

APPENDICES

APPENDIX-A
Different Farm Machinery and Equipment in Use in different States, Gaps and Future Requirements

ANDHRA PRADESH
Farm mechanization gaps and equipment required

Sl. No.	Crop	Operation	Traditional implements/practices			Improved implements required			Agro climatic zone(s) facing mechanization gaps
			Name	Power source	Size	Name	Power source	Size	
1.	Paddy	Sowing (wet lands)	Broadcasting	Human	–	Power operated paddy row seeder	5 hp diesel engine	2m, 10 rows	All zones
2.	Paddy	Sowing (dry lands)	Broadcasting	Human	–	Tractor drawn paddy drill	35 hp tractor	2 m, 9 rows	All zones
3.	Paddy	Weeding	Weeding	Human	–	Manual weeder	Manual	45 cm, 2 rows	All zones
4.	Maize	Shelling	Thresher	5 hp electric motor	50 cm × 10 cm cylinder	Tractor operated dehusker-cum-sheller	35 hp tractor	60 cm × 30 cm threshing drum	Northern Telangana and Southern Telangana zones
5.	Sugarcane	Harvesting	Knife	Human	45 cm	Self-propelled sugarcane harvester	10 hp diesel engine	1.5 m cutter bar	All zones
6.	Both dry and wet land crops	Leveling	Wooden leveler	Bullocks	120 cm 25 cm	Improved leveler	Bullock	(150 × 25) cm with (150 × 10) cm blade	All zones
7.	All dry land crops	Sowing	Gorru	Bullocks	4 row	Improved gorru	Bullock	6 nos. with metering mechanism	All zones
8.	Dryland row crops	Interculture	Danthi	Bullocks	30 cm to 60 cm	Improved danthi	Bullock	3 blades 20 cm × 10 cm	All zones
9.	All dry land row crops	Interculture	Local tools	Human and Animal	–	High clearance power weeder	5 hp diesel engine	47.5 cm width	All zones
10.	All dry land row crops	Spraying	Knapsack sprayer	Human	20 litre capacity	High clearance sprayer	5 hp diesel engine	6 m width 14 nozzles	All zones
11.	Pulses (Green gram, black gram, bengal gram)	Harvesting	Sickle	Human	20-22.5 cm	Self-propelled harvester	5 hp diesel engine	1.2 m cutter bar	All zones
12.	Root crops (Groundnut, potato, carrot)	Tillage	Local tools	Bullocks and tractors	–	Rotavator with ridger	4.5 hp tractor	1.5 m	All zones
13.	Cotton	Picking	–	Human	–	Self-propelled cotton picker	5 hp diesel engine	–	Coastal AP and Telangana
14.	Vegetables (Okra, beans, cucumber)	Sowing	Dibbling	Human	–	Tractor drawn vegetable planter	35 hp tractor	2 m width 4 to 6 rows	All zones
15.	Vegetables (Chillies, brinjal, tomato)	Trans-planting	–	Human	–	Self-propelled vegetable planter	5 hp diesel engine	1.6 m width 2 rows	All zones
16.	All three crops	Spraying	Foot sprayer	Human	–	Orchard sprayer (self-propelled)	5 hp diesel engine	10 m height 3 nozzles	All zones
17.	Orchard trees (Mangoes, sapota, guava, lemon, orange etc.)	Harvesting	–	Human	–	Power operated tree shaker	5 hp diesel engine/tractor	–	All zones

ARUNACHAL PRADESH, ASSAM, MANIPUR, MEGHALAYA, MIZORAM, NAGALAND, SIKKIM AND TRIPURA**Traditional and improved agricultural implements being used by the farmers for different operations and improved agricultural machinery to be introduced for popularization**

Operation	Implements being used		Improved implements suggested for introduction
	Traditional	Improved	
Seedbed preparation			
Ploughing	Khasi spade; local plough	Khasi spade, MB plough	Power tiller mounted 12.5 cm MB plough; Animal drawn Puddler; 10 cm light ridger plough
Harrowing	Peg tooth harrow	Disc harrow (offset); power tiller	Peg tooth puddler; comb harrow; ANGRAU animal-drawn puddler
Shallow cultivation	–	–	3 tines cultivator (Animal drawn/Power tiller)
Clod crushing	Local plough	–	–
Land leveling	Leveler	–	Animal drawn leveler
Seeding/planting			
Sowing	Dibbler	–	Metallic dibbling stick; B.D. seed drill; CIAE seed drill; pre-germinated paddy seed drill; seed-cum-fert. drill
Planting	–	–	Manual and self-propelled mechanical rice transplanter; semi-automatic vegetable transplanter; sugarcane cutter planter
Weeding and hoeing			
Weeding	Khasi spade (small)	–	8 cm weeder; wheel hoe with showel and V-blade
Interculture	Khasi spade (small); hand fork	–	V-blade hand hoe; CIAE low cost weeder
Bund/furrow making	Khasi spade	–	Bullock drawn and Power tiller operated bund/border former
Spraying and dusting			
For field crops	–	–	Hand rocking sprayer; foot sprayer; hand compressed sprayer; knapsack sprayer; power sprayer
For tall crops	–	–	Hand rocking sprayer; foot sprayer; hand compressed sprayer; knapsack sprayer; power sprayer
For trees/shrubs	–	–	Hand rocking sprayer; foot sprayer; hand compressed sprayer; knapsack sprayer; power sprayer
Irrigation			
Water lifting	Swing bucket	Shallow tube wells	Diesel and electric pumping sets; foot pumps; diaphragm pumps
On field application	–	–	Drips; sprinklers
Harvesting/digging/uprooting			
	Sickle	–	Serrated sickle; fruit harvester; orchard ladder; walking type vertical conveyor reaper
Threshing/shelling			
	Maize sheller	Pedal operated paddy thresher	Tubular maize sheller; power operated drum paddy thresher; axial flow power thresher; multicrop thresher
Winnowing/cleaning/grading			
	–	–	Manual and power operated winnowing fan; grain precleaner; fruit grader

Operation	Implements being used		Improved implements suggested for introduction
	Traditional	Improved	
Straw management			
Reaping	–	–	Auxillary engine operated bush/grass cutter
Incorporating in soil	Manual	–	Shredding with tractor-mounted shredder and incorporation with MB plough; retrieval, composting and vermi-composting
Baling	–	–	Baler
Densifying	–	–	Feed block making machine
Stubble shaving	–	–	Power tiller, Tractor-mounted stubble shaver
Other operations (not listed above)			
Milling of cereals, pulses and oilseeds	Counter poise foot pounder	Huller	Mini grain mill; mini rice mill; mini dal mill; mini oil expeller
Cutting trees	Dao	–	Auxillary engine operated disc and chain saw
Chaff cutting	Dao	–	Manual and power operated chaff cutter
Horticultural tools	Dao, knife	–	Horticultural tools

BIHAR

Farm tools and equipment to be developed

Sl.No.	Crop	Operation	Tool/implement required to be developed	Specification			
				Capacity	Power source	Expected annual use (h)	Individually owned or for custom hiring
1.	Paddy	Transplanting	Transplanter,	0.15 ha/h	Self-propelled,	200	Custom hiring
						Threshing	Thresher
2.	Wheat	Harvesting	Reaper	0.2 ha/h	Self-propelled 3.7kW power tiller	200	Own/Custom hiring
3.	Potato	Planting, Harvesting	Potato planter, Potato digger	0.1-0.2 ha/h	Tractor		
4.	Jute	Planting	Jute planter				
5.	Onion	Transplanting	Transplanter	0.2 ha/h	Self-propelled 3.7kW	200	Own/Custom hiring

Farm tools and equipment in use

Sl. No.	Operation	Name of implement	Power source and size	No. of persons required to operate	Work capacity (ha/h)	Crops for which used
1.	Tillage	Spade	Human	One	0.008	Paddy, wheat, jute
		Desi plough	A pair of bullocks	One	0.016	
		M.B. plough	A pair of bullocks	One	0.036	
		Cultivator, M.B. plough, Disc plough	Tractor	One	0.4, 0.25, 0.35	
2.	Interculture	Khurpi	Human	One	0.007	All crops
3.	Plant protection	(i) Sprayer	Human	One	0.2	All crops
		(ii) Duster	Human	One	0.2	All crops
4.	Harvesting	Sickle	Human	One	0.005	All crops
5.	Threshing	Thresher	Engine/motor	Two	2-3 q/h	Paddy, wheat

Farm tools and equipment requiring improvement

Sl. No.	Farming system	Crop	Operation	Tools/implements required to be improved	
				Implement	Power source
1.	Hand tools	Paddy	Field preparation, sowing/transplanting, interculturing Harvesting, threshing	3 tine grubber, paddy weeder, improved sickle, ferti. broadcaster, sprayer, foot operated paddy thresher	Human
		Wheat			
2.	Bullock operated farm	Paddy	Field preparation, sowing/transplanting, interculturing Harvesting, threshing	Puddler, M.B. plough, seed drill/transplanter, disc harrow-cum-puddler, ridger	A pair of bullocks
		Wheat			
3.	Tractor operated farm	Paddy	Field preparation, sowing/transplanting, interculturing Harvesting, threshing	M.B. plough, peddler, disc harrow, cultivator, rotavator, ridger, seed-cum-ferti. drill, reaper, thresher (wheat/paddy)	Electric motor for thresher Tractor
		Wheat			

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Improved implements suggested for introduction

