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## Farm mechanization level for paddy production in Uttar Pradesh: A review

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### Abstract

Agricultural mechanization offers a significant opportunity in agriculture to produce timely farming operations; reducing the cost of operation; optimizing productive use of costly input (seeds, fertilizers, chemicals for plant defense, aquaculture and agricultural machinery) the mechanization strategy will differ depending on the circumstances and resources of the region. The strategy for agricultural mechanization in the eastern U.P. because of landholding trends, the resources available in the area, the population dependent on farming, significant cropping systems being pursued in that area, the availability of agricultural energy and infrastructural facilities available for the promotion of agricultural machining and agro-processing programmers, the region is suggested.

**Keywords:** Mechanization, productivity, rice farms, southern mechanization, mechanization level, paddy cultivation, transplanted, weeder

### 1. Introduction

The country's farm mechanization is set to reach a new era. It is felt that the process of agricultural mechanization needs to be rethought and reengineered so that small- and marginal farmers are efficiently included (Aggrawal 1983) <sup>[1]</sup>. The ICAR organization has guided farm mechanization programmers in the country to best make use of accessible agricultural power resources and increase the availability of farm power (Singh, 1999) <sup>[28]</sup>. The growth of agricultural mechanization is predictable to combine the rising order in food grains and other food and non-food supplies (Srivastava, 1999) <sup>[32, 34]</sup>. The expected decrease in the number of animals drawn underlined the need to better reframe the farm mechanization program. Agricultural transformation is a felt demand of the day. Mechanization has been well received around the world as one of the key elements of agricultural modernization (Vatsa, 2013) <sup>[35]</sup>.

The availability of mechanical resources and better tools and equipment has made it possible for states such as Punjab, Haryana, and the western part of Uttar Pradesh to achieve high land productivity rates. The same pattern should also move toward other nations. The availability of farm power and output are closely related (Singh, 2001) <sup>[25]</sup>. The introduction of better plant varieties and the creation of an ideal environment is mostly responsible for increasing plant's and animals' potential over and above agricultural manufacture (Singh, 2000a) <sup>[23]</sup>. The planting, cultivation, and harvesting of a crop requires both a significant level of power and an appropriate range of equipment and tools (Pandey, 2000) <sup>[16]</sup>. Mechanizing agriculture has allowed for the growth of the area that can be planted and helped to produce higher production levels than before, mainly because of the precise handling of crop husbandry tasks (Gajri *et al.*, 2002) <sup>[8]</sup>. In most developing countries, annual costs are higher for farmers. The cost of inputting power on farms is greater annually than in respect to fertilizers, seeds, or agro-chemicals for most farmers in developing countries (Gite, 2003) <sup>[8]</sup>.

### 2. Present status of farm mechanization

Indian farming is gradually shifting from human and livestock dependence to mechanical power. Mechanical power is mainly inspired by large landholdings and is still beyond the scope of the small-scale farms, as small-scale farmers are not able to own agricultural machinery themselves due to their economic conditions. The Department of Agriculture, through its Mechanical Wing, popularized the use of agricultural machinery for the small-marginal farmers of the state to make farm machinery available to small-scale farmers. From the end of the day to the end, the Department purchased a diverse range of schemes to grant

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farmers an incentive at subsidized rates for their production inputs, including power-tilling machinery (Power Tillers), tractors, JCBs, Bulldozers and Power Reapers. (Nabard; Ananamus 2019) <sup>[3]</sup>. The Department is also introducing loan-cum subvention schemes under which farmers are subsidized for the purchase of farm machinery such as power tillers, power reapers, irrigation power pumps, etc. The Department also works with the Department to demonstrate new and improved machines. Dealers must test the reliability and acceptability of the system. In the country, the current state of mechanization is one of the least developed. Therefore, mechanized behavior needs to be broadened in particular in places with low farm power, to help farmers to get the best return from their land. The main obstacles to agricultural mechanization in the State are:

- Small landholdings fragmented
- The high cost of ownership of agricultural equipment
- Lack of credible domestic farmers financing options

The total state control is intertwined. Small and marginal farmers hold most of this land and cannot buy farm machinery themselves, because of their economic situation. Only if the

State central government increases its share of support for farmers can this be addressed? Steps must also be taken to ensure that the financial institutions simplify their process to help farmers demand to lend for the purchase of farm machinery. (Nabard; Ananamus 2019) <sup>[3]</sup>.

