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Specification and selection of farming equipment

JF Rickman,

IRRI, Mozambique

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Outline

- Comparison of different farming system
- Matching equipment to farm size
- Determine specification of each piece of equipment
- Evaluation of a product support and spare parts
- Cost

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Human system of farming (80-90%)






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Animal +human based system (9-16%)






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Small equipment (less 1%)






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Small equipment for milling and transport


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Commercial System (less 1%)






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Which system of production should we select ?

Factors to consider are:

- Energy requirements
- Cost-fixed and operating
- Time to complete task
- Capital investment needed

Comparison of the different systems for plowing 1ha

	Human	2 Animals	2-wheel tractor	4-wheel tractor
Power		1kW	12 kW	40kW
Distance	750 m-3 (100 truck loads)	50km	20km	5km
Time (days)	120-140	10-12	1	2hr
Hours/day	5-6	5-6	8-10	10-12
Energy (hour)	2MJ	22MJ	170MJ	775MJ
Work (MJ /ha)	1560	1584	1530	1550

Total System Comparison

Energy (MJ/ha)

	Human	Animal	Small-equip	Commercial equip
Land preparation	3120	3168	3060	3100
Planting	1228	2382	1228	1951
Weeding	2400	2880	1600	2700
Harvesting	640	640	664	1525
Transport	128	172	340	386
Total	7516	9242	6892	9662

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Total Operating and Fixed Cost ($/ha)

	Human	Animal	Small-equip	Commercial equip
Land preparation	520	88	93	89
Planting	92	56	92	62
Weeding	150	180	120	149
Harvesting	80	80	33	42
Transport	16	8	10	5
Total	**858**	**412**	**348**	**347**

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Time (labor days/ha)

	Human	Animal	Small-equip	Commercial equip
Land preparation	**260**	**22**	**2**	**0.5**
Planting	**40**	**12**	**40**	**0.2**
Weeding	**75**	**90**	**60**	**0.6**
Harvesting	**40**	**40**	**11**	**0.3**
Transport	**8**	**4**	**0.2**	**0.1**
Total	**423**	**168**	**113**	**1.7**

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Capital Cost ($/ha)

	Human	Animal	Small-equip	Commercial equip
Power source		330	160	100
Plow and harrows	20	16	15	24
Trailer		50	23	6
Cone weeders			13	
Boom Sprayer			4	42
Thresher /combine			20	100
Total	20	396	235	272

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Comparing the options

- Similar amount of energy needed
  - especially for land preparation and weed control
- Large differences in time required
- Farm equipment

-less capital investment and less operating costs, reasonable time

-power source for transport, pumping, threshing, electricity

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Matching Equipment to Farm size

- Determine most critical operation
- What area has to be covered in what time period
- Type of plow-moldboard, disc, tine
- Determine tractor size (power kW,hp)

Other factors-What is the field sizes, distance between field

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Theoretical Determination Power Needed

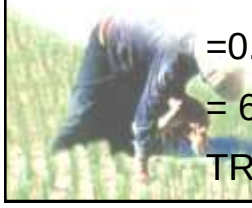
- Most critical operation = First plowing
- Details=5 ha, 8days, 6hrs/day, field efficiency 70%
- Area/h = 5ha/8days/6hrs/70% = 1488 m2/h
- Width plow = Area /Speed x 1000

  = 1488m2/ 3.6km/h= 0.42m =0.5m
- Engine power required = width plow x draft plow x speed /3.6 x 2

