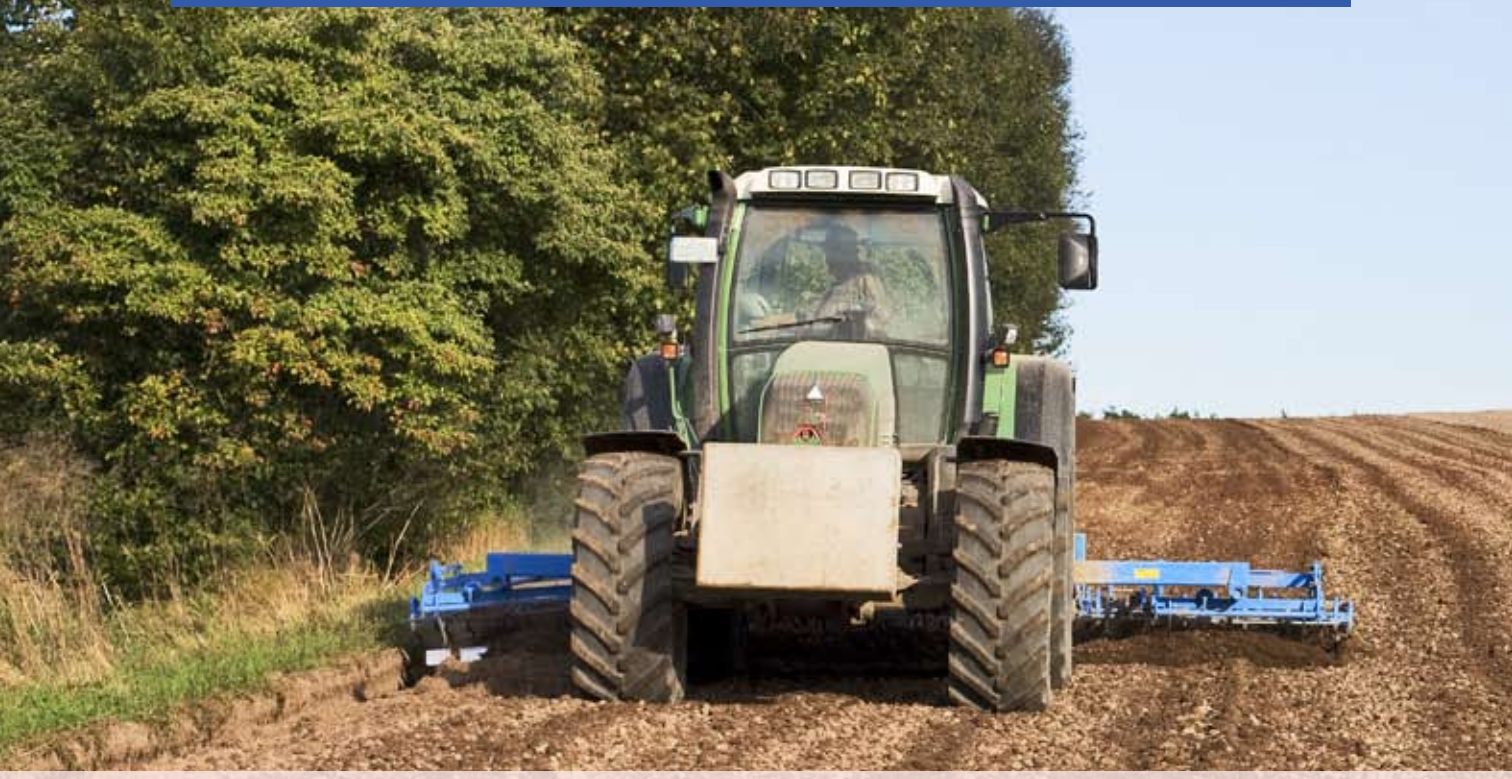
FARM MECHANIZATION

Ensuring Productivity and Livelihood Security



Agriculture has witnessed tremendous change with farm machines performing several important operations spanning from land preparation to harvesting and post-harvest processing. Indian agriculture although heavily dependent on manual labor has started moving away to automation owing to a host of factors. The declining labour force, spiraling labour charges and most importantly the considerable pressure that has fallen upon the farms to be more productive and efficient has fuelled this trend. The increasing demand for food from an increasing population and the thrust on market led production has forced open the gates of farm mechanization.

