

COMMITTEE ON AGRICULTURE, ANIMAL HUSBANDRY AND FOOD PROCESSING

RESEARCH AND DEVELOPMENT IN FARM MECHANIZATION FOR SMALL AND MARGINAL FARMERS IN THE COUNTRY FIFTY-EIGHTH REPORT

CHAPTER 1: INTRODUCTION

The Indian Council for Agricultural Research (ICAR) is one of the world's largest agricultural research systems, with over 113 institutes in India. The ICAR provides scientific and technological assistance to improve agricultural output and has implemented a number of initiatives and policies aimed at increasing farmer income. It is dedicated to changing Indian agriculture through its research. Agriculture is one of India's most important industries, accounting for over 20% of the country's GDP. As a result, rapid agricultural expansion is required not just to satisfy expanding food demand but also to boost the income of individuals who rely on agriculture for a living, as agriculture employs about half of the nation's population.

According to the Land Use Statistics (2018-19), India's net sown area is over 42% of the entire geographical area, with a net irrigated area of 71.6 hectares. According to the 11th Agricultural Census, small and marginal land holdings account for around 86% of overall operational holdings. It has been found that farm mechanization lowers cultivation costs while also increasing productivity by making efficient use of resources. In India, mechanization in farm activities for the four main crop phases has been 70, 38, 31, and 32 percent, respectively, in 2019–20. SMAM (Sub Mission on Agricultural Mechanization) was launched in India to promote farm mechanisation in 2014-15.

Agricultural research is critical to the development of environmentally sustainable global food systems and the provision of food security. The Indian National Agricultural Research System has yielded substantial results in terms of agricultural mechanization, the creation of climate resilient technologies, high yielding varieties (HYVs) of seeds, and so on.

The country has not only succeeded in the Green Revolution but also in the White, Blue, Golden, Brown, and Grey Revolutions over the last 75 years. Productivity has risen by 6% to 70%. In comparison to industrialized countries such as China and Brazil, which have reached 59.5% and 75% farm mechanization, respectively, India is not far behind, having achieved 47% agricultural mechanization. Rice mechanization is currently at 53 percent. It is 69 to 70 percent for wheat. Similarly, it is approximately 47 percent in other crops such as makka, millet, dalhan, tilhan, kapas, sugarcane, and so on.

CHAPTER 2: AGRICULTURE MECHANIZATION

Agricultural mechanization is critical to increasing production in developing nations. During the last 41 years, the utilization of tractors and electric motors in farm power availability increased from 6.8 to 45.8% and 14.0 to 26.8%, respectively. The Indian Agricultural Equipment Market has seen rapid growth, with a surge in demand for equipment such as tractors, power tillers, combine harvesters, rotavators, threshers, rice planters, and so on.

The government has implemented the SMAM scheme to provide incentives to small and marginal farmers. In addition, the government has implemented the SMAM plan, which provides incentives to small and marginal farmers. Small/marginal farmers, especially ST/SC women, received equipment subsidies of up to 50% of the cost. The Ministry of Agriculture has gradually increased the financial allocation for SMAM and claimed that 75% mechanization would take another 25 years.

The SMAM acts as a platform for bringing together all efforts that promote the inclusive growth of agricultural mechanization by taking a 'single widow' approach with a special emphasis on small and marginal farmers. **This scheme's initiatives include offering additional subsidies to SC, ST, and women farmers in North Eastern states, as well as establishing CHCs, farm machinery banks, and hi-tech centers in regions such as Punjab, Haryana, Uttar Pradesh, and the NCT of Delhi.**

Research and development in cotton ginning mechanization has resulted in reducing the trash content of Indian cotton to less than 5% and has also contributed to improving its quality. However, no formal study has been done by the department to assess farm mechanization in the nation, but strategies have been provided by properly identifying the state mechanization gaps. The availability of farm power and farm yield have been found to have a linear relationship. The national average of farm power availability in Indian States in 2018-19 was roughly 2.49 kW/ha; consequently, to meet the increasing demand for food grains, farm power availability must be increased to 4 kW/ha by the end of 2030. The government is also training farmers in various states through Krishi Vigyan Kendras and offering subsidies to lessen the imbalance in farm power availability between states.

CHAPTER 3: SUB-MISSION ON AGRICULTURAL MECHANIZATION (SMAM)

In 2014-15, a Sub Mission on Agricultural Mechanization (SMAM) was launched to equip marginal and small farmers with mechanized tools and machines, aiming for inclusive growth in the Farm Mechanization Sector. The objectives include increasing farm mechanization reach, promoting 'Custom Hiring Centers', creating hubs for high-value farm equipment, and raising stakeholder awareness through demonstration and capacity building activities.

