



## Farm Mechanization for Small Farmers

**Himanshu Yadav<sup>1</sup>**

**Sarvesh Kumar<sup>2</sup>**

**Abhishek Kumar<sup>3</sup>**

**Ishika Gautam<sup>4</sup>**

<sup>1</sup>Ph.D. Scholar Department of Extension Education, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh- 221005

<sup>2</sup>Associate professor Department of Extension Education, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi 221005 Uttar Pradesh India

<sup>3</sup>Ph.D. Scholar Department of Extension Education Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh- 221005

<sup>4</sup>Ph.D. Scholar, Department of Agriculture Extension Education, Institute of Agriculture Science, Banaras Hindu University Varanasi Uttar Pradesh 221005



Open Access

\*Corresponding Author

**Himanshu Yadav\***

### Article History

Received: 01.08.2026

Revised: 05.08.2026

Accepted: 10.08.2026

This article is published under the terms of the [Creative Commons Attribution License 4.0](https://creativecommons.org/licenses/by/4.0/).

### INTRODUCTION

Farm mechanization means the use of machinery and tools along with advanced technology to carry out various farm operations efficiently and economically. The use of machinery is done for land preparation, seeding, planting, transplanting, intercultural operations, protection of plants, irrigation, harvesting, threshing, processing, and transportation of the harvest. Mechanization of farms is an important aspect of modern farming since it minimizes manual labor requirement, makes the farm operations timely, increases work efficiency, and enables farmers to plan their farming operations effectively. However, mechanization of farms has been linked with large tractors and machinery which may not be economical for small land owners. Thus, farm mechanization of small farmers should encompass machinery which is cost-effective, appropriately sized, multi-purpose, energy-saving, and readily available.

Small and marginal farmers form a major portion of the farming sector in India and the size of their farms is quite small and fragmented in nature. The production system adopted by them is normally characterized by lack of capital, use of family labor, shortage of labor at certain seasons, poor purchasing power, and lack of access to modern machinery. The rising costs and shortage of agricultural labor has further accentuated the need for mechanization. At certain seasons of agriculture, the problem faced by farmers in getting labor for sowing, planting, weeding, harvesting, and other activities after harvest becomes quite serious. Delay in such activities will adversely affect crop production and quality. Proper mechanization can help small farmers perform various agricultural activities within the optimal period.



### Need for Agricultural Mechanization among Small Farmers

The main reason why there is a need for agricultural mechanization among small farmers is due to the increasing shortage and expense of agricultural labour. Agricultural labour is moving out of the agricultural sector into other economic pursuits such as construction, manufacturing, transportation, and others. This makes labour availability during the busy season of agriculture unpredictable. Small farmers who are unable to employ many labourers will greatly gain from small machinery which carries out agricultural processes fast and effectively.

Mechanization also assists in eliminating drudgery from agriculture. Women and elderly people usually engage themselves in activities like weeding, planting, harvesting, threshing, and transporting agricultural produce. Some of these activities involve strenuous tasks for humans. Lightweight machinery, such as power weeders, improved hoes, small seeders, reapers, threshers, and

harvesters designed for specific crops, can ease physical labor.

Another key benefit of mechanization is timeliness. Agricultural practices must be done within an ideal period to enhance their effectiveness. Delay in planting, transplanting, weeding, watering, spraying, and harvesting can result in poor performance of the crops. Small machinery can assist farmers in completing the tasks in the stipulated period and prevent production losses that might occur due to late completion of the operations.

Farm mechanization also leads to better quality and precision in agricultural practices. Proper seed planting, uniform spacing, fertilization, and plant protection are essential in increasing the quality of crops and efficient use of resources. Precise machinery can help in applying inputs precisely and prevent wastage of resources.

### Suitable Machines for Small Farmers

Machines for small farmers are not necessarily the ownership of large tractors and heavy machinery. The machine should be chosen based on the farm size, crops grown,

soil, availability of labor force, financial ability, and local farming systems. In some cases, smaller and light machines might be suitable for small and fragmented land as they operate well in narrow fields and cost less.

Power tillers are some of the machines that are highly beneficial for small farmers. Power tillers are smaller and lighter compared to normal tractors and can perform such tasks as plowing, puddling, harrowing, ridging, intercultivation operations, and transportation if there are appropriate attachments. This is especially true since their versatility makes them ideal for small farms and vegetable gardens.