- Tawi plough, soil stirring plough, power tillers, Tawi plough with Pora attachment.
 - Tractor mounted (TM) disc plough and disc harrow, rotavator.
 - Peg tooth harrow, tine tiller, bar harrow, paddy puddler-cum-leveller, tractor mounted disc harrow, harrow-cum-puddler, rotavator (where fine seed bed is needed).
 - Tractor mounted-clod crusher.
 - Rake-cum-leveler, scrapper, floats.
 - Zero-till seed-cum-fertilizer drills, raised-bed-planter, TD/AD inclined planter.
 - Multicrop seeder (cup metering), TM/PT planter.
 - Automatic/semi-automatic planter in valley and plains.
 - Manual/self-propelled rice transplanter (under introduction).
 - Semi-automatic vegetable transplanter.
 - Tractor operated auger for pit making, plant replacer.
 - Wheel hoe for upland and star weeder/cono-weeder for wetland.
 - Wheel hoe, cultivator, power weeder.
 - Tractor mounted scrapper and disc type bund formers (in plains), Tractor mounted furrower.
 - Knapsack power sprayer, knapsack rocking sprayer with long boom..
 - Power/PT operated sprayer.
 - Air assisted/ Aeroblast sprayers.
 - Electric pumpsets-centrifugal for low lifts, submersibles for higher lifts, foot pump and diaphragm pumps for low lifts.
 - Sprinkler sets for field crops and closely planted horticultural crops and drips for crops in larger grid.
 - Potato digger, orchard ladder, walking /riding and tractor mounted vertical conveyor reaper for wheat, barley, oats, rice etc.
 - Power operated paddy thresher; sunflower power thresher, multicrop power thresher.
 - Tubular sheller, Engine/motorized maize sheller.
 - Power operated winnower, fruit grader, rotary/oscillating screen pre-cleaner, petkas type cleaner-grader.
 - Zero-till drill, straw incorporator, straw shedder and incorporation with MB plough.
 - Baler, Feed Block Machine.
 - Tractor mounted stubble shaver.
 - Hand and power operated chaff cutters.
 - Mini-rice Mill, Mini Dal Mill and Mini Oil Expeller (engine or motor operated for on-farm agro-processing).
 - Solar Dryer for Apricots/Fruits, Saffron Solar Drier.
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JHARKHAND

Farm tools and equipment in use

Sl. No.	Operation	Name of implement	Power source and size	Number of persons required to operate	Work capacity (ha/h), (kg/h)	Crops for which used	Expected annual use (h) approx.
1.	Tillage	Desi plough	Bullock drawn, 15 cm	One	0.158	All <i>kharif</i> and <i>rabi</i> crops	500
		Birsa ridger plough	Bullock drawn, 15 cm	One	0.173	All crops	500
2.	Interculture	Dutch hoe	Manually operated, 10 cm	One	0.050 (by 2 labours)	All crops	400
		Khurpi	Manually operated, 5 cm	One	0.018	Upland crops	100
		Kudal	Manually operated, 20 cm	One	0.075 (by 2 labours)	Multipurpose	350
3.	Plant protection	Knapsack sprayer	Manually operated, 15 litres	One	0.20	All crops	200
4.	Harvesting	Local sickle	Manually operated	One	0.018 ha/h	All field crops	100

Farm tools and equipment requiring improvement

Crop	Operation	Tool/implement required to be improved	Tool/implement required to be improved	
			Implement	Power source
Upland rice	Weeding	Dutch hoe	Local khurpi	Human
	Harvesting	Naveen sickle	Local sickle	Human
		Puddler	Birsa ridger plough/desi plough	Bullocks
		Japanese paddy weeder	By hand pulling	Human
	Harvesting	Vertical conveyor reaper	Local sickle	Human
	Threshing	Multicrop thresher	By beating on wooden plank	Human
Maize, Arhar	Seedling and fertilizer application	Rotary dibbler/any planter	Behind the plough/broadcasting	Human
Groundnut	Planting with fertilizer application	Groundnut planter/Jyoti planter/CRIDA plough drill	Behind the plough	Human
	Harvesting	Groundnut digger	Spade	Human
Vegetable	Seedling and fertilizer application	Naveen dibbler	By hand dibbling and planting	Human
Wheat	Harvesting	Vertical conveyor reaper	Local sickle	Human
	Threshing	Multicrop thresher	Bullock trading	Bullocks

Farm tools and equipment to be developed

Sl.No.	Crop	Operation	Tool/implement required to be developed	Specification			Expected annual use (h)
				Size	Capacity	Power source	
1.	Rice	Puddling	Puddler	50 cm	0.1ha/day	Bullock	240
		Transplanting	Transplanter	–	–	Human	240
		Weeding (transplanted rice)	Paddy cono weeder	15 cm	0.25 ha/h	Human	240
		Threshing	Paddy thresher	85–120 cm	80–100 kg/h	Human	450
2.	Vegetable	Seeding and fertilizer application	Dibbler	Single row	0.028 ha/h	Human	240
3.	Fruits (mango, guava, litchi)	Harvesting	Fruit harvester (plucker)	Single action	100 kg/h	Human	500
4.	Potato	Planting	Planter	Single row	0.10 ha/h	Bullock	240
		Grading	Grader	–	140 kg/h 400 kg/h	Human Electric motor	240
5.	Wheat	Direct seeding without tillage operation	Seed-cum-ferti. drill	2–3 row	0.12 ha/h	Bullock	240
6.	Oilseed	Seedling	Seed-cum-ferti. drill	Single row	0.20 ha/day	Bullock	240
					0.06 ha/h	Human	

KARNATAKA
Farm tools and equipment in use

Sl. No.	Operation	Name of implement	Power source and size	Number of persons required to operate	Work capacity	Salient features	Crops for which used	Expected annual use (h) approx.
1.	Tillage	M.B. Plough (TM)	Tractor 35 hp	One	1 ha/day	–	–	–
		Tiller (TM)	Tractor 35 hp	One	1.5 ha/day	9 tines	All crops	720
		Puddler (TM)	Tractor 35 hp		1 ha/day			
		Pal guru (TM)	Tractor 35 hp		1.5 ha/day			
2.	Sowing and planting	Local seed drill (AD)	Bullocks	Two	0.4 ha/day	Manual metering	Jowar	600
		Tractor drawn seed drill	Tractor		2 ha/day	Star wheel	Jowar	300
3.	Plant protection	Manual Knapsack sprayer	Human	One	0.55ha/day	Hand operated	All crops	600
		Power sprayer	1.5 hp engine	One	1.4 ha/day	Power operated	All crops	300
4.	Harvesting	Combine, Harvester	58 hp engine	Three	12 ha/day	Power operated	Paddy	720
5.	Threshing	Thresher	5 hp engine	Three	200 kg/h	Power operated	Paddy	240

Farm tools land equipment requiring improvement

Sl. No.	Crop	Operation	Tools/implements required to be improved	
			Implement	Power source
1.	Sugarcane	Planting	Planter	Bullock
2.	Bengal gram/green gram & black gram/sorghum/bajra	Sowing	Seed drill	Bullock/tractor 45 hp
3.	Red gram	Dusting and spraying	Duster, sprayer	3.5 hp petrol engine
4.	Paddy	Transplanting, harvesting	Transplanter/drum seeder and front mounted reaper	Self-propelled 35 hp tractor
5.	Groundnut	Harvesting and threshing	Digger and thresher	Bullock 5.4 hp diesel engine
6.	Castor	Decortication	Decorticator	5 hp engine
7.	Sunflower	Sowing and harvesting	Tractor drawn multi-crop planter/harvester	35 hp tractor
8.	Safflower	Harvesting and threshing	Combine harvester	35 hp tractor
9.	Cotton	Spraying and harvesting	High clearance sprayer&mechanical picker for cotton	10/5 hp diesel engine
10.	Wheat	Harvesting	Front mounted reaper	35 hp tractor
11.	Ragi	Sowing, harvesting	Seed-cum-ferti. drill,	Bullock/tractor
		Threshing	Reaper and thresher	5 hp diesel engine
12.	Coconut/arecanut/mango/papaya	Harvesting	Harvester	Manual plunker
13.	Chili	Drying	Batch type dryer	5 kW electric heater
14.	Tur	Spraying/dusting, combine threshing and harvesting	Duster/combine/harvester	3.7 kW petrol engine 35 hp tractor

Farm tools and equipment to be developed

Sl. No.	Crop	Operation	Tool/implement required to be developed	Specification			
				Size	Capacity	Power source	Expected annual use (h)
1.	Paddy	Transplanting	Transplanter	Small/medium	1–1.5	2.97 kW Self-propelled, diesel engine	750
	Paddy/wheat	Harvesting and threshing	Combine	Medium	10 ha/day	2.97 kW Self-propelled/tractor	800
2.	Sorghum/bajra	Harvesting	Ear head harvester	Medium	2 ha/day	Tractor	500
3.	Red gram	Dusting	Duster	Medium	1–2 ha/day	Bullocks/2.6 kW petrol engine	800
4.	Groundnut	Harvesting	Harvester	Medium	1 ha/day	Self-propelled, 3.7 kW diesel engine	400
		Threshing	Thresher	Medium	200–250 kg/h	Diesel engine 5.96 kW	400
5.	Cotton	Harvesting/picking	Mechanical harvester/picker-2 row	Medium	2 ha/day	Self-propelled, diesel engine	450
6.	Sugarcane	Planting	Planter	Medium	1 ha/day	Tractor	250
		Interculturing and earthing up	Weeder, earthing tool	Small	1 ha/day	Diesel engine 3.7 kW	600
		Harvesting	Harvester	Medium	2–4 ha/day	Tractor	1000
7.	Ragi	Harvesting and threshing	Harvester/thresher	Medium	2–3 ha/day	Self-propelled/tractor	800
8.	Potato	Harvesting/picking	Planter digger	Medium	1-2 ha/day	Self-propelled/tractor	450
9.	Coconut/arecanut	Harvesting	Engine operated tree climber/harvester	Medium	1 ha/day	Engine	1000
10.	Chilli	Drying	Batch type dryer/forced circulation	Medium	100 kg/batch	Solar/electrical power	1000
11.	Safflower	Harvesting and threshing	Combine harvester	Medium	2 ha/day	Self-propelled/tractor	200
12.	Tur	Dusting	Duster	Small/medium	1 ha/day	Engine 2.6 kW	400

