

CHAPTER 3.9

# Prospect of Farm Mechanization

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## Introduction

The productivity of farms depends greatly on the availability and judicious use of farm power by the farmers. Agricultural implements and machines enable the farmers to employ the power judiciously for production purposes. Agricultural machines increase productivity of land and labour by meeting timeliness of farm operations and increase work out-put per unit time. Besides its paramount contribution to the multiple cropping and diversification of agriculture, mechanization also enables efficient utilisation of inputs such as seeds, fertilizers and irrigation water.

Over the last few years, there has been considerable progress in agriculture mechanization. It is generally believed that the benefits of modern technology have been restricted to farmers with large land-holdings. Yet the fact remains that even small farmers are adopting and utilizing selected farm equipment for efficient farm management through custom hiring. Mechanical equipment for various farm operations like tillage, sowing, irrigation, plant protection and threshing etc. are generally being used by the farming community. The demand of important agricultural equipment like tractors, power tillers, combine harvesters, irrigation pump sets, diesel engines, has shown an increasing trend. According to the 17th Indian livestock census (2003), the population of 44 items of Agricultural Implements and Machinery during 1977 was 109.66 million (reference). This went up to 126.85 million in 1982 and further to 154.38 million in 1987 and then decreased to 141.93 million in 1992. Again during 1997, it increased to 180.57 million and further to 223.84 million during 2003.

At present, Bihar has 111672 tractors, 4000 power tillers, 66128 mould board ploughs, 50000 cultivators, 15000 seed drills, 290000 sprayers, and 300000 threshers. While recommended electricity consumption for farming purpose is 2 KW ha<sup>-1</sup>, but presently it

is only 0.8 KW ha<sup>-1</sup> in Bihar due to limited availability of electricity ([http://bameti.org/pdf/state\\_profile.pdf](http://bameti.org/pdf/state_profile.pdf), accessed on 10.03.2012). Mechanization in West Bengal is mostly confined to the use of power tillers, small implements, plant protection equipment and power threshers. With the growing seasonal demand and high cost of labour, the need for mechanization is being increasingly felt. However, introduction and adoption of agricultural machinery in the recent past has mainly been confined to the northern States of India. However, with the increase in the irrigation facilities and modernisation of the cropping practices, the demand for agricultural machinery has shown an increasing trend in the southern and western parts of the country. Keeping in view the small land holding in the eastern states, individual ownership of farm equipment is not a feasible and viable proposition. Realizing this, the concept of “Farm Machinery Hub” is being promoted in many states. This enables small farmers to hire the equipment needed on rental basis.

Moreover, reliance on animate power for day to day management of farm operations is slowly decreasing due to less availability of fodder crop availability and difficulty in raising them alone for tillage operation round the year. Improved implements such as M B plough, puddler, disc harrow, peg tooth harrow, spring line harrow are more efficient and that why they are being adopted by farmers. Further, use of sowing or planting devices is also registering a higher growth due to their impact on seed and fertiliser use. The number of draught animals has also shown a decline as a consequence of farm mechanization. The eastern and the north-eastern States have been less responsive to adoption of agricultural machinery. Small size and scattered holdings of the farmers stand in the way of mechanization (Table 1). As a result of this, farm machinery generally remains under utilized.

**Table 1. Number of operational holdings by major size group in %**

Eastern states	Marginal (<1ha)	Small (1-2 ha)	Semi medium (2-4 ha)	Medium (4-10 ha)	Large (>10 ha)
Assam	62.65	20.69	12.98	3.54	0.18
Bihar	84.18	9.24	5.09	1.42	0.08
Chhattisgarh	53.67	22.00	15.61	7.53	1.20
Odisha	56.43	27.39	12.32	3.57	0.32
West Bengal	80.44	14.86	4.17	0.52	0.01
Eastern UP	69.00	18.10	9.46	3.12	0.32
Average	67.73	18.71	9.94	3.28	0.35
India	62.88	18.92	11.69	5.48	1.02

Source: Bhatt et al. (2011)

## Farm Power Availability

There has been close relationship between farm power availability and increased productivity. Those states where availability of farm power is more have, in general, there is higher productivity as compared to others as shown in Table 2.

## Energy Use

### Ploughing

In eastern India there is a vast difference in use of source of power for ploughing purpose. Bihar, Uttar Pradesh and West Bengal are ahead in using mechanical power

i.e. tractor and power tiller for ploughing while Chhattisgarh, Assam and Jharkhand are laggards (Table 3). The state Government should facilitate the small scale industry for manufacturing of equipment according to the need of the state and accordingly give subsidy for agricultural mechanization.

