

FARM MECHANIZATION IN AGRICULTURE

Abstract

Efficiency in technology increases output and productivity while also allowing farmers to grow a second or many crops, making Indian agriculture attractive and a way of life by transitioning from subsistence to commercial agriculture. More agricultural inputs must be used, and crops must be protected from a variety of challenges, to increase productivity. There are several obstacles to the promotion of mechanization efforts to establish an acceptable agricultural technique. Reducing crop and food product losses .increased land productivity. Status of farm mechanization increases under subsidy schemes. Clear idea on usage of the machines makes farmers easy to understand its operations. Increases the status of the farmer. This has led to many practical applications of the implements and machineries.

Keywords: Agriculture

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I. INTRODUCTION

It is an crucial component of contemporary agriculture is farm mechanization. Along with decreasing human labour and agricultural costs, it increases production. Additionally, mechanization increases the effectiveness with which other inputs are used, the safety and comfort of agricultural workers, and the quality and added value of the produce. Efficiency in technology increases output and productivity while also allowing farmers to grow a second or many crops, making Indian agriculture attractive and a way of life by transitioning from subsistence to commercial agriculture. More agricultural inputs must be used, and crops must be protected from a variety of challenges, to increase productivity. To meet the rising need for food grains, the average farm power supply for the nation's cultivated lands has also increased, from 0.48 kW/ha in 1975–1976 to 1.84 kW/ha in 2013–14 and 2.49 kW/ha in 2018–19. This average has to rise to 4.0 kW/ha by the end of 2030. Agricultural mechanization entails the use of different sources of power and improved farm equipment and tools with the goal of reducing the labor-intensive tasks performed by humans and draught animals, improving cropping intensity, precision in metering and placing inputs, and timelines of efficient utilization of various crop inputs (seed, chemical, fertilizer, irrigation, water, etc.), as well as reducing losses at various stages of crop production.

Farm mechanization's ultimate goal is to increase overall productivity and production while maintaining the lowest possible production costs. In addition, it facilitates value addition, the formation of agro-processing businesses for the generation of additional income and employment from agricultural products, and the preservation of the produce and byproducts from qualitative and quantitative damages. It is a crucial component of the user's overall growth in rural India.

II. CONSTRAINTS IN MECHANIZATION

There are several obstacles to the promotion of mechanization, including as

1. Each agro climatic zone requires a certain kind of equipment zone.
2. Small and dispersed land holdings .
3. Farmers' limited ability to make investments.
4. Insufficient irrigation infrastructure.
5. The farmers' low level of expertise.
6. Inadequate facilities for farm machinery maintenance and repairs.
7. Insufficient irrigation infrastructure

III.SCOPE OF FARM MECHANIZATION

Due to their low output per hectare from their holdings, Indian farmers do indeed have the lowest wages per capita. Mechanization is one of the few significant ways to raise farm production per hectare. India may need to implement mechanization on several levels. Generally speaking, there are three ways to go about it:

1. By implementing the upgraded agricultural tools for bullock power on small properties.
2. By using power tillers, small tractors, and tractor-drawn equipment on medium-sized properties to enhance current sources.

3. By augmenting the animal power source with the heavy tractors and equipment on the remaining estates.

However, a lot of people believe that Indian agriculture can't be entirely mechanized. Introduce just the improved versions of tools drawn by animals. It is believed that

- India has an excess of agricultural labour .
- The country has a enough number of draught animals to efficiently do farm tasks.
- The bulk of Indian farmers have too modest of land holdings to warrant using tractors on their fields.
- The farmers' financial capabilities are insufficient to purchase a tractor and implements that are pulled by tractors.
- The country's population lacks knowledge about technology.
- Under the current circumstances, the tractor and tractor-drawn equipment cannot be used efficiently in the absence of a proper farm road system.
- Using mechanical power will not be able to improve the yield.
- Production costs will not be reduced by mechanization.
- Not every aspect of farm operations can be mechanized.
- Agriculture will lose a significant portion of its labour force.

