CONTENTS

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Status, Challenges and Strategies for Farm Mechanization in India

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Abstract

Economic growth in Indian agricultural sector lags behind growth in industry and services, creating an ever widening rural-urban income gap. Agricultural mechanization plays a key role in improving agricultural production and productivity in developing countries. The average farm size in India is small (1.16 ha) and small and marginal land holdings (less than 2.0 ha) account for 85% of land holdings. Mechanizing small and non-contiguous group of small farms is against 'economies of scale' for individual ownership of farm machinery. The status of farm mechanization in India is analysed by the trend in growth of mechanically power-operated farm equipment over traditional human and animal power operated equipment. It was observed that there was a direct correlation between farm power availability and productivity during the past six decades. Haryana state of India has the highest tractor density per thousand hectare of net seeded area of 84 tractors and followed by 76 tractors for Punjab against all India average of 33 tractors. The sale of transplanter, power weeder, combine harvesters, rotavator and thresher in India is growing at a compound annual growth rate (CAGR) of 50, 50, 28, 20 and 10 %, respectively. The available farm power and productivity in India are expected to reach 2.2 kW/ha and 2.3 t/ha, respectively by the year 2020.

The widely fragmented and scattered land holdings in many parts of the country need to be consolidated to reap benefits of agricultural mechanization. There is a need to innovate custom service or a rental model by institutionalization for high cost farm machinery such as combine harvester, sugarcane harvester, potato combine, paddy transplanter, laser guided land leveller, rotavator etc. to reduce the cost of operation and can be adopted by private players or State or Central Organizations in major production hubs. The farm machinery bank may be established for machines being manufactured elsewhere in the country to supply in low mechanised region on custom hiring basis. Financial assistance or procurement subsidy may be provided for the purchase of agriculture machinery and equipment on individual ownership or custom hiring basis.

Keywords: Mechanization, Farm power, Mechanization strategy, Tractor density.

Introduction

India accounts for only about 2.4 % of the world's geographical area and 4 % of its water resources, but has to support about 17 % of the world's human population and 15 % of the livestock. Agriculture is an important sector of the Indian economy, accounting for 14 % of the nation's GDP and about 11 % of its exports. Agriculture in India is currently growing at an average compound annual growth rate (CAGR) of 2.8 %. There was a record food grains production of 264.4 million tonne during 2013-14 (FAO, 2014). About half of the population still relies on agriculture as its principal source of income and it is a source of raw material for a large number of industries. Accelerating the growth of agriculture production is therefore necessary not only to achieve an overall GDP target of 8% and meet the rising demand for food, but also to increase incomes of those dependent on agriculture and thereby ensure inclusiveness in our society (Anonymous, 2013).

Agricultural mechanization technology plays a key role in improving agricultural production in developing counties, and should be considered as an essential input to agriculture (Rasouli *et al.*, 2009). The term 'farm mechanization' is used as an overall description of the application of the variety of tools, implements, equipment, machinery, power and

other mechanical inputs. Proper use of mechanized inputs into agriculture has a direct and significant effect on production, productivity and profitability on agriculture farms, along with labour productivity and quality of life of people engaged in agriculture (Bishop, 1997; Clarke, 2000). Empirical evidence confirms that there is a strong correlation between farm mechanization and agricultural productivity. States with a greater availability of farm power show higher productivity as compared to others (Singh *et al.*, 2011).

Increasing demand for industrialization, urbanization, housing and infrastructure is forcing conversion of agricultural land to non-agricultural uses. The scope for expansion of the area available for cultivation is limited. According to agriculture census 2010-11, small and marginal holdings of less than 2 hectare account for 85 % of the total operational holdings and 44 % of the total operated area. The average size of holding for all operational classes (small and marginal, medium and large) has declined over the years and has come down to 1.16 hectare in 2010-11 from 2.82 hectare in 1970-71 (Anonymous, 2013).

