

Road Map for Farm Mechanization in Assam State

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ABSTRACT

Assam has the largest cultivable plain land in North-East India but power consumption for mechanization is 0.75 kW/ha which is still below the national average of 1.5 kW/ha. For sustainable food grain production and drudgery reduction, mechanization of agriculture is mandatory to an optimum level. An attempt has been made to find out optimum requirement of farm power and machinery for mechanization of major crops of Assam state. The required number has been decided based on appropriate capacity of each machine and area under a particular crop. Results showed that Assam state will require 37,616 numbers of tractors and 43,886 numbers of power tillers which will increase the density of tractor and power tiller up to 13.7 and 16.1 per thousand ha, respectively. Estimated requirement also includes 29,257 units of mould board plough, 42,839 units of cultivators, 52,245 units of paddy transplanter, 4,180 units of combine harvester and some other specific implements and machinery.

Keywords: Assam, Farm Power, Mechanization, Road map

INTRODUCTION

Tools, implements and powered machinery are essential and major inputs to agriculture for enhancing production, productivity and reducing drudgery. The term Mechanization is generally used as an overall description of the application of these inputs in agriculture (Clarke 2000). Mechanization saves seeds and fertilizers by 15-20%, reduces time and labour requirement by 20-30% and increases productivity by 10-15% (Pandey 2008). Three main sources of farm power being utilized for these tools, machines and equipments are manual (human), draft animal and mechanical power. In many developing countries up to 80% of farm power is provided by animate source of power. In most developed countries human beings are used less as a source of power and more for machine operation and control. However, India has progressed so much than earlier times and reduced the animate farm power to a great extent (Table 1). In implementation

of mechanization project the type and degree of mechanization should be decided by the producer to best suit his business in his own particular circumstances. The choice of suitable source of power will therefore be just one of a number of choices that the farmer has to make (Clarke 2000).

Table 1: Percent contribution of different power sources in Indian Agriculture (2005-06)

Power source	Percent contribution (%)	
Agricultural worker	6	<i>Average farm power = 1.5 kW/ha</i>
Draught animals	8	
Tractor	47	
Power tiller	01	
Diesel engine	18	
Electric motors	20	

(Pandey 2008)

This document presents a comprehensive understanding of mechanization requirement of State of Assam. The document has been concised

to the total need of farm power, implements/ machines, storage facilities and processing equipments for almost all farm operations and crops grown in the state. Actual power requirement may be decided considering the available power in the state.

METHODOLOGY

About the state

The state of Assam lies between 89° 42' E to 96° E longitude and 24° 8' N to 28° 2' N latitude spread over an area of 78,438 km². It has six agro-climatic zones viz. North Bank plain zone, Upper Brahmaputra valley zone, Central Brahmaputra valley zone, Lower Brahmaputra valley zone, Barak valley zone and Hill zone. Administratively, the state is divided into 27 districts. With the 'Tropical Monsoon Rainforest Climate', Assam is a temperate region and experiences heavy rainfall and humidity. Winter lasts from late October to late February. The minimum temperature ranges between 6 to 8°C and maximum between 35 to 38°C. The peak of the monsoons is during June. The net sown area in the state is 2.734 million ha which is approximately 35% of its total geographical area. The climate of the state ranges from subtropical to sub-temperate and humid which is suitable for growing variety of crops namely paddy, wheat, maize, pulses, oilseeds, plantation crops, jute, vegetables and fruits. Per capita land holding in the state is less than one ha (Anonymous 2013, Agriculture Vision 2012, NEDFI 2010).

Cropping system

Average productivity of the crops mainly paddy, oilseeds, pulses ranges between 1150-2577, 400-550 and 500-550kg/ha, respectively. Almost all types of soil are present in Assam but major being the acidic soil. The major farming systems prevail in the state are Rice-Rape seed/Vegetables+ Fish and Rice- Rape Seed / Vegetables + Goat + Pig + Poultry + Cattle and benefit from these systems ranges between Rs. 50000 to Rs. 90000. For rice growers average annual income is Rs. 40000/ha whereas, it goes up to Rs. 75000/ha for those who practice integrated farming including fishery and animal husbandry. The average wage rate all over the state varies from Rs. 200/day to Rs. 250/day. Major part of the labourers' group is from women (Anonymous 2013).