IV. SOCIAL CONSIDERATION TO FARM MECHANIZATION

In India, efforts to establish an acceptable agricultural technique are focused on enhancing and raising agricultural output rather than on saving manpower. The majority of people think that India has a surplus of workforce as well as that there are for the farming of the available farmland, there are simply too many draught animals. Above all, there is an erroneous worry that widespread rural unemployment will result from farm mechanization because almost two-thirds of all occupations in India are related to agriculture. However, the reality is that India's growing food needs must be addressed by increasing land productivity through higher yields as well as multiple cropping, which would need hiring more people to perform various farm tasks.

From the perspective of energy application, Indian agriculture is moving from stages 1 and 2 (human power and animal power) to stages 3 and 4 (a power tiller or four-wheel tractor). However, throughout the nation, both mechanical and animal power will coexist. To avoid having to walk behind an animal-drawn vehicle, tiding procedures must be included.

The following factors can assist in raising the nation's agricultural output:

1. In the near future, agriculture will have to employ as many workers per cultivated hectare or more.
2. The utilisation of equipment intended for large-scale mechanization is constrained by the modest and dispersed land holdings and the meager economic circumstances of the typical farmer. Therefore, there is more opportunity for the employment of power tillers and related machinery on such farms. Puddling activities in rice-growing regions are better suited for power tillers coupled to rotavators .

3. In order to accomplish the goals of under intensive agriculture in low intensive energy use areas, the power availability on the farm should be increased by 2.5 times greater.
4. Cropping intensity should be raised from its current level of 100 to 180 percent to 200 to 250 percent.
5. The number of holdings has increased as a result of land fragmentation, necessitating the introduction of farm machinery of the proper size for tillage, planting, transplanting, and harvesting of crops. Machine customization will have a lot of potential in the future.
6. To meet the needs of farmers, a cost-effective multi-crop thresher may be created. There is an urgent requirement for high capacity threshers that can thresh wheat and paddy crop at a moisture level of 15% to 20%.
7. Farm equipment on-demand should be promoted because it has enhanced power availability on farms, which has raised land productivity.
8. Post-harvest technology on Indian fields needs special attention.

V. FUNDING

1. **The State Development Plan (SDP):** It aims to provide individual farmers with equipment and implements. This machinery executes a single operation or a selection of processes on a crop. Typically, the State Development Plan (SDP) used by the State Government to support this. The BE 2017–18 budget allotment is Rs. 146.63 crores.
2. **Rashtriya Krishi Vikas Yojana(RKVY):** RKVY is a 60:40 (Central:State) funded central sector scheme known as RashtriyaKrishiVikasYojana. aims to provide a group of farmers (RythuMithra Groups, Joint Liability Groups, etc.) with a crop-based group (set) of machinery or equipment.
3. **Sub-Mission On Agriculture Mechanisation (SMAM):** Central Sector Scheme with finance distribution of 60:40 (Central: State) for farm equipment supply. All central funding is provided for instruction and demonstrations. The BE 2017–18 budget includes Rs. 155.765 crores.

In 2017–18, a total of Rs. 415.555 crores will be budgeted for the Farm Mechanization Scheme. Transparency in the scheme's implementation is of the utmost significance because significant sums are involved. To provide a swift and transparent transaction from the time an application is received until the equipment is delivered and the firms are paid. The online application process through Meeseva has been used for the past two years and has been quite successful.

These pieces of machinery are designed to carry out all or most of the practical farm tasks for a given crop. The RastriyaKrishiVikasYojana (RKVY) of the Indian government is providing the funding for this. The financial provision in 2017-18 is Rs.113.16 crores .

VI. BENEFITS OF FARM MECHANIZATION

The benefits of farm mechanization are as follows

1. The operation's promptness.

2. Operational accuracy.
3. Enhanced working conditions.
4. Increasing safety.
5. Lessening of labor's drudgery.
6. Reducing crop and food product losses.
7. 7 .increased land productivity.
8. A higher financial return to farmers.
9. Enhanced respect for farmers.
10. Rural areas' progress and prosperity.

VII. LIMITING FACTORS IN FARM MECHANIZATION

1. Limited acreage.
2. Farmers' reduced capacity for investment.
3. There is an abundance of agricultural manpower.
4. The nation has enough draught animals accessible.
5. A lack of appropriate agriculture equipment for certain tasks.
6. A lack of machine maintenance and repair facilities.
7. A lack of skilled labour.
8. There is insufficient communication between research organizations and manufacturer.
9. Exorbitant machine costs.
10. Insufficient machine quality control.

