



## Trend in Sustainable Mechanization of Indian Agriculture

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### Abstract

Agriculture is one of the most important sectors of the Indian economy contributing 18.5% of national income, about 15% of total exports and supporting two-thirds of the work force. At the same time, biotic and abiotic stresses, degrading and depleting land and water resources and climate change are major challenges for sustainable agricultural production and productivity. The small and marginal land holdings (less than 2.0 ha) account for more than 86% of land holdings. The labour availability in agriculture is expected to go down to 26% of total workforce by 2047. Mechanizing small and non-contiguous group of small farms is against 'economies of scale' for individual ownership of farm machinery. With no possibility of increase in net cultivated area and diminishing farm labour availability, intensive agriculture with higher input use efficiency is essential for the growth of Indian agriculture in near future.

Farm power and agricultural machinery are essential inputs for sustainable agricultural production and productivity to feed India's burgeoning population. The intensification of crop production must be sustainable with low environmental footprint. A holistic, value-chain approach is necessary for agricultural mechanization, going beyond green production through precision agriculture and digital agriculture. Precision agriculture for region specific crop planning, controlled precision application of inputs (seeds, fertilisers, chemicals, water, etc), multi-functional farm equipment to conserve energy and to reduce turnaround time, application of drones in agriculture, application of sensors, micro-processor and computer in agriculture are some of the futuristic technologies that need more attention for sustainable agriculture in India. There is a need to simplify these technologies and make them cost-efficient for maximum adoption at the farmers' level.

**Keywords:** Sustainable agriculture, Mechanization, Precision Agriculture

Indian population is expected to reach 1.6 billion by 2047. At the same time, biotic and abiotic stresses, degrading and depleting land and water resources and climate change are major challenges for sustainable agricultural production and productivity. Over the years, Indian farming system has not given an expected remuneration to farmers besides its remarkable growth in food-grain production and processing sectors. However, agriculture remains a principal means of livelihood for over 58% of the rural households and 86% of small and marginal land holdings (Mehta *et al.*, 2019). In addition, as per World Bank estimates, half of the Indian population will be urban by the year 2050. It is estimated that the percentage of agricultural workers to total work force will reduce from 54.6% in 2011 to 25.7% in 2050. This highlights the need to enhance farm power availability and farm mechanisation level in the country (Mehta *et al.*, 2014; NITI, 2018).

Agricultural mechanization is an important symbol of agricultural modernization. The agricultural equipment is the carrier of agricultural modernization and thus an important tool used to promote agricultural mechanization. The level

of economic development has a positive impact on the mechanization level. The levels of farm mechanization in USA, Russia, Brazil, China and India have been reported as 95, 80, 75, 60 and 47%, respectively. However, the level of mechanization is inversely proportional to contribution of agriculture in the countries GDPs (World Bank Indicators, 2013; Mehta *et al.*, 2019). Therefore, there is a need for further promotion of farm mechanisation.

Presently, the farm machinery in India are being primarily used for production of field crops like cereals, pulses and oilseeds crops. The agricultural mechanization is at an early stage in India and growing at 7.5% per annum in spite of challenges of small land holdings, cropping pattern, market prices of crops and government policies and legislations. The ignorance of these challenges will exaggerate the redundant labour force, low return against inputs for yield and ultimately decrease the enthusiasm of farmers in agriculture. Due to lower probability of increase in net cultivated area and scarcity of agriculture labour in the near future, Indian agriculture may require energy intensive agriculture with higher input use efficiency, better

soil health management practices and value addition to produce in production catchments.

The agricultural scenario has changed during all these years, and farmers now fully understand the value of time which is scarce and inputs which are ever costlier. So, it is a challenge not only to cover the farm area in shorter time but also to use all inputs (seeds, fertilizers, chemicals, water, energy etc.) precisely and efficiently. There was a need to sustain Green Revolution through time, energy and input saving equipment which were efficient, covered larger area per day, improved productivity per unit area and per unit costly inputs (seed, fertilizer, water, energy) and gave the farmers sufficient time for preparation for next crop. Further, the previous generation of farmers is giving way to new generation which is more educated, looks beyond his village and conscious of doing operations smartly on time and with less drudgery. Thus, today's challenges in farming cannot be met by yesterday's technologies and machinery.

Modern engineering interventions in agriculture are the need of the hour to reduce cost of cultivation, to improve input use efficiencies, to provide right timing and right sizing of the mechanical inputs, to provide better control over the pre and post-harvest operations, to reduce post-harvest losses, to harness energy through clean sources, to prevent burden on environment and animate power sources, and to make agricultural operations safer, more comfortable and gender neutral. In modern agriculture, farm mechanization has become imperative to growth and sustenance as it facilitates the judicious utilization of agricultural inputs. The use of available farm power with efficient farm implements has resulted in increased farm productivity.

Time has come to think of newer designs of agricultural machinery which are of higher capacity, more efficient, perhaps remote/drone controlled, automated robot operated, operator/user friendly especially for women who are taking up agriculture in larger number due to several factors like migration of male folks to cities causing real problem of farm successors.

Within Indian ecosystem, labour-intensive farm activities are automated, stakeholders (farmers, labours, manufactures, etc.) and decision makers across the value chain are more connected with one another, and information and data, physical products, service and touch point experiences will be united as one integrated solution that solve users/stakeholders needs. It will enable the agricultural machinery manufacturing industries for sustainable production in country.

Present Indian agriculture is highly labour intensive whereas smart agriculture is all about machines and technologies. The themes of precision agriculture (PA), digital agriculture (DA) and artificial intelligence (AI) in agriculture can be applied across disciplines and may bring a paradigm shift in how we see farming today. There are four recurring themes for sustainable smart agricultural mechanization in India.

1. Farm power and agricultural machinery are essential inputs if sustainable agricultural production and productivity are to be increased and managed to feed India's burgeoning population.
2. The intensification of crop production must be sustainable. Its environmental footprint (carbon and energy) must be as low as possible, and in any case lower than the rate of natural renewal.
3. Top-down solutions are rarely efficacious. All stakeholders need to be considered from the outset and the private sector must lead the development process on the field.
4. A holistic, value-chain approach is necessary for agricultural mechanization, going beyond green production through precision agriculture and digital agriculture.

If agricultural mechanization efforts are to succeed in India, there is an urgent need for all stake holders like farmers, manufacturers, supporters, planners or decision makers, to understand and contribute to sustainable agricultural mechanization efforts across the entire farming system. The agricultural machinery manufacturing sector in India requires incentives for the manufacturing of equipment for sustainable mechanized agricultural practices.

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