The Sub-mission on Agricultural Mechanization with the Rashtriya Krishi Vikas Yojana (RKVY) have been merged. Financial assistance of 40-50% is provided for individual ownership of farm machinery under various schemes. 40% is for the establishment of farm machinery banks, providing custom hiring services for small and marginal farmers. Farm mechanization has been increasing steadily due to various government programs and private sector participation

The economic benefits of using improved technologies over traditional practices through technology assessment, demonstrations, and capacity building by KVKs. The programs focused on improved agricultural crop production technology, operation, repair, maintenance, post-harvest technology, and small-scale processing. **Prototype training centers have been established for small farmers to use farm equipment cooperatively and benefit from technology.**

Financial assistance has been provided to farmers for purchasing agricultural machinery, ranging from 40% to 50% of the project cost, depending on their categories. This assistance is also available to rural youth, farmers, cooperative societies, registered farmers, FPOs, and panchayats for setting up Custom Hiring centers and hi-tech hubs, and higher assistance is available for village level Farm Machinery Banks. The Sub-Mission on Agricultural Manufacturing (SMAM) aims to provide 50% of the cost of farm machinery to small and marginal farmers. The scheme is implemented through State and Union Territory governments, with the government contributing 100% to Central Sector Schemes and 60% to Centrally Sponsored Schemes, except for the North Eastern States and Himalayan region States.

GST on tractor parts and components has been reduced, implementing emission norms for tractors, reducing subsidies for high-horsepower tractors, and promoting tractor use in other sectors. Since the implementation of SMAM in 2014-15, a total of Rs 5377.7 crore has been released. There is a plan to reach unreached areas through field demonstrations of required technologies and machinery at the village level. .

Customs hiring centers and farm machinery banks have been established in almost all states, except for the Union Territories of Ladakh and Dadra and Nagar Haveli. These centers provide farm mechanization support to neighboring farmers, resulting in 10-20% savings in inputs, 25-30% reduction in production costs, 15-25% increase in production, and 25-40% increase in gross income. There is an aim to promote custom hiring of farm machinery and farm machinery banks to help small and marginal farmers access high-value machines. The establishment of these centers under the Sub-Mission on Agricultural Mechanization (SMAM) and Promotion of Agricultural Mechanization for In-Situ Crop Residue Management schemes has enabled farmers to access high-value machines that cannot be purchased by individual farmers.

The Committee for Formulation of Standards Related to Agricultural Machinery (FAD-11) has been constituted, and four Farm Machinery Training and Testing Institutes have been established for testing and performance evaluation of farm machinery and equipment. 37 different institutions under State Governments, State Agricultural Universities, and the Indian Council of Agricultural Research have been authorized for testing and performance evaluation of machines and equipment.



CHAPTER 4: RESEARCH AND DEVELOPMENT OF SMALL AND MARGINAL FARM MECHANIZATION

A variety of operations have been conducted in the areas of farm mechanization of production and post agriculture production over the course of the previous five years (2017–2022). 158 new farm machines were created, 1748 farmers received practical training on improved agricultural implements and machinery, more than 18500 research prototypes were produced, and 16 programs for the development of rural youth entrepreneurs focused on the custom hiring of agricultural machinery were organized.

The ICAR-CIAE, Bhopal-developed Soil Plant Analysis Development (SPAD) Meter for assessing crop nitrogen status has been made available to farmers. To assist farmers from economically disadvantaged areas in meeting the demand for maintaining expensive machinery, a farm machinery bank model has been established in which a group of farmers owns and shares the machines among themselves at mutually agreed-upon charges to maintain the bank.

Drones are being encouraged in the realm of technology for use in spraying operations, and more research is being done to use drones in areas like agricultural health monitoring, crop yield estimation, fertiliser applications, etc. A center for Agri-electronics and Automation in Agriculture has been developed at ICAR-CIAE, Bhopal, in the field of artificial intelligence. Institutes of ICAR and centers of AICRPs have created tools and equipment that lessen the drudgery of agricultural operations and labor requirements in hilly and tribal areas to meet the needs of farm mechanization in desert regions, steep terrains, and inaccessible areas.