A few authors have studied the status of farm mechanization with reference to the intensity of power or energy availability, and its impact in increasing agricultural and labour productivity (Singh, 2006; Van den Berg *et al.*, 2007). Giles (1975) reviewed power availability in different countries, and demonstrated that productivity was positively correlated with potential unit farm power. The NCAER (1981) assessed the impact of tractorisation on the productivity of land (yield and cropping intensity), and economic growth (income and employment). Binswanger (1982) defined the status of mechanization by the growth of mechanically power-operated farm equipment over traditional human and animal power operated equipment. Rijk (1989) reviewed the growth of mechanization in different Asian countries, and suggested for the formulation of strategy for mechanization policy based on economics of use of animate and mechanical power for different field operations.

Table 1 Population dynamics of Indian agricultural workers (No. in million)

Particulars	1991	2001	2011	2020 (Projected)
Country's population	846.4	1028.7	1210.7	1323.0
Total no. of workers	313.7	402.2	481.7	566.0
No. of workers as % of population	37.1	39.1	39.8	42.8
No. of agricultural workers	185.3	234.1	263.0	230.0
Cultivators	110.7	127.3	118.7	110.0
Agricultural labourers	74.6	106.8	144.3	120.0
Percentage of agricultural workers to total workers	59.1	58.2	54.6	40.6
Percentage of females in agricultural work force	35.1	39.0	37.2	45.0

This paper discusses the relevant background information on population dynamics, socio-economic status, status of availability of farm power and machinery, and challenges and strategies for mechanization of Indian agriculture.

Socio-Economic Status of Agricultural Workers

The availability of labour to work in agriculture is crucial in sustaining agricultural production. The population dynamics of Indian agricultural workers shows that by 2020, the population of agricultural workers in the country will be about 230 million of which 45 % will be the female workers (**Table 1**). It is predicted that the population in rural areas will decrease to 62.83 % in 2025 and to 44.83 % in 2050 (Soni and Ou, 2010). Thus, there is going to be a significant role of farm workers in country's agricultural production. Agricultural wages have traditionally been low, due to low productivity and large disguised unemployment in agriculture sector. However, in recent years there is sharp increase in agricultural wages due to economic growth and adoption of employment generation policy like the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) and increase in minimum wages due to the Minimum Wages Act. However, agricultural wages, in general, are still much lower than the industrial wages. This further strengthens the necessity for agricultural mechanization in a manner that is inclusive and suitable for Indian conditions.

Women in rural India play a major role in shaping the economy of the country. In Indian agriculture, women perform four different types of roles viz. as a worker (a source of power), as an operator (a controller), as a manager (a farmer) and as an entrepreneur (a business person). At present, most of the Indian women carry out the role of workers only. The hand operated tools/equipment available have been primarily developed for male workers, and women workers have to use these whenever required. As a result, the output is lower and may lead to many occupational health problems. To make them capable for other roles, it is necessary to design machines suitable to them and upgrade their skill for operating these machines. Also for the roles of manager and entrepreneur, their knowledge base will have to be suitably updated.

Farm Power Availability

Agricultural workers, draught animals, tractors, power tillers, diesel engines and electric motors are used as sources of farm power in Indian agriculture. **Table 2** shows

Table 2 Farm power availability from different sources in India

Year	Farm power, kW/ha						Total power, kW/ha
	Agriculture workers	Draught animals	Tractors	Power tillers	Diesel engines	Electric motors	
1971-72	0.045	0.133	0.020	0.001	0.053	0.041	0.293
1975-76	0.048	0.135	0.040	0.001	0.078	0.056	0.358
1981-82	0.051	0.128	0.090	0.002	0.112	0.084	0.467
1985-86	0.057	0.129	0.140	0.002	0.139	0.111	0.578
1991-92	0.065	0.126	0.230	0.003	0.177	0.159	0.760
1995-96	0.071	0.124	0.320	0.004	0.203	0.196	0.918
2001-02	0.079	0.122	0.480	0.006	0.238	0.250	1.175
2005-06	0.087	0.120	0.700	0.009	0.273	0.311	1.500
2011-12	0.100	0.119	0.804	0.014	0.295	0.366	1.698
2012-13	0.093	0.094	0.844	0.015	0.300	0.494	1.841