Status of mechanization

The state has no manufacturing unit of tractor, power tiller or any other self propelled machinery and all are imported from outside the states. Small scale manufacturers are available in districts but not in every district. Local village artisans generally make sickles and small hand tools. There is a lack of extension and training activities of improved agricultural tools and equipments. Nationalized, private and cooperative credit societies are available in almost every block of the state.

Present level of mechanization in the state (0.75 kW/ha) can be categorized into low to medium and it is still below the national average of 1.5 kW/ha (Srivastava 2004). For a sustainable growth in agriculture average farm power availability should be more than 3.5 kW/ha to maintain the highest productivity level. The main source of power is animal and human, and in some pockets mechanical power is available such as tractor and power tiller. Currently the state is on the highway of mechanization and in this process already 5772 tractor and 20777 power tillers have been provided to the farmers till 2012 (Table 2). Therefore, it is a primary need to increase the level of mechanization to increase productivity and solve the problems of labour shortage in the state.

Table 2: Present farm power level of Assam state

Implement	Total numbers
Tractor	5772
Power tiller	20777
Power paddy thresher	43
Rotavator	111
Self propelled reaper	20
Small implements	99884

Source: Data provided by the Department of Agriculture, Govt. of Assam during personnel interaction in 2012.

Suitable equipments and machinery

Identified implements and machinery suitable for state of Assam have been presented in Table 3 with their capacity and coverage. The factor of seasonal use describes the frequency of use of a particular implement in a season such as a plough is used once but a weeder is used twice or thrice in a season. Coverage of a particular machine/equipment has been calculated by multiplying its capacity by number of days used in a season and

then divided by factor of seasonal use. Total number of machines and equipments necessary for complete mechanization of the state has been calculated by dividing the cultivated area with the capacity of the machine.

RESULTS AND DISCUSSION

Farm power need

Tractor and power tiller are the prime movers for almost all agricultural implements and major farm power sources. The total farm power need for major agricultural operation (Table 3) has been calculated based on the average capacity of a 35 hp tractor and 10 hp power tillers. Out of total farm power need in the state, 70% tractor and 30% power tiller strength has been considered. The ratio of tractor and power tiller can be changed as per the government policy. Table 3 shows that a total of 37616 tractors and 43886 power tiller are necessary for complete mechanization of the state. It is mandatory to find out the actual farm power availability in terms of manual, animal and mechanical power sources. The existing farm power availability can be deducted from the proposed numbers. Tractors should be recommended for plain areas and power tiller for hilly areas. The choice among power tiller/tractor and their make should be left to the farmers.

Mechanization in rice

The machinery required for paddy cultivation are mould board plough, rotavator, puddler, paddy transplanter and sprayer. Mould board plough is suitable for all type of soil except sandy and rocky soil and soil with high vegetative cover. In this soil condition disc plough can be used. Rotavator can be adopted if necessary power requirement is available because, to operate a rotavator of 1.5 m width, 50hp tractor is necessary. Power tiller operated rotary blades are suitable for shallow ploughing up to a depth of 15 cm and most suitable in cultivation of paddy and vegetable crops. But continuous operation should be avoided. MB plough and disc plough should be used only once in a year to conserve power requirement. For tillage in second and third season tractor operated cultivator can be used.

For using a paddy transplanter, farmers should be trained in raising of mat type nursery and field

should be levelled thoroughly. Power weeder can be adopted in case of check row transplanting. Combine harvester should be recommended for larger field and where whole paddy straw is not needed and also the area should be free from water logging and flood. The whole paddy straw can be recovered with the use of vertical conveyer reaper (VCR) or reaper binder though it can not be operated in water logged condition and in case of lodged crops. For harvesting and threshing operations, 50% can be met by VCR/reaper binder subsequently by power thresher and another 50% by combine harvester. Water logged and flooded areas should continue with the traditional practice of manual harvesting using improved sickle. The power operated thresher can be used for threshing of paddy after harvesting with VCR or by sickle. Requirement of storage bin has been calculated considering the fact that only 50% of the produce will be stored for seed, self consumption and offseason sell.