CHAPTER 5: CHALLENGES IN MECHANIZATION

Some of the factors that affect agricultural mechanization in India are land size, cropping pattern, market price of crops, including MSP, availability, and cost of labor. Key challenges faced in this area and progress made to overcome them are as follows:

S.No.	CHALLENGES	PROGRESS
1	<p>Small farm sizes in India account for 86% of total land holdings, which hinders mechanization unless suitable machinery is made available or land amalgamation occurs. This makes it difficult for farmers to own machinery, limiting the benefits of mechanization to large landholders only.</p>	<p>Development of suitable equipment for small and marginal farmers, regularly demonstrating and training them, providing hands-on training, displaying farmers equipment at exhibitions and fairs, and providing financial assistance for procurement under the Agricultural Mechanization (SMAM) scheme.</p>
2	<p>Mechanizing small and non contiguous groups of farms is against economies of scale, especially in activities like preparation and harvesting, as it will make individual ownership of agricultural machinery increasingly uneconomical as the average farm size shrinks.</p>	<p>Various manual, animal-drawn farm tools are being developed for small and fragmented land-holdings, promoted by institutes, AICRP centers, and state governments.</p>
3	<p>Indian farmers struggle to acquire high-cost, energy-efficient farm machinery due to capital shortages.</p>	<p>Rural youth and farmers are trained to establish custom hiring centers, benefiting small and marginal farmers by reducing cultivation costs without owning machines.</p>

4	<p>Farmers often make inappropriate selections for tractors, power tillers, and other prime movers without proper guidance, leading to fuel waste and high production costs.</p>	<p>Software has been developed for farmers and hiring centers to select suitable farm machinery based on their agro-climatic conditions, reducing fuel waste and production costs.</p>
5	<p>India faces challenges in farm mechanization due to cost-conscious farmers, inadequate service centers, and the inability of local low-cost manufacturers to meet standard equipment designs.</p>	<p>Testing centers are ensuring commercial machines adhere to BIS standards to improve manufacturing quality and reduce breakdowns. Regular interaction between the institute and manufacturer ensures information on new developments, licenses, and training. Standard parts are promoted, and manufacturers are trained in manufacturing technology for improved quality and compatibility.</p>

CHAPTER 6 : OBSERVATIONS AND RECOMMENDATIONS

STATUS OF AGRICULTURAL MECHANIZATION IN INDIA

The importance of modern agriculture in increasing productivity and making cost-effective use of inputs like seeds, fertilizers, chemicals, pesticides, and natural resources. Agriculture is growing at an average Compound Annual Growth Rate (CAGR) of 2.8%, with about half of the population relying on agriculture as their principal source of income. India's overall Agriculture Mechanization Level is 47%. The contribution of Agricultural Mechanization in India leads to savings in seed, fertilizer, germination rate, time, weed, labor, crop intensity, and yield. However, 86% of Small and Marginal Farmers have less than 2 hectares of land holdings, making it difficult for them to purchase their own machinery. The government must prioritize the development of small equipment/machines for Small and Marginal Farmers to add quality and value to farm produce, making agriculture more attractive and profitable. There should be a 75% level of farm mechanization from 47% in a shorter period than the Department's 25-year target.

AGRICULTURAL EQUIPMENT MARKET GROWTH

The Indian Agricultural Equipment Market is experiencing rapid growth, with a surge in demand for machinery in the Asia-Pacific Region. The demand for tractors, power tillers, combine harvesters, rotavators, threshers, and rice trans-planters has been significant. However, no formal study has been conducted to assess farm mechanization in the country. The Department of Agriculture and Farmers Welfare (DA&FW) has submitted a proposal by ICAR to assess state-wise mechanization gaps and formulate strategies. There is an urgent need for a systematic study to understand the country's mechanization level objectively. The Department should review the proposal and use real-time data to prepare implementable plans for small and marginal farmers.

PORTABILITY OF FARM EQUIPMENT SUITABLE FOR SMALL AND MARGINAL FARMERS

Small and Marginal Agricultural Land Holdings (less than 2 Hectares) make up 86% of the total operational holdings in India, accounting for 47% of the total operated area. The average farm size is small, and farm machinery is expensive, making it difficult for small farmers to purchase it. The government has introduced custom hiring of farm equipment, allowing groups of farmers to own and share machines at mutually agreed charges through the Farm Machinery Bank. However, standardization of farm machinery is a complex issue, and the government needs to enforce compatibility and matchability in the manufacture of agricultural implements. This would also help in setting up ancillary units to specialize in the manufacture of these standard components, increasing the product spectrum and employment opportunities.

BUDGETARY ALLOCATION FOR PROCUREMENT OF AGRI-EQUIPMENTS

The Indian government is providing subsidies to farmers to procure machinery to improve farm input and power availability. The Central DBT Portal for Agriculture Machinery Mechanization is well-received in India for its Single Window clearance for equipment procurement. However, electronic agricultural equipment requires clearance from both the Department of Electronics and DA&FW. There should be an automatic link in the DBT Portal for the Department of Electronics.