Current level of Farm Mechanization

Despite being the top producer of food grains, India ranks lower in the adoption of farm machines for its agricultural operations. Farm mechanization in India currently stands at about 40%-45%, a figure which is low when compared to countries such as the U.S. (95%), Brazil (75%) and China (57%). However, the level of mechanization has seen strong growth through the last decade.The farm power availability on Indian farms has grown from 1.47 kW/ha in 2005-06 to 2.02 kW/ha in 2013-14.

Farm equipment market in India is currently estimated at USD 8.8 billion in 2017 and it is expected to reach USD 12.5 billion by 2022. The farm equipment market is expected to grow at a CAGR of 7.5 per cent during the forecast period of 2015-2022. With a gamut of agricultural operations and with the availability of farm machines for each type of farm operation, the future would see a palpable increase in the level of farm mechanization in India.

A number of agriculture equipment is either domestically manufactured or imported in India. Major agricultural

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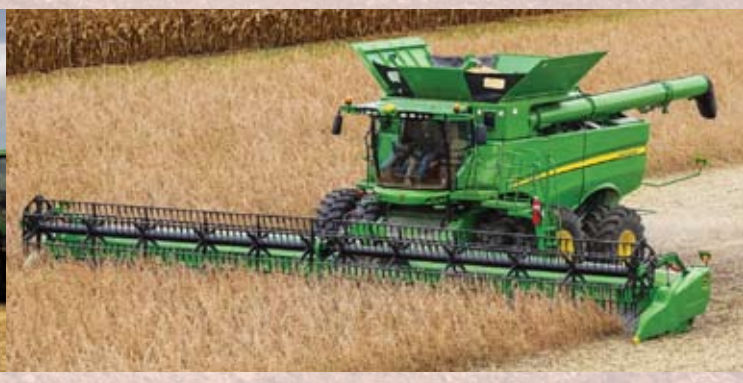

equipment includes tractor, combine harvesters, power tiller, thresher, rotavator and multi-crop planter etc.

Tractors constitute the largest segment in the agricultural equipment market in India and account for over 80 per cent of the total number of agricultural equipment sold in India. In addition, India is the largest manufacturer of tractors and accounts for nearly one-third of the total tractor production in the world. The sale of tractor has been growing due to the increasing rate of mechanisation. Tractors and tractor-driven equipment are the key products of the organised market. The tractor market in India is expected to grow at a CAGR of 7 per cent during 2015-2022. Currently, the total sales for tractors in FY 2017 was 691,631 units with exports accounting for 12 per cent, i.e. 84,650 units. A good monsoon for the current year combined with continued effort by the government to move towards mechanisation and an increase in construction activity will likely result in significant growth in demand for tractors in FY2018.

Combine harvesters, another key category, is used to harvest grain crops. The three harvesting activities are reaping, winnowing, and threshing. Crops such as oats, rye, barley, sorghum, soybeans, corn, flax, sunflowers, canola, and wheat can be harvested using combine harvesters. The harvester market in India is expected to grow at a CAGR of 14 per cent during the forecast period of 2015-2022.

Power tillers are widely used in India as they are used in smaller farm sizes and can reduce field-levelling time considerably. By adding different attachments, power tillers can be used for various other processes such as land levelling, seed bed preparation, puddling, ridging, sowing and inter-culture. The increased government focus on farm mechanisation in India has led to the growth of the power tiller market which is expected to grow at a CAGR of 9.5 per cent during 2015-2022. The penetration of power tillers in India is higher in southern and eastern India as compared to the others parts of the country on account of the small size of land holdings per farmer in these respective regions. In fact, small land sizes and high cost of labor, coupled with rising income levels in rural areas, provide a huge untapped opportunity.

While tractors and power tillers still outsell other farm equipment like paddy transplanters and combine harvesters, the gap has been closing in recent years. It is because of rural youth population is migrating to cities in search of better paying jobs in services and factories. This is creating a big market for specialized machineries, such as threshers, rotavator, transplanters, reapers, zero till drills, laser levellers and power weeders.

The level of mechanization varies greatly by region in India. The green revolution states in the north such as Punjab, Haryana and Uttar Pradesh have high level of mechanization. The western and southern states in the country have a lower level of mechanization owing to the smaller and scattered land holdings. In north-eastern states, the level of mechanization is extremely low as their hilly topography, high transportation cost, lack of state financing and other financial constraints due to socio-economic conditions and dearth of agricultural machinery manufacturing industries have hindered the growth of farm equipment sector within these states.

