in the farm (Hunt, 1983).

Undersized machines may give a lower investment but the increased labor cost may offset the savings.

Economics of Agricultural Machinery

The machine that would give the lower investment and operating costs is recommended.

The final decision is influenced by the following:

- suitability of the machine to the crop, to the field, and to weather conditions.
- timeliness of field operation which is governed by the capacity of the machine.
- availability of capital.
- cost and availability of labor and fuel.

Economics of Agricultural Machinery

Benefits and Costs of Agricultural Machinery Operation

Costs can be grouped into two categories:

Fixed costs

are expenses incurred regardless of whether the machine is operated or not.

(a) depreciation

(b) interest on investment

(c) shelter

(d) taxes and insurance

(e) repair & maintenance

Economics of Agricultural Machinery

Fixed costs

1. Depreciation (D) is the reduction in the value of the machine as a result of use (wear and tear) and obsolescence availability of newer and better model).

Straight-line method.

$$D = \frac{\text{Initial cost - Salvage value}}{\text{Useful life}} = \frac{IC - SV}{L} \qquad \text{eqn. 1}$$

where:

SV = salvage value of the machine at the end of useful life usually estimated at zero to 10 percent of initial cost.

L = useful life based on experience and similar machines

Fixed costs

2. Interest on Investment (IOI) is the charge for the use of the money invested on the machine regardless of whether the money was borrowed or not. It is given by the equation below.

$$IOI = \frac{(IC + SV)}{2} X\ r \qquad \text{eqn. 2}$$

where r = interest rate

= bank interest rate on agricultural loans

Economics of Agricultural Machinery

Fixed costs

3. Shelter is provided to protect the machine from robbers and adverse weather conditions, for ease of making repairs, and for better appearance of the farm. Included in the computation of depreciation, interest on investment, insurance, and repair and maintenance.

4. Insurance is the cost of protection of the machine and shelter against calamities and theft.

Economics of Agricultural Machinery

Fixed costs

5. Repair and maintenance costs are fixed allowances provided for the repair of machine and shelter. Usually estimated at 10 percent of initial cost.

6. Taxes are sometimes collected in some places when machine is required to be registered with the local government.

Economics of Agricultural Machinery

Benefits and Costs of Agricultural Machinery Operation

Costs can be grouped into two categories:

Variable costs

are expenses incurred as a result of machine operation

- power costs
- labor
- other inputs.

Project Appraisal

Project appraisal provides a comprehensive review of all aspects of the project.

It includes economic and financial analysis wherein analysis of economic soundness of the project, quantification and valuation of costs and benefits and ensuring financial viability are done

Economics of Agricultural Machinery

Project Appraisal

The methods more often used for evaluating a project as presented by (Sarma, 2010) are:

(1) Simple rate of return (SRR),

(2) Payback Period (PBP),

(3) Break-Even Point (BEP),

(4) Benefit Cost Ratio (BCR),

(5) Net present Value (NVP) or Net Present Worth (NPW)

(6) Internal Rate of Return (IRR)

Project Appraisal

Undiscounted measures of project appraisal do not take into consideration the change in the value of money over time

i.e. SRR, PBP and BEP

Discounted measures of project appraisal take into account the time value of money through the process of discounting

i.e. BCR, NVP and IRR

Undiscounted Measures of Project Worth

Simple Rate of Return

The SRR is a commonly used criterion of project evaluation. It basically expresses the average net profits (Net Cash Flows) generated each year by an investment as a percentage of investment over the investment's expected life

$$SRR = Y/I \qquad \text{eqn. 3}$$

where:

Y = the average annual net profit (after allowing depreciation) from the investment

I = the initial investment

Undiscounted Measures of Project Worth

The calculated SRR should be compared with the investor's Required Rate of Return (RRR) to judge the profitability of the investment.

The investment will be accepted if SRR > RRR, otherwise it will be rejected.

When the SRR of all the investment opportunities is greater than the RRR of the investor, then the investment yielding the highest SRR should be selected.