VIII. RECOMMENDATIONS FOR FARM-MECHANIZATION

1. To create a national farm mechanization policy.
2. To create an apex body to carry out the national policy on farm mechanization. This could serve as a foundation for industries to manage their equipment capabilities, sales, and maintenance.
3. To establish sufficient training facilities for providing instruction on proper machine selection, use, maintenance, and repair to engineers, mechanics, technicians, operators, and users of farm power and machinery.
4. To begin measuring and testing farm power and equipment based on location.
5. To set up suitable facilities for machine repairs and spare components.
6. To upgrade the tractor testing facility in accordance with international stations for testing.
7. To enhance industrial policies to sustain higher standards of machinery and implements.
8. Extension of Agricultural Engineering .To keep farmers informed about the different applications of engineering to agriculture, education must be created on a solid foundation.
9. In order to increase their income, landless labourers require financial support to buy hand tools.
10. Special consideration should be given to post-harvest technology.
11. Encouragement of the custom hiring system is necessary in rural areas.

IX. STATUS OF FARM MECHANIZATION IN INDIA

1. Improved hand tools
2. upgraded tools drawn by animals

3. Equipment powered by tractors
4. Special farm hiring units
5. Additional stationary devices, such as a thresher and irrigation pump Dusters, sprayers, etc.

X. BETTER MANUAL TOOLS

Improved manual tools play a crucial role for reducing the worker's physical fatigue. The amount of work produced per unit of time rises. Sickles, Khurpi, running knives, wheel hand hoes, lo handle hoes, manually operated seed drills and many other objects fall under this category: The manual tools have some size and design variations depending on the situation.

XI. IMPROVED ANIMAL DRAWN IMPLEMENTS

More than 80% of farmers rely on equipment pulled by animals. The output and quality of work are both improved by improved implement. This includes enhanced steel ploughs, cultivators, harrows, drills for seeds and fertilizer, multipurpose toolbars, bakhar, levelers, puddlers, and many more instruments. Local businesses currently produce a sizable number of equipment pulled by animals.

Farmers that rely on animals for power typically employ moldboard ploughs and soil stirrers. Work output is poor since traditional implements only have a field capacity of 0.3–0.4 ha/day.

Then, disc harrows pulled by animals were developed. Depending on the size of the draught animals, these harrows either have four or six discs.

Further alterations to the harrow's construction resulted in the introduction of a drum between two discs in place of the spool, giving rise to the term "Harrow Puddler." The drum's presence prevents discs from sinking deeper than 125 mm while the machine is puddling. As a result, even medium-sized draught animals NAD are able to pull the tool. The drums assist simple seed bed preparation and break up soil clods during dry seed bed operation. This significantly reduces the need for time and energy.

The land used for shifting cultivation in hillside agriculture is not well suited for the utilization of powerful mechanical power.

Farmers in this area rely primarily on people and draught animals. However, mechanical power is gradually growing every day.

XII. TRACTORS AND SUITABLE IMPLEMENTS

1. A tractor is a crucial piece of agriculture mechanization equipment. Tractor-operated vehicles are used to cover about 10% of the country simply tools.
2. In India, the manufacture of locally produced tractors began in 1961. The first tractor manufacturer in the world is M/s Eicher Good earth Ltd. In India.

Due to growing crop intensity, animate power (human + animal) is insufficient to maintain timeliness in field operations, so mechanical power is effectively used. Examples include tractors, power tillers, engines, and electric motors. Operations like threshing, irrigation, and tillage demand more energy, hence mechanical power is being used to carry out these tasks. About 10 to 25 percent of the energy used in field operations goes into seed bed preparation.

(Tractor-drawn) Energy-efficient machinery includes:

- Rotavator
 - Disc harrow
 - A cultivator with a clod crusher and pulverizing roller attachment.
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- **Rotavator:** Using a tractor-drawn rotovator saves energy. In heavier soils, it reduces time and energy use by 32–35%. It is Due to its high price, not all farmers who own tractors do.
 - **Disc Harrow:** It is a widely used tool for seed beds preparation. It is employed in every circumstance.
 - **A Cultivator with a Clod Crusher and Pulverizing Roller:** It is an add-on made for the typical tractor-drawn cultivator. It is affixed to the cultivator's back. This facilitates breaking up soil clumps and speeds up the process of preparing the seed bed. This is very well-liked by farmers because it is affordable, practical, and usefulness.