Mechanization in wheat

Tillage operations in wheat can be accomplished using the equipments recommended for paddy in subsequent *rabi* season. However, for sowing operation tractor operated fluted roller seed drill can be used. Vertical conveyor reaper recommended for paddy can also be used for harvesting of wheat. Threshing of wheat should be done using wheat thresher which is operated by tractor or power tiller. Number of flour mills is calculated considering that 80% of the wheat produced to be milled for consumption purpose.

Mechanization in pulses

For land preparation of pulse crops the equipments listed for paddy may be used. However, for sowing purpose tractor operated seed cum ferti-drill and zero till drill can be adopted in a ratio of 80:20 of total requirement. In case of high precision sowing, tractor operated inclined plate planter can be used successfully. In the areas where land preparation is not done and seeds are sown directly in the field after harvest of the previous crop, tractor operated Zero-till drill can be adopted. Mechanical weeders can be adopted for weeding in pulses and harvesting can be done using the same reaper adopted for harvesting paddy. Multi crop thresher can be adopted for threshing most of the pulses efficiently. The storage bin required is of 1 ton capacity at household level.

Table 3: Identified implements and machinery suitable for state of Assam

Name	Capacity ha/day	Annual use (day)	Coverage (ha)	Required number	Crop recommended
Tillage					
Tractor with cage wheel (35-45 hp)	3	60	30	37616	All crops
Power tiller (8-14 hp)	1	60	15	43886	All crops and cage wheel for Paddy
MB plough (2 bottom)	1.5	60	30	29257	Paddy, potato, sugarcane
Disc harrow (offset, 12 disc)	2.5	60	75	34272	All crops
Cultivator (Spring loaded 9 tine)	4	60	60	42839	All crops
Rotavator	3	60	90	6269	All crops
Other tillage					
Ridger	2	30	60	966	All crops
Bund former	2	20	40		All crops
Sub-soiler	0.5	30	180	-	Periodic use to break plow pan
Puddler	6	20	120	21419	Paddy
Seeding and planting					
Paddy transplanter	1.2	30	36	52245	Paddy
Seed cum ferti-drill	6	30	90	4462	Pulses, wheat, oil seeds, maize, groundnut
ZT drill	6	30	90	261**	Pea, lentil, mustard, paddy, wheat
Inclined plate planter	4	15	60	1958	Maize and other row crops
Sugarcane planter	1.6	15	24	1239	Sugarcane
Potato planter	3.2	30	96	966	Potato
Raised bed planter	2	30	60	-	Pulses
Harvesting and Threshing					
Vertical conveyer reaper	1.5	30	45	19592	Paddy, wheat, pulses
Reaper binder	1.5	30	45	-	Paddy, wheat
Potato digger	3	15	45	3141	Potato
Paddy/wheat thresher	4	30	60	15673	Paddy, wheat
Combine harvester	4	30	120	4180	Paddy, wheat
Multi crop thresher	300 kg/h, 4.5ha/day	30	135	2730	Cereals, pulses and oilseeds
Plant protection					
Hand Compression Sprayer	1.5	30	45	-	All crops except orchards
Fog generator	1.5	30	45	-	All crops except orchards
Rocker Sprayer	2	30	60	-	All crops and orchards
Foot Sprayer	2	30	60	-	All crops and orchards
Knapsack Sprayer	1.5	30	45	41796	All crops except orchards
Boom Sprayer	10	30	300	-	All crops and orchards
Processing					
Winnower	1.5	30	22.5	-	All crops
Dal mill	1.4	15	21	5594	Pulses
Straw baler	3.5	15	52.5	-	Paddy
Straw combine	3.2	15	48	-	Paddy, wheat
Expeller	300 kg/h, 4ha/day	300	1200	219	Oilseeds
Flour mill	200kg/h, 1ha/day	300	300	119*	Wheat, pulses
Mini rice mill	1	300	300	3135	Paddy
Storage bin	2 ton	300	1	940407	Cereals and pulses
Cold storage (1250 bag capacity)	300 ton			1605***	Horticultural crops
Drier	120-240 kg/batch	360	According to crop	-	All crops
Weeding, inter-culture and Others					
Chaff cutter	500	150		-	
Power weeder, ha/h	1.2	60	36	26122	All crops
Duck foot tyne cultivator	4	60	120	-	For sugarcane and other row crops