KERALA

Farm tools and equipment in use

Sl. No.	Operation	Name of implement	Power source and size (hp)	No. of persons required to operate	Work capacity	Salient features	Crops for which used	Expected annual use (h)	Scope for improvement in design
1.	Tillage	(i) Tractor cultivator	35	1	0.30 ha/h	9 tine	Paddy	650	–
		(ii) Tractor cage wheel	35	1	0.30 ha/h	X-wide cage wheel	Paddy	460	Puddler should be attached with tractor
		(iii) Tiller rotavator	10	1	0.10 ha/h	Puddling	Paddy	800	Angle of blade to be improved
2.	Sowing/ planting	Self-propelled transplanter	3.5	3	0.18ha/h	Riding	Paddy	575	More extension work needed
3.	Interculture	Cultivator	Tractor 35	1	0.5 ha/h	-	-	210	Rotavator to be used
4.	Plant protection	(i) Knapsack	Manual	1	0.30 ha/h	–	Paddy	150	–
		(ii) Knapsack	Engine, power tiller	1	0.40 ha/h	–	Paddy	260	–
		(iii) Rocker		3	0.20 ha/h	Tree crops	Arecanut/ coconut	30	Power tree sprayer for arecanut, coconut, etc. needed
		(iv) Power sprayer		3	0.25 ha/h	Portable	Rubber	400	More demonstration and availability on custom hiring
5.	Harvesting	(i) Sickle	Manual	1	0.004 ha/h	Local	Paddy	200	Crop tigers are to be introduced
		(ii) Sickle	Manual		0.05 ha/h	Climbing	Coconut	400	Climbers are not available
		(iii) Sickle	Manual		–	–	–	–	All crops are harvested manually
		(iv) Tapping knife	Manual		500 trees/day	–	Rubber	400	Ergonomically and plant friendly designs are needed

Farm tools and equipment to be developed

Sl. No.	Crop	Operation	Tool/implement required to be developed	Specification			
				Size	Capacity	Power source	Expected annual use (h)
1.	Paddy	Dry sowing	Seeder	8–10 row	0.4 ha/h	Tractor	200
2.	Paddy	Wet sowing	Seeder	8–10 row	0.25ha/h	Tractor	200
3.	Paddy	Transplanting	Transplanter	8–10 row	0.12 ha/h	Self-propelled	250
4.	Paddy	Harvesting	Reaper	1.6 m	0.2 ha/h	Tiller	350
5.	Paddy	Harvesting	Reaper	2.2 m	0.4 ha/h	Tractor	400
6.	Paddy	Threshing	Axial-flow paddy thresher	Portable 5.96 kW	1000 kg/h	Engine 5.96 kW/ motor 3.7 kW	600
7.	Coconut/ arecanut	Climbing and harvesting	Climber-cum-harvester	Knapsack	20 min/tree	Petrol engine 1.49–2.23 kW	1200
8.	Coconut/ arecanut	Dehusking nuts	Dehusker	Power operated	2 min/nut	Engine 3.7 kW	1500
9.	Rubber	Pit making	Power tiller/engine/ tractor mounted pit digger	10 to 35 hp	110 pits/day	Power tiller/ engine/tractor	1000
10.	Rubber	Mulching	Power tiller operated	10 hp	1.2 ha/day	Power tiller	800
11.	Rubber	Manuring	Fertilizer applicator	1 to 1.5 m	0.2 ha/h	Power tiller	200
12.	Rubber	Tapping	Hand tool	Human	400 to 500 trees/day	Manual 200	1500
13.	Rubber	Rubber sheet curing	Modern smoke house	Electric motor operated	–	Electric motor	1000
14.	Pepper	Plant protection	Sprayers	0.746 kW	0.4 ha/h	Petrol engine	300
15.	Pepper	Drying	Hot air dryer	0.746 kW	50 kg/h	Electric motor	200
16.	Pepper	Threshing	Thresher	0.746 kW	50 kg/h	Electric motor	100
17.	Cardamom	Mulching	Mulching machine	3.7 kW	0.1 ha/h	Mini tiller	250
18.	Cardamom	Forking	Mini tiller	3.7 kW	0.1 ha/h	Mini tiller	250
19.	Cardamom	Plant protection	Sprayer	0.746 kW	0.4 ha/h	Petrol engine	300
20.	Cardamom	Curing	Washer-cum-dryer-cum-polisher	0.746 kW	5 kg/h	Electric motor	400

Farm tools and equipment requiring improvement

Sl. No.	Farming system	Crop	Operation	Tool/implement required to be developed	Conventional Implement	practice Power source	Factors calling for improvement (please specify)				
							Capacity (ha/h)	Efficiency	Poor functioning	Drudgery	Safety
1.	TOF	Paddy	Transplanting	Power transplanter	Manual	Human	Low	Low	Soil	-	-
2.	TOF	Paddy	Harvesting	Reapers	Sickle	Human	Low	Low	High	Traction	Traction
3.	TOF	Paddy	Threshing	Thresher	Beating	Human	Low	Low	Wet crop	Dusty	Transportation
4.	MF+TOF	Rubber	Pit making, smoking	Pit diggers, modern smoke house	Manual, fire wood smoke	Human	Low	Low	Yes	Yes	Yes

MADHYA PRADESH**Farm tools and equipment requiring improvement**

Sl. No.	Crop	Operation	Tool/implement required to be improved
1.	Soybean	Weeding	BD Dora
		Harvesting	Self-propelled reaper
2.	Wheat	Seeding	Dufan/Tifan
		Harvesting	Sickle
3.	Cotton	Seeding	BD/TD planter
		Plant protection	Power operated sprayer
4.	Rapeseed and mustard	Seeding	BD seed-cum-fertilizer drill
		Interculture	Hand hoe
		Threshing	Thresher (engine/motor operated)
5.	Gram	Seeding	TD planter
		Interculture	Hand/wheel hoe
6.	Paddy	Transplanting	Rice transplanter
		Interculture	Weeder
		Harvesting	Self-propelled reaper

Farm tools and equipment to be developed

Sl. No.	Crop	Operation	Tool/implement to be developed	Size, capacity and power source	Expected use, (h/year)
1.	Soybean	Weeding	Weeding attachment to self-propelled walking type reaper	3-5 row, 3.7 kW diesel engine	200-300
		Harvesting	Small combine	1 m width, 37.3 kW diesel engine	300-500
2.	Paddy	Transplanting	Self-propelled mechanical rice transplanter	6-8 rows, diesel engine 3.7-4.47 kW	200-300
3.	Wheat	Harvesting	Small combine	1 m width, 37.3 kW diesel engine	300-500
4.	Cotton	Weeding	Power weeder	2-3 rows, 4.47- 7.46 kW diesel engine	150-200
		Spraying	Spraying attachment to power weeder	4.47- 7.46 kW diesel engine	150-200
5.	Vegetable	Transplanting	Tractor operated vegetable transplanter	2 row, 35 hp tractor	250-300

Farm tools and equipment in use

Sl. No.	Operation	Name of the implement	Power source and size	Number of persons required to operate	Work capacity (ha/h)	Salient features	Crops for which used	Expected annual use (h)	Capacity	Scope for improvement in design	Durability	Safety
1.	Tillage (animal drawn)	Indigenous country plough	Bullock pair	One	0.02	Triangular shape	All crops	750	-	-	By steel share	-
		Iron plough	Bullock pair	One	0.03	Long life	All	750	-	-	By steel share	-
		Blade harrow	Bullock pair	One	0.05	Straight blade	All	800	Capacity may increase as per bullocks weight	Improvement of blade under moist soil, the size of blade may increase as per soil type	-	-
	(Power operated)	Wooden rake	Bullock pair	One	0.4-0.5	Straight	All	800	-	-	By steel	-
		Cultivator	Tractor 25, 35, 45, 50 hp	One	0.35-0.45	9, 11, 13 rigid tine with reversible shoval or sweep and shoval	All	900	Trained persons	Trained persons	-	-
		Disc harrow	Tractor 35 and 45 hp	One	0.45-0.60	Two gang offset disc	All	600	Trained persons	Trained persons	-	-
		Blade harrow	Tractor 35 and 45 hp	One	0.50-0.60	Three straight blade	Kharif crops	300	Trained persons	Trained persons	-	-
		Rotavator	Tractor 35 and 45 hp	One	0.35-0.40	L shape blade	All crops	700	Trained persons	Trained persons	Breakage of chain and wear out of blades	-
		Rotary/Puddler	Tractor 35 and 45 hp	One	0.18-0.20	Puddler with cage wheel	Paddy	200	Trained persons	Trained persons	-	-
		MB plough	Tractor 35 and 45 hp	One	0.3-0.4	2-3 bottom	For fallow or weeded field	300	Trained persons	Trained persons	Care and maintenance	-
		Disc plough	Tractor 35 and 45 hp	One	0.3-0.4	2-3 bottom	For fallow or weed field	300	Trained persons	Trained persons	-	-
2.	Sowing/planting (animal drawn)	Manual broadcasting	Manual	One	0.5	Easy and cheap	Paddy+all grains + pulses + millet crops	-	-	-	-	-
		Country plough (Nari)	Bullock pair	Two	0.02	Depth of seed placement may adjusted/easy and cheap	All grains + pulse + oilseed + millets	+300	Mechanical seed metering in place of manual metering	-	-	-

Sl. No.	Operation	Name of the implement	Power source and size	Number of persons required to operate	Work capacity (ha/h)	Salient features	Crops for which used	Expected annual use (h)	Scope for improvement in design			
									Capacity	Efficiency	Durability	Safety
		Tiffan	Bullock pair	Two	0.08	Three furrow opener with reversible shovel	All crops	400	-	-	-	-
	Power operated	Seed drill	Tractor	One	0.20-0.25	Fluted roller metering mechanism reversible shovel	All crops	800	Trained person	Care and maintenance	Chain guard	-
3.	Inter-culture	Khurpi	Human	One	0.002	Flat edge	All crops	300	-	-	-	-
		Spade	Human	One	0.004	Flat edge	Wide row and vegetable crops	150	-	-	-	-
		Cycle wheel/paddy hoe/wheel hoe	Human	One	0.004-0.008	Adjustable depth different tool width	All crops at soil working condition	300	-	-	-	Provision of pulling hook
4.	Plant protection	Knapsack sprayer	Human	One	0.15	Compression type, 14 litre	All crops	300	-	-	-	Mask
		ULV sprayer	Battery 6V	One	0.20	Single disc	All crops	200	-	-	-	Mask
		Mist blower	Petrol engine 0.89 kW	One	0.35	More effective for pulse crops	All crops	150	-	-	-	Mask
5.	Harvesting	Local sickle	Human	One	0.004	Multiple use	All crops	350	-	-	Material substitution	-
		Serrated sickle	Human	One	0.005	Limited to paddy and wheat	Paddy and wheat	300	-	-	-	-
		Combine harvester	Self-propelled	Two	1.00	4.2 m cutting width	Paddy, wheat, soybean and gram	800	-	-	-	-
6.	Threshing	Bullock treading	Bullock pair	One/two	0.8 q/h	For paddy	Paddy	100	-	-	-	-
		Tractor treading	Tractor	Three	2 q/h	For paddy	Paddy	50	-	-	-	-
		Manual threshing	Manual	Two	1.25 q/h	For paddy	Paddy	100	-	-	-	-
		Power thresher	Electrical motor 2.24 - 7.46 kW	Three	2.5 q/h	All crops	All crops	400	Size matching the power input	Care and maintenance	Belt guard	-