XIII. CUSTOM HIRE SERVICE

Farmers without personal tractors, combines, or threshers and other devices attempt to rent out machines for users to use when paying basis. Giving or receiving machine services in exchange for money is referred to as "custom hiring service"
Ex :Krushiyanradhare.

State Agro Industries corporations, governmental organizations, cooperative societies, and private machine owners all carry out custom hiring work. Tractors are used for a variety of tasks including hot weather ploughing, seed bed preparation, ridge building, leveling and land reclamation. It is also possible to hire combines, threshers, irrigation pumps, Winnowers, sprayers, dusters, etc.

Due to the following reasons, even small and marginal farmers are currently favouring custom hiring:

1. Ownership of small parcels of land.
2. The next generation's awareness of drudgery.
3. Draught animal maintenance is very expensive.
4. Machines are readily available in the area.
5. Because of the following factors, custom hiring services promote the use of large machines:

6. The cost per unit of output is lower for large machines.
7. Simple to use for custom recruiting work that is profitable.
8. Combining massive primary movers for increased overall efficiency.

XIV. INTERIM NEEDS

1. The creation of multiple-purpose devices that can save Time and effort are needed to keep farming activities on schedule.
2. Widespread development of sprinkler and drip irrigation devices to conserve water.
3. Creation of combination machinery, such as
 - Minimum tillage
 - Zero-till
 - Till planter
 - Rotoplanter
 - Sugarcane sett cutter and planter
 - Efficient threshing and harvesting
 - Skillful transplanter of rice
4. Improvements to the use of biofuels, wind energy, and solar energy.
5. Effective fuel use for mechanical power sources by improved machinery and design.
6. Rainwater must be collected, protected from seepage, and efficiently used and evaporated.
7. Surface water-based, low-cost micro irrigation and sprinklers must be created and made available for purchase.

XV. LAND PREPARATION EQUIPMENT

1. **Chisel Plough:** In dry farming, especially, deep tillage employing a chisel plough is crucial for increasing crop output. Deep tillage helps improve rainwater infiltration and storage in the crop root zone by fracturing compacted subsoil layers. Better root system development, increased crop output, and more drought tolerance are all effects of the improved soil structure. The land is better able to absorb rainwater after summer fallow ploughing using a chisel plough, and soil erosion is reduced. High draught requirements are necessary for deep tillage, particularly when the soil is dry and in the ideal condition for chiseling.

Due of the inability of the current deep tillage instruments to operate with 35-45 hp, tractor deepploughing is not utilized in India.

The designed implement is made of 3 mm thick hollow rectangular tubular mild steel parts for its structure, which is both strong and light. The implement is made up just of three simple parts: the frame, the standard, and the share. The share measures 150 mm in length, 25 mm in breadth, and 20 degrees in lift angle. A shear pin guards the tool, preventing damage from excessive loading. Up to a depth of 40 cm, the tool could be utilized for deep tillage. When the implement is used with 1.5 m between rows, it covers 0.42 hectare each hour.

2. **Irrigation Channel Former:** In garden grounds, beds are first made to the necessary size for irrigating the crop, and irrigation channels are then formed at regular intervals. Human

effort is used for this, which takes more time and money. A tractor-drawn channel former was created to make irrigation channels in order to solve this issue. Two inner and two outer blades make up the channel-forming part. A cultivator shovel is attached at the intersection of these two inner blades to dig into the soil. On both sides of the irrigation furrow created by the inner blades, the soil gathered in a 105 cm wide strip is moulded into a 35 cm wide bund. The amount of area covered by the tractor when moving forward at a speed of 3 to 4 km per hour and stopping every 5 m varies from 1.2 to 1.5 hectares per hour. Depending on the size of the field and the soil's condition, the efficiency of the field ranges from 70% to 80%. When channels are built at a 5 m interval, coverage is 9.0 hectares per day for a cost of Rs. 12,000 for the unit.