**Table 2. Farm power availability and average productivity of food grains in Eastern India in 2001**

Name of the States	Farm Power Availability (kW ha <sup>-1</sup> )	Food grain productivity (Kg ha <sup>-1</sup> )
Uttar Pradesh	1.75	2105
West Bengal	1.25	2217
Assam	0.80	1443
Bihar	0.80	1622
Jharkhand	0.60	1095
Odisha	0.60	799
Chhattisgarh	0.60	799
India	1.35	1723

Source: Srivastava (2006)

**Table 3. Variation in the proportions of households in use of diesel and animals for ploughing in Eastern India**

State	Percentage of farmer households ploughing land using	
	Diesel	Animal
Bihar	64	35
Jharkhand	2	98
West Bengal	53	47
Chhattisgarh	10	90
Assam	3	97
Uttar Pradesh	81	18
India	47	52

Source: NSSO (2005)

### Irrigation

Bihar, Uttar Pradesh and West Bengal are heavily dependent on tube wells for irrigation (Table 4). Electric pumps are cheaper to operate, since power is supplied at minimal cost to agriculture, are mainly used by farmers having access to electricity. Due to electricity woes most of the farmers depend upon diesel operated pumps for irrigation purpose. About two-thirds of Indian farmers are using diesel operated pumps for irrigation purpose. Most of these farmers are concentrated in Bihar, Assam, Jharkhand and Uttar Pradesh. In Bihar, 97% of farm households irrigate land by using diesel water pumps, followed by 87% in West Bengal (Table 5). However, pumping water for irrigation using diesel operated pump is very costly affair. It not only affects their afford ability for purchasing farm equipment

**Table 4. Major sources of irrigation of cereal crops**

State	<i>Kharif</i>				<i>Rabi</i>			
	Percentage of area irrigated by				Percentage of area irrigated by			
	Tube well	Well	Canal	River/spring	Tube well	Well	Canal	River/spring
Bihar	72	1	15	5	83	1	9	2
Jharkhand	7	39	5	20	8	46	18	20
West Bengal	55	4	17	6	60	4	14	7
Chhattisgarh	20	1	67	4	65	3	10	6
Assam	32	7	20	12	45	7	13	9
Uttar Pradesh	81	1	15	1	81	3	14	7
India	53	12	23	4	63	14	14	4

Source: NSSO (2005)

but also susceptible to heavy losses in agribusiness.

### Threshing

Threshing is the process of separating grains from the harvested crop and providing clean grain without much loss and damage. Most of the farmers of Bihar and Uttar Pradesh use diesel engines or tractor for threshing purposes while other states in eastern states are dependent on animal power (Table 6). So it is necessary to design small manual or animal driven threshers.

Farm mechanization has been helpful to bring about a significant improvement in agricultural productivity. Thus, there is strong need for mechanization of agricultural operations. The factors that justify the strengthening of farm mechanization in the country can be numerous. The timeliness of operations has assumed greater significance in obtaining optimal yields from different crops, which has been possible by way of mechanization. For instance, the sowing of wheat in Punjab is done up to the first fortnight of November. A delay beyond this period by every one week leads to severe decrease in the yield. This is also

correct in the case of other crops and for other farm operations like hoeing, irrigation, harvesting, threshing and marketing which need to be performed at appropriate time otherwise the yield and farm income is affected adversely.

Secondly, the quality and precision of the operations are equally significant for realizing higher yields. The various operations such as land levelling, irrigation, sowing and planting, use of fertilizers, plant protection, harvesting and threshing need a high degree of precision to increase the efficiency of the inputs and reduce the losses. For example, sowing of the required quantity of seed at proper depth and uniform application of given dose of fertilizer can only be possible with the use of proper mechanical devices. However, when such operations are performed through indigenous methods, their efficiency is reduced. Thirdly, the time taken to perform different operations is a factor determining the cropping intensity. So as to ensure timeliness of various operations, it is quite indispensable to use such mechanical equipment which have higher output capacity and cut down the number of operations to be performed. This has helped in increasing area under cultivation and

**Table 5. Variation in the proportions of households using diesel pumps and electric pumps for irrigation in eastern India**