Operation-wise, the level of mechanisation varies from 42 percent for soil working and seed bed preparation, 29 percent for seeding and planting, 34 percent for plant protection and 37 percent for irrigation.

India is a strong exporter in agricultural machinery with a CAGR of 6.2 per cent over the last four years. India's leading export market for agricultural machinery continues to be the United States despite a decrease in the percentage of exports from 23.2 per cent in FY 2016 to 20 per cent in FY 2017. In contrast, the import for agricultural machinery has seen a CAGR of around 6.8 per cent. China continues to be India's leading partner for imports with 10.2 per cent of total imports for agricultural machinery. India's export market is dominated by tractors, with approximately 60,000 units exported per annum. India is the global market leader today for tractor exports accounting for approximately one-third of the

total exports. India's largest share of tractor export was to the United States of America in the year 2017. It exported 84,650 units to USA which was approximately 12 per cent of its total exports in 2017.

Players in Indian Market

In India the farm machine requirements are met by producers of different scales. Among them, Village level craftsmen are the primary source of supply, repair, and maintenance of hand tools in villages. They deal with a number of farm tools such as spades, sickles, local ploughs, sowing devices, yokes, levellers, grinding wheels, hand mills, hand operated milk churning tools, sieves, wooden storage structures, bullock carts, and manual water lifting devices etc. There are more than 100,000 village-level artisans currently operating in India. They exert considerable influence over the farmers and is believed to effect the decisions of the farmers.

Small-scale industries who occupy the next level, manufacture and supply improved farm equipment such as ploughs, cultivators, disc ploughs and harrows, seed drills, planters, plant protection equipment, reaper harvesters, combine harvesters, soil working tools, seeders, graders, mills, and oil expellers and many others. They also manufacture equipment for tractor and power tiller manufacturers. There are nearly 2,500 small-scale industries currently operating in India.

Organized farm machinery industries are more sophisticated and structured. They are in the business of manufacture of sophisticated agriculture machinery such as diesel engines, electric motors, irrigation pumps, sprayers and dusters, land development machinery, tractors, power tillers, post-harvest and processing machinery and dairy machinery. They also provide after-sales services to the distributors. They focus on product upgradation and process technologies through their own R&D efforts. There are nearly 250 medium- to large-scale units currently operating in India.

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India – A Potential Market for Farm Machines

India's agricultural dominance remains unrefuted. The production surpluses and the demands emanating from them has extended the trade of agricultural products beyond borders. With a stable market inside and outside the country, there has been tremendous pressure on the farm sector for reliable production. This has warranted the use of technology and automation in many agricultural operations.

Besides the obvious reason of production increment, several other factors necessitated the introduction and expansion of mechanization in agriculture. Labor shortage is being experienced at peak seasons due to the enactment of the National Rural Employment Guarantee Act and huge demand from the construction sector in cities. It has been observed that the