3. **Ridger:** Utilising a tractor-drawn ridger, it is possible to efficiently and affordably create ridges and furrows, which can then be used to plant seedlings or scatter seeds. The unit is priced at Rs. 30,000. The unit's key characteristics include the formation of ridges and furrows, adjustable row to row and plant plant spacing, suitability for sowing in single or paired rows, the ability to cover an area of 3.5 ha in a single day, and cost and time savings of between 24 and 90% when compared to conventional methods.
4. **Rotovator:** The three-pin linkage of the tractor is where the rotary tiller is attached. The cardan shaft is used to join the PTO shaft to the tiller's gear box input shaft. Take a tractor with a tiller to one end of the field. Utilizing a hydraulic control lever, the tiller is lowered to the desired operating depth after properly adjusting the depth control brackets.

To connect the rotary drive to the tiller, the PTO shaft is turned on. The tiller rotates as the tractor moves forward, tilling the ground. In orchard and plantation crops, rotovators are employed as a secondary tillage and intercultural implement. Mini tractors can also use rotovators, which come with a variety of blades.

XVI. SOWING EQUIPMENT

1. **Tractor Cultivator Mounted Seed Planter:** This planter is commercially available and can be fitted to a tractor-drawn cultivator. This is helpful for planting crops in rows such as paddy, peanuts, sorghum, maize, and pulses. Suitable for planting a greater area in a shorter amount of time before the moisture in the dry tracts is lost.

The seeds are dropped into the furrows created by the cultivator shovels after being placed in a seed box with a cup feed type seed metering mechanism attached on the cultivator frame. The cultivator's existing shovel-style furrow openers have detachable side wings fastened to them, which aids in planting the seed at the proper depth. Clutch is used to transfer ground wheel drive power to the seed metering discs.

A square bar is available at the unit's back to seal the seeds in the furrows. The position of the cultivator tynes allows for adjustment of the row-to-row distance. By adjusting the sprockets that are placed in the metering shaft, the distance between the seeds can be altered. The headland pattern must be followed during sowing. A marker is offered for simple use. The operator can stop the seeds from falling by disengaging the provided clutch. It is advised to use the device at speeds under 4 kph. In order for the top

half of the seed box to stay horizontal while the unit is in use, the top link needs to be adjusted. The planter can cover 4 hectares of ground every day.

- 2. Basin Lister Cum Seeder Attachment to Cultivator:** When crops are sown in dry farming, these tools are used to create basins at regular intervals and retain enough soil moisture for the crop to utilise throughout crucial stages. The basin lister is made up of 393 trenchers, each measuring 30 cm in width, as well as cams, cam shafts, cam followers, ground wheels, and a frame. The trencher bottoms are equipped with a removable sharing point for the penetrating part. The cams hoist up each trencher equipped with a cam follower at regular intervals. The cams are supported by ground wheels and positioned at a 120 degree angle on a shared axle. One of the ground wheels transmits the force needed to rotate the cam. The provision of spring tension reduces wheel slippage. The typical nine-tined cultivators are equipped with the basin lister unit. The seeds are dropped between the basins into the seed box, which is installed on the cultivator frame along with a cup feed type seed metering mechanism. Four rows of seeds are sowed, 45 cm apart. Through a clutch, power is extracted from the ground wheel to drive the seed measuring discs. By adjusting the sprockets that are placed in the metering shaft, the distance between the seeds can be altered. The operator can stop the seeds from falling by disengaging the provided clutch.

By removing the basin lister attachment from the cultivator, the same tool can be used to create broad beds that are divided by furrows. The unit comprises of two sheet metal floats linked to the sides of the cultivator tynes to create broad beds that are 180 cm apart from each other and separated by furrows. Per day, 3.5 hectares of space can be covered.