State	Percentage of farmer house holds irrigating land using	
	Diesel Pumps	Electric Pumps
Bihar	97	2
Jharkhand	81	2
West Bengal	87	13
Chhattisgarh	28	63
Assam	87	4
Uttar Pradesh	84	16
India	66	33

Source: NSSO (2005)

**Table 6. Variation in the relative importance of different sources of energy for threshing in Eastern India**

State	Percentage of farmer households in which threshing was done using		
	Electricity	Diesel	Animal
Bihar	0.9	80	19
Jharkhand	0.1	6.29	3.7
West Bengal	2.9	22.5	71.1
Chhattisgarh	0.2	14.5	85.3
Assam	0.0	0.0	100
Uttar Pradesh	6.2	89.9	3.8
India	11.5	61.1	27.2

Source: NSSO (2005)

increase in cropping intensity. Higher productivity of land and labour is another factor, which clearly justifies farm mechanization. Not only the output per hour is more, the total labour requirement is also reduced. Mechanisation will negate the effect of labour shortage in agrarian community. As production increases with mechanization of the farm operations, it creates a good scope for commercialization of agriculture.

There are good chances to reduce the cost of production if farm operations are mechanized as it saves labour, both human and bullock. In the absence of mechanization, the ever-increasing wage rate of human labour and cost of upkeep of draught animals could have increased the cost of production much higher. Further, large scale production means less per unit cost on the farms. Moreover, it reduces the weather risk and risk of non-availability of labour on time and thus wastage is minimized. Timely marketing is also made possible by quick mechanical transportation, cleaning and handling. Further, the area under fodder and feed for draught animals could be reduced due to decline in their use. Thus more land can be brought under commercial crops. The use of farm mechanization enlarges the employment opportunities both on farms and in nonfarm sectors through increase in area under plough, multiple cropping, development of agro-industries and related services. On the other hand, displacement of human labour does take place and demand for semiskilled labour in place of unskilled labour is increased. Also, the drudgery for human labour is reduced

### **Mechanisation Scope for Farmers in Eastern Region**

Less than four percent farmers in eastern region are having farms greater than 4 hectare. Since these are large farmers they can use more power for their farms. Use of large machines (owned) should be preferred along with custom hiring to the small land holders. Use of Tractive power (tractor) for drawing field machines is advisable as it will be sustainable for the larger land holdings usually greater than four hectare. For small and marginal farmers (Land holding <4 ha) use of tractor is not sustainable unless it is used for other purpose. Power tiller should be used for most of the farm activities. Table 7 shows different farm equipment / machines used for different farm operations along with their suitability according to land holding size.

### **Constraints and Suggestions in Mechanization**

From the above discussions, it can be concluded that there is vast scope for use of tractor or power tiller operated equipment. Some of eastern states viz. Jharkhand, Chhattisgarh and Assam are frontrunners in animal energy use. In these states the scope of small equipment like single wheel hoe, cono weeder, animal drawn plough, patela harrow, 3 row seed cum fertilizer drill, potato digger etc. are immense. It is true that farm mechanization has shown good results in terms of raising the agricultural production and improving the standard of living of cultivators in different region. Machine has also its limitations. Its operation needs skilled person and little knowledge about their parts. The biggest bottleneck in their popularization is lack of repair and maintenance facility. If any machines gets some problem in the field or any small parts is broken, it's get very difficult to take machine to a workshop and repair it. Also too much time is wasted in repairing