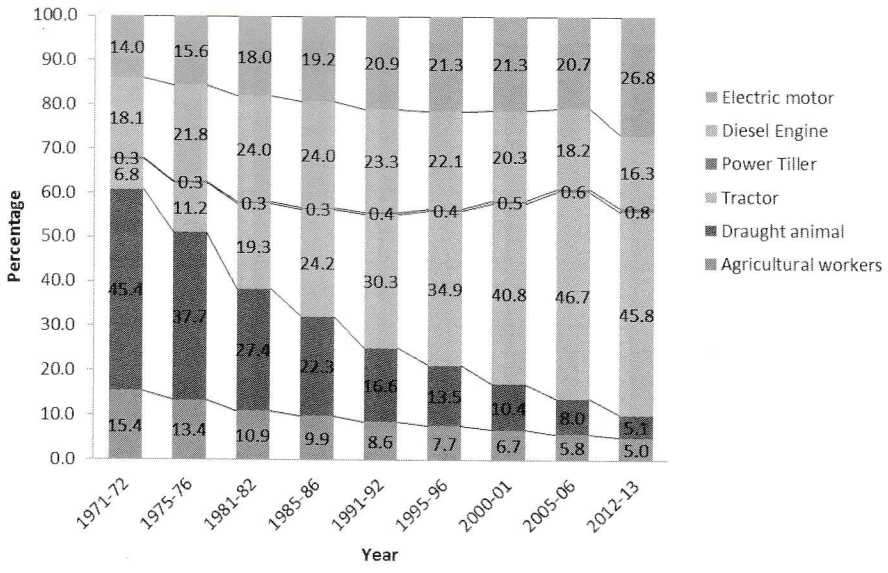
Table 3 Cropping intensity and power availability on Indian farms

Year	Cropping intensity, %	Productivity, t/ha	Power available, kW/ha	Power per unit production, kW/t	Net sown area per tractor, ha
1975-76	120	0.94	0.36	0.38	487
1985-86	127	1.18	0.58	0.49	174
1995-96	131	1.50	0.92	0.61	84
2005-06	132	1.65	1.50	0.91	47
2010-11	141	1.92	1.68	0.88	31
2012-13	141	2.06	1.84	0.89	30

the available farm power (kW/ha) in Indian agriculture from these sources and total farm power. It indicates that the composition and relative share of different sources of power for farming operations have undergone significant change during the last four decades. The availability of draught animals power has come down from 0.133 kW/ha in 1971-72 to 0.094 kW/ha in 2012-13, whereas the share of tractors, power tillers, diesel engines and electric motors has increased from 0.020 to 0.844, 0.001 to 0.015, 0.053 to 0.300 and 0.041 to 0.494 kW/ha, respectively during the same period. The total power availability on Indian farms has increased at a CAGR of 4.58% from 0.293 to 1.841 kW/ha during the last forty one years.

The percentage share of agricultural workers and draught animal power sources in total power reduced from 15.4 to 5.0 % and 45.4 to 5.1 %, respectively over the years from 1971-72 to 2012-13 (**Fig. 1**). The combined share of agricultural workers and draught animals in total farm power availability in India reduced from 60.8 % in 1971-72 to 10.1% during 2012-13. On the other hand, the share of tractor and electric motor in farm power availability increased from 6.8 to 45.8 % and 14 to 26.8 %, respectively during the last 41 years. The share of tractor power was maximum and increased by 39 % during the period. The share of diesel engine was almost the same over the years from 1971-72 to 2012-13. The share of power tiller is less than one percent during the period in spite of small size farms in India.

Fig. 1 Trend in use of power sources in Indian agriculture



Cropping Intensity and Power Availability

The cropping intensity in Indian agriculture increased with increase

in power availability (**Table 3**). It was 120 % with power availability of 0.36 kW/ha during 1975-76 and increased to 141 % with increase in power availability to 1.84 kW/ha during 2012-13. Net sown area per tractor indicated the reverse trend during the same period, which was 487 ha/tractor in 1975-76 and reduced to 30 ha/tractor in 2012-13. The power availability per unit production increased from 0.38 kW/t in 1975-76 to 0.89 kW/t in 2012-13 during last thirty seven years. There may be many reasons including rainfall, crop varieties, timely use of tractors, electricity availability etc. in increasing the food grain productivity during the period.