- 3. Ridger Seeder (Tractor Drawn):** suitable for creating ridges and planting seeds along the sides of the ridges, such as sorghum, maize, and pulses. The seed box, seed metering system, ground drive wheel, power transmission system, seed calibration lever, seed shutter 394 lever and furrow opener are all components of the tractor-drawn ridger seeder. They are all fixed to a t frame mounted on the two bottom tractor-drawn ridger. Six slots and six different fluted type rollers are mounted on a single shaft in the trapezoidal seed box to adjust the seed rate. The seed metering mechanism is propelled by the ground wheel at the back. There is a spring tensioner available to reduce ground wheel slippage. The seed shutter lever places the slotted plate in the appropriate slot in the seed box for sowing on either one side or both sides of the ridges as necessary. The seed calibration lever regulates the flow rate. In order to serve as furrow openers for the planting of seeds, mild steel tubes are placed on either side of the ridger bottom. The ridger seeder can cover 3.5 hectares of ground per day.
- 4. Paddy Seeder Drawn by A Tractor:** This seeder can be attached to a tractor-drawn cultivator, which is readily accessible in the marketplace. This is helpful for paddy line sowing. Suitable for planting a larger area faster before the delta regions lose all of their moisture before the water is released into the canal. The seeds are dropped into the furrows created by the cultivator shovels after being placed in a seed box with a cup feed type seed metering mechanism attached on the cultivator frame. The cultivator's existing shovel-style furrow openers have detachable side wings fastened to them, which aids in planting the seed at the proper depth. Clutch is used to transfer ground wheel drive power

to the seed metering discs. A square bar is available at the unit's back to seal the seeds in the furrows. The position of the cultivator tynes allows for adjustment of the row-to-row distance. By adjusting the sprockets that are placed in the metering shaft, the distance between the seeds can be altered. Headland 395 pattern must be followed during sowing. A marker is offered for simple use. The operator can stop the seeds from falling by disengaging the provided clutch. It is advised to use the device at speeds under 4 kph. In order for the top half of the seed box to stay horizontal while the unit is in use, the top link needs to be adjusted. 4 hectares can be covered in a single day.

5. **Lowland Paddy Seeder:** The most common farming method is to put paddy seedlings in wetlands. A third of the total labour needed for paddy farming is spent on nursery raising and transplanting. Workers are scarce during the busiest times for transplanting. This causes seedlings to be transplanted later and with older seedlings, which lowers output.

This machinery is used to plant paddy seeds that have already germinated directly into moist ground without transplanting. The paddy seeder is made up of two seed drum hoppers, two skids, a 600 mm internally lugged ground wheel, and a handle, all of which are fastened together in a 16 mm conduit pipe structure. The seeder may sow either 6 rows at 200 mm between rows or 8 rows at 150 mm between rows. Before using the seeder, the fields must be thoroughly ploughed, puddled, and levelled at least two days beforehand. 50 kilogramme of seed must be sown per hectare. In terms of yield, transplanted paddy is comparable. With the use of long-handled instruments, intercultural weeding is made simple. To cover one ha, two workers (one operator and a helper) are required. One hectare of field can be processed through the device each day.

XVII. POST HOLE DIGGER

For the purpose of planting seedlings and saplings, a hole digger is a tool that will drill or dig holes of various sizes and depths. It is a three point linkage attachment for tractors with category I and II mountings. The apparatus comprises of an auger that the tractor power take off drives through bevel gears. The universal drive shaft is used for power transfer.

There are offered replaceable auger points in sizes ranging from 15 cm to 60 cm. The hole has a maximum diameter of 60 cm and a maximum depth of 90 cm. The unit is priced at Rs. 85,000. There are other post hole diggers that can be used with a powertiller, allowing holes to be dug that are 30 cm in diameter and 30 cm deep. The price of the item is Rs 40000/-

1. **Interculture and Weeding:** Weeding by hand or manually is the farming method that is used the most frequently. There are manual weeders accessible, but their daily capacity is only 10–20 cents. Therefore, these weeders were unable to promptly weed big farms. More crucial than weeding frequently is timely weeding. Farmers must then hire additional workers in order to finish the weeding operation within the allotted time, which increases labour costs and workforce shortages. Manually operated and power powered weeders were introduced to get around these problems.
2. **Power Rotary Weeder:** For weeding between rows of crops including peanuts, tapioca, cotton, sugarcane, maize, orchards, coconut, and arecanut plantations, a power weeder is helpful. The 5.4 hp, 34 kg Lamborghini diesel engine that powers the power rotary

weeder is installed on the frame. 398The gearbox gear box transfers power from the engine to the ground wheels and rotary weeder. The wheel settings can be changed in accordance with the crop's row-to-row spacing.