There are also mini tractors or compact tractors which may serve as alternatives to the conventional large tractors. Mini tractors and compact tractors perform multiple tasks but need less turning space and mobility. Such machines can be used by farmers growing vegetables, fruits, pulses, oilseeds, cereals, and other crops.

Seed drills and seed-cum-fertilizer drills may help to increase the efficiency of sowing operations. Seed drills will help to give uniform distribution and spacing of seeds with less use of seed and labour. Specific purpose small scale seeders and planters for specific crops may be very helpful for small farmers producing vegetables, maize, pulses, and oilseeds.

Mechanical and power weeders are highly useful for small-scale farmers since weeding operation is the most labour-intensive operation in crop production. Wheel hoe, rotary weeders, cono weeders, power weeders and crop-specific inter-row weeders may help to decrease labour cost and timely weed management in the field. For crops such as rice, vegetables, pulses and horticultural crops, suitable weeders may be very helpful.

Small scale sprayers and dusters may help to enhance the efficiency of plant protection operations. Different models of knapsack sprayers, battery operated sprayers, motorized sprayers, tractor-mounted or power

operated sprayers may be chosen according to farm size and crop needs. Battery operated sprayers are very useful for small farmers since they reduce pumping labour and spray uniformly if calibrated properly

### **Mechanization of Horticultural Crops**

There is a lot of room for farm mechanization in the horticulture sector as fruit and vegetable farming involve extensive labor during all phases of production. Such activities as nursery preparation, bed formation, transplanting, weed control, spraying, pruning, harvest, grading, sorting, and transporting consume a lot of labor. Machines could facilitate the reduction of costs and improvement of efficiency among horticultural farmers.

Vegetable transplanters would be helpful in the process of transplanting tomatoes, chillies, brinjals, cabbage, cauliflowers, and other transplanted vegetables. Even though automatic transplanters may be too costly for each farmer individually, manual and semi-automatic machines would be cheaper to purchase.

Also, machines such as mulchers and bed makers would be helpful for vegetable farming as raised-bed formation would make drainage better and crops establishment faster. The use of small-scale plastic mulch laying machines would be helpful for farmers to install mulch in their vegetable and horticultural crops.

For orchards, there could be machines and equipment for pruning, spraying, mowing, harvest, and transportation. There are battery-powered pruning machines, motorized sprayers, grass cutter, small orchard tillers, and aid in harvesting fruits which become useful to orchard owners.

### **Smaller Scale Harvesting & Post-Harvest Mechanization**

Harvesting is probably the most crucial process of crop production since any delay would result in considerable quantitative and qualitative loss of production. For small farmers, harvesting could involve a lot of



manual work that may prove troublesome when the time is crunch. Smaller scale reapers, reaper binders, crop specific harvesters and improved harvesting machines would enable faster harvesting.

Threshers would help in separating the grains from harvested crops. Multi-crop threshers could be advantageous since they can be used in harvesting several crops, thereby increasing machine use. Small farmers can buy these machines as a group or hire them from custom hiring centers. Post-harvest mechanization is equally important. Cleaning, grading, sorting, drying, milling, shelling, packaging and transporting are activities that have an impact on the end result of the agricultural produce. Smaller machines like grain cleaners, graders, shellers, mini rice mills, pulse mills, vegetable washers, fruit graders and packing machines can be useful for farmers.

For horticultural crops, post-harvest machinery can play a major role in value addition. Small farmers can use simple equipment for washing, grading, cutting, drying, pulping, processing, and packaging fruits and vegetables. Such technologies can help convert raw produce into higher-value products and provide additional income opportunities.

### **Solution through Custom Hiring Centres**

One of the primary problems preventing small farmers from using agricultural machines is the high cost of such machinery. The purchase of a tractor, combine harvester, transplanter or any other machinery will not always be feasible for the farmers owning smaller farms. Custom hiring offers a good solution to this problem.

The concept of custom hiring involves hiring the machinery required for a specific task. Thus, instead of purchasing expensive machinery, the farmer will be able to make use of modern machinery through custom hiring. The custom hiring centers can provide tractors, power tillers, seed drills, planters, sprayers, weeders, reapers, threshers, harvesters, and

other machinery depending on the local requirements.

Farmer Producer Organizations, cooperatives, self-help groups, and rural entrepreneurs can prove to be helpful in providing custom hiring facilities. The collective ownership and renting system would help in increasing the use of machines and reducing the cost involved in mechanization of the farms. Employment opportunities can also be created by local service providers through the maintenance of agricultural machinery.