* Considering 80% to be floured for consumption purpose, **If 20% pulses are grown in zero-till condition,

*** Considering 50% to be stored in cold storage for seed and other purposes, to store potato, turmeric, onion, ginger

Mechanization in oil seed crops

The equipments listed for land preparation of paddy can also be used for oil seed crops. Sowing of oil seed crops can be done using tractor operated seed-cum-ferti drill. Power operated multi crop thresher can be adopted for threshing of oil seed crops. The storage bin of 1 ton capacity can be adopted for storage of oil seeds at household level. The mechanical press type oil expeller can extract oil from most of the oil seeds.

Mechanization in tuber crops

Sowing of potato can be done using tractor operated potato planter. Tractor operated ridger is suitable for making ridges and earthing up operation in root crops. However, the harvesting can be done with the help of tractor operated digger. The number of cold storage structure is calculated based on four chambers of 1250 bag capacity each. It is also assumed that 50% of the produce is to be stored in cold storage for seed and other purposes.

Suitable hand tools and equipments for small holdings and hilly areas

Small hand tools and equipments are most necessary tools for small land holders and for interculture operations where power operated machinery can't be operated. Table 4 presents a list of equipments suitable for different operations. These equipments are suitable for inter row operation like weeding, side dressing etc. Some hand held equipments may be recommended for hilly areas where larger machine can't work. These could be given to farmers in a package of equipments specific for rice cultivation such a package could include M. B. plow, cono weeder, paddy thresher, sickle, winnower and knapsack sprayer.

Mechanization in Horticultural Crops

For horticultural crops, no other major machinery is needed separately than discussed earlier. Some specific tools and equipments required are listed in Table 5 which farmers may choose according to their requirements. The major problem associated with the low profit from horticultural crops is the post harvest loss due to lack of proper storage and transportation facilities and unawareness about the value addition. Agro-processing centres may address this problem. An Agro Processing Centre (APC) can be established

Table 4: Human and animal operated Hand tools and equipments

Name of Equipment	Use
Octagonal & Tubular Maize Sheller	Maize shelling by hand
Hand Grass Slasher	Grass cutting
Multi purpose "U" blade Weeder	Weeding
Metallic Tip dibbler	Seed sowing and planting
Hand Fork	Weeding and interculture
Garden Rake	Weed collection, straw accumulation, soil arrangement
"V" blade Weeder	Weeding
Straight blade Weeder	Weeding
Bordoli Seed Drill	Seed sowing
Adjustable Row Marker	Row marking for line sowing of crop
Wheel Hoe with one sweep blade	Weeding
Wheel Hoe with three-sweep blade	Weeding
Animal drawn Bund Former	Bund forming
Animal drawn Ridger Plough	Ploughing, bund forming, earthing
Animal drawn Mould board plough	Ploughing
Rotary Paddy weeder	Weeding in paddy
Pre germinated Paddy Seeder (4 Row)	Paddy sowing
Seed drill for Upland Paddy or Lin Seed (three wheeler)	Sowing
Seed drill for Maize or Groundnut (three wheeler)	Sowing
Groundnut Decorticator	Decortications of groundnut
Hand Operated winnower with Fan Guard	Cleaning of chaffs from threshed grains
Manual Trolley with single wheel	Transportation of soil, crop, seedlings etc.
Pedal Paddy thresher	Threshing of paddy
Power Paddy thresher cum blower without Motor	Threshing of paddy
SRI Row Marker	Row marking in SRI method
Cono weeder	Weeding in paddy
Knapsack sprayer	Spraying of chemicals

in each administrative Block. It can be operated and maintained on community basis or through Government agency. The equipments requirement for a location specific Agro Processing Centre can be decided based on major crops of the area to be processed. The APC may have the equipments and facilities listed in Table 6.