Farm tools and equipment requiring improvement

Sl. No.	Farming system	Crop	Operation	Tool/ implement required to be developed	Conventional practices			Factor calling for improvement			
					Implement	Power source	Capacity	Efficiency	Poor functioning	Drudgery	Safety
1.	Bullock operated farms (BOF)	Paddy	Ploughing	–	Country plough/iron	Bullock pair plough	–	–	Yes	–	–
			Puddling	Puddler	Country/iron plough	Bullock pair	–	–	–	–	–
			Sowing	Seed-cum-fertilizer drill	Broadcasting Nari (attachment behind the country plough)	Manual	Fast coverage	–	Free flow and no damage of seeds	–	–
						Bullock pair	–	–	–	–	
			Trans-planting	Trans-planter	–	Manual	–	–	–	–	–
			Interculture	Power weeder	Khurpi/weeder	Manual	Fast weeding	Increase weeding eff.	Clayey to sandy	–	–
			Harvesting	Small combine	Sickle	Manual	Fast harvesting	Yes	Yes	–	Yes
	Threshing	Multicrop thresher	–	Bullock pair/tractor	–	Yes	Yes	–	Yes		
	Kodo-kutki/ others millets	Ploughing	–	Country plough/iron plough	Bullock pair	–	Yes	Yes	–	–	
		Sowing	Seed-cum-fertilizer drill	Broadcasting Nari (attachment behind the country plough + mixed sowing)	Manual	Fast coverage	–	Free flow and no damage of seeds. The seed drill is required for small seeds	–	–	
					Bullock pair	–	–	–	–		
		Interculture	Power weeder	Khurpi/weeder	Manual	Fast weeding	Increase weeding eff.	Clayey to sandy	–	–	
		Harvesting	Small combine	Sickle	Manual	Fast harvesting	Yes	Yes	–	Yes	
		Threshing	Multicrop thresher	–	Manual/bullock pair/tractor	–	Yes	Improvement in threshing for small seeds	–	Yes	

APPENDIX-A: DIFFERENT FARM MACHINERY AND EQUIPMENT IN USE IN DIFFERENT STATES, GAPS AND FUTURE REQUIREMENTS

Sl. No.	Farming system	Crop	Operation	Tool/ implement required to be developed	Conventional practices			Factor calling for improvement			
					Implement	Power source	Capacity	Efficiency	Poor functioning	Drudgery	Safety
		Soybean, black gram, green gram, pigeon pea and jowar	Ploughing	-	Country plough/ iron plough	Bullock pair	-	-	Yes	-	-
			Sowing	Seed-cum-fertilizer drill	Broadcasting Nari (attachment behind the country plough + mixed sowing)	Manual	Fast coverage	-	Free flow and no damage of seeds.	-	-
						Bullock pair	-	-	The seed drill is required for small seeds	-	-
			Interculture	Wet land power weeder	Khurpi/weeder	Manual	Fast weeding	Increase weeding eff.	Clayey to sandy	-	-
			Harvesting	Small combine	Sickle	Manual	Fast harvesting	Yes	Yes	-	Yes
		Threshing	Multicrop thresher	-	Manual/bullock pair/tractor	-	Yes	Improvement in threshing for small seeds	-	Yes	
		Wheat	Sowing	Seed-cum-fertilizer drill	Broadcasting, Nari (attachment behind the country plough + mixed sowing)	Manual	Fast coverage	-	Free flow and no damage of seeds.	-	-
						Bullock pair	-	-	The seed drill is required for small seeds	-	-
			Interculture	Power Weeder	Khurpi/weeder	Manual	Fast weeding	Increase weeding eff.	Clayey to sandy	-	-
			Harvesting	Small combine	Sickle	Manual	Fast harvesting	Yes	Yes	-	Yes
			Threshing	Multicrop Thresher	-	Manual/bullock pair/tractor	-	Yes	Improvement in threshing for small seeds	-	Yes

STUDY RELATING TO FORMULATING LONG-TERM MECHANIZATION STRATEGY FOR EACH AGRO CLIMATIC ZONE/STATE IN INDIA

Sl. No.	Farming system	Crop	Operation	Tool/ implement required to be developed	Conventional practices			Factor calling for improvement			
					Implement	Power source	Capacity	Efficiency	Poor functioning	Drudgery	Safety
		Linseeds, chickling, vetch gram	Sowing	Seed-cum-fertilizer drill	Broadcasting, Nari (attachment behind the country plough + mixed sowing)	Manual Bullock pair	Fast coverage -	- -	Free flow and no damage of seeds. The seed drill is required for small seeds	- -	- -
			Interculture	Weeder	Khurpi/weeder	Manual	Fast weeding	Increase weeding eff.	Clayey to sandy	-	-
			Harvesting	Small combine	Sickle	Manual	Fast harvesting	Yes	Yes	-	Yes
			Threshing	Multicrop thresher	-	Manual/ bullock pair/ tractor	-	Yes	Improvement in threshing for small seeds	-	Yes
2.	Tractor operated farms (TOF)	Paddy	Ploughing	Rotavator	Cultivator disk	Tractor harrow	- -	- -	Yes	-	-
			Puddling	Puddler	Cage wheel	Tractor	-	-	-	-	-
			Sowing	Seed-cum-fertilizer drill	Broadcasting, Nari (attachment behind the country plough + mixed sowing)	Manual Bullock pairs	Fast coverage -	- -	Free flow and no damage of seeds	- -	- -
			Trans-planting	Trans-planter	Manual	Manual	-	-	Clayey to sandy loam	-	-
			Interculture	Power weeder	Khurpi/weeder	Manual	Fast weeding	Increase weeding eff.	Clayey to sandy loam	-	-
			Harvesting	Small combine	Sickle	Manual	Fast harvesting	Yes	Yes	-	Yes
			Threshing	Multicrop thresher	Manual/thresher	Bullock pair/ tractor	-	Yes	Yes	-	Yes
	Kodo-kutki		Tillage	Rotavator	Cultivator, disc harrow	Tractor	-	-	-	-	-
			Sowing	Seed drill	Broadcasting	Manual	-	-	-	-	-
	Pulse crops		Sowing	Seed metering mechanism for pulses	Broadcasting	Manual	-	-	Clay-sandy loam	-	-

APPENDIX-A: DIFFERENT FARM MACHINERY AND EQUIPMENT IN USE IN DIFFERENT STATES, GAPS AND FUTURE REQUIREMENTS

Sl. No.	Farming system	Crop	Operation	Tool/ implement required to be developed	Conventional practices			Factor calling for improvement			
					Implement	Power source	Capacity	Efficiency	Poor functioning	Drudgery	Safety
3.	BOF + TOF	Paddy	Weeding	Power weeder for wetland	Khurpi	Manual	-	-	Clay-sandy loam	-	-
			Threshing	Multicrop power thresher	-	Bullock pair, tractor	-	-	Improvement in threshing unit of multicrop thresher	-	-
		Kodo-kutki	Sowing	Mechanical seed metering for bullock drawn and tractor drawn	Broadcasting	Manual	-	-	-	-	-
		Wheat	Tillage	Rotavator	Cultivator, disk harrow	Tractor	-	-	May also be used for puddling	-	-
		Linseed/ chickling vetch gram/ mustard/ pulses and oilseed crops	Sowing	Mechanical seed metering for bullock drawn and tractor drawn	Broadcasting	Manual	-	-	-	-	-
				Planter	Broadcasting	Manual	-	-	Uniformity of plant population	-	-
		Threshing	Power operated multicrop thresher	Bullock pair/ tractor/ thresher	-	-	-	-	-		

Farm tools and equipment to be developed

Sl.No.	Crop	Operation	Tool/implement required to be developed	Specification			Expected annual use (h)
				Size	Capacity	Power source	
1.	Paddy	Puddling	Puddler BOF	0.7 m	0.10 ha/h	Bullock pair	200
2.	Paddy and small seeds	Sowing	Seed metering mechanisms on tiffan and tractor drawn seed drills	3 row for BOF,	0.07 ha/h	Bullock pair	200
				6-9 row for TOF	0.40 ha/h	Tractor	200
3.	Paddy	Planting	Transplanter	Small	0.15 ha/h	Self-propelled 2.97 kW	150
4.	Paddy and other crops	Weeding	Wetland power weeder	3 row	0.08 ha/h	2.24 kW diesel engine	200
		Harvesting	-	Medium	0.4 ha/h	Self-propelled tractor	200
5.	Wheat and other <i>rabi</i> crop	Sowing	Seed drill zero tillage seed-cum-fertilizer drill	0.8 m	0.15 ha/h	Bullock drawn	200