Undiscounted Measures of Project Worth

Payback period (PBP) is length of time it takes to recover the invested capital or until the net benefits equal the investment cost.

Depreciation is not included in the computation of cost to avoid double accounting since the initial capital is included in the computation.

Undiscounted Measures of Project Worth

$$\text{PBP} = \frac{\text{Initial investment}}{\text{Avearage annual net benefits}} \qquad \text{eqn. 4}$$

where:

Ave. annual net benefits =

$$\frac{\sum_{1}^{n} (\text{Total Benefits} - \text{Total Costs})}{n}$$

n = no. of years of benefits

Undiscounted Measures of Project Worth

Individual investments are ranked according to their relative pay back period with the shortest being the most favored.

The acceptability of the investment is determined by comparison with the investor's required pay back period (RPP).

Accept the investment when the PBP<RPP, otherwise reject the investment.

Undiscounted Measures of Project Worth

Although it is simple and easy to use, the PBP method has two major weaknesses as a measure of investment worth:

(1) this method fails to consider earnings after the pay back period is reached

(2) it fails to consider the difference in timing of cash flows.

Undiscounted Measures of Project Worth

Break-even point (BEP) is level of operation where it neither produces a profit nor incurs a loss.

$$AFC + VC(X) = B(X) \qquad \text{eqn. 5}$$

where:

AFC = annual fixed cost

VC = unit variable cost

B = Unit benefit

X = no. of units for break-even point

Undiscounted Measures of Project Worth

Break-even point (BEP)

Select an investment with BEP that has a lower break-even point among the alternatives.

An investment should be operated above the BEP to be economical.

Discounted Measures of Project Worth

Discounting is a process of translating future values in present worth by applying a set of discount factors.

$$PW = DF \times V \qquad \text{eqn. 6}$$

where:

PW = present worth

DF = Discount factor = $\frac{1}{(1+r)^n}$

r = prevailing bank interest rate

n = no. of years

V = worth of money in the future

Discounted Measures of Project Worth

Example: Find the present worth of P1,000 to be received two years from now at the prevailing bank rate of 21%.

Solution:

$$PW = \frac{1}{(1+0.21)^2} \text{ x P1,000}$$

$$= 0.683 \text{ x P1,000} = P683$$

Economics of Agricultural Machinery

Discounted Measures of Project Worth

Benefit-cost ratio (BCR) is the ratio of present worth of benefit stream to present worth of cost stream and is given by the equation below:

$$BCR = \frac{\sum_{i=0}^{n} \frac{B_i}{(1+r)^i}}{\sum_{i=0}^{n} \frac{C_i}{(1+r)^i}} = \frac{PWB}{PWC} \qquad \text{eqn. 7}$$

where:

B_i = benefits in period i where i runs from zero to n

C_i = Costs in period i where i runs from zero to n

PWB = present worth benefits

PWC = present worth costs

.

Discounted Measures of Project Worth

The investment is said to be profitable when the BCR is one or greater than 1.

Depreciation and interest on investment are not included in the costs to prevent double accounting.

Depreciation is taken cared of by the inclusion of the investment cost while interest on investment is taken cared of by the discount factor.

Discounted Measures of Project Worth

Net Present Value is computed by finding the difference between the present worth of benefit stream less the present worth of cost stream.

It is simply the present worth of the cash flow stream since it is a discounted cash flow measure of project worth along with internal rate of return.

$$\text{NPV} = \text{PWB} - \text{PWC} = \sum_{i=0}^{n} \frac{B_i - C_i}{(1+r)^i} \qquad \text{eqn. 8}$$

Discounted Measures of Project Worth

Internal rate of return (IRR) is that discount rate which just makes the net present value (NVP) of the cash flow equal zero.

It is considered to be the most useful measure of project worth. It represents the average earning power of the money used in the project over the project life.

It is also sometimes called yield of the investment.

Discounted Measures of Project Worth

It is the maximum interest that a project can pay for the use of resources if the project is to recover its investment and operating cost and still break-even.