Table 5: List of hand tools and equipments suitable for horticulture

Name	Purpose
1. Light Ridger Plough	Ploughing, bund making, interculture
2. Light Weight Power Tiller	Ploughing, weeding
3. Metallic Tip Dibbler	Planting
4. Naveen Dibbler	Planting
5. Manual Seed Drill	Seed drilling
6. Wheel hoe	Weeding
7. Long Handle Weeders	Weeding
8. Weeding trowel	Weeding, plant uprooting, side dressing
9. Hand Cultivator	Weeding, plant uprooting, side dressing
10. Hand Fork	Weeding
11. Hedge Cutter	Hedge cutting
12. Major Scissor	Pruning, branch cutting
13. Super Scissor	Pruning, branch cutting
14. Grafting Knife	Pruning, branch cutting
15. Knapsack sprayer	Chemical spraying
16. Rocking Sprayer	Chemical spraying
17. Foot Sprayer	Chemical spraying
18. Hand Rotary Duster	Dusting
19. Fruit Harvester Hold and Twist Type	Fruit harvesting
20. Fruit Harvester Cut and Hold type	Fruit harvesting

Table 6: Equipments and facilities required for agro-processing centre

Sl. No.	Equipment
1.	Non IBR boiler
2.	Cold Chamber -10 Ton capacity for storing fruit juice/pulp and other concentrated products for further processing
3.	Fruit mill/pulper (capacity 50 kg/h)
4.	Pineapple sizer cum corer (capacity 10-12 fruits/min)
5.	Fruit juice extractor
6.	Tubular pasteurize heat exchanger
7.	Semi automatic vacuum bottle filling machine (double head)
8.	Capping machine
9.	Double seaming machine for cans
10.	Can body reformer
11.	Canning retort
12.	Autoclave (75 lit volume)
13.	Straight line Exhaust box
14.	Electric tray dryer
15.	Hammer mill/grinder (15-25 kg/hr capacity)
16.	Hand Operated Heat sealing machine
17.	Steam jacketed kettle
18.	Hand operated crown corking m/c
19.	Rice huller cum polisher
20.	Digital Electronic Balance, capacity 5 kg.
21.	Storage tanks for fruit juice
22.	Plastic crates, working knives, working tables, packaging materials etc.

CONCLUSION

Sustainable agriculture requires optimum use of farm machinery to achieve the higher productivity. Mechanization of agriculture boosts agricultural production but policy should be to get higher output with minimum input. Farmers require the availability of the widest choice of appropriate farm tools, machinery and equipment at affordable prices as well as access to spare parts and service to allow him/her to make the best choice to suit his/her requirements. They should be able to freely choose the type, size and extent of mechanization inputs from a range of mechanization inputs available in the market.

To reach the mechanization to a sustainable level, Assam state will require 37616 numbers of tractors and 43886 numbers of power tillers which will take the state to higher level than national average of tractor and power tiller density per thousand hectare. There will also be necessity of 29257, 42839, 52245 and 4180 numbers of mould board plough, cultivators, paddy transplanter, combine harvester, respectively and many other agricultural implements and machinery.

The production and selling of farm tools and machinery should be left totally to the private sector, and the Governments should pull out of all activities concerned with manufacturing, importation and retailing. There should be proper linkage between manufacturer, wholesaler, retailer and farmer for the successful and sustainable development of agricultural mechanization. The government should formulate extensive training and demonstration service by mobilizing the KVKs. When the place is beyond reach of KVK, separate programme has to be formulated. The extension work may also be given to private sector. Testing of Farm Machinery is a very important subject. Before launching of any machinery/equipment it should be tested by government agencies.

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