## 2.1 Farm power availability

### 2.1.1 Human power

Human and animal power, the two sources of renewable energy has traditionally been used for crop production both in Punjab and in Indian agriculture. Agricultural workers execute field planning, sowing, and transplantation, applications of fertilizers, intercultural activities, spraying, harvesting, and threshing. In 1960-61 and 1970-71 the percentage of agricultural workers in total workers was 55.89% and in 2011-12 the figure was 62.67%. But, on the absolute basis, due to population growth, agricultural workers have increased from 1.93 million (516% per 1000 ha) in 1960, to 3.55 million (835% per mille ha) in the year 2000-01 and then further declined to 3.04 million (731% per thousand ha) in 2012-13 (see table 1).

**Table 1:** Population density of farm power sources in Uttar Pradesh

Year	Agriculture workers	Draught animal	Tractors	Power tillers	Diesel engine	Electric motors
1960-61	131.10	80.4	0.037	0	0.23	0.20
1970-71	125.70	82.6	0.168	0.0096	1.70	1.60
1980-81	148.0	73.4	0.531	0.0162	2.88	3.35
1990-91	185.30	70.9	1.192	0.0323	4.80	8.07
2000-01	234.10	60.3	2.531	0.1147	5.90	13.25
2010-11	263.00	53.50	4.207	0.3213	8.20	16.50
2011-12	266.08	53.0	4.553	0.3621	8.30	16.70
2012-13	269.20	52.8	4.858	0.4021	8.35	16.80
2013-14	272.00	52	5.237	0.4409	8.45	17.00

**Source:** Singh (2013) <sup>[30]</sup>; Singh *et al.* (2010) <sup>[27]</sup>; Singh *et al.* (2009) <sup>[26]</sup>; Live Stock Census; Agricultural Census 2011 <sup>[13]</sup>;

More than a handful of studies also showed that the net displacement of human labor during the agriculture process was not substantial and was better than winning for human work because of multiple crops with increased crop strength and production (Dixit *et al.*, 2014; Sharma *et al.*, 2014) <sup>[6]</sup>. Farming of machinery, the selling and buying of spare parts, fuel and lubricants, repair and maintenance of tractors, motors, and other machinery is part of non-farmer jobs created by mechanization. Thus, the marginal reductions in primary agriculture jobs because of agricultural interventions have more than been compensated for by non-farm labor in forestry, secondary and tertiary industries.

### 2.1.2 Animal power

Draught animal power is a reliable and popular foundation of agricultural power in the growing state. The most common sources of draught animal traction are bullocks, buffalos, camels, goats, mules, and asses. Draught animals have made a diminishing contribution over the years. The dripping of motive power (tractive and rotative), commonly used to grow crops, raise water, transport rural, extract oil, crush sugar canned sugarcane, cuts, and transport, were the key sources of powered animals before 1960-61. Work is difficult to perform; they are gradually carried out with mechanical power (Singh, 1992; 1996) <sup>[20, 21]</sup>.

This results in irrigation and threshing. They are born and brought up in the system of the village and sustained on local feed and fodder. Dung and urine have also been used to generate farm manure and biogas as an indirect source of

energy. They also help preserve the ecological balance. Despite their increased popularity, however, farmers face several constraints like rapid plough share wear, strong draught, and poor harness design, and other tools (Phaniraja and Panchasara, 2009) <sup>[17]</sup>. As real streets in rural areas increase, and electricity is available in rural areas, the majority of jobs are now done using other convenient and cheaper choices.

### 2.1.3 Mechanical power

The mechanical power of various farm operations in concentrated agriculture becomes critical for the optimum use of additional capital and in-time completion. Mainly inanimate power supplies such as the tractors, diesel engines, electric engines, and the automated machinery have turned Uttar Pradesh farming from survival farming to mechanized farming. A large number of agricultural equipment and machinery have been planned, produced, evaluated, and tested for the challenges of farm mechanization by the Department of Farm Machinery and Power Engineering, U. P. There have been systemic shifts in the state due to the number of all farm machines. In the gross area cultivated u.p. The state in India has the highest tractor density. During 2012–2013, approximately 4.76 lakh tractors on cultivated land of 4.15 million hectares were used compared to only 79 of 3.75 million hectares of tractors in 1960–61. In 1960-61, the net area sown by tractor, on the other hand, was 447 ha, down to 8.7 ha in 2012-13. The tractor with a higher power has the potential to increase to full and will be the future condition of

government confidence and customary recruiting. In the last decade, the proportion distribution of horsepower was distorted (Bector *et al.*, 2008; Mandal, 2013) <sup>[5, 13]</sup>.