At this point, the BCR is equal to one. This is usually done by trial and error and by interpolation and using following equations:

$$\text{IRR} = \left[\text{LIR} + (\text{HIR} - \text{LIR}) \text{x} \frac{\text{NPV}_{\text{LIR}}}{\text{abs} / \text{NPV}_{\text{HIR}} - \text{NPV}_{\text{LIR}} /} \right] \quad \text{eqn. 9}$$

Discounted Measures of Project Worth

NPV = net present value $\sum_{i=0}^{n} \frac{B_i - C_i}{(1+r)^i}$ = PWB - PWC

where:

LIR = lower interest rate

HIR = higher interest rate

Procedures in conducting area assessment for CHS of AMTs

Assessment Procedure

Rapid Rural Appraisal (RRA)

A systematic procedure of interdisciplinary activities for generating community information and analyses

Other Terms for RRA: (Cardenas, 2000)

- Participatory Rapid and Systematic Appraisal (PRSA)
- Rapid Community Appraisal (RCA)
- Participatory Rapid Rural Appraisal (PRRA)
- Participatory Rapid Community Appraisal (PARCA)

Why the need of RRA?

rapid, reliable and cost-effective site assessment that involves stakeholders participation, community knowledge using the bottom-up planning approach.

Assessment Procedure

Tools and Methods

- personally talking to local people
- directly observing the local conditions
- studying existing conditions prior to project implementation

Variations in RRA application

- type of topic, questions or issues
- purpose or context for which the information is needed
- conditions in the particular area

Aspects on Type of Topic, Questions or Issues

- scope and specificity
- degree and precision needed
- type of subject matter

RRA Applications

- **Exploratory and baseline appraisal** - usually employed in the beginning of a development activity to aid in understanding project implementation

- **Planning appraisals** - used to plan a whole project or some aspect of a project, gain consensus, stimulate accountability and initiate implementing plans of action among local folks

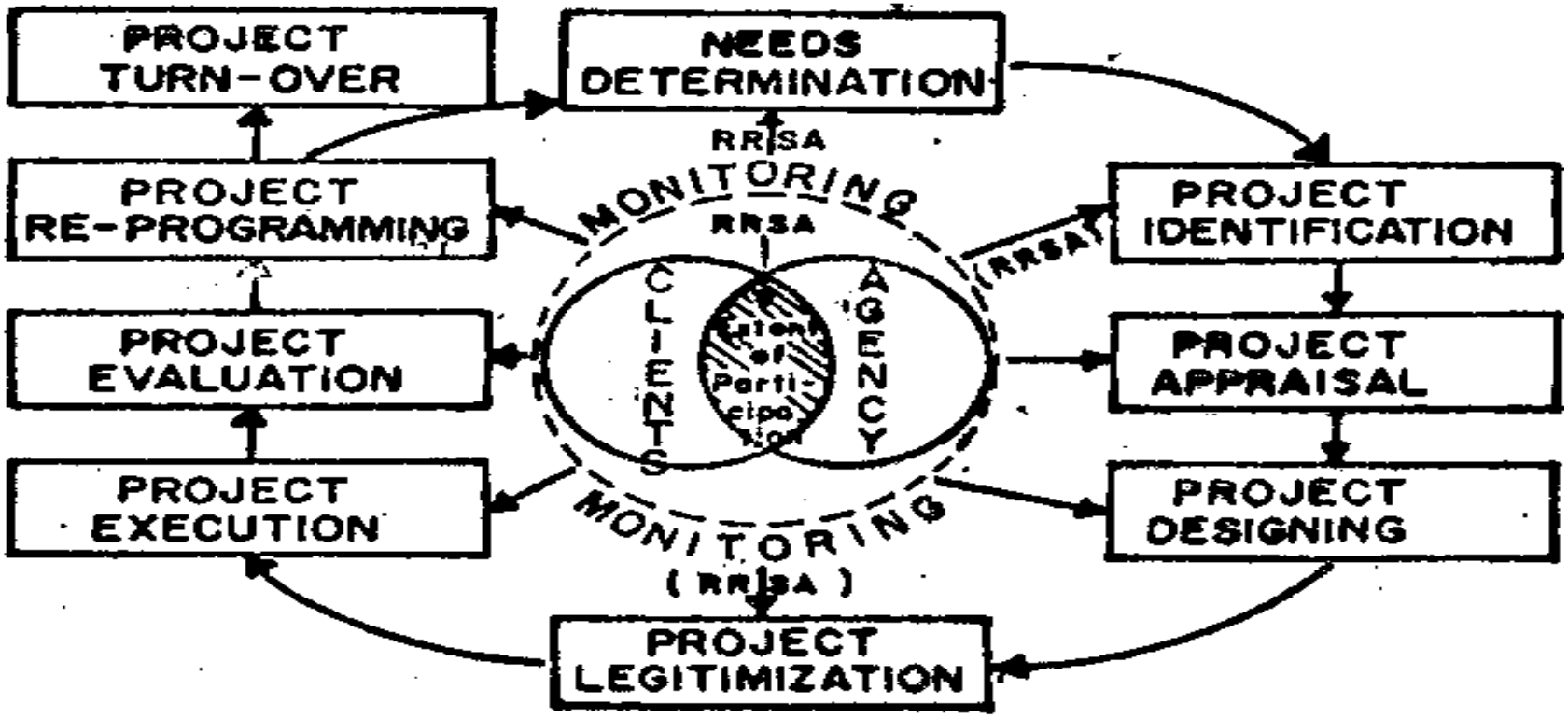
- **Feasibility appraisals -** type of a topical appraisal that can be used to detect flaws in technical design and suggest better alternatives for the project

