

Mechanization Options for Alternate Land Use and Resource Conservation

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Present day of conventional agriculture is under transition stage which demands alternative land use with resource conservation for higher profits. Mechanization is one of the tools to implement the technologies recommended by the researchers who have been working in this field. High labour charges and shortage of skilled labour forcing the farmer's to look for alternate agriculture with less risk. Hence the farm mechanization would be the answer for efficient and cost saving in implementing the desired technologies at on-farm.

The alternate land systems could be an agroforestry with intercropping, Biofuel plantation, and waste land development integrated with watershed management etc. All these systems need the combination of implements to reduce the drudgery and enhance the quality of operations to be performed at site.

The mechanized operations include land preparation, leveling, seed bed preparation, bedmaking, broad bed and furrow sowing, tree hole digging, sowing, intercultivation, harvesting and value addition.

The following subheads deal with the specific machinery and methods of mechanization for different operations.

Mechanized options available for intercropping in Agro-forestry system:

Bed makers (seed bed makers):

The tillage operations, defined as mechanical manipulation of soil, are performed to achieve the desired seedbed to provide optimum environment for seed germination and plant growth. Seed preparation for sowing/planting of different crops is done through primary and secondary tillage operations.

The optimum seed bed preparation for raising upland crops, involves the following unit operations:

1. **Loosening of soil:** Local plough and blade harrow and other traditional implements used for loosening of soils. These are simplest tools designed to break the topsoil and multi-passes are carried out to prepare seedbed. M.b Plough, soil stirring plough, ridger plough, toolframes with tillage sweeps are improved implements designed for breaking soil.. ploughs are used to break soil and invert furrow slice to control weeds.
2. **Clod size reduction:** Clod breaking operation is required to produce a granular soil structure in the final seedbed: Tine cultivator and disc harrow are used for breaking of clods. Generally these are operated after one pass of mouldboard plough or ridger plough.
3. **Clod sorting:** Operation of tools with narrow tines such as comb harrow and spike tooth harrow, in loosened soil, produces a sorting effect, bringing larger clods and aggregates on surface. Some times large size clods on the surface are recommended because of their stability under rainfall which helps in reducing soil erosion.

4. **Smoothing** of seed bed is required for proper operation of sowing machines, better destruction of irrigation water and quick disposal of excess rain water.

Different seed bed requirements under different Agro-climatic conditions:

Optimum tillage to achieve maximum crop yields with minimum energy consumption should be the aim of seedbed preparation. **In arid and semi arid** areas with high average soil temperature and dry spells, there is a need to break the soil, which becomes very hard. A pointed tool like chisel or bar point are used on country plough to break soil without inverting or disturbing crop residue, in order to collect and store rain water and reduce wind erosion and evaporation losses. Under such conditions lister plough, rigid tine cultivator, duckfoot sweeps and other similar equipment are useful and can be operated for one or two passes.

Under black soil regions (vertisols) of Madhya Pradesh, Maharashtra, Gujarat and Andhra Pradesh, soils-dry up and develop deep cracks during hot summer weather and hence ploughing is not very essential. Mould board ploughing may be done once in 2-4 years to destroy weeds. For such soils shallow cultivation by a blade harrow or sweep cultivator is sufficient to prepare a good seedbed, when weeds are under control. Continuous operation of mould board for few years may be required to control the weeds.

In humid areas, it is desirable to have deep tillage accompanied by soil inversion and burying of crop residues. This helps in enhancing nitrogen fixation in soil and incorporation of biomass.

In dryland areas tillage requirements are mainly linked with improved moisture intake and retention, reduced evaporation and checking of weed growth. Studies have indicated that increased infiltration rate and higher crop yields can be achieved under dryland conditions by performing deep tillage by mould board plough.

Animal drawn Tillage and seed bed preparation implements:

1. M.B. Plough
2. 3 or 5 tyne cultivator
3. Disc harrows: They are equipped with 4-6 discs are widely used for secondary tillage. Output 0.12/ha
4. Leveller and land smootheners: Levelling blades, singh pata, ladders and patella harrows . Wide leveling plank helps in compacting soil aggregates in top layer which reduces the loss of soil moisture due to evaporation .(output 0.25-0.35ha/h)

Tractor drawn Implements:

1. M.B. plough
2. Disc pough
3. Shovel type cultivator
4. Duckfoot type cultivator
5. Disc harrows trailed or mounted type (tandom, off-set)
6. Ridger plough



Bed-furrow formers: Though animal drawn bed –furrow formers are available, their efficiency is very less. The tractor drawn be-furrow former is capable of forming alternate beds and channels. It saves 90 % of labour. These beds are suitable for planting crops like sorhum maize, cotton. This sbed and furrow system is ideal for efficient irrigation management.