The farm power availability and productivity increased from 0.25 to 1.84 kW/ha and from 0.52 to 1.92 t/ha, respectively over the years from 1951 to 2012 (**Fig. 2**). It has been observed that farm power availability and food grain productivity have a direct relationship (r^2 = 0.986) during the last six decades (**Fig. 2**). Similar trend was observed by Giles (1975). The predicted values of farm power availability and productivity in India are 2.2 kW/ha and 2.3 t/ha, respectively for the year 2020.

Status of Farm Mechanization

The Indian agricultural equipment market is experiencing a rapid growth with expected strong potential for future growth as well. The demand for agricultural machinery in Asia-Pacific region was more than twice than in any other region. In Asia-Pacific region, India has remained one of the primary nations which fuelled the growth of the market for tractors, power tillers and agricultural equipment.

Tractor and power tiller

The sale of tractors in India has grown at a CAGR of 10.64 % from 217,456 in 2001-02 to 661,431 in 2012-13 during the last 11 years. The Indian tractor market has traditionally been dominated by 23-30 kW tractor segment. Based on the power, sale of tractors in India during the last 13 year is shown in **Fig. 3**. The trend shows that sale of more than 37 kW tractors increased from 7.3 % to 13.8 % during the last thirteen years (2000-2013). Similarly, the sale of tractors in the range of 31-37 kW increased from 14.1 to 36.4 % during the same period. It indicates that requirement of higher power category tractors in India increased for using high capacity machines on custom hiring basis. During the same period, the sale of medium power tractors (23-30 kW) decreased from 55.0 to 40.4 % and low power tractors (15-22 kW) from 23.0 to 6.3 %. The sale of less than 15 kW tractors was only 3.13 % d... ing 2012-13. The present trend sale of tractors in different pow... range in India indicates the highe... share of 40.4 % for 23-30 kW cat... gory tractors. Haryana state of Ind... has the highest tractor density of ... tractors per thousand hectare of n... sown area and followed by Punja... (76), Uttar Pradesh (51), Bihar (44... and Tamil Nadu (43) states. Overa... tractor density per thousand hectar... of net sown area in India is 33. Th... lowest tractor density is in Keral... (4) and followed by Assam (9), an... West Bengal (17) among the state... of India.

The relationship between tracto...

Fig. 2 Trend of farm power and agricultural productivity from 1952 to 2012

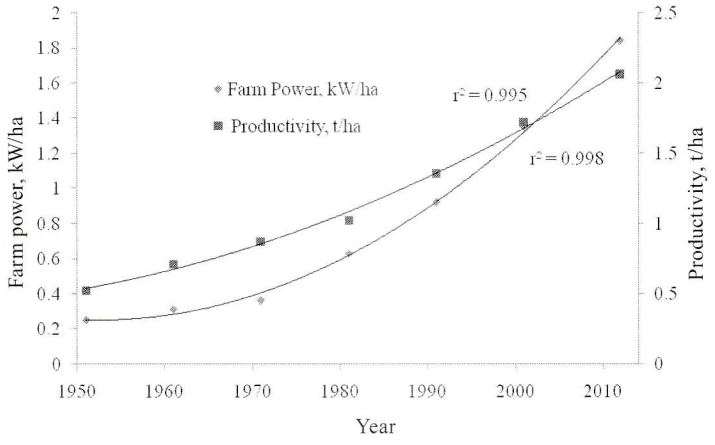
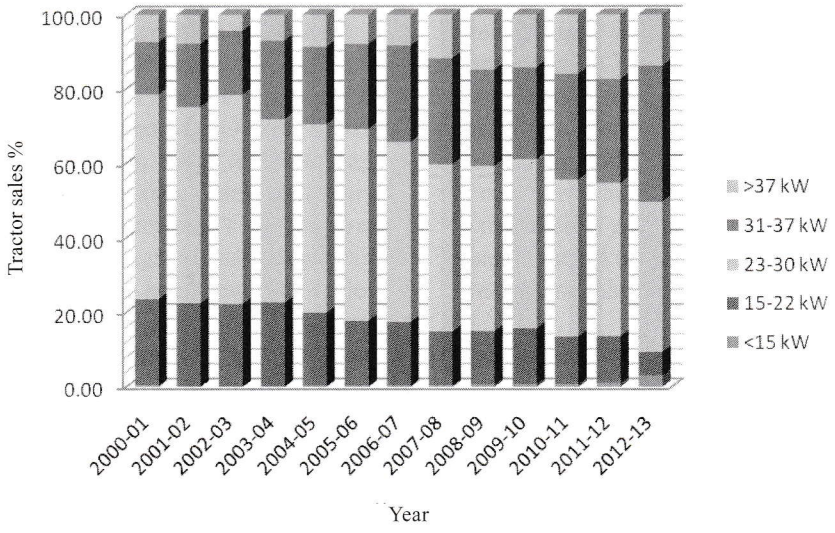