- **Monitoring appraisals** -used in performance review and detecting problems during the project implementation

- **Evaluation appraisals** - aid project implementers in making project changes and in concluding projects

RRA Applications

PARTICIPATIVE PROJECT CYCLE



RRA Applications

Formulation of Guide Questions

Exploratory appraisal should cover the following aspects:

- bio-physical aspect
- socio-cultural and political aspect
- economic aspect

Field Work

- Respondents should be well represented and informed of the activity (sampling method can be applied)
- Key informants should be carefully identified
- Use Semi-Structured Interview (SSI) questionnaire.
- Suggested techniques for gathering bio-physical information are:
  - ✓ participatory modeling
  - ✓ participatory transects and diagramming
  - ✓ village mapping, etc.

Other forms of participatory data gathering and analysis

- ✓ seasonal calendar
- ✓ farm diagram
- ✓ village map
- ✓ product flows

RRA Applications

Information checklist

a. Socio-Economic Setting

Demographic information
Income sources (off-farm, on-farm)
Labor availability and distribution
Transport facilities
Market and credit
Channels of market information
Cooperatives and other organizations
Land holdings and inheritance pattern
Land tenure status
Social Services

b. Cultural Setting

Migration and ethnic groups
Ethnicity and preferences
Leadership patterns
Social structure
Customs and traditions
Organizations in the community, their roles and impacts
Social network
Rights and obligations with regards to sex, age and groups
Prevailing attitudes and beliefs
Indigenous practices related to the use of natural resources
Peace and order situation
History of the area

c. Bio-physical Environment

Land use pattern*& soil fertility*
Rainfall pattern
Availability of water supply
Typhoon occurrence
Drought periods
Land size
Cropping pattern/ farming system
Availability of seeds, seedlings& animal stock
Dominant pests & diseases
Topography, elevation and temperature range*

**Can be observed and need not be asked from farmers*

Assessment Techniques

RRA Techniques

Interview/Discussion Techniques

- semi-structured
- key informant
- focus or interest groups
- individual and house

Other Oral Linguistic Techniques

- eliciting indigenous technical knowledge
- folk taxonomy
- local custom analysis
- eliciting traditional systems of orgs.
- historical profile analysis
- oral histories
- socio-linguistic status distinction

Assessment Techniques

RRA Techniques

Community Exploration
- community appraisals
- group trek
- brainstorming
- participatory workshop

Site Characteristic Techniques
- agro-ecosystems zoning
- rapid site description

Transect Techniques
- transect analysis
- cross-section
- mapping/drawing

Ranking, Rating and Sorting
- item/class ranking
- contrast sets, etc.