### **Role of Farmer Producer Organizations**

Farmer Producer Organizations can promote mechanization by bringing small farmers together and creating collective demand for machinery. When farmers purchase or rent machines collectively, the cost per farmer can be significantly reduced. FPOs can maintain machinery pools and provide equipment to members according to their production schedules.

Collective mechanization can also improve bargaining power. An FPO may negotiate better rates for machinery purchase, spare parts, repair services, fuel, and maintenance. It can also organize training programmes for farmers and machine operators. Such collective approaches are especially useful in areas where individual farm sizes are small but several farmers grow similar crops.

### **Mechanization and Women Farmers**

Women contribute significantly towards farm work through their involvement in planting, weeding, harvesting, processing, and post-harvest operations. Unfortunately, most farm tools have been developed without proper consideration of the needs of women physically. Women friendly farm tools must be light in weight, ergonomic design, easy to use, and flexible based on the height and strength of the user.

Mechanization is capable of removing the drudgery from repetitive farm works and saves precious time. Better designs of farm

tools will help in reducing physical injuries and exhaustion. Thus, gender sensitive mechanization is essential for development programs in agriculture.

### **Digital Technologies and Smart Mechanization**

Current farm mechanization is closely related to digital agriculture. The small farmers can take advantage of modern technologies such as GPS navigation, sensors, mobile applications, automated irrigation system, weather-based advisory, drones, and remote sensing. Although advanced technologies may be costly in the initial stage, technology service models can make them affordable for small farmers.

Spraying and monitoring using drones can be offered as a service without the need for farmers to buy drones themselves. Likewise, monitoring crops using satellites and digital advice portals can offer information related to crop growth, irrigation needs, pests presence, and weather. Such innovations can help in addition to physical mechanization and decision-making.

Solar powered machinery can also have applications in small scale agriculture. Solar pumps, solar dryers, and other small machinery can rely on solar power. Renewable energy machinery can be of particular importance in regions where electrical supply is not reliable and/or fuel prices are high.

### **Economic Advantages of Farm Mechanization**

Farm mechanization may cut down costs associated with labor-intensive operations and make the most productive use of the existing resources. If machinery is applied correctly, then farmers will carry out operations quicker and till more land using the same labor. Mechanization can minimize losses associated with harvesting and post-harvest operations.

The economic efficiency of the machine is affected by its purchase cost, its annual utilization, operating costs, maintenance costs, energy consumption, and service life. So,

small farmers should consider the machine's cost per unit of operation rather than its purchase cost only. In addition, it can be profitable to rent the machine if it is needed only for some operations annually.

Multi-purpose machines and interchangeable implements are especially useful for small farms because one power source can carry out different operations. So, the annual machine utilization becomes higher.

### **Environmental Aspects**

Farm mechanization should be encouraged along with the rational resource management. Over-mechanization causes soil compaction, damages the structure of the soil and fuel consumption. That is why the selection of machines depends on the type of soil, field condition, the needs of crops and the size of the farm.

Minimum tillage, residue management, direct seeding, and precision application of inputs, among others, which are conservation agriculture techniques, can help avoid unnecessary disturbances of the soil and increase the efficiency of resource use.

Mechanization may also play an important role in ensuring effective irrigation and fertilizer application. Such equipment as drip irrigation equipment, fertigation equipment, seeders, and properly calibrated sprayers may help reduce losses from the use of water, fertilizers, pesticides, and other inputs. Therefore, mechanization can contribute to economic and environmental sustainability.

### **REFERENCES**

- Liao, W., Zeng, F., & Chanieabate, M. (2022). Mechanization of small-scale agriculture in China: Lessons for enhancing smallholder access to agricultural machinery. *Sustainability*, 14(13), 7964.
- Mehta, C. R., Chandel, N. S., & Senthilkumar, T. (2014). Status, challenges and strategies for farm mechanization in India. *Agricultural Mechanization in*

- Asia, Africa and Latin America*, 45(4), 43-50.
- Sims, B. G., & Kienzle, J. (2006). Farm power and mechanization for small farmers in sub-Saharan Africa.
- Sims, B., & Kienzle, J. (2016). Making mechanization accessible to smallholder farmers in sub-Saharan Africa. *Environments*, 3(2), 11.
- Van Loon, J., Woltering, L., Krupnik, T. J., Baudron, F., Boa, M., & Govaerts, B. (2020). Scaling agricultural mechanization services in smallholder farming systems: Case studies from sub-Saharan Africa, South Asia, and Latin America. *Agricultural systems*, 180, 102792.