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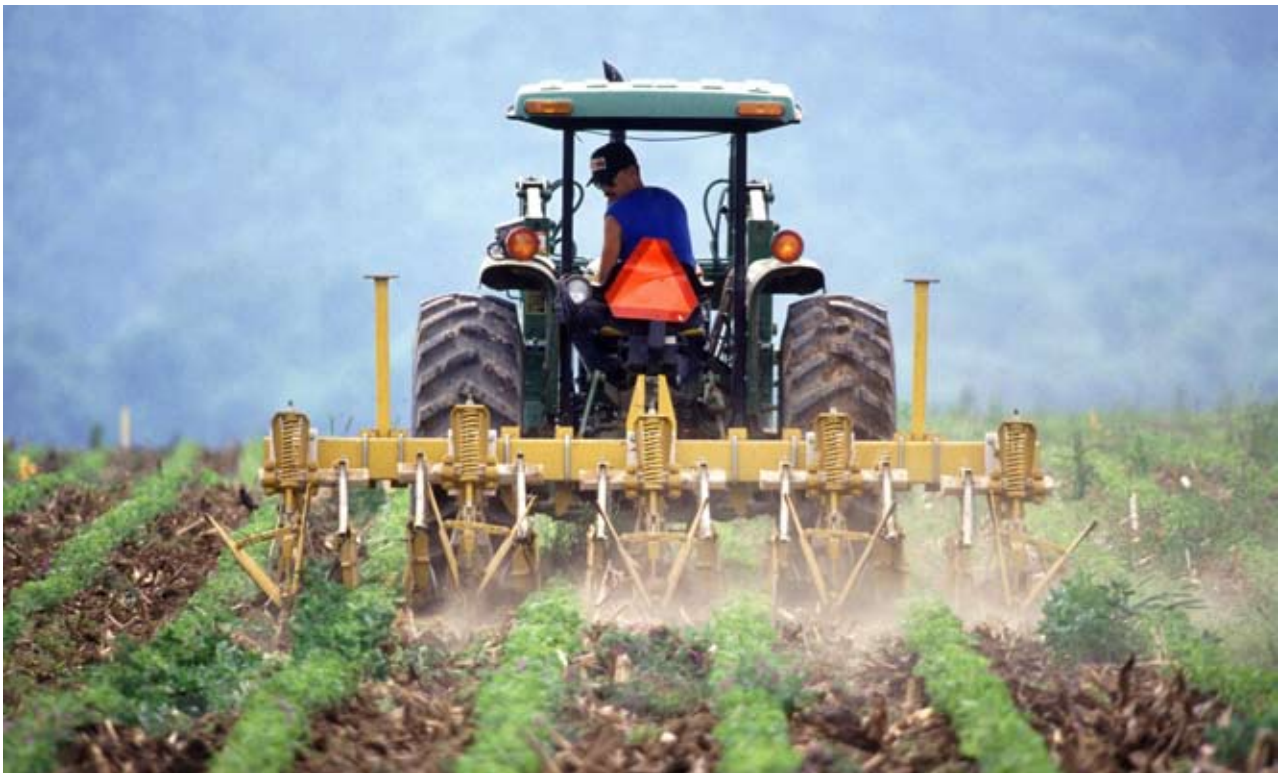
percentage of agricultural workers to total workers in India has been gradually declining and it is expected to further decline to 25.7% by 2050 leading to severe farm labor shortage. Contract Farming Business establishments provide farmers with specialized farm equipment and various amenities to improve crop yield through the adoption of latest agricultural technologies. The continuation and growth of contract farming with more entities getting involved provides future opportunities for the expansion of the industry.

The government is promoting 'balanced farm mechanization' by providing subsidy on various equipments and by supporting bulk buying through front-end agencies. The government also provides credit and financial assistance to support local manufacturing of farm mechanization equipment. Both Central and State governments have been increasing its focus to develop farm mechanization in the Himalayan and North Eastern region where the Centre alone has allotted Rs.3,700 crore for next five years starting 2016-17. This would push the demand for machines such as power weeder, sprayers, and other smaller implements suitable for hilly and terrace cultivation.

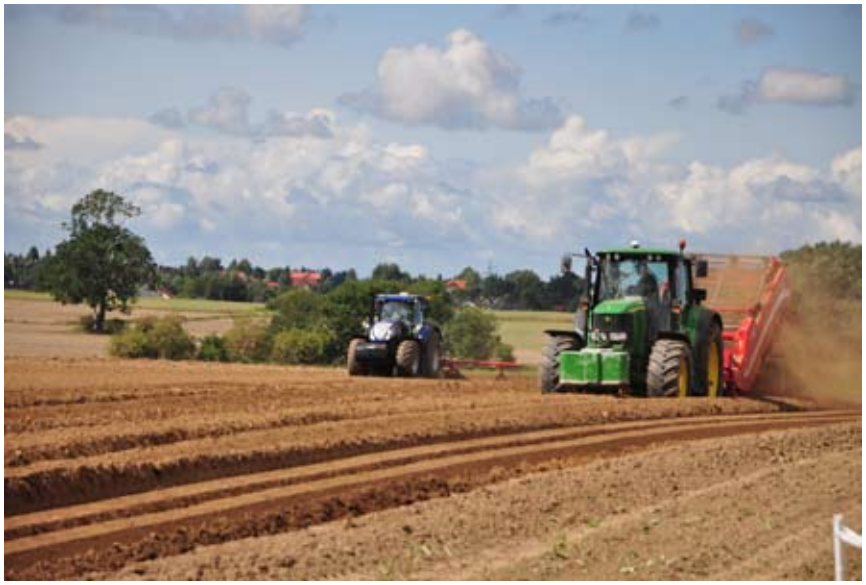
Low Penetration of Farm Equipments in India provides a strong growth opportunity. In 2012-13, it was estimated that the penetration of tractors was about 20 per 1,000 hectares. The penetration is lower with the small and marginal farmers who own land less than 5 hectares. This segment forms over 80 percent of the land holdings in the country. Thus, there is a lot of potential for increasing the penetration and therefore growing the market size.