Fig. 3 Power wise sale trend of tractors in India



density and productivity in major states of India is shown in **Fig. 4**. The lines of average tractor density (33 tractors/1000 ha) and average foodgrain productivity (2.06 t/ha) are superimposed on **Fig. 4** to divide these states into four categories i.e., high tractor density and high yield, high tractor density and low yield, low tractor density and low yield and low tractor density and high yield. The first category was of high tractor density and high yield states of Haryana, Punjab, Tamil Nadu (TN), Uttar Pradesh (UP) and Andhra Pradesh (AP). These states utilized maximum tractor power for increasing productivity. The second category is low tractor density and high yield states such as West Bengal (WB) and Kerala. This indicated that these states utilized more human and animal power sources than tractor power source. The third category is high tractor density and low yield states of Bihar and Gujarat. This may be because of lack of awareness on agricultural machinery and tractor usage. The fourth category is of low tractor density and low yield in eight states of Assam, Himachal Pradesh (HP), Odisha, Maharashtra (MH), Jammu & Kashmir (J & K), Madhya Pradesh (MP), Rajasthan (RJ) and Karnataka. This may be due to resource poor farmers and low farm power availability in these states.

Table 4 Market Overview of the major farm machinery used in India

Name of machinery	Market size annually	Approximate cost, US $
Tractor	600,000	7,000-12,000
Power tiller	56,000	2,100
Combine harvester	4,000-5,000	22,000-5,000
Thresher	100,000	1,600-2,500
Rotavator	60,000-80,000	1,300-2,000
Rice transplanter	1,500-1,600	
Walking type		2,500-4,200
Riding type		3,300-16,600
Self-propelled vertical conveyor reaper	4,000-5,000	1,300-2,000
Zero till seed drill	25,000-30,000	750-850
Multi -crop planter	1,000-2,000	850-1,000
Laser land leveller	3,000-4,000	5,800-6,500
Power weeder	25,000	8,500