In the years 1998-99 and 2007-08 the percentage of tractors with categories 21-30hp and 31-40hp was cut from 22% to 15% and from 58% to 46%. At the same time, 41-60 hp (Bhalla 2010; Singh *et al* 2013) <sup>[30]</sup> rose from 19.5% to 37.5% and 0.2% to 1.6% (Bhalla 2010; Singh *et al* 2013) <sup>[30]</sup>. Custom hires for tractors are increasingly popular for awning, sowing, planting, harvesting, threshing, and transport by cooperative companies and individual farmers. In the last 50 years, diesel engines that have been used in stationary operations, especially for irrigation water and grain mills, oil expellers, sugar cane crushers, threshers, and chaff cutters, have increased from 7 000 million to 0.19 million. In the past, farmers used chemical propagation manually, causing various health risks and ecological and environmental risks. Sprayers have been developed to mitigate these hazards and use chemicals efficiently. The population of dusters and sprayers was estimated at six million in 1970-71, and in 2012-13 it increased to 0.61 million.

#### 2.1.4 Electrical power

Electrical motors are the primary basis of stationary power for irrigation, threshing, and various post-harvesting operations. The majority of irrigation pumps have been powered by electric motors over the years by rural electrical energy and their size has increased due to the decrease in water in many areas. As for the energy for rural areas in the U.P. Most farmers, wherever groundwater is available, also have independently or jointly constructed tube pits. In the 1960–61 period, the number of pumps operating with electric motors increased from 6600 (1, 75 per thousand ha) to 0,119 million in the 2012–13 period (Table 1). The above trends demonstrate significantly rapid growth in electric motors, due to higher efficiency, low service, and the propagation of rural electricity in combination with preferential energy tariffs. The Government has played an important role in popularizing the funds provided through financial incentives for irrigation equipment. Also, the decrease in groundwater and higher motors for submersible pumping of water has been greater than the demand for energy.

### 3. Mechanization for land development

New technical mechanization, chemical use, knowledge, and public policies promoting the maximization of production have increased agricultural productivity. Though these changes have many positive effects, the deprivation of the land and the pollution of farmworkers' wages and jobs have fallen, higher manufacturing costs have decreased as well as economic and social conditions in rural areas (Aggrawal, 1983; Sindhu and Grewal, 1991; Singh, 2001). These agricultural practices are now under discussion by people who want sustainable agriculture for growers, farm employees, consumers, politicians and other stakeholders in the entire agricultural manufacture system to address these environmental and social issues and to provide new and economically viable opportunities (Srivastava, 1999; Karmakar *et al.*, 2001; Vasta, 2013) <sup>[32, 34, 35, 12]</sup>.

There is still the production of concepts, practices, and policies to describe the concept of sustainable farming (Rijk, 1989; Joshi, 1998; Srivastava, 2001) <sup>[18, 10, 33]</sup>. This combines three key objectives: environmental protection, economic growth, and economic and social justice (FAO, 1997a; MOA,

1998) <sup>[7, 15]</sup>. For future generations to be sustainable, they must comply with the present requirements without compromising their capacity to live up to their needs (Singh, 1999; Singh, 2000a) <sup>[22, 23]</sup>. Sustainability Control of natural and human capital is therefore of utmost importance. Human income management involves taking into account the social responsibilities of farmworkers, their livelihoods, the wants of rural communities, and the health and safety of consumers in both the present and the future. Land stewardship and other relevant natural revenues keep this vital capital base ornamental on a long-term basis (Singh, 2001) <sup>[25]</sup>. To achieve sustainability, a system perspective is essential. This includes livestock, local habitats, and populations that are counteracted locally and internationally by this agriculture scheme (Karmakar *et al.*, 2001) <sup>[12]</sup>.