As per the Vision 2030 document by Indian Council of Agricultural Research, domestic demand for food grains is expected to increase at around 2% CAGR in CY2000-30. Food grains demand is expected to reach 355 MT in CY30 vis-à-vis 192 MTin CY10. Fruits and Vegetables demand is expected to reach 290 MT in CY30 vis-à-vis 136 MT in CY10. However, given the limitations in land use and in increasing cropping intensity over a certain period, increasing the yield from the same land is an urgent requirement to meet the needs of a growing domestic population.



This limitation can only be overcome by increasing the food productivity, for which farm mechanization plays a vital role.

Emergence of custom hiring centers have also given another reason to adopt farm mechanization. Around 85 per cent of India's agricultural lands belong to marginal and small farmers with farms less than two hectares. This set of farmers find it difficult to purchase farm equipment which needs significant investment. Custom Hiring, under these circumstances solve an important issue faced by them who struggle to optimise their usage of modern machinery mainly due to adverse economies of scale, especially in operations like land harvesting and preparation. Different stakeholders including private and government organisations have been participating in promoting the concept of custom hiring in India.



Government Backed Mechanization

Farm mechanisation has the potential to raise farmers' income and hence can play a significant role in realising the government's vision of doubling farmers' income. Several schemes has hence been developed and implemented by the government to aid in the expansion of farm mechanization.

The Government of India through several schemes and policies have tried to further enhance the spread of farm mechanization. Rashtriya Krishi VikasYojna (RKVY), Mission for Integrated Development of Horticulture (MIDH), National Mission on Oilseeds and Oil Palm (NMOOP) and National Food Security Mission (NFSM) are the schemes that are intended to expand country's agricultural productivity. Provisions have been made under this scheme to adopt farm mechanization and hence the government has accorded an important status to the sector.

Under the National Food Security Mission (NFSM) launched in October, 2007, provisions for assistance (up to 50 percent the cost of machinery) have been provided for adoption of farm machinery such as pump sets, tractor mounted sprayers, seed drills, zero till seed drill etc. to varying degrees. Similarly, under the Mission for Integrated Development of Horticulture (MIDH), an important intervention is 'Horticulture Mechanisation' which aims to improve farm efficiency and reduce drudgery of the workforce. Assistance in this regard is provided for activities such as procurement of power operated machines and tools, besides import of new machines. Assistance is also available to grower associations, farmer groups, self-help groups, and women farmer groups etc. (with more than 10 members) that are engaged in cultivation of horticulture crops. 60 percent of the cost of machines will be borne by such groups. Mission on Agricultural Extension and Technology (NMAET) also includes a Sub-Mission on Agricultural Mechanisation (SMAM) which is implemented in all the states to promote the usage of farm equipment and to increase the ratio of farm power to cultivable unit area up to 2kW/ha.

Sub-Mission on Agricultural Mechanisation(SMAM) under the Ministry of Agriculture was started in 2014-15. This scheme is implemented in all the states to promote the usage of farm mechanisation and increase the ratio of farm power to cultivable unit area up to 2.8 kW/hectares by 2022 under its new 7-year plan.SMAM is a sub-mission under National Mission on Agricultural Extension and Technology and enlists 8 components under it ranges from promoting agricultural mechanisation through training, testing and demonstration to providing financial assistance to farmers to help them procure agricultural machinery and equipment.

Capacity building and training are an essential part of the submission because they aim at sustainability and ensure proper utilisation of the technology to maximise productivity, thereby increasing returns for farmers. States with low mechanisation like the north-eastern states and others need special attention and had been neglected before the implication of the sub mission. SMAM aims to promote farm machinery and equipment in these states and has incorporated it as a component of the sub-mission.