**Table 7. Farm equipment/machines for different operations**








S. No	Name of equipment/machines	Remarks		Suitability for farmers
1	<b>Seed Bed Preparation (Tillage) Equipment</b>			
a.	Mould-board plough	It is a very common implement used for primary tillage operations or for opening up any cultivable land with a view to prepare a seed bed for crop growing.		medium and large farmers (land holding >4 ha)
b.	Rotavator	Rotavator is used for seedbed preparation, weed control, mixing of soil with crop residue and fertilizer and puddling of the soil. It saves time (30-35%), water (30%) and cost of operation (20-25%) as compared to tillage by cultivator and harrow. In a single pass a good seedbed and pulverization of soil is achieved.		medium and large farmers (land holding >4 ha)
c.	9 & 11 tyne cultivator (rigid and spring type)	It consists of frame, tynes with reversible shovels and gauge wheels. The implement is mounted type and is operated by tractor.		medium and large farmers (land holding >4 ha)
d.	Tractor drawn Disc harrow	Disc harrow is very much suitable for hard ground, full of stalks and grasses. It cuts the lumps of clods, soil and roots. Discs are mounted on one, two or more axles, as it is pulled ahead, discs rotate on the ground.		medium and large farmers (land holding >4 ha)
e.	Animal drawn indigenous plough/country plough	It is the most commonly used in this country. The shape and size of the plough varies with places and regions due to variation in soil types and tillage requirements.		small and marginal farmers (land holding <4 ha)
f.	Animal drawn Patela harrow	It consists of a wooden plank, collection hooks and lever for lifting. It is secondary tillage equipment for clod crushing, stubble collection, levelling and smoothing of land.		small and marginal farmers (land holding <4 ha)
g.	Post hole digger	Post hole digger is equipment, which can drill/dig holes of varied sizes and depths in soil. It is used to make pits for plantation of Mango, Coconut, Teak, Pomegranate, Lemon, etc. Double pit digger is modern equipment making two pits in single time which save time and labour. It is also very useful for sugarcane, banana and jatropha planting.		medium and large farmers (land holding >4 ha)

Table 7. Continued



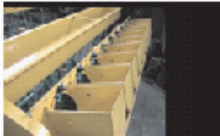


S. No	Name of equipment/ machines	Remarks		Suitability for farmers
<b>2 Sowing and Planting Equipment</b>				
a.	Zero till seed cum fertilizer drill	It helps to seed a crop directly into the cultivated field just after the harvest of the previous crop with the least disturbance of the soil. It eliminates or reduces time and energy intensive conventional tillage operations. The furrow openers are of inverted 'T' type. Use of zero-till drill for direct sowing of wheat after rice saves time and cost as compared to the conventional practice of seedbed preparation and sowing.		medium and large farmers (land holding >4 ha)
b.	Seed cum fertilizer drill	Seed cum fertilizer drill is used in the same way as zero till seed cum fertilizer drill, but in the cultivated land i.e., after the seed bed preparation.		medium and large farmers (land holding >4 ha)
c.	Inclined plate planter	The planter is suitable for sowing bold and small seeds such as cotton, soybean, groundnut, chickpea, sorghum, and mustard. It has six modular seed boxes with independent metering mechanisms enabling it for intercropping.		medium and large farmers (land holding >4 ha)
d.	Sugarcane planter	The planter can be operated by any tractor. It is a mounted type. It can plant sugarcane in rows. Two way mould board shaped furrow is used to open furrows. The cutting unit cuts sets of the sugarcane. The operator has to lift the cane from seed tray and place it in the slanting chute. Cane slides down to cutting unit(s) through gravitational force. Hence operator finds enough time for sets cane feeding. Sets in furrows are covered with loose soil. A tamping roller presses the furrow soil lightly to conserve soil moisture.		medium and large farmers (land holding >4 ha)
e.	Self-propelled/walking type rice transplanter	The rice transplanter consists of prime mover, transmission, engine, float, lugged wheels, seedling tray, seedling tray shifter, pickup fork and pickup fork cleaner. It is a walk behind type rice transplanter using mat type nursery and it transplants the seedling uniformly without damaging them. The planting depth and hill-to-hill spacing can be adjusted. Automatic depth control helps in maintaining uniform planting		medium and large farmers (land holding >4 ha)

Table 7. Continued






S. No	Name of equipment/ machines	Remarks		Suitability for farmers
		depth. For operation, the machine is transported to the field and mat type nursery is loaded in the tray of the transplanter. The machine is put in transplanting mode and operated in the puddled or un puddled field		
f.	Happy seeder	It combines two units, one for straw management and the other one is for sowing wheat after paddy. Green gram can also be sown in summer after wheat harvest in standing stubble which helps in moisture conservation and soil temperature regulation.		medium and large farmers (land holding >4 ha)
g.	Dibbler	It is single row manually operated equipment for dibbling bold or medium seeds in row or gap filling into well prepared soil. It is suitable for drilling wheat, field pea, and maize in small plot.		small and marginal farmers (land holding <4 ha)
h.	Paddy drum seeder	The seeder consists of a seed drum, main shaft, ground wheel, floats and handle. Joining smaller ends of frustum of cones makes the seed drum. Nine metering holes of 10mm diameter are provided along the circumference of the drum at both ends for a row-to-row spacing of 200mm. Two floats are provided on either side to prevent the sinkage and facilitate easy pulling of seeder.		small and marginal farmers (land holding <4 ha)
i.	Animal drawn 3 row seed cum fertilizer drill	It is an animal drawn simple, light weight, and compact machine to sow crops like wheat, gram, sorghum, soybean, lentil, pea, sunflower, safflower etc. in black soil under rain fed condition. The fluted roller metering mechanism, fitted in the unit, gets the drive from ground drive wheel of 300mm diameter through chain and sprocket. The shoe type furrow opener with non-clogging boot places the seed at desired depth.		small and marginal farmers (land holding <4 ha)