MAHARASHTRA
Farm mechanisation gaps and equipment required

Sl. No.	Crop	Operation	Traditional implements/practices		Improved implements required			Agro climatic zone(s) facing mechanization gaps
			Name	Power source	Name	Power source	Size	
1.	Paddy	Puddling	Local plough	A pair of bullock	Puddler	Bullock, diesel engine	–	Zone–I, II, III, IV, IX
		Trans-planting	Manually	Manual	Transplanter	Manual	Manual	–
		Harvesting	Manually	Manual	Reaper	Diesel/kerosene engine	2.24 kW	–
		Threshing	Manually	Manual	Thresher	Electricity/diesel/kerosene engine	3.7 kW	–
2.	Jowar/bajra	Harvesting	Manually	Manual	Reaper	Tractor 5 hp	2 m	Zone–V, VI, VII, VIII
3.	Nachani/Varai	Sowing	Local seed drill	A pair of bullock	Seed drill	A pair of bullock	Automatic 2/3 row	Zone–I, II, IV
4.	Pulses, pigeon pea/black gram/green gram	Harvesting	Manually	Manual	Harvester	Diesel/kerosene engine	3.7-5.22 kW	All zones except III, IV
5.	Safflower	Harvesting/threshing	Manually	Manual	Harvester	Diesel/kerosene engine	2.24-5.22 kW	Zone–V, VI
6.	Cotton	Sowing	Manually	Manual	Check row planter	Tractor	35 hp	Zone–VI, VII, VIII
		Interculturing	Local hoes	Pair of bullock	Power weeder	3.7 kW diesel engine	SP (1 m)	–
		Shredding	Manually	Manual	Cotton stalk shredder	Tractor	35 hp	–
7.	Sugarcane	Planting	Manually	Manual	Planter single/double bud planter with 1.5 m row spacing	Tractor	50 hp	All zones
		Harvesting	Manually	Manual	Harvester	Self-propelled	112 kW	–
8.	Grapes	Pruning	Manually	Manual	Vine pruning machine	Diesel/kerosene engine	2.24-3.37 kW	Zone–VI
		Thinning	Manually	Manual	Grape bunch thinning	Diesel/kerosene engine	2.24-3.37 kW	–
9.	Banana	Interculturing	Manually	Manual	Interculturing, earthing up implement	Diesel engine	3.7-5.22 kW	Zone–VI, VII
		Stem shredding	Manually	Manual	Stem shredder	Diesel engine	3.7-5.22 kW	–
10.	Vegetables	Interculturing	Manually	Manual	Power weeder for ridges and furrows layout	Self-propelled diesel engine	3.7-5.22 kW	All zones

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Sl. No.	Crop	Operation	Traditional implements/practices		Improved implements required			Agro climatic zone(s) facing mechanization gaps
			Name	Power source	Name	Power source	Size	
11.	Fruit crop	Inter-culturing	Khurpi, Spade	Human	Power weeder (Self-propelled)	Diesel engine	3.7-5.22 kW	All zones
12.	Cashewnut	Shelling	By hand	Human	Shelling machine	Electric motor	3.7 kW	Zone-I, II
13.	Coconut	Harvesting	Manual	Human	Coconut climber/harvester	Human	-	Zone-I, II, III, IV, V, VI
14.	Grass	Grass cutting	Khurpi, sickle	Human	Grass cutter	Diesel/kerosene engine	3.7 kW	All zones

Farm tools and equipment in use							
Sl. No.	Operation	Name of the implement	Power source	Number of persons required to operate	Work capacity ha/h	Salient features	Expected annual use (h)
1.	Tillage	MB plough	Bullock drawn 2 pairs	2	0.02	Useful for heavy soils depth up to 20 cm, operation is done before sowing season	300
		Wooden plough	A pair of bullock	1	0.017	Used after receiving rains after heavy ploughing for pulverizing the soil and mixing manure	300
		Blade harrow	A pair of bullock	1	0.07	Used in all types of soils for leveling weeding and seed bed preparation	600
		Clod crusher/ leveler	A pair of bullock	1	0.15	Used for breaking clods in all types of soil particularly in <i>rabi</i>	100
		Moghada	A pair of bullock	1	0.10	Used for preparation of seedbed in <i>rabi</i> season	200
		MB plough	35 hp tractor	1	0.2	Single bottom, two bottom, all types of soils reversible, depth of ploughing varies 20–30 cm in different types of soils	500
		Cultivator	35 hp tractor	2	0.4	Tune type used for breaking clods, cleaning and preparation of seed bed	500
		Blade harrow	35 hp tractor	2	0.4	Used in all types of soils weed, removing and leveling	500
2.	Sowing planting	Ridger	35 hp tractor	1	0.6	Used for preparation of ridges for sugarcane and vegetables	200
		Local seed drill	A pair of bullock	2	0.30	Manual metering co alter type wooden	240
		Two bowl seed drill	A pair of bullock	3	0.30	Manual metering of seeds and fertilizer, co alter type	240
3.	Inter-culturing	Tractor drawn seed drill	35 hp tractor	3	0.40	Manual metering of seeds and fertilizer, mounted on cultivator frame	240
		Local hoe	A pair of bullock	3	0.40	2 hoes can be used at a time, blade type	250
		4.	Plant protection	Sprayers	Human	2	0.10
Dusters	Human			2	0.10	Manually operated, mostly used for vegetable crops	200
5.	Harvesting	Sickles	Human	1	0.05	Serrated sickles are used in some of the areas for harvesting paddy and wheat. Most of the farmers are using local sickles	200
6.	Threshing	Threshers	3.7 kW electric motor or diesel engine	5	300–800 kg/h	Butler type cylinder sieve sets and blower for cleaning mostly used for threshing jowar, wheat, bajra	500

PUNJAB**Current level of mecahnization of different crops**

Sl. No.	Operation	Crops	Technologies being used/ available commercially	Remarks
1.	Tillage	Crops like Wheat, Cotton, Maize, Groundnut, Sunflower etc. except Paddy	<ol style="list-style-type: none"> 1. Trailed & mounted type harrows of different sizes 2. Spring & rigid tine cultivators 3. M.B. Plough 4. Disc plough 5. Rotavator 6. Chisel plough 7. Leveler/suhaga 	Mainly harrows and cultivators are used along with suhaga for seed bed preparations
2.	Puddling	Paddy	<ol style="list-style-type: none"> 1. Cultivator and Suhaga 2. Pulverizing roller 	Mainly cultivator with suhaga is used for puddling
3.	Sowing/planting	Wheat	<ol style="list-style-type: none"> i. Tractor mounted seed cum ferti. drills with two types of metering mechanism (a) fluted roller, (b) cup feed ii. Strip till drill iii. No till drill 	9-row seed drills are used widely for sowing wheat; Use of strip till drill & No till drill is limited.
		Bold grains like Sunflower, Maize, Groundnut, Cotton, Gram, Peas etc.	Tractor operated planters with two types of seed metering mechanism (a) Inclined plate (b) Vertical disc with spoons	Use of planters is limited
		Garlic, Potato	Manually operated planter i. Tractor operated semi-automatic planter of two types (a) Rotary magazine type (b) Conveyor belt type ii. Automatic planters	Machine is under evaluation. Mainly semiautomatic planters are used

Mechanization gaps and future requirement of machinery

Sl. No.	Mechanization gap in operations in fields	Crop	Type of Machinery required
1.	Puddling	Paddy	Tractor operated rotary puddler
2.	Transplanting	Paddy	Manually and engine operated transplanters with fixed type of fingers. Also trials may be conducted on the transplanter that use root washed seedlings
		Vegetables like Cauliflower, Tomato, Brinjal, Onion, etc.	Tractor operated one-row and two row transplanters
3.	Planting	Potato	Two-row tractor operated automatic planters.
		Garlic	Manually operated precision planter. Currently developed planter needs modifications
4.	Spraying	Paddy	Power operated knapsack sprayer with larger boom
		Cotton	High clearance sprayer with air blast
		Sunflower/Orchards	Aeroblast sprayer with modifications
5.	Harvesting	Sugarcane	Tractor front mounted single row harvester windrower
		Fodder	(a) Self propelled light weight walk behind type for barseem b) Tractor operated flail type for tall fodder
		Cotton	Knapsack type single row engine operated cotton picker
		Garlic/Onion	Tractor front mounted digger windrower

RAJASTHAN**Farm tools and equipment requiring improvement**

Sl. No.	Farming system	Crop	Operation	Conventional practices		Tool/implement required to be developed
				Implement	Power source	
1.	BOF	Bajra, Maize, Wheat, Jowar, rice	Tillage	Desi plough	Bullock	Improved plough
			Sowing	Pora method	Bullock	Seed ferti. drill
			Interculture	Bukhar	Bullock	Sweep type cultivator
2.	BOF + TOF	Bajra, Maize, Wheat, Jowar, Rice	Spraying	–	–	High capacity sprayer
			Harvesting	Sickle	Human	–

Mechanization gaps and equipment required

Sl. No.	Crop	Operation	Traditional implements/practices			Improved implements required			Agro climatic zone(s) facing mechanization gaps	
			Name	Power source	Size (mm)	Name	Power source	Size		
1.	Bajra	Tillage	Indigenous plough	Animal	25	–	–	–	IA, IB, IBA	
		Sowing	Behind the plough pora method	Animal	25	Seed-cum-ferti. drill	Tractor	6-row 1,800 mm		
		Interculture	Khurpi/kudali	Human	60–80	–	–	–		–
			Blade harrow	Animal	120–180	–	–	–		–
			Indigenous plough Three tine cultivator	Animal Animal	25 90–120	–	–	–		–
Harvesting	Sickle	Human	120–150 length	Harvester	Tractor	1,500 mm	–			
Threshing	Manual	–	–	Thresher	Engine/motor	500–1,000 kg/h	–			
2.	Jowar	Tillage	Indigenous plough	Animal	25	–	–	–	IA, IIIA, IIIB, IVA	
		Sowing	Behind the plough pora method	Animal	25	Seed-cum-ferti. drill	Animal	2-row 900 mm		–
		Interculture	Khurpi/kudali	Human	60–80	–	–	–		–
			Blade harrow	Animal	120–180	–	–	–		–
			Indigenous plough Three tine cultivator	Animal Animal	25 90–120	–	–	–		–
Harvesting	Sickle	Human	120–150 length	Picker	Tractor/engine	Single or two row	–			
Threshing	Manual	–	–	Thresher	Engine/motor	1,000–1,200 kg/h	–			
3.	Maize	Tillage	Indigenous plough	Animal	25	–	–	–	IIB, IIIA, IVA, IVB, V	
		Sowing	Behind the plough pora method	Animal	25	Planter	i. Animal	3-row 900 mm		–
							ii. Tractor	6-row 1,800 mm		
		Interculture	Khurpi/kudali Blade harrow Indigenous plough Three tine cultivator	Human	60–80	Power weeders	i. Self-propelled ii. Tractor	1,400–		–
				Animal	120–180			1,500 mm		
				Animal	25			1,400–		
Harvesting	Sickle	Human	120–150 length	Corn picker	i. Self-propelled ii. Tractor	1,500–	–			
		Animal	90–120			1,500 mm				
Threshing	Manual	–	–	High capacity dehusker-cum-sheller	Engine/motor	1,500–2,000 kg/h	–			