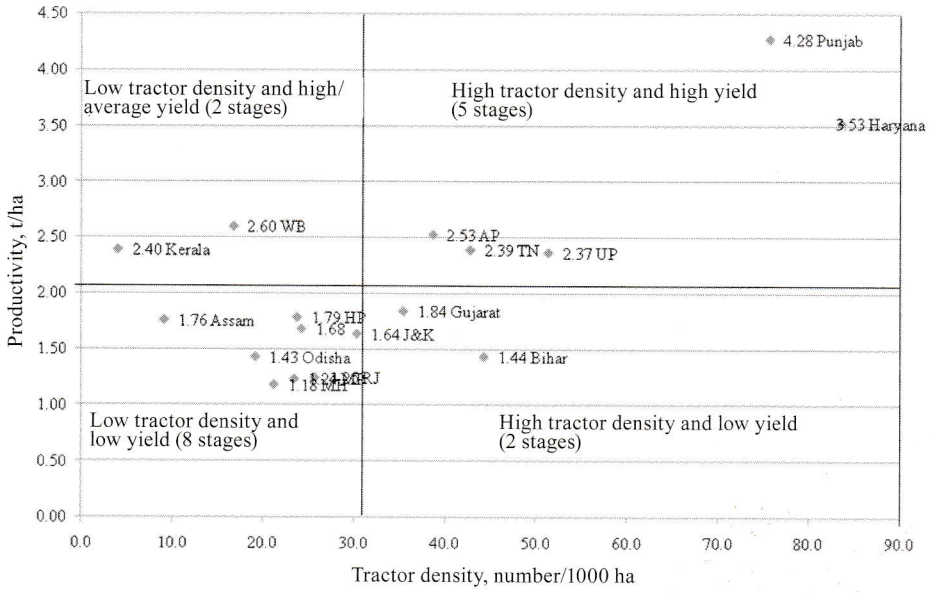
The current market for power tillers in India is estimated at 56,000 numbers during 2013-14. The market for power tillers in India is mainly concentrated in the eastern and southern parts of the country owing to the small land holdings per farmer in these regions and high cultivation of rice crops. Overall power tiller density is 2.21 per thousand hectare of net sown area. The power tillers market in India is dominated by two players from south India these are VST Tillers Tractors Ltd., Bengaluru (Karnataka) and Kerala Agro Machinery Corporation Ltd. (KAMCO), Athani (Kerala).

Farm machinery

The combine harvesters market in India is estimated at 4,000-5,000 units annually by sales which have grown at a CAGR of 28 % since 2006. The tractor mounted combine harvesters occupy around 60 % of the total combine harvesters market in India and is mainly concentrated in southern states viz. Tamil Nadu, Kerala, Andhra Pradesh and Karnataka of the country on custom hiring. This is followed by self-propelled combine harvesters which represent 40 % of the market. Tractor operated combine harvester, costing about 60-70 % of the self propelled combine are owned individually by farmers with large size farms (> 4 ha). The self-propelled combines are largely owned by custom-hiring contractors (Singh, 2004). Punjab, Haryana and Tamil Nadu states have a strong presence in the combine harvester market in India.

Table 4 presents the market overview of the major agricultural machinery used in India. From the table it is estimated that the highest annual requirement is 100,000 for

Fig. 4 Tractor density and productivity in different states of India



threshers and followed by 60,000-80,000 for rotavator, and 25,000 for power weeder. Light weight power weeders are also required for hilly terrains. In case of market growth per annum, the highest growth of 50 % was for rice transplanter. It has been observed that the sale of high cost machinery like combine, laser guided land leveller and rice transplanter is growing fast on custom hiring mode due to more demand.

The market for threshers (multi-crop and paddy), rotavator, planters and zero till drill in India is highly un-organized and is dominated by large number of small and medium scale enterprises (SMEs) located majorly in the states of Punjab, Haryana, Uttar Pradesh, Bihar, Madhya Pradesh, Gujarat, Maharashtra, Tamil Nadu and Andhra Pradesh. The future growth of the threshers market is estimated at a CAGR of 10 % and trend is towards use of tractor operated high capacity threshers on custom hiring mode. The rotavators are being considered better than the conventional tillage equipment among the Indian farmers. The rotavators market in India is growing at a CAGR of 20 %. This equipment saves considerable amount of fuel and accomplishes soil pulverization in short time.

The market for self-propelled (walking and riding type) rice transplanters in India was almost nil 5-6 years back as the rice transplantation was done completely manually with the use of labour. Presently, many companies in India are importing rice transplanters from China and Korea and marketing them in all regions of country. The rice transplanters market in India has grown from about 550 in 2008-09 to 1,500-1,600 units in 2013-14. The industry is expected to grow by more than 50 % in 2014-15 with Chhattisgarh, Odisha, Bihar and southern states showing positive sign of adoption of technology.

The zero till drill is preferred by farmers from Indo Gangetic plains particularly in northern states of India viz Punjab, Haryana and Uttar Pradesh. The sale of zero till drill in India is around 25,000-30,000 per annum in rice-wheat cropping system due to limited time available for sowing of wheat after rice harvesting.