  =0.5m x6kN/mx3.6km/h/3.6x2

  = 6kW (7.5hp) minimum

  TRACTOR needed 9-12kw



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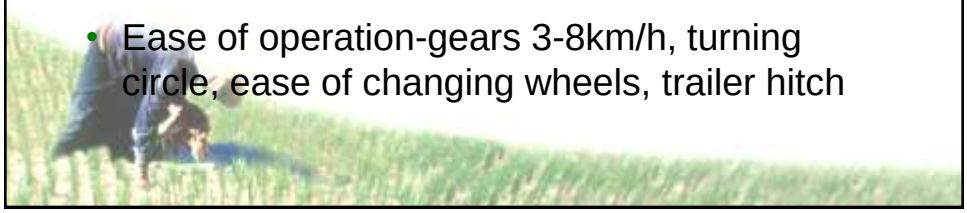
Selecting the Tractor

- Power to weight – 50kg/kW
- Tire options-large narrow tires give best traction. Availability replacement tires
- Tractive ability-front wheel assist (+10%), cage wheels
- Ease of maintenance-water, air filters, oil, grease, fuel
- Ease of operation-gears 3-8km/h, turning circle, ease of changing wheels, trailer hitch



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Selecting the tractor

- Safety- rollover protection, shade
- Simplicity-minimize electronics and computer controlled over rides
- Auxiliary functions –external hydraulics, power take offs, belt drives for other attachments-pumps/generators,
- COST

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2-Wheel Tractors

- Multi purpose vehicle
- Use in wet and dry conditions
- Simple mechanical design
- Cost $300/kW
- Operators fatigue, although rides on versions are now available.
- 40% efficiency
- 1ha/day/2people

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4-Wheel Tractor
(2 wheel drive tractor)

- Smaller turning circle,
- Simplicity of design,
- Fewer mechanical parts, and
- Cost $250-300/kW
- Inability to work in wet soil
- 50% efficiency
- Work rate (40 kW Engine)

  1st Plow = 1ha/hr

  2nd plow = 1.5ha/hr

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4-Wheel Tractor

(4 wheel drive or front wheel assist)

Advantage

- Better traction in wet soil
- 10% more efficient
- Lighter for the same power
- $275-330/kW
- Larger turning circle
- More complex in design
- 55% efficient

Work rate (40kW Engine)

I st Plow = 1.1 ha/hr

2nd Plow = 1.7 ha/hr

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Track laying tractors.

(Chain tractor, Crawler, Caterpillar)

- 65% efficiency
- Good flotation
- Multipurpose
- Cost
- High repair and maintenance

Mainly used for civil works and

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Summary of different tractors for rice

Tractor Type	2 wheel tractor	4wheel tractor- 2wheel drive	4wheel drive tractor	Tracklayers
Power	9-12kw	15-100 KW	15-200 KW	30-100 kW
Efficiency	40%	50%	55%	65%
Farm size	4-10ha	5-50 ha	5-100ha	10-100ha
Cost	$300/kW	$250-300/kW	$275-330 kW	$400-500/kW

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Tillage Equipment

- Primary tillage-Mouldbord, Disc,Tine
- Secondary-Tandem disc, Tine harrows. Rotovator

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Primary Tillage Implements
Moldboard and Disc Plow




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Primary Tillage Implements
Offset and Chisel plow



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Secondary Tillage Implements
Tined cultivator

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Secondary Tillage Implements
Tandem Disc

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Secondary tillage- Rotovator




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Puddling

- Create hard pan to reduce deep water percolation
- Kill emerging weeds prior to planting
- Level fields
- Softens soil for transplanting

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Puddling using 2 wheel tractor

- Cage wheels

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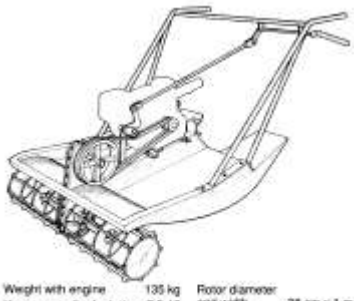
Puddling using a Hydro tiller



Weight with engine	135 kg	Rotor diameter and width	38 cm x 1 m
Horsepower (brake hp)	7.5-12	Rotor speed	325 rpm
Fuel	diesel or gasoline	Field capacity, first pass (puddling and incorporating)	1.8 ha/8 h
Length	195 cm		
Width	100 cm		
Height	75 cm		