Table 7. Continued



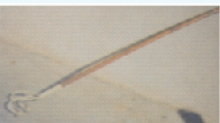


S. No	Name of equipment/ machines	Remarks		Suitability for farmers
j.	Power tiller drawn seed cum fertilizer drill / planter	Specially designed for power tiller of 10-12 hp size to drill seed and fertilizer in row. It is suitable for sowing seeds of wheat, soybean, Bengal gram, sorghum etc. in medium and heavy soil. It consists of main frame, seed and fertilizer boxes, metering mechanism, transport wheel, furrow openers etc.		small and marginal farmers (land holding <4 ha)
<b>3 Weeding and Inter-cultivation Equipment</b>				
a.	Self-propelled Power weeder	Power Weeder is used for stirring and pulverizing the soil before planting or to remove weeds and to loosen the soil after the crop has begun to grow.		medium and large farmers (land holding >4 ha)
b.	V blade hand hoe	V blade hoe is used for weeding of the vegetable crop planted in the rows and earthing operation. It is a long handled weeding tool for operation in between crop rows. Consists of v blade, arms, ferrule and wooden handle. The pulling actions cause penetration of the blade into the soil and cut or uproot the weeds. Because of v shape , the blade creates small furrow between crop rows and also earthing of the plants		small and marginal farmers (land holding <4 ha)
c.	Three tined hand hoe (grubber)	It is for weeding, interculture and breaking of the soil crust in vegetable gardens, in flower crops and nurseries It is a simple and light weight, manually operated equipment for weeding and interculture in upland row crops in black soil. It consists of long handle, ferrule, three tynes and sweep type blades. The operator uses pull force to break the soil crust and uproot the weeds.		small and marginal farmers (land holding <4 ha)
d.	Single wheel hoe	It is used for weeding and interculture of vegetables and other crops sown in rows. It is a widely accepted weeding tool for weeding and interculture in row crops. It is manually operated equipment for weeding and inter-culture in upland row crops spaced above 240 mm. It consists of wheel frame, V-blade with tyne and handle. Weeds cutting and uprooting are done through push and pull action of the unit.		small and marginal farmers (land holding <4 ha)

Table 7. Continued

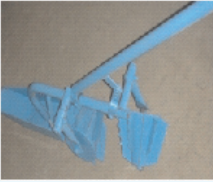




S. No	Name of equipment/machines	Remarks		Suitability for farmers
e.	Double wheel hoe	It is manually operated equipment for weeding and inter-culture in upland row crops in black soil region. It consists of twin wheels, frame, V-blade with tyne, U clamp, scrapper and handle. Weeds cutting and uprooting are done through push and pull action of the unit.		small and marginal farmers (land holding <4 ha)
f.	Cono weeder	The cono weeder is used to remove weeds between the rows of paddy crop efficiently. It is easy to operate, and does not sink in the puddle. The weeder consists of two rotors, float, frame and handle. The rotors are cone frustum in shape, smooth and serrated strips are welded on the surface along its length. The rotors are mounted in tandem in opposite orientation. The float controls working depth and doesn't allow rotor assembly to sink in the puddle. It is operated by pushing action.		small and marginal farmers (land holding <4 ha)
g.	Power tiller operated sweep Cultivator	Specially designed as matching equipment for 6-8 HP size power tiller to perform intercultural operation in soybean, sorghum, bengal gram, pigeon pea and other wider spaced crops in medium and heavy soil. It consists of main frame with hitch system, handle, drive wheel, tyne and sweeps.		small and marginal farmers (land holding <4 ha)
4	<b>Plant Protection Equipment</b>			
a.	Power sprayer	It is used for developing high pressure and high discharge for covering larger area. They are operated by engine or electric motors. Mostly are hydraulic sprayers and consists of power unit to drive the pump, pump unit, piston, pressure gauges, air chamber, delivery pipes, nozzles etc. Portable sprayers use petrol engines so that they can be easily taken to different sites. These are suitable for spraying in orchards, tea and coffee plantations, vineyards and field crops.		medium and large farmers (land holding >4 ha)
b.	Knapsack sprayer	It consists of a pump and a air chamber permanently installed in a 9 to 22.5 litre tank. The handle of the pump extending over the shoulder or under arm of operator makes it possible to pump with one hand and spray with the other. Uniform pressure can be maintained by keeping the pump in continuous operation. It is used for spraying pesticides and insecticides on small trees, shrubs and row crops.		small and marginal farmers (land holding <4 ha)