Assessment Techniques

RRA Techniques

Map Techniques
- sketch mapping
- thematic maps
- overlay analysis
- mapping of aerial photos
- historical pattern mapping

Diagrams and other Graphics
- categorical (circle, pie and Venn Diagram)
- resource diagrams
- seasonal diagrams
- patterns analysis
- decision and logic trees

Significant Time Analysis
- seasonal events calendars
- timelines
- flow charts

Source: ENS 211, 2001

Assessment Techniques

RRA Principles

- Accuracy and appropriate precisions
- Avoiding assumptions and haste
- Conscious judgment
- Exploration and flexibility
- Indigenous knowledge
- Interdisciplinary
- Iteration
- Progressive Learning
- Triangulation

RRA Principles

- Organize the RRA team
- Introduce the team, explain the purpose, keep a low profile, be polite, thank the participants for attending the discussion after the interview.
- Assign roles to RRA team (e.g. topic leaders of topic, group "facilitator" who guides interview or discussion, an arbiter who courteously pacify potential arguments, etc.)
- Summarize the day's activity. Discuss and identify findings, determine data gaps and plan for the next activities.

Post Evaluation

Self Assessment Test

Identify the following:

_____ 1. The application of animal and machine power to multiply man's ability to perform production operations .

_____ 2. Mechanization model that motivates in increasing the level of mechanization in order to cultivate large agricultural lands with limited available manpower.

_____ 3. Examples of machines that reduce yield losses.

_____ 4. The most common form of representing the level of agricultural mechanization of a country.

_____ 5. A farming system comprising the development and organization or grouping of parcels of lands to effect the efficient application and utilization of powered machines. This includes the necessary physical and institutional infrastructures.

_____ 6. The expenses incurred regardless of whether the machine is operated or not.

_____ 7. It is the reduction in the value of the machine as a result of use (wear and tear) and obsolescence availability of newer and better model.

_____ 8. It is considered to be the most useful measure of project worth. It represents the average earning power of the money used in the project over the project life.

_____ 9. A systematic procedure of interdisciplinary activities for generating community information and analyses.

_____ 10. It is usually employed in the beginning of a development activity to aid in understanding project implementation

Self Assessment Test

Enumerate the needed information

1-2 Models of Mechanization

3-5 Potentials of Mechanization

6-7 Purpose of the establishment of Custom Hiring Services

8-12 Major key players in the implementation of Custom Hiring Services

13-14 Beneficiaries of Custom Hiring Services

15-17 Benefits of Land Consolidation (contiguous farming)

18-20 Three major aspects to be considered in the establishment of Custom Hiring Services

Self Assessment Test

True or False: Write T if the statement is true and F if the statement is false.

_____ 1. High land area to farmer ratio mechanization model is motivated into increasing the level of mechanization in order to increase yields and cropping intensities to meet the growing demands for food and agricultural raw materials.

_____ 2. Tractor increases labor productivity.

_____ 3. Intermediate level of mechanization involves operations done solely with the use of mechanical power source operated by man.

_____4. Farmers preference on agricultural machines should be considered in establishing the custom hiring services.

_____ 5. Land consolidation encourages synchronize farming to make better use of resources.

_____ 6. Large area and large farm plots are prerequisite for the implementation of custom hiring services of agricultural mechanization technologies.

_____ 7. The availability of Custom Hiring Service for agricultural mechanization technologies n the area will automatically displaces human labor.

_____ 8. The technical aspect of Custom Hiring Services of agricultural mechanization technologies include the perception of the farmer beneficiaries.

_____9. Livelihood generation can be realized when implementing Custom Hiring Services of agricultural mechanization technologies

_____10. In Custom Hiring Services of agricultural mechanization technologies , the economic aspect of using the machines is not important.

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END OF PRESENTATION

Thank you for listening ! ☺