To engage or disengage the power gearbox from the engine to the ground wheels, a clutch with a lever from the operators' grip must be moved. Between the gearbox and the rotary weeder, there is an additional clutch that allows power to be engaged or disengaged. The rotary weeder has three rows of discs that are each equipped with six curved blades that alternately point in opposite directions. When these blades rotate, weeds can be chopped and mulched into the soil. The rotary weeder's 350 mm wide coverage area and adjustable depth of operation allow it to weed and mulch the soil in fields that have been planted with crops. In addition to the rotary weeder, the operator can easily fit sweep type blades, junior hoes, cultivators, or ridgers to the device in place of the rotary weeder. You can cover 0.8 hectares of land each day.

- 3. Mini Tractor:** Mini tractors are now employed for a variety of tasks, including secondary tillage for interculture, digging trenches, channel farming, and other tasks where using regular-sized tractors is impractical. These little tractors are perfect for horticulture crops because of their small size, which also enables them to manoeuvre amongst orchid trees. In plantation crops, several of the tiny tractors can also be utilised for plant protection purposes.

4. Plant Protection Machinery

- **Power Tiller Operated Boom Sprayer:** The spray boom, mast, spray pump, pressure regulator, chemical tank, double tail wheel, and foliage deflectors make up this attachment. The motorised tiller's hitch bracket is connected to a separate frame that carries the tail wheels. The technology permits a smaller articulated turn with a 1.1 m minimum turning radius. The 100-liter chemical tank was manufactured of reinforced fibre, and the attached frame was designed tough to handle it. The range of the tread width is 55 to 85 cm. So, different horticultural crops, like turmeric, can be sprayed. A 6 m long spray boom with 3.0 m on either side of the power tiller was selected. Ten hollow cone nozzles on the boom have a combined discharge rate of 7.3 l/min. The boom is supported by a height-adjustable apron moving on the separate mast located on the front of the power tiller. Two M.S. rollers were installed at the top of the mast to guide a pair of stay wires that support the boom in the desired position. The stay wires that are included for elevating the boom to a vertical position make transit simple.

To suit the crop, the boom's individual sections can be equipped with the necessary number of nozzles. Continuous adjustments can be made to the nozzle spacing. The fluid is pumped to the boom by a single-stage reciprocating pump with an integrated pressure regulator and pressure gauge. Additionally, a cut-off valve is provided on the discharge time to the boom to prevent nozzle drippage when the spray is turned off. The operator can spray while seated on the seat that is built into the attached frame.

5. Harvesters

- **Self Propelled Vertical Conveyor Reaper:** The non-lodging paddy crop is harvested using this machine. Gear box, ground wheels, handle, cutter bar assembly, star wheels, and gathering header assembly make up the machine. In order to make room for the machine, the crop needs to be manually harvested along all four sides of the field for a width of 0.5 m. To initially set up the equipment in the field, a 2 x 1.5 m area needs be manually harvested at one corner. The harvester should always be turned to the left side since the crop is released at the right side of the reaper. 50 mm is the height of the cut, and 1 litre of fuel is used per hectare. The reaper can cover 1.5 ha /day.
- **Mini Paddy Combine Harvester:** Two reciprocating cutter bars make up the riding type small combine; one is used to trim the ear heads, and the other to trim the remaining stubble. It has a diesel engine powering it. The four bar reel in the header unit is used to direct the ear heads towards the cutter bar. The cut ear heads are directed towards the threshing cylinder by the convergent auger. There is a spike-tooth cylinder as well as a concave and cylinder casing with angled louvres. A screen and aspirator are used to clean the threshed material. The damaged straw is discarded at the threshing cylinder's end. There is a platform and bag holder provided for bagging cleaned grain.
- **Groundnut Harvester:** At soil moisture levels between 8 and 15%, the groundnut harvester is used to harvest and windrow groundnut crops. The groundnut harvester is made up of a windrower, a pick up conveying mechanism, and tools to uproot the plant and loosen the soil. The blade of the soil-engaging tool is made of a straight mild steel that is 15 mm thick, 100 mm wide, and 1800 mm long. The tool has shanks at both ends that secure it to the main frame at a 15-degree rake angle. Two 6 mm endless ship chains spaced 1800 mm apart make up the pickup conveying system, which has a length of 1700 mm. A gatherer windrows the transported harvest at the back. It is run by a 35 horsepower tractor. The payback time is five years, and the breakeven mark is 17 hectares annually. The harvester has a field capacity of 2.0 hectares per day.
- **Husker Sheller Maize:** The device can simultaneously remove the outer sheath of the maize cobs and separate the kernels from the cobs.