APPENDIX-A: DIFFERENT FARM MACHINERY AND EQUIPMENT IN USE IN DIFFERENT STATES, GAPS AND FUTURE REQUIREMENTS

Sl. No.	Crop	Operation	Traditional implements/practices			Improved implements required			Agro climatic zone(s) facing mechanization gaps
			Name	Power source	Size (mm)	Name	Power source	Size (mm)	
4.	Cotton	Tillage	Indigenous plough	Animal	25	–	–	–	IA, IIA, IIIA, IVA IVB
		Sowing	Behind the plough pora method	Animal	25	Planter	i. Animal ii. Tractor	3-row 900 6-row 1,800	–
		Interculture	Khurpi/Kudali	Human	60–80	Cultivators	i. Animal	2-row 500	–
			Blade harrow Indigenous plough Three tine cultivator	Animal Animal Animal	120–180 25 90–120	Power weeders	ii. Tractor	1,400–1,500	–
Harvesting	Sickle	Human	120–150 length	Cotton picker	i. Tractor ii. Self-propelled	Single row 2-row	–		
5.	Soybean	Tillage	Indigenous plough	Animal	25	–	–	–	IVA, IVB, V
		Sowing	Behind the plough pora method	Animal	25	Planter	i. Animal ii. Tractor	3-row 700–800 6-row 1,800	–
		Interculture	Khurpi/kudali	Human	60–80	Power weeders	i. Animal	400–600	–
			Blade harrow Indigenous plough Three tine cultivator	Animal Animal Animal	120–180 25 90–120		ii. Tractor	1,400–1,500	–
		Harvesting	Sickle	Human	120–150 length	Reapers and combines	i.Tractor iiSelf-propelled	1,500–2,000	–
Threshing	Manual	–	–	High capacity thresher	Power	700–1,000 kg/h	–		
6.	Sesamum	Tillage	Indigenous plough	Animal	25	–	–	–	IIA
		Sowing	Behind the plough pora method	Animal	25	Planter	i. Animal ii. Tractor	3-row 900 6-row 1,800	–
		Interculture	Khurpi/kudali	Human	60–80	Weeder/cultivator	i. Animal	400–600	–
			Blade harrow Indigenous plough Three tine cultivator	Animal Animal Animal	120–180 25 90–120		ii. Tractor	1,400–1,500	–
		Harvesting	Sickle	Human	120–150 length	Reapers	Power	1,000–1,500	–
Threshing	Manual	–	–	Thresher	Power	500–1,000 kg/h	–		

STUDY RELATING TO FORMULATING LONG-TERM MECHANIZATION STRATEGY FOR EACH AGRO CLIMATIC ZONE/STATE IN INDIA

Sl. No.	Crop	Operation	Traditional implements/practices			Improved implements required			Agro climatic zone(s) facing mechanization gaps
			Name	Power source	Size (mm)	Name	Power source	Size (mm)	
7.	Wheat	Tillage	Indigenous plough	Animal	25	–	–	–	IB, IIA, IIB, IIIA, IIIB, IVA, IVB, V
		Sowing	Behind the plough pora method	Animal	25	No till drill multicrop seed drill	i. Animal ii. Tractor	3-row 600 7–9 row 2,100–2,250	–
		Harvesting	Sickle	Human	120–150 length	Vertical conveyor reaper combine	i.Tractor iiSelf-propelled	2,200 1,000	–
		Threshing	Treading	Human	–	Thresher	Power	800–1,000 kg/h	–
8.	Mustard and rapeseed	Tillage	Indigenous plough	Animal	25	–	–	–	IB, IIA, IIB, IIIA, IIIB, IVA, IVB, V
		Sowing	Behind the plough pora method	Animal	25	Planter	i. Animal ii. Tractor	3-row 900 4-row 1,500	–
		Interculture	Khurpi/kudali Blade harrow Indigenous plough Three tyne cultivator	Human Animal Animal Animal	60–80 120–180 25 90–120	Power weeders	i. Animal ii. Tractor	400–600 1,400–1,500	–
		Harvesting	Sickle	Human	120–150 length	Harvester	Tractor	1,500–2,000	–
		Threshing	Thresher	Electric/ diesel engine	–	High capacity thresher	Power	600–800 kg/h	–
9.	Paddy	Tillage	Indigenous plough	Animal	25	Puddler Rotavator	Power Power	1,250 1,250	IB, IVB, V
		Sowing	Behind the plough pora method	Animal	25	Rice transplanters pre-germinated seeders	Manual Power Manual Power	4-row 800–1,000 8-row 1,800–2,000 4-row 800 9-row 1,800	–
		Interculture	Khurpi/kudali	Human	60–80	–	–	–	–
		Harvesting	Sickle	Human	120–150 length	Reaper Paddy combines	Self-propelled	900–1,000	–
		Threshing	Manual	–	–	Axial flow paddy threshers	Power	1,200–1,500 kg/h	–

APPENDIX-A: DIFFERENT FARM MACHINERY AND EQUIPMENT IN USE IN DIFFERENT STATES, GAPS AND FUTURE REQUIREMENTS

Sl. No.	Crop	Operation	Traditional implements/practices			Improved implements required			Agro climatic zone(s) facing mechanization gaps
			Name	Power source	Size (mm)	Name	Power source	Size (mm)	
10.	Ground-nut	Tillage	Indigenous plough	Animal	25	-	-	-	IIA, IIIA, IIIB, IVA
		Sowing	Behind the plough pora method	Animal	25	Planter	i. Animal	3-row 900	-
							ii Tractor	7-9 row 2,000	
		Interculture	Khurpi/kudali Blade harrow Indigenous plough Three tyne cultivator	Human	60-80	-	Cultivators and earthing equipment	3-row 900 7-9 row 2,000	-
				Animal	120-180				
				Animal	25				
Harvesting	Sickle	Human	120-150 length	Groundnut digger	i. Animal	1-row 450-500	-		
					ii. Tractor	1,200			
Threshing	Manual	-	-	i. Groundnut decorticator ii. Stripper	Power Power	100-150 kg/h 100-150 kg/h	-		

UTTAR PRADESH
Farm Mechanization gaps and equipment required

Sl. No.	Crop	Operation	Traditional implements/practices			Improved implements required		Agro climatic zone(s) facing mechanization gaps
			Name	Power source	Size (mm)	Name	Power source	
1.	Paddy	Puddling	Cultivator	Tractor	9/11 tine	Puddler	Tractor	V
			Desi plough	Bullock		Puddler	Bullock drawn	
		Transplanting	–	Human	–	Paddy transplanter	TD/BD	
		Fertilizer application	–	Human	–	–	–	
		Weeding	Khurpa	Human	–	–	–	
		Plant protection	Sprayer	Hand operated	–	Power sprayer	Engine mounted	
		Irrigation	Tube well	Diesel engine/ electric motor	–	–	–	
		Harvesting	Sickle	Human	152.4-203.2	–	–	
		Threshing	Wooden plank	Human	127-177.8	Paddy harvester	Tractor	
Winnowing	–	Human	–	Thresher winnower	Tractor/engine operated			
2.	Maize, guar/bajra	Field preparation	Cultivator/ harrow	TD/BD	9/3 tine	Rotavator	Tractor operated	V
		Sowing	–	Human	–	Seed drill	BD/TD	
		Irrigation	Tube well	Diesel engine/ electric motor	–	–	–	
		Harvesting	Khurpa/sickle	Human	101.6/ 152.4-203.2	Harvesting tool	Manual	
		Threshing; maize	–	Human	–	Maize sheller	TD/engine operated	
		Jowar, bajra	–	Bullocks	–	Multicrop thresher	TD/BD	
3.	Rapeseed mustard	Field preparation	Cultivator/ harrow	TD/BD	9/2 tine	Rotavator	Tractor operated	V
		Sowing	–	Human	–	Seed drill	–	
		Irrigation	Tube well	Diesel engine/ electric motor	–	–	BD/TD	
		Plant protection	Foot sprayer	Human	–	Power sprayer	Manual	
		Harvesting	Sickle	Human	152.4-203.2	Harvester	Tractor	
		Threshing	Wooden plank	Human	127-177.8	Multicrop thresher	Tractor	
4.	Wheat/ Barley/ Gram	Field preparation	Cultivator/ harrow	TD/BD	9/3 tine	Rotavator	Tractor operated	V
		Sowing	–	Human	–	Seed drill	BD/TD	
		Irrigation	Tube well	Diesel engine/ electric motor	–	–	–	
		Plant protection	Sprayer	Human	–	Power sprayer/duster	Engine mounted	
		Harvesting	Sickle	Human	152.4-203.2	–	–	
		Threshing	Thresher	Tractor/engine	2.98-7.46 kW	Reaper/harvesting machine multicrop thresher	Tractor/ diesel engine	
		–	–	–	–	–	–	