Table 7. Continued






S. No	Name of equipment/ machines	Remarks		Suitability for farmers
c.	Motorised Knapsack sprayer	It has the same function as the knapsack sprayer except a small two stroke petrol engine is used to create centrifugal suction force to create pressure for discharge of the liquid.		small and marginal farmers (land holding <4 ha)
d.	Hand rotary duster	The duster consists of a hopper, fan, discharge tube, rotating handle, shoulder straps etc. the duster has mechanical agitator connected to the gearbox placed in the hopper, which churns the chemical preventing the clogging of outlet. The fan is enclosed in the casing and is rotated with the handle through gearbox.		small and marginal farmers (land holding <4 ha)
5.	<b>Harvesting Equipment</b>			
a.	Self-propelled walking type vertical conveyer reaper (VCR)	It is an engine operated, walk behind type harvester suitable for harvesting and windrowing cereals and oilseed crops. During forward motion of reaper, crop row dividers divides the crop, which come in contact with cutter bar, where shearing of crop stem takes place. The cut crop is conveyed to one side of the machine by conveyer belt fitted with lugs and is windrowed in the field. The crop is bundled manually.		small and marginal farmers (land holding <4 ha)
b.	Tractor mounted vertical conveyer reaper	The machine is mounted in the front of a tractor and is used for harvesting cereal crops like wheat and paddy. It cuts the crop, conveys it vertically to one side and drops in a windrow for easy collection. The field capacity of the machine is about 0.4 ha h <sup>-1</sup> when operated at forward speed of 2.5-3.5 km h <sup>-1</sup> .		medium and large farmers (land holding >4 ha)
c.	Self-propelled vertical conveyer reaper	It is a self-propelled harvester suitable for harvesting cereals and oil seed crops. The cut crop is conveyed to one side of the machine by conveyer belt fitted with lugs and is windrowed in the field.		small and marginal farmers (land holding <4 ha)
d.	Combines	Combine, is a machine that harvests grain crops. The name derives from the fact that it combines three separate operations, reaping, threshing, and winnowing, into a single process. It is mainly used for harvesting wheat and now a days also for paddy crop.		medium and large farmers (land holding >4 ha)

Table 7. Continued








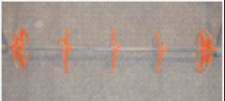

S. No	Name of equipment/ machines	Remarks		Suitability for farmers
e.	Tractor operated straw reaper or straw combine	Straw combine is used to recover wheat straw after combine operation and is operated by a tractor. Straw collected by straw combine is cut into pieces and collected in the trolley. Also some grains are collected along with straw. The capacity of machine on an average is 0.4 ha h <sup>-1</sup> while operating at a speed of 2.5 km h <sup>-1</sup> and straw recovery is about 55-60%. Two persons are required for its operation. The quality of straw is comparable with mechanical thresher. There is also additional grain recovery of 50-100 kg ha <sup>-1</sup> . The cost of grain recovered can be compensated to the amount paid for hiring the machine.		medium and large farmers (land holding >4 ha)
f.	Animal drawn potato digger	It is operated by pair of bullock and used for digging of groundnut and potato. It can also be used for secondary tillage operation (harrowing). It consists of beam, frame, handle, ground wheel depth adjustment mechanism and V-blade.		small and marginal farmers (land holding <4 ha)
g.	Tractor operated automatic potato planter	The automatic potato planter has a hopper, two picker wheels for picking the tubers, seed tubes, furrow openers, three bottom ridger to form two ridges, a fertilizer metering system and a frame. Hopper is rectangular in shape at the top with sides sloping towards bottom. At the bottom of the hopper, agitators are provided to improve the delivery of potato tubers to feeder. The agitators and the screw conveyors ensure proper feed of the tubers to the picker unit. The picker units of the planter are set in motion from the ground wheel. The planter has fertilizer distributors for the application of fertilizers during planting.		medium and large farmers (land holding >4 ha)
6.	<b>Threshing Equipment</b>			
a.	Multi crop thresher	Suitable to thresh crops like wheat, maize, sorghum, gram, soybean, pigeon pea and sunflower. Operated by 20 hp three phase electric motor or 35 hp tractor pto (power takeoff). It consists of hopper with automatic feeding, spike tooth cylinder, three aspiration blower, concave, shaker unit, bagging unit, hitch system and pneumatic transport wheel.		medium and large farmers (land holding >4 ha)