TRAINING AND ORGANIZING DEMONSTRATIONS

Providing training and demonstrations in Farm Machinery through four dedicated Institutes (FMTTIs) in Madhya Pradesh, Haryana, Anantapur, and Assam. The institutes are promoting the use of farm machinery for rural youth and farmers, and encouraging them to establish Custom Hiring Centres. A consistent and adequate allocation of funds and urges the Finance Ministry not to reduce budget allocations for this purpose. Adequate funds should be allocated for the overall development of the mechanization of agriculture.

ESTABLISHMENT OF THE DIRECTORATE OF AGRICULTURAL ENGINEERING

A Directorate of Agricultural Engineering in each State to monitor and implement government policies and programs of mechanization more effectively must be established.

RESEARCH AND DEVELOPMENT FOR SMALL AND MARGINAL FARM MECHANIZATION

158 improved equipments/machines, commercialized 47 technologies, manufactured 18500 machines have been developed, conducted prototype feasibility testing of 76 improved farm equipments, issued test certificates for more than 400 commercial machines, trained 7369 farmers, organized 16 Entrepreneurship Development Programs on Custom Hiring, conducted frontline demonstrations of 105 improved farm machinery in 4386 locations, and demonstrated technologies to 10 lakh farmers through Kisan Mela Industries Meet and agri-exhibitions. However, the Department should involve other agencies at the district, block, and village levels to provide technological demonstrations to all farmers at the grass root level. Brochures and printed materials on new research in machinery and tools available at all KVKs at the district level.

UPGRADATION OF TESTING CENTRES

There is a need for a streamlined testing procedure, training of engineers, and upgrading of testing centers due to rapid technological advancements. Test centers for agricultural machines have been established at selected institutes for regular certification testing. Scientists are involved in evolving standards through the Bureau of Indian Standards. The government should develop a mechanism to allocate funds to these institutes for testing commercial machines and upgrading these centers, addressing the issue of the non-availability of financial support.

ROLE OF SUB-MISSION ON AGRICULTURAL MECHANIZATION (SMAM)

This is a government initiative providing 40-50% of the cost of equipment to Small and Marginal Farmers for the purchase of Tractors, Power Tillers, Combine Harvesters, Rotavators, and Rice transplanters. The scheme is implemented through State and UT Governments, with the Government of India contributing 100%. An additional subsidy of 10% is provided to Small and Marginal Farmers over and above general category farmers. Tractors are also used on a rental basis. SMAM has been merged with the Rashtriya Krishi Vikas Yojana (RKVY) since 2014-15, releasing a total of Rs. 5377.7 Crore. In order to increase farm mechanization for Small and Marginal Farmers and offset the adverse economics of scale due to small landholdings and high individual ownership costs, the government should promote low-cost farm equipment. However, the mandate of SMAM should not be diluted by the merger.

FARM POWER AVAILABILITY

There is a linear relationship between farm power availability and farm yield, an increase from 2.49 KW per ha to 4.0 KW per ha by 2030 to meet the increasing demand for food grains was recommended. The average farm power availability is 2.4888 kw, and it is urgent to improve it to a minimum of 4.00 KW/Ha by 2030. The Committee also noted that agricultural productivity is directly linked to farm power availability, and the government is training farmers for mechanization through KVKs and subsidies.

PROMOTION OF RURAL ENTREPRENEURSHIP

Development of a mobile app, Krishi Yantra Mitra, for Agro-climatic zones was recommended, it should be widely publicized and beneficial to farmers. Testing centers must be established for commercial machines for ICAR institutes and manufacturers to stay updated on new developments in the field. There is an urgent need to promote rural entrepreneurship for rural employed youth, particularly in Agro and Allied businesses, to create job opportunities and reduce migration to urban areas. This will promote rural development and employment in villages.

LOW HORSE POWER TRACTORS

GST for tractor parts and components should be reduced by approximately 40 hp. to help small and marginal farmers afford farm equipment and provide necessary assistance in purchasing essential farm equipment. This would not only benefit these farmers but also provide necessary support.

AGRICULTURE RESEARCH SERVICE (ARS)

A new Agricultural Research Service (ARS) discipline has been started for the selection of scientists through the All India Examination. Automation is crucial for improving harvest time, efficiency, and productivity in agriculture. More engineers must be trained in Electronics and Instrumentation.

THE NATIONAL INSTITUTE OF AGRICULTURAL ROBOTICS AND ARTIFICIAL INTELLIGENCE (AI)

There is an urgent need for tiny robots and AI in Indian farm operations due to the fragmented land. National Institute of Agricultural Robotics and AI, a proposal submitted in the SGoS- 8 Vision India-2047 was proposed.