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Puddling with 4 wheel drive tractor

- Sealed differentials
- 4 Wheel drive tractor
- Large narrow tires
- Sealed rotovator with depth control

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Equipment summary

	Moldboard	One way Disc	Offset disc	Tine Implement	Rotovator
Power source	Animal, 2 wheel and 4 wheel tractor	2 wheel and 4 wheel tractor	4 wheel tractor	Animal, 2 wheel and 4 wheel tractor	2 wheel and 4 wheel tractor
Width	1-3 shares	2-4 disc	9-21 discs	1-15 tine	0.5m-3.0 m
Soil disturbance	High	Medium - high	High	Low	Very high
Plow action	Total inversion	Inversion	Inversion /cutting	Cutting	Total inversion and pulverization.
Soil Penetration	Share design	Machine weight	Machine weight	Weight/ design	Rotary action of tiller
Weed control	Bury	Bury	Cut/bury	Cut	Bury and chopping
Handle obstacles	Poor	Good	Good	Medium - good	Poor
Power requirement	High	Medium - heavy	Medium - heavy	Low-medium	Very high

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Characteristic needed in a thresher/combine

- Large diameter threshing drum
- Good traction-large diameter wheels or tracks
- Long cleaning area
- Adjustable air fans
- Sufficient power (20kW/ton/hr)
- Easy access to engine
- Good quality bearings

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Peddle Thresher

Peddle threshing

- Grain 150kg/hr
- Cost $100-500

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Portable mechanical thresher

Machine thresher

- 15hp engine
- Grain 1ton/hr
- Cost $3-4000
- High repair and maintenance
- Short straw

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Small 2 wheel tractor threshers

- Built on 2wheel tractor-15hp
- Cost $4-5000
- Small wheels – traction problems
- Stability problems
- Need standing crop

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Small combine harvesters

- Cost $25-30000
- 1-2 ton/ hr
- Traction problems in wet
- Prefer Hydrostatic drives
- 4 wheels for stability

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Large combine harvesters

- Cost $60-200,000
- Throughput 10t/hr
- High maintenance
- Very specialized equipment
- Tracks or tires

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Small Rice mills

- Sufficient power-min 10kw
- Pre cleaner-scalper
- Rubber rollers and sieve supply
- Polished grain separator
- Keep grain temperature below 42C

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Single pass rice mill

- Throughput 250-300 kg/hr
- Cost $3-4000
- Power min 15 kW
- Need rubber roller for husking
- Replacement rollers and steel sieves regulary

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Multi stage rice mills

- Cost $10-11000
- Multi stage 750-1000kg/hr
- Lower temperature
- Better separators
- Less grain breakages

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Evaluating the dealerships or suppliers

- New stock on hand
- Spare parts on hand
- Workshop
- Trained mechanics
- Backup equipment
- General appearance-cleanliness
- Reputation

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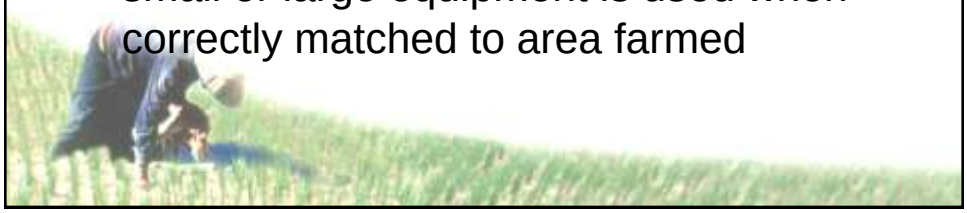
Power require to increase production

- 1 kW power to produce 5 tons grain
- 1kW power to farm 2-3ha
- 1kW power cost $300-350
- Total cost per ha is similar whether small or large equipment is used when correctly matched to area farmed



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THANK YOU