The 7-year plan which ranges from 2016-17 to 2021-22 implemented from August, 2017

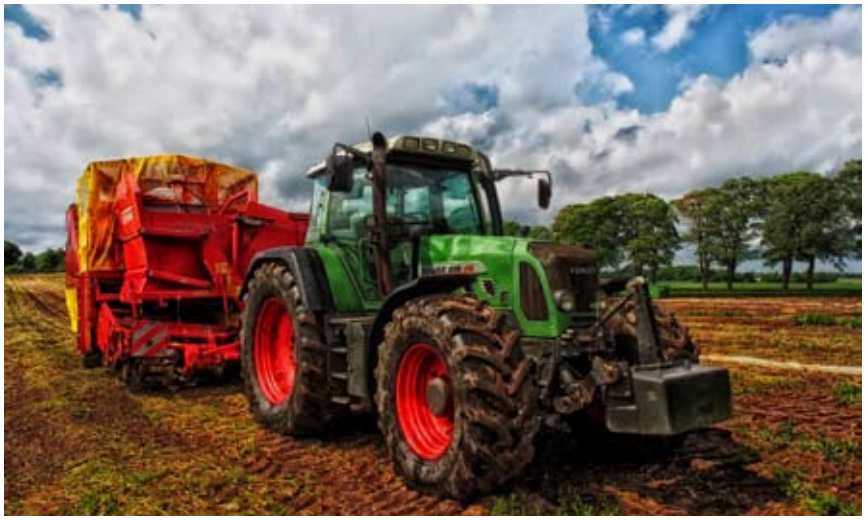
has defined new targets for the sub-mission

- Farm Power availability of 2.8 kW/hectares to be achieved by 2022 from the existing level of 2.02 kW/hectares in 2016-17.
- 1,48,000 trainees to be trained to develop skilled manpower in farm mechanisation sector.
- 10,270 agricultural machineries to be tested.
- 2,80,000 CHCs to be established at the village level.
- 19,000 demonstrations to be organised on farmer fields.
- 19,00,000 numbers of farm machinery to be distributed under SMAM.
- 8 new Farm Machinery Training and Testing Institutes (FMTTIs) to be established in addition to the existing 4.
- 2,00,000 beneficiaries to be benefitted from distribution of farm machinery for individual ownership in north-eastern and Himalayan region.

Going Digital National Portal on Mechanisation and Technology is an active online portal developed and launched by Department of Agriculture to help farmers across the country to get acquainted with and apply for all types of schemes and subsidies they are eligible for. Online booking for farm equipment testing, financial assistance application and other numerous facilities can be directly accessed by farmers even in remote villages. Portals are also separately available and functional for state level schemes and policies under SMAM and other missions like RKVY, MIDH, NMOOP and NFSM which allow aid and subsidies for farm mechanisation across all crop types, ranging from cereals, horticulture crops to oilseeds as per their functional guidelines and regulations.

Challenges Ahead

Although India offers immense opportunities in farm mechanization, there are several factors that can delay or to some extent hinder the



adoption of automation. Majority of the functional farms are small holdings. The average farm size in India is less than 2 hectares, making not only the farms smaller in size for successful operation of farm machines but also reducing the investment potential of such farmers. This explains the rather slow expansion of farm mechanization in India. The situation demands development of farm machines that are appropriate for small holdings or making them available through collective ownership or on custom hiring basis.

India has until the recent past has not looked beyond the conventional tractors. In fact whatever mechanization that have happened in India can be attributes as tractorisation and not mechanization in the true sense. Tractors have an annual market of 600,000-700,000 units in India whereas, threshers, the next largest segment, has an annual market of just 100,000 units. The penetration of tractors has grown from one per 150 hectares to one per 30 hectares on agricultural land. However, such a growth in penetration has not been seen in other agricultural implements. It is to be noted that for a sustainable agricultural future, other farm implements, and not just tractors, need to be advanced to farmers in the country.

Also, the entire process of acquiring farm equipment is very tedious and cumbersome for a farmer. A farmer has to go through various levels/ departments to get his land records verified. Post clearance, he has to go through further checks from the District Agriculture Officer in order to obtain approval and clearance for the purchase. This process itself becomes a big hindrance and discomfort to the farmer. Another issue that has been persistent is financing the purchase of standalone implements. This seems to discourage farmers from investing at large, as they need to shell out a huge amount.

Besides, farm equipment, especially the energy-efficient options, is capital intensive and is a major investment for most of the farmers in India. A majority of them belong to the low income bracket. The quality and after-sales service of farm equipment is another concern, since agriculture is largely carried out in rural parts of India and there is still an inadequacy of service-centres for proper maintenance.

Agri Mechanization is crucial for India as we desperately need to break free from the low productivity bracket. Our objective is not only to satisfy the gaps in production but also to ensure incomes to farmers associated with agriculture. Farm mechanization is the next big step that India needs to take firmly and confidently.