Table 7. Continued

S. No	Name of equipment/ machines	Remarks		Suitability for farmers
b.	Groundnut decorticator	It is a manually operated equipment to separate kernels from groundnut pods. The unit consists of frame, handle, oscillating arm sieve with oblong hole. The pods are feed in batches of 2 kg and crushed in between concave and oscillating arm having cast iron/ nylon shoe to achieve shelling.		small and marginal farmers (land holding <4 ha)
c.	Pedal operated paddy thresher	It consists of wire-loop type threshing cylinder, power transmission system, mild steel sheet body and foot pedal. The threshing cylinder consists of wire-loops of "U" shape embedded in wooden or metallic strips joined to two discs. On pressing the pedal the cylinder starts rotating. For operation paddy bundle is held in hands and ear head portion of the crop is placed on the rotating cylinder. The wire loops hit the ear heads and grain get detached.		small and marginal farmers (land holding <4 ha)
e.	Tubular maize sheller	It is a hand operated tool to shell maize from dehusked cobs. The unit consists of galvanized mild steel pipe with four tapered fins riveted to its inner periphery, the Sheller is held in left hand, a cob held in right hand is inserted into it with forward and backward twist, to achieve the shelling. Octagonal designs are also available.		small and marginal farmers (land holding <4 ha)
7	<b>Other Machines</b>			
a.	Marker	Small equipment used for marking of the wet paddy field for SRI (system of rice intensification) method of paddy transplanting so that row to row as well as plant to plant distance is maintained.		small and marginal farmers (land holding <4 ha)
b.	Laser land leveller	Laser land leveling is leveling the field within certain degree of desired slope using a guided laser beam throughout the field. It contains a laser guided scrapper, transmitter and receiver. It is a precision equipment to level the field.		Should be purchased by farmers group or by Panchayat.

the machine leading to losses. A number of constraints have been advanced against farm mechanization. Some of constrains and remedies are as under:

1. Small size and scattered holdings of the farmers stand in the way of mechanization. As a result of this, farm machines generally remain under utilized.
2. Majority of small cultivators are poor who are not in a position to purchase the costly machinery like tractors, combine harvesters etc.
3. The farm machinery have large turning radius and thus require comparatively larger farm for economical use.

4. Lack of proper knowledge of farmer to purchase farm machinery and matching implement, operate and maintain it properly leads to wrong choice, and makes it uneconomical and risky.
5. The lack of repair and replacement facilities especially in the remote rural areas is another hindrance in efficient small farm mechanization.
6. The Government run and privately owned Industrial Training Institutes (ITIs) may be encouraged to introduce job oriented vocational training programmes on fabrication of farm implements, repair and maintenance of tractors / power tillers and other farm machineries.
7. Due to the seasonal nature of the agriculture, the farm machinery remains idle for much of the time. Thus, idle machinery means unnecessary high costs unless proper alternate use of such machinery in the off-season is made.
8. For small farmers it's not sustainable to purchase heavy machinery but can be purchased or hired on community basis or if there is formation of any groups of small farmers. The societal interrelation among farmers plays a vital role in adoption of agricultural machineries. . Custom hiring of costly equipment and formation of Self Help Group of farmers should be facilitated.
9. Promotion of machine manufacturers in Eastern India through small scale industry, and should be given incentives for availability of quality equipment at competitive rates along with after sales service and repair facility.
10. Public promotion (subsidy) by Government to farm machines through fast delivery mechanism. Also extensive monitoring of quality of machines delivered to farmers is required.
11. Easy credit policy for the local manufacturers.
12. Strengthening of R&D institutes in eastern India for development of new prototypes, and refinement of machines suitable for local situations.
13. Effective public-private-partnership (PPP) including R&D institutions, manufactures and farmers for farm level of acceptable equipment is required.

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