Challenges in Farm Mechanization

Farm Mechanization in India is still in its early stages during the last two decades and is only able to achieve a meagre growth rate of less than 5 %. Even though, higher share of labour (55 %) with lesser contribution to GDP (14 %) with overall mechanization level of 40-45 % makes farming in India less remunerative. The level of mechanization in India is still lower than United State (95 %), Western Europe (95 %), Russia (80 %), Brazil (75 %) and China (57 %) (Renpu, 2014). The average farm power availability in the country is still at a low level as compared to other developing countries like China, Korea and Japan. Unlike other agricultural sectors, farm mechanization sector in India has a far more complex structural composition. It is facing various challenges related to farm machinery and equipment, technology, markets, operations, legislation, policy framework and other related areas. Land size, cropping pattern, market price of crops including Minimum Support Price (MSP), availability of labour and cost of labour are the major factors deciding the agricultural mechanization. These challenges pose a serious impediment to the growth of the industry and agriculture. The key challenges faced by the farm mechanization in India (Mehta and Pajnoo, 2013) are as follows.

1. The average farm size in India is small (1.16 ha) as compared to the European Union (14 ha) and the United States (170 ha). Therefore, there will be little mechanization unless machines appropriate for small holdings are made available. Due to small size of land holding it is difficult for the farmers to own machinery. As a result, the benefits of mechanization are enjoyed by only a section of the farmers who have large farm holdings.

2. Mechanizing small and non-contiguous group of small farms against 'economies of scale' especially for operations like land preparation and harvesting. With continued shrinkage in average farm size more farms will fall into the adverse category thereby making individual ownership of agricultural machinery progressively more uneconomical.

3. The major constraint of increasing agricultural production and productivity is the inadequacy of farm power and machinery with the farmers. The average farm power availability needs to be increased to minimum 2.5 kW/ha to assure timeliness and quality in field operations, undertake heavy field operations like sub-soiling, chiseling, deep ploughing and summer ploughing.

4. Matching equipment for tractors, power tillers and other prime movers are either not available or farmers make inappropriate selection in the absence of proper guidance, resulting in fuel wastage and high cost of production.

5. Almost 90 % of tractors are sold in India with the assistance of some financial institution. Sale of farm machinery is driven by factors like financial support, limit of funding (in terms of percentage of the cost), funding/financing institution and the applicant's profile (deciding the credibility of the loanee).

6. The high cost and energy efficient farm machinery are capital intensive and majority of Indian farmers are not able to acquire these assets due to shortage of capital with them.

7. Cropping pattern decides the extent of mechanization required for timely operations and achieving optimum results. The scope of mecha-

nization increases with intensive cropping pattern. Price realized by the crop is also an important factor, as it indicates the cash in hand for the farmer.

8. Hill agriculture, which covers about 20 % of cultivated land, has little access to mechanization. This situation has to be improved by developing and promoting package of technology for mechanization of hill agriculture to achieve higher productivity.

9. There are wide technology gaps in meeting the needs of various cropping systems and regions. The Indian farmers have limited access to the latest equipment and technology. Further, there is little feedback from the farmers for product improvement and product acceptance.

10. The quality of farm implements and machinery manufactured by small scale industries in the country is generally not of desired standard resulting in poor-quality work, longer down time, low output and high operational cost. The quality of equipment has to be improved.

11. The after sales service of farm machinery is the other concern in India as the majority of farmers are cost conscious. There are inadequate service centers for proper upkeep of the machinery.

Strategy for Mechanization of Indian Agriculture

Agricultural mechanization should contribute to sustainable increase in productivity and cropping intensity so that the planned growth rates in agricultural production are achieved. Mechanization is capital intensive and substantial sums have been invested in our country. In the absence of good planning and direction, investment on mechanization may not yield the expected results. India adopts a policy of selective mechanization under diverse conditions, which makes the agricultural mechanization a challenging task. An appropriate mechanization technology suiting to the needs of the farmers is required to be adopted. This may be achieved by following a few points as mentioned below.