'Post harvest mechanization has great potential to increase rural entrepreneurship and livelihood'

Mechanization in the post harvest operations have immense potential to enhance the productivity and efficiency of Indian agriculture. The ICAR-Central Institute of Post-Harvest Engineering and Technology (CIPHET) Punjab, is a nodal institute to undertake lead researches in the area of the Post-Harvest Engineering and Technology appropriate to agricultural production catchment and agro-industries. In an interview with Agriculture Today, Dr. R K Singh, Director, ICAR-CIPHET, Ludhiana discusses about mechanization in the processing of agricultural commodities.

What is the extent of mechanization in food processing segment in India?

Mechanization in Food processing segment covers all levels of handling and processing technologies, from simple and basic hand tools to more sophisticated and power-driven equipment. The food processing sector is highly fragmented industry. It widely comprises sub-segments like food grains processing, fruits and vegetables, milk and milk products, beer and alcoholic beverages, meat and poultry etc. Earlier, huge number of entrepreneurs in this industry were small in terms of their production and operations, and were largely concentrated in the unorganized segment. Presently, there are more than 900 flour mills, 5300 fruits and vegetables processing units, 450 fish processing units and 200 meat processing units in the organised sector. The mechanization is largely required at the rural level where processing of agricultural produce is very traditional and highly unorganized.

Primary milling of grains is considered to be the most important activity in this industry. Around 65% of rice production is milled in modern rice mills. There are 139208 traditional rice mills and 35088 modern rice mills in India. Dal milling is the third largest in grain processing industry, and have about 11,000 mechanized mills in the organised sector. Oilseed processing is another major segment. There are approximately 50, 000 mechanical

oil expellers in the country.

Fruit and vegetable (F&V) processing is mainly dominated by unorganised players, who occupy a share of about 60 per cent of the total market size. Over the last few years, the industry has witnessed rapid growth of Ready to Eat foods, frozen vegetables, processed mushroom etc. Presently, the mechanized processing of fruits and vegetables is estimated to be around 2.2 % of the total production in the country. The major processed items in this segment include pulps and juices, fruit based ready to serve beverages, canned fruits and vegetables, jams, squashes, pickles etc.

How has the mechanization improved the efficiency of the post harvest processing operations?

Mechanization continues to play an increasingly important role in post-harvest processing operations such as shelling, milling, processing, packaging, transportation, storage and marketing. Mechanization in post harvesting sector replace the lengthy and laborious work with more labour saving, quality-improving machinery and process technology to improve postharvest handling and agro-processing. This also improves the efficient use of resources, enhances market access and contributes to mitigating climate related hazards. Mechanization improved the efficiency of the postharvest processing operations by Improved productivity and timeliness of agricultural operations; Enhance income and greater profitability of farmers; Increased safety of the process and operator; Mitigating climate related hazard; Relieves labour shortages; Processing of food items in hygienic conditions; Improved food quality; Reduced postharvest losses; Reduction in by-product generation; Lower production cost in the long term; Creation and maintenance of brand value through quality product and Reduced fatigue and human labour.

About 65-70% of total food grains produced in the country are stored at farm level with intention of immediate sale in market. This is driven by lack of availability of suitable machinery and other accessories at their disposal for handling and processing of farm produce

How can the post harvest mechanization enhance rural entrepreneurship and livelihood?

Postharvest mechanization has great potential to increase rural entrepreneurship and livelihood by generating employment possibility along the value chain of the production. Post-harvest operations such as storage, processing (cleaning grading, shelling, milling and dehusking) add value at each step of food production which leads to entrepreneurship development in terms of setting up the agro-processing center. Postharvest machinery and equipment transform the farmer from 'producer' to 'producer-cum-processor' to get more profits by increasing quality through value addition and efficient utilization of by-products in addition to reducing postharvest losses. Establishing small and tiny units of agro-processing centers in rural areas and linking them with urban markets can be one of the alternatives to increase income and employment opportunity for youth. This sector generates the demand for more production of agricultural commodities resulting into more intensive agriculture and ultimately employment generation in rural areas.

An entrepreneur can start processing of agricultural commodities into more refined products including: milling maize and other grains, cooking, curing or drying meat, drying fruits and vegetables, mixing commodities such as nuts and raisins, create handicrafts with commodities such as grasses and flowers etc. Each of these represents a value-adding possibility in which entrepreneurial farmers can become involved to capture value within the value chain. If they can organise the necessary finances, they can establish a business.

Perishables need immediate cold storage facilities within the vicinity of the farms. If the rural farmers are educated about the latest scientific mechanized techniques and cost-effective ways of storage, they can form co-operatives and communities to pool in resources and make the trained youth responsible for setting up basic infrastructure.