A hopper, rotor sieve, blower, auger and elevator make up the husker Sheller. In the rotor sieve assembly, the sheath is removed and the cob is shelled. The auger transports the shelled kernels to one end, where they are elevated to the appropriate level for convenient collection. The efficiency of shelling is 98%. 95% less time is spent shelling, and 60% less money is spent shelling as a result. The device can produce 24 quintals of kernels or 85 quintals of cob each day.

- **Sunflower Sheller:** It is employed to remove the husk and shell the sunflower seeds. The high speed rotor, rubber-lined stator, blower, and sieve assembly make up the sunflower sheller. Six curved vanes with two flutes each make up the rotor. A tapered hardwood surface covered in a thick layer of firm rubber serves as the stator.

The sieve assembly sorts the seeds as they are fed into the hopper. The graded seeds are introduced into the elevating mechanism through the rotor's inlet. The seeds are hurled at the stator by the rotor at a high rate of speed, and the force of the collision crushes the seeds.

- **Castor Sheller:** Castor is traditionally shelled by hand after drying in the sun, either by beating with a wooden pick. Castor pods are cleaned and shelled with a castor sheller. It consists of a feeding hopper, a blower, and a shelling mechanism with rubber-coated discs. Castor is fed by a feed hopper to the shelling equipment. It can be used to shell and winnow dry castor pods. The device can be run manually or by an electric motor with 0.5 horsepower. Compared to the traditional method of manually pounding or rubbing with hardwood planks, it saves 88% labour and operating time and 69% on operating costs. The unit has a 165 kg/h capacity.
- **Power Tiller Operated Slasher Cum in-Situ Shredder:** Crop residues that have been incorporated into the soil will decompose quickly. The residue decomposes most quickly when it is buried 10 cm, and agricultural wastes can also decompose more quickly by being crushed. For small and medium-sized farmers, a power tiller is the perfect source of power. The power tiller operated slasher cum in-situ shredder was created for use in orchards and vegetable gardens to destroy weeds and crop wastes. The slasher assembly, power transmission system, and hitch frame are the unit's working parts. The power tiller chassis frame is where the machine is front mounted. A v-belt transfers power from the power tiller's engine pulley to the bevel gearbox. The slashing assembly is made up of four cutting blades that are attached to a rotary header that is curved. An area of 0.8 hectares can be worked by the slasher cum in-situ shredder each day for eight hours. When compared to the traditional way of clearing standing crop residues, the power tiller operated slasher cum in-situ shredder gives savings of 73% in cost and 75% in time. The unit costs Rs. 15,000 in total.
- **Brush Cutter:** Power driven brush cutters are stronger tools that can get rid of thick weeds and high grass. It is powered by a 1-hp petrol engine. It comprises of a revolving disc with serrated edges that is circular. To protect the user from flying grass and stones, a baffle guard is offered. The object can be moved in a variety of left- and right-directional directions.

XVIII. CONCLUSION

Agriculture has benefited greatly from the process of mechanization, notably tractorization, which has reduced the need of bullock labor by up to 60% in some circumstances. Numerous studies have found that the impact on human manpower has been quite small, with displacement being less than 15%. Noting that mechanization shouldn't be assessed in isolation because it produces additionally. Opportunities for human labor, such as machine administration, supervision, operation, maintenance, and repair. It is recommended to fully deploy automation in operational holdings greater than 20 hectares, which make about 13% of the cultivated area, in order to maximize the benefits. Selected mechanization should be implemented gradually on farms between 5 and 20 hectares because they account for 40% of the area under cultivation. The advantages of mechanization can be maximized while the impact on human labor is reduced by doing this. Animal, mechanical, and electric

power were acknowledged by the National Commission on Agriculture (NCA) as complimentary sources for carrying out diverse duties. For time-sensitive tasks like sowing, planting, harvesting, and threshing, particularly in rain-fed areas where labor needed to be finished quickly during rainfall, NCA called for tractorization. Tractorization was also thought to be the most effective method for non-repetitive jobs such command area development, land reclamation, leveling, terracing, and eliminating perennial weeds like kans (*Saccharum spontaneum*) as well as wild plants.

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