APPENDIX-A: DIFFERENT FARM MACHINERY AND EQUIPMENT IN USE IN DIFFERENT STATES, GAPS AND FUTURE REQUIREMENTS

Sl. No.	Crop	Operation	Traditional implements/practices			Improved implements required		Agro climatic zone(s) facing mechanization gaps
			Name	Power source	Size (mm)	Name	Power source	
5.	Potato	Field preparation	Cultivator/harrow/desi plough	TD/BD	9/3 tine	Rotavator	Tractor operated	V
		Planting	Khurpa	Human	100	Planter	BD/TD	
		Earthing up	Kudal/desi plough	Human/BD	127	Earthing equipment	BD/TD	
		Irrigation	Tube well	Diesel engine/electric motor	-	-	-	
		Plant protection	Sprayer	Human	-	Power sprayer	Engine mounted	
		Digging	Khurpa/desi plough	Human/BD	100-254	Potato digger (front mounted)	Tractor	
6.	Pigeon pea	Field preparation	Cultivator/harrow/desi plough	TD/BD	3 tine	-	-	V
		Sowing	-	Human	-	Seed drill	BD/TD	
		Irrigation	Tube well	Diesel engine/electric motor	-	-	-	
		Harvesting	Khurpa/garasa	Human	100-254	Harvesting tool	Manual	
		Threshing	Wooden plank	Human	-	Multicrop thresher	TD	
7.	Sugarcane	Field preparation	Cultivator/harrow/desi plough	TD/BD	9/3 tine	-	-	V
		Setts cutting	Garasa	Human	100	Setts cutting	TD/engine	
		Furrow opening	Desi plough	BD	-	Ridger body	TD	
		Sett dropping	-	Human	-	-	-	
		Fertilizer	-	Human	-	-	-	
		Soil cover	Desi plough	BD	-	-	-	
		Planking	Wooden plank	BD	-	Sugarcane planter	TD/BD	
		Irrigation	Tube well	Engine/electric motor	-	-	-	
		Interculture	Desi plough BD cultivator	BD	-	-	-	
		Earthing	Spade	Human	-	Earthing equipment	TD	
Harvesting	Khurpa/garasa	Human	-	Harvester	TD			

Farm tools and equipment requiring improvement

Sl. No.	Crop	Operation	Tool/implement required to be improved		Factors calling for improvement			
			Implement	Power source	Efficiency	Poor functioning	Drudgery	Safety
1.	Rice	Transplanting	Transplanter	Small engine	Poor	Yes	Present	Nil
		Harvesting	Reaper/combine	Tractor	Good	Yes	Present	Less
2.	Wheat	Seeding	Seed drill		Average	Yes	Present	Provided
		Harvesting	Reaper/combine	Tractor	Good	Yes	Present	Less
3.	Potato	Planting	Semi-automatic planter	Tractor	Average	Yes	Present	Nil
		Harvesting	Digger	Tractor	Poor	Yes	Present	Nil
4.	Sugarcane	Planting	Planter	Tractor	Average	Yes	Present	Nil
		Harvesting	–	Human	–	–	Present	Nil

Farm tools and equipment to be developed

Sl.No.	Crop	Operation	Tool/implement required to be developed	Specifications			
				Size	Capacity	Power source	Expected annual use (h)
1.	Rice/wheat	Tillage	Rotavator (low weight)	26.11 kW	0.5 ha/h	Tractor	200
2.	Rice/wheat	Transplanting seeding	Mechanical transplanter seed cum-ferti. drill	10–15 rows	0.5 ha/h	Small engine	300
3.	Rice/wheat	Harvesting	Reaper with baler	26.11 kW	1 ha/h	Tractor	400
4.	Potato	Planting	Automatic planter with fertilizer 3 rows	26.11kW	0.5 ha/h	Tractor	400
5.	Sugarcane	Planting	Automatic sugarcane planter 3 rows	26.11kW	0.5 ha/h	Tractor	300
6.	Vegetables	Planting	Multi row transplanter	35 hp tractor or small engine	0.25 ha/h	Tractor/engine	200

Farm mechanization gaps and equipment required

Sl. No.	Crop	Operation	Traditional implement/practice			Improved implement required			
			Name	Size	Power source	Name	Size	Power source	
1.	Wheat	Tillage	Desi plough, Cultivator, Harrow	9 tine 6 × 2 disc	Bullock pair Tractor 35 hp Tractor 35 hp	TD Rotavator	1.25 m	Tractor 35 hp	
						MB Plough (TD)	2 bottom	Tractor 35 hp	
						Disc plough (TD)	2 bottom	Tractor 35 hp	
						BD disc harrow	8 disc	Bullock pair	
						TD disc harrow	8×2 disc	Tractor 35 hp	
						Multipurpose tool frame			
		Sowing	–	Seed drill	9 row	Human Tractor	Three row seed-cum-ferti. drill	3 row	Bullock pair
							TD seed-cum-ferti. drill	9 row	Tractor 35 hp
		Interculture	Khurpi	–	–	Human	TD zero till seed drill	9 row	Tractor 35 hp
							TD raised bed planter	3 × 71 cm	Tractor 35 hp
		Fertilizer application	Broadcasting	–	–	Human	Power sprayer	5 litre tank	0.186 kW engine
Plant protection	–	–	–	–	Knapsack sprayer	14 litre tank	Human		
Harvesting	Sickle	–	–	Human	Power operated sprayer	5 litre tank	0.186 kW engine		
					Self-propelled VC Reaper (Vardaan)	120 cm	Self-propelled		
Threshing	Thresher	–	–	3.7 kW electric motor	Tractor front mounted reaper	211 cm	35 hp tractor reaper		
					High capacity multicrop thresher	35 hp	35 hp tractor		
2.	Paddy	Tillage	BD plough Cultivator	– 9 tine	Bullock pair 35 hp tractor	Rotavator (TD)	1.5 m	Tractor 35 hp	
						Multipurpose tool frame	8 disc	Bullock pair	
						BD disc harrow	4×2 disc	Bullock pair	
						Disc harrow (TD)	8×2 disc	Tractor 35 hp	
		Puddling	BD plough, Cultivator	– 9 tine	–	Bullock pair, Tractor + cage wheel	BD puddler	100 cm	Bullock pair
		Transplanting	Manual	–	–	Human	Self-propelled, 8-row, rice transplanter	8×23.8 cm	Self-propelled
		Interculture	Khurpi	–	–	Human	Cono weeder	–	One person
		Plant protection	–	–	–	Human	Knapsack sprayer	14 litre tank	One person
							Power operated sprayer	5 litre tank	0.186kW engine
		Harvesting	Sickle	–	–	Human	Tractor front mounted reaper	211 cm	35 hp tractor reaper
							Self-propelled VC reaper (Vardaan)	120 cm	Self-propelled
Threshing	Manual	–	–	Human	CIAE multicrop thresher	3.7 kW	Electric motor		
					Flow through paddy thresher	3.7 kW	Electric motor		
Fertilizer application	Broadcasting	–	–	Human	Knapsack sprayer	14 litre tank	One person		
					Power operated sprayer and duster	5 litre tank	0.186 kW engine		

STUDY RELATING TO FORMULATING LONG-TERM MECHANIZATION STRATEGY FOR EACH AGRO CLIMATIC ZONE/STATE IN INDIA

Sl. No.	Crop	Operation	Traditional implement/practice			Improved implement required		
			Name	Size	Power source	Name	Size	Power source
3.	Potato	Tillage	BD plough	–	Bullock pair	Rotavator (TD)	1.5 m	Tractor 35 hp
			Multipurpose tool frame	8 disc	Bullock pair	BD disc harrow	4×2 disc	Bullock pair
			Disc harrow (TD)	8×2 disc	Tractor 35 hp			
		Sowing	Spade/khurpi	–	Human	TD potato planter	2×58.5 cm	35 hp tractor
		Interculture	Khurpi	–	Human	Wheel hoe	–	Human
		Plant protection	Knapsack sprayer	14 litre tank	Human	Knapsack sprayer	14 litre tank	Human
			Power operated sprayer	5 litre tank	0.186 kW engine			
Fertilizer application	Broadcasting	–	Human	Knapsack sprayer	14 litre tank	Human		
Harvesting	Power operated sprayer	5 litre tank	0.186 kW engine					
	Spade	–	Human	TD potato digger-cum-elevator	128 cm	35 hp tractor		
		BD plough	–	Bullock pair				
4.	Sugarcane	Tillage	BD plough	–	Bullock pair	TD Rotavator	1.5 m	35 hp tractor
			Cultivator	9 tine	35 hp tractor	BD disc harrow	8 disc	Bullock pair
			TD disc harrow	8×2 disc	35 hp tractor	Multipurpose tool frame	–	Bullock pair
		Sowing	Chopper, spade	–	Human	TD sugarcane setts cutter planter	2×60 cm	35 hp tractor
Interculture	Khurpi	–	Human	Self-propelled rotary power weeder	–	3.7 kW diesel engine		
Plant protection	–	–	Human	Knapsack sprayer	14 litre tank	Human		
				Power operated sprayer	5 litre tank	0.186 kW engine		
5.	Oilseed, pulse, mustard	Sowing	–	–	Human	Mustard drill	3×22 cm	Bullock pair
		Pigeonpea, gram, millet	–	–	Human	Wheel hoe	–	Human
		Interculture	–	–	Human	CIAE Multicrop thresher	3.7 kW	Electric motor
6.	Fruit crop (guava, mango)	Harvesting	–	–	Human	Fruit harvester*	–	–
		Fruit crop Anwala	–	–	Human	Fruit harvester*	–	–

Note: *Harvester needs to be developed

UTTARANCHAL

List of implements and machinery to be developed

Sl. No.	Agro-climatic zone (districts)	Crop	Operation	Tool/ implements presently used	Specifications of new equipments			Whether existing tools/ equipment to be modified or new one to be developed
					Size	Capacity	Power source	
1.	Tarai and plains (US Nagar and Haridwar)	Paddy	Transplanting and threshing	Transplanter, paddy thresher	8 row	800–1,000 kg/h	Diesel engine Self-propelled, motor/tractor	Existing equipment to be modified
2.		Sugarcane	Planting	Planter	2 row	0.20 ha/h	Trailer and tractor	Existing equipment to be modified
			Harvesting	Harvester	1–2 row	0.36 -0.5t/h	Tractor/self-propelled	Recommended on custom hiring
3.		Potato	Planting	Potato planter	2 row	0.20 ha/h	Tractor	Recommended on custom hiring
			Harvesting	Potato digger	1–2 row	0.2 ha/h	Tractor	Recommended on custom hiring
4.		Sunflower	Threshing	Thresher	–	5–6 q/h	Tractor/motor	Recommended on custom hiring