Rotavators and residue incorporation implements: Rotavators are best suitable for pulverization of the soil after primary tillage and also for incorporating the residue which is left in the ground as well as green residue if any grown on the surface of the soils. Field capacity of the rotavator is around 0.45 ha/hr. It is driven by the pto of the tractor. Blades with different shapes can be used in the rotavator. A 35-hp tractor can be sufficient enough to use these implements.



Rotavator in operation

Planting and Planting Machinery:

The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing, seed rate, seed to seed spacing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields.

Normally seed drills are needed to maintain the timeliness and precision application of seed and fertilizer to get the higher productivity and profitability. These seed cum fertilizer drill reduces the labour cost, covers more area per hour and reduces the input cost.

Studies show that the yields are increased by 20 -25 % and 40-50 % of saving is observed in labour cost.

Planting machinery can be powered by bullock or tractor or self propelled machinery.

Functions of the seed drill:

1. Meter seeds of different sizes and shapes
2. Place the seed in the acceptable pattern of distribution in the field
3. Place the seed accurately and uniformly at the desired depth in the soil
4. cover the seed and compact the soil around it to enhance germination and emergence.

Plough planter, 2-row seed drill, 4- row seed drill are the main types in bullock drawn equipment.

Four-row, 6-row and 9-row seed drills are available in tractor drawn implements. The can cover the area of 1 ha in an hour if the skilled operator is available.

Some of the precision planters like pneumatic planters are also available in India for breeding type experiments.



CRIDA 6-row planter

Prunes and Pruning machinery:

Pruning is done to make a tree more productive and bear quality fruits, increase longevity of the tree, make it into more manageable shape and to get maximum returns from the orchards. It includes removal of parts of the tree especially shoots, roots, limbs, buds or nipping away of terminal parts. In ornamental crops, pruning gives more aesthetic look to plant. The essential tools are **knives, shears, secature and saws.**

Generally shearing type of pruners are used for pruning fruits like grapes, where as, citrus pruning is mostly done with **wood saw** or similar small local tools, which are quite time consuming and in appropriate. Hence **electrically powered, manual pruner** was developed to prune fruit trees,

to increase pruning efficiency. The pruner was tested for tree branches, 8, 10, 12, 14 and 16 mm diameter branches at varying speeds 46.58 m/s, 24.76 m/s and 9.23 m/s. It was found that pruner performance was better at highest speed for all five-branch diameters

In Citrus machine hedging:

With increased hedgegrow planting system, machine pruning is becoming more necessary to save time. There will always be some crop loss from hedging. The benefits of improved access and increased fruit size have to be weighed against the crop loss and the cost of the operation.



Citrus pruner

Harvesters and combines:

Harvesting operation involves cutting/digging/picking/laying/gathering/curing/transport and stacking of the crops. In normal practice loss observed up to 5-10 % due to cutting and conveying losses. It can be reduced by using the precision harvesters and combines.

Types:

Reapers: Reapers are used for harvesting of crops mostly at ground level. It consist of crop-row-divider, cutter bar assembly, feeding and conveying devices. Reaper are classified on the basis of conveying of crops such as vertical conveying reaper, horizontal conveying reaper, bunch conveying reaper and reaper binders.

Strippers: Stripper is used for collection of matured seeds/pods from the plants or seed crops.

Diggers: For digging the groundnut and potato and other crops. Bullock drawn and tractordrawn diggers are available in the market.

Cobine harvester: Various designs of combine harvester having 2-6 m long cutter bar are commercially available. The function of combine harvester is to cut, thresh, winnow and clean grain. It consists of header unit, threshing unit, separation unit, cleaning unit and grain collection . The function of the header is to cut and gather the crop and deliver it to the threshing cylinder. The crops are threshed between cylinder and concave due to impact and rubbing action. The material is shaken and tossed back by the straw rack so that grain moves and falls through the openings in the rack on to the clening show while the straw discharged at the rear. The grain is conveyed with collected in a grain tank.

In horticulture and agro forestry systems, the end products need to be primarily processed for higher profits to the farmers. Dehydration is one of the simple operations which can be performed on-farm. Tamarind, amla, chillies, turmeric, curry leaf etc. can be dehydrated at the site using driers. Many driers are available in the market. It is very much essential to have a suitable on-farm dryer with auxiliary power backup for value addition of the agriculture product.

CRIDA herbal dryer: This herbal dryer mainly consists of a drying cabin about 8 cubic meters volume in which the sieves are arranged on a stand in 4-6 layers in which the curry leaf or Henna and other things can be kept for drying. A heating unit with a hot plate kept at the bottom heated with LPG burners is attached to the drying cabin. The hot air from the heating unit is blown to the chamber using a 0.5 hp blower. The temperature inside the drying chamber is measured and controlled by a micro processor controller which in turn controls the gas flow inside the burners. The humidity is also measured using a humidity sensor attached to the micro processor unit. The humidity inside the drying chamber is controlled by opening and closing the ventilators provided at the top. The trials showed that the quality of the dried products was superior to the conventional methods. Biogas can also be used as a fuel source for the CRIDA dryer.