Recognizing the importance of rural entrepreneurship and skill development number of initiatives like "Start-up India" and "Stand-up India", ASPIRE (A Scheme for Promoting Innovation, Rural industry and Entrepreneurship),

Pradhan Mantri Kaushal Vikas Yojna and Aajeevika are recently launched by Government of India. Indian government has established separate ministry 'Ministry of Skill Development and Entrepreneurship' for promoting entrepreneurship and skill development. In this way entrepreneurship in mechanised post harvest processing and value addition is emerging as a solution of rural unemployment, rural poverty & can enhance rural entrepreneurship and livelihood.

Which are the areas in post harvest segment that badly needs automation?

Being a biological material, agricultural commodities are prone to large variation in size, shape, texture and other properties that plays important role in its postharvest management. It is high time that machineries are equipped with techniques to adopt to varying nature of agricultural produce. Looking at the technological interventions in postharvest segment so far, it is evident that technologies for labour intensive operation (threshing, milling etc) are readily available whereas mechanisation in skill dependent operations (harvesting of delicate F&V, grading, sorting etc) is scarce and cost intensive. Emphasis on use of artificial intelligence, machine learning, image processing, and robotics in such machinery could boost its widespread adoption in farming as well as industrial community. Further, automation is required in storage (specially controlled atmosphere) and packaging (modified atmosphere) of fresh fruits and vegetables, cold chain management including pre-cooling facilities. Besides, the working condition of agro-processing industries are not very conducive for human being due to lot of air and noise pollution. The sophistication in postharvest machines is required for their precise and safe operation which can be achieved through automation.

What are the challenges associated with the adoption of mechanization in post harvest operations?

Indian agriculture is characterized by small land holdings and hence small portion of produce owned by large number of farmers/producers which limits the consistent supply of quality raw materials for processing. About 65-70% of total food grains produced in the country are stored at farm level with intention of immediate sale in market. This is driven by lack of availability of suitable machinery and other accessories at their disposal for handling and processing of farm produce. Commodity specific design of post-harvest machineries restricts their use for limited period which demotivates the farmers from its wide scale adoption.

Purchase of any equipment is a significant investment for most of the manufacturers in India. Hence, reasonable financing norms are a must for ensuring mechanization in any industry. An issue that has been persistent in financing is the purchase of standalone implements. This seems to discourage the people from investing at large, as they need to shell out a huge amount. As the majority of customers are cost conscious; quality of the product takes a major hit. In addition, the inability of local low cost manufacturers to come up to the levels of standard designs of equipment also poses a big challenge in adoption of mechanization in post-harvest operations.

Knowledge about selection of machinery is inadequate. Shortage of skilled, semi-skilled and unskilled workers has emerged as a critical factor causing a major hindrance to the growth of mechanization. The after sales service of farm machinery is the other concern in India as the majority of the manufacturers are cost conscious. There are inadequate service centers for proper upkeep, repair and maintenance of the equipment and the market lacks regulations on Custom Hiring services.

What are the policy measures that supports post-harvest mechanization?

The Indian Government gives considerable importance to the food-processing sector. The Ministry of Food Processing Industries is concerned with the formulation and implementation of various policies and plans for the Food Processing Industries within the overall national priorities and objectives. The government has implemented various programmes that supports post-harvest mechanization in the country through several schemes. NABARD has created a separate window with a corpus of Rs. 1,000 crore for refinancing loans to the sector, especially for agro-processing infrastructure and market development. The Department of Animal Husbandry, Dairying and Fisheries (DAHD&F), GOI launched a pilot scheme titled "Venture Capital Scheme for Dairy and Poultry" in the year 2005-06. The main objective of the scheme was to extend assistance for setting up small dairy farms and other components to bring structural changes in the dairy sector. Under the Central sector scheme of Cold Chain, Value Addition and Preservation Infrastructure, government provides grants in aid up to 50% (75% in North East and Hills) of a cold chain project subject to maximum Rs. 10 Crore. Such cold chain projects can be set up by individuals, groups of entrepreneurs, cooperative societies, Self Help Groups (SHGs), Farmer Producer Organizations, NGO, Public Sector Companies etc. Loan to food & agro-based processing units and cold chain has been classified under Agriculture activities for Priority Sector Lending (PSL) subject to aggregate sanctioned limit of Rs. 100 crore per borrower.