Farm tools and equipment used in plain zone

Sl. No.	Operation	Name of implements	Power source	Number of persons required to operate	Work capacity (ha/h)	Crops for which used	Expected annual use (h)
1.	Tillage	MB plough	Bullocks	One	0.04	All crops	350
		Harrow	Bullocks	One	0.125	All crops	200–300
			Tractor	One	1–1.2	All crops	200–300
		Cultivator	Tractor	Two	0.6–0.8	All crops	400–500
2.	Sowing/planting	Seed drill	Tractor	Two	0.5–0.8	Wheat	100–150
		Sugarcane planter	Tractor	Four	0.125	Sugarcane	100–150
3.	Interculture	Hand hoe	Human	One	0.02–0.04	Row crops and maize	100
		Wheel hoe	Human	One	0.02–0.04	Row crops and maize	100
		Cultivator	Tractor	One	0.40	Sugarcane	100–150
4.	Plant protection	Sprayer	Human	One	0.4–0.6	All crops	50
		Duster	Human	One	0.4–0.6	All crops	50–100
5.	Harvesting	Sickles	Human	One	0.005	All crops	150
		Combine harvester	Self-propelled	Eight	0.6–0.8	Paddy and wheat	200–300
6.	Threshing	Thresher	Tractor	Four	500–600 kg/h	Wheat	200
			Electric motor/ diesel engine	Four	400–450 kg/h	Wheat and paddy	200

Farm tools and equipment used in hill zone

Sl. No.	Operation	Name of implements	Power source	Number of persons required to operate	Work capacity (ha/h)	Crops for which used	Expected annual use (h)
1.	Tillage	Desi plough	Bullocks	One	0.02	All crops	50
2.	Sowing/planting	Desi plough, spade (kudali)	Human	Two	0.02	Wheat	10
3.	Interculture	Hand hoe (khurpi/kudali)	Human	One	0.002	Row crops and maize	100
4.	Plant protection	Sprayer	Human	One	0.4–0.6	All crops	20
		Duster	Human	One	0.4–0.6	All crops	5–10
5.	Harvesting	Sickles	Human	One	0.005ha/h	All crops	150
6.	Threshing	Olpad thresher/bullock treading	Bullocks and Human	One to two	10–20 kg/h	Wheat	10–20

Farm tools and equipment requiring improvement in plain/hill zone

Sl. No.	Crop	Operation	Tools/equipment required to be improved		Factors calling for improvement	
			Implements	Power source	Capacity	Drudgery
1.	Paddy	Puddling	Rotary puddler	Tractor/bullocks	0.1-0.25 ha/h	Reduce drudgery
		Transplanting	Transplanter	Self-propelled	0.15 ha/h	–
		Harvesting	Combine harvester	Self-propelled	1 ha/h	–
2.	Wheat	Sowing	Zero-till seed drill	Tractor	0.3 ha/h	–
		Harvesting	Combine harvester	Self-propelled	1 ha/h	–
3.	Sugarcane	Planting	Sugarcane planter	Tractor	0.12 ha/h	Reduce drudgery
4.	Lahi	Sowing	Ferti. seed drill	Tractor	–	–

Farm mechanization gaps and equipment required for plain zone

Sl. No.	Crop	Operation	Traditional implement/practice			Improved implement required		
			Name	Power source	Size	Name	Power source	Size
1.	Paddy	Puddling	Cultivator	Tractor	9 tine	Puddler	Tractor 35 hp	1 metre
		Transplanting	Manual	Human	-	Self-propelled paddy transplanter		8 rows
		Interculture Harvesting	Manual Manual	Human Human	- -	Pesticide sprayer Combine harvester	Manual Self-propelled	3-4 metre width
2.	Wheat	Field preparation	Harrow	Tractor	12-14 disks 35-45 hp	Harrow + clod crusher	Tractor	12-14 discs 35-45 hp
		Sowing	Ferti. seed drill	Tractor	-	zero till drill	Tractor	1.8 metre width
		Interculture	Manual	Human	-	pesticide	Tractor	1.8 metre width
		Harvesting	Manual	Human	-	combine harvester	Manual/self-propelled	1.2 metre width
3.	Sugarcane	Field preparation	Plough/harrow	Tractor	35-45 hp	Plough/harrow	Tractor	1.8 metre width
		Planting	Ridger/spade	Tractor/manual	35-45 hp	Cutter planter	Tractor	35-45 hp
		Harvesting	Manual	Human	-	Manual	Human	-
4.	Rapeseed and mustard	Field preparation	Plough/harrow	Tractor	35-45 hp	Plough/harrow	Tractor	35-45 hp
		Sowing	Broadcasting	Human	-	Ferti. seed drill	Tractor	35-45 hp
		Harvesting	Manual	Human	-	Manual	Human	-
		Threshing	Bullock/tractor treading	Bullock/tractor	Pair of bullock/ 35-45 hp tractor	Combine harvester	80-90 hp	3-4 metre width

Farm mechanization gaps and equipment required for hill zone

Sl. No.	Crop	Operation	Traditional implements/practices			Improved implements required			Agro climatic zone(s) facing mechanization gaps
			Name	Power source	Size	Name	Power source	Size	
1.	Paddy	Puddling	Wooden Damala	Bullocks	11 pegs	Steel Damala	Bullocks/ power tiller	11 pegs	Hilly region (unirrigated), Dehra Dun, Tehri, Pauri, Uttarkashi, Chamoli, Rudraprayag, Nainital, Almora, Bageshwar, Champawat, Pithoragarh
		Transplanting	Manual	Human		Manual	Human		
		Interculture	Manual	Human		Manual	Human		
		Harvesting	Manual	Human		Manual	Human		
		Threshing	Manual	Human		Thresher for hills	Human		
2.	Wheat	Field preparation	Nasoora/danela	Bullocks	-	Pant hill, Nasoora,	Bullocks/ power tiller	-	
		Sowing	Manual	Human	-	Manual	Human	-	
		Interculture	Manual	Human	-	Manual	Human		
		Harvesting	Manual	Human	-	Manual	Human		
		Threshing	Bullock treading	Bullocks		Allpad thresher	Bullocks		
3.	Sugarcane	Field preparation	Plough/harrow	Tractor/ bullocks	35-45 hp	Plough/harrow cutter planter	Tractor/ bullocks	35-45 hp	
		Planting	Ridger/spade	Human	35-45 hp	Manual	Tractor	35-45 hp	
		Harvesting	Manual	Human	-		Tractor	35-45 hp	
4.	Rapeseed	Field preparation	Nasoora/danela broadcasting	Bullocks	-	Nasoora/danela broadcasting	Bullocks Human	-	
		Sowing	Manual	Human	-	Manual	-	-	
		Harvesting	Bullocks	Human	-	Manual	-	-	
		Threshing	Bullock/tractor treading	Bullock/tractor	-	Combine harvester	-	-	
5.	Potato	Field preparation	Nasoora/danela	Bullocks	-	Nasoora/danela	Bullocks	-	
		Earthing	Spade	Human	-	Spade	Human	-	
		Harvesting	Spade	Human	-	Spade	Human	-	

WEST BENGAL

Farm mechanization gaps and equipment required

Sl. No.	Crop	Operation	Traditional implement/practice			Improved implement required		
			Name	Power source	Size	Name	Power source	Size
1.	Paddy	Puddling	Desi/Bose plough	Pair of bullocks	12-15 cm	Puddler	Pair of bullocks	70 cm
		Transplanting	-	Human	-	Drum seeder	Human	8 × 20 cm
		Weeding	-	Human	-	Wet land weeder	Human	14 cm
		Harvesting	Sickle	Human	32 mm × 1.5 mm serrated blade with 130 mm radius of curvature	Vertical conveyor reaper	2.61 kW petrol start kerosene run engine	120 cm
2.	Wheat	Sowing	Desi plough	Pair of bullocks and human	12-15 cm	Seed drill	Pair of bullocks	3 × 20 cm
		Weeding	Khurpi	Human	35 mm × 2 mm flat blade	Dry land weeder	Human	14 cm
		Harvesting	Sickle	Human	32 mm × 1.5 mm serrated blade with 130 mm radius of curvature	Vertical conveyor reaper	2.61 kW petrol start kerosene run engine	120 cm
		Threshing	-	Pair of bullocks	-	Thresher	3.7 kW diesel engine	-
3.	Mustard	Sowing	Broadcasting	Human	-	Seed drill	Pair of bullocks	3 × 20 cm
		Weeding	Khurpi	Human	35 mm × 2 mm flat blade	Dry land weeder	Human	14 cm
4.	Groundnut	Sowing	Row marker	Human	3 × 30 cm	Groundnut planter	Pair of bullocks	2 × 30 cm
		Earthing	Spade	Human	10-15 cm wide 12-18 cm long blade with short handle	Leveller	Power tiller	-
		Digging	Spade	Human	12-20 cm wide 15-20 cm long blade with long handle	Groundnut digger	Power tiller	30 cm
		Stripping	Pedal thresher	Human	60 cm long cylinder	Groundnut pod stripper	Power tiller	27 cm dia × 125 cm long cylinder
		Decorticating	-	Human	-	Decoricator	Human	21 × 5 cm shoes (3 nos.)
5.	Potato	Sowing	Row marker	Human	3 × 30 cm	Potato planter	Pair of bullocks	Single row
		Earthing	Spade	Human	10-15 cm wide 12-18 cm long blade with short handle	Leveller	Power tiller	-
		Digging	Spade	Human	12-20 cm wide 15-20 cm long blade with long handle	Potato digger	Power tiller	30 cm
6.	Jute	Sowing	-	Human	-	Jute seed drill	Human	Single row

Note: 1 hp = 0.745699 kW; 1 kW = 1.341022 hp

Source: Project Co-ordinator, AICRP on Farm Implements and Machinery, CIAE, Bhopal.