An organizational approach allows us to explore links between agriculture and other environmental aspects. It also means that researchers, farmers, farmers, customer policymakers, and others are involved in research and education interdisciplinary in the agricultural systems, both before and after production. A mechanism that links many small yet practical steps in making the transition to sustainable farming is a mechanism (Brar, 1998; Joshi, 1998; Mandal *et al.*, 1999; Velayutham *et al.*, 1999) <sup>[4, 10, 11, 36]</sup>. Sustainable agriculture is the goal of all the system participants, including farmers, farmers, policymakers, researchers, retailers, consumers, and other stakeholders (Karmakar *et al.*, 2001) <sup>[12]</sup>. To improve sustainable agriculture, every community has a role to play. The link between farming mechanisms and sustainable agriculture and rural development is important (Vatsa, 2013) <sup>[35]</sup>.

### 4. Mechanization for tillage and seedbed preparation

The horticultural instruments are a hammer, carpenter's hammer, dah, felling Dao, tea-pruning Dao, billhooks, blossoming knob, grafting knife, blossom, knife, and knife, cutting knife, multifunction cutting knife, pruning knife, pneumatic sectors, pneumatic sectors, hedge shear chain, string trimmer, forest shear, grass shaving, garden blade, flat saw, hedge shears, lopping shear, grass-shear. The contemporary horticultural mechanization includes various increasing techniques and fabrication operations, work operations, technical procedures, appropriate soil management systems techniques, orchard tractors, groundwork machines, mulching machinery and mowing grass, post-hole diggers, sprayers, cutting cutters, pickers, packing machines, etc. Mounting, tapping, and spraying remain a manual activity and must be mechanized. The average agricultural power density is 1 kW ha<sup>-1</sup> in India. Power availability during a crucial period of operations causes limitations in timeliness. The required power density is estimated at 3, 75 kW ha<sup>-1</sup> in time for an operation. (The 2013 Anonymous) <sup>[2]</sup>.

Desi baker and patela seedbed preparation was the traditional seedbed preparation tool most popular before the 1960s. The improved instruments adopted by farmers were the growth in the use of tractor-drawn machines within the range of 9-17 percent Cultivator, disc harrow, plow molding, puddle, disks harrow, peg harrow, spring tine harrow, rotavator and patela harrow operated by animals and tractors. Specific farmers' and disk harrow sizes are used, but farmers with over 15 tines and disk harrows with more than 18 disks are not commonly used due to the agricultural road and land constraints. Consequently, the capacity for low power tractors



is not completely used. (The 2013 Anonymous) <sup>[2]</sup>.

### 5. Mechanization in sowing and planting

The sowing line not only saves seed but also makes it easier to control fertilizer application near the root field. Also, the application of mechanical weeding can help control weeds. The farmers use Dufan (2 rows), Tifan (3 rows), Enatigoru, and FESPO plows, all of which cover more areas and costs less. Mechanically calibrated seed drills and seed fertilizer seed boards worked on animals and tractors have been produced and manufactured to match different plant and regional applications for effective use of seed and fertilizer. (Singh *et al*, 1999) <sup>[28]</sup>.

### 6. Mechanization plant protection

In irrigated and rain-food farming during Kharif, weed control is a serious problem, and if not controlled, the yield is affected by 20-60%. Khurpi is the most popular weed removal tool, but one hectare takes between 300–700 hours. Using long handlebar wheel hoe and pinion weeding, cut down to 25-110 hours weeding time. Weeder and cultivator operated by Bullock are used in weed control. Specific designs for plant safety are available for low-cost hand-operated sprayers and dusters. Pulse spraying has become popular for cotton, paddy, sugarcane, fruits and plants, oilseeds, and pulses.

### 7. Mechanization Harvesting and threshing

Motivated by the following factors is the technology for the development of harvest and threshing devices: 1. Reduction in production costs and reduction of harvesting and loss of post-harvest production and production quality, 2. Economic considerations Social facts – non-disposition of labor, timeliness of the harvest cycle, and 3. Ergonomic considerations – avoidance of drudgery.

### 8. Conclusions

Appropriate agricultural equipment and the increased use of agricultural equipment can cover the yield gap. However, due to the revolution in manufacturing and housing colonies, cultivable waste also increases, because of a yearly decline in the total crop area. The use of machinery is important to maintain crop yield and meet food requirements. Improved crates, planters, tractors, machines of harvesting, and spraying. There are many opportunities in Prayagraj to benefit from this business, but only by implementing successful government policies and strategies. It is also necessary to strengthen and enhance the effectiveness of national research institutes and in the final analysis, which will enable the better use of innovative machines.

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