1. The widely fragmented and scattered land holdings in many parts of the country need to be consolidated (virtual or real) to give access for their owners to the benefits of agricultural mechanization.

2. There is a need to have more interaction among the farmers, research and development workers, departments of agriculture and industry to make farm machinery research and development base stronger.

3. To achieve higher production levels, the quality of operations like seedbed preparation, sowing, application of fertilizer, chemicals and irrigation water, weeding, harvesting and threshing will have to be improved by using precision and efficient equipment.

4. The rice transplanting operation can be mechanised by introduction of self-propelled walking type rice transplanters on small and medium land holdings. The riding type rice transplanter may be introduced on large size land holdings on custom hiring basis (Mehta and Pajnoo, 2013).

5. The benefits of agricultural mechanization should be extended to all categories of farmers with due consideration to small and marginal farmers, to all cropping systems including horticultural crops and to all regions of the country especially the rainfed areas.

6. There is a need to innovate custom service or a rental model by institutionalization for high cost farm machinery such as combine harvester, sugarcane harvester, potato combine, paddy transplanter, laser guided land leveller, rotavator etc. and can be adopted by private players or State or Central Organizations in major production hubs.

7. The high capacity rice combines may be introduced to paddy growing areas on custom hiring basis. It will help in timely harvesting and better yield of paddy crop.

8. Medium and large scale farmers may be provided with Govt. subsidies to encourage them to buy and to apply advanced medium and high size machinery such as cotton picker, rice transplanter, sugarcane harvester and combine harvester on their fields (Mehta and Pajnoo, 2013).

9. The farm machinery bank may be established for machines being manufactured elsewhere in the country and supply to users/farmers on custom hiring mode.

10. Provision may be made for special credit support at lower interest rates to rural individuals, venturing into entrepreneurial use of farm machinery through custom hiring (Mehta and Pajnoo, 2013).

11. Manufacturing units that are set-up in areas with lower mechanization needs to be supported by extending tax and duty sops. This would result in easier reach of the equipment to farmers in those areas (Mehta and Pajnoo, 2013).

12. There is a need for quality manufacturing and after sales support for reliability of farm machinery. This may be achieved by streamlining of testing procedure, training of engineers and conducting testing of farm equipment for standardisation and quality control in farm equipment manufacturing.

13. There is a need for strengthening training programmes at various levels and for different categories of people on operation, repair and maintenance of agricultural machinery, tractors, power tillers, rice transplanters, combines etc. and for transfer of technology.

14. The quality of life and work environment of farmers/farm women need to be improved. Their work involves considerable drudgery and discomfort. Proper ergonomic designs of agricultural equipment, incorporating latest safety measures and 'comfort features' should be made available.

Conclusions

The production and productivity in Indian agriculture cannot be enhanced by primitive and traditional practices of farming. The average farm size in India is 1.16 ha and mechanizing small and non-contiguous group of small farms is against 'economies of scale' especially for operations like land preparation and harvesting. With continued shrinkage in average farm size, more farms will fall into the adverse category thereby making individual ownership of agricultural machinery progressively more uneconomical.

The combine share of agricultural workers and draught animals in total farm power availability in India reduced from 60.8 % in 1971-72 to 10.1 % in 2012-13. The average farm power availability needs to be increased from 1.84 to 2.5 kW/ha by 2025 to assure timeliness and quality in field operations. Therefore, India adopts a policy of selective mechanization under diverse conditions, which makes the agricultural mechanization a challenging task.

The widely fragmented and scattered land holdings in many parts of the country need to be consolidated to give access for their owners to the benefits of agricultural mechanization. The small farms can be mechanised by use of improved manual tools and animal drawn farm equipment on individual ownership basis or high capacity farm machinery on custom hiring basis. Medium and large scale farmers may be provided with Govt. subsidies to encourage them to buy and to apply advanced medium and high capacity machinery such as cotton picker, rice transplanter, sugarcane harvester and combine harvester on their fields. The farm machinery bank may be established in low farm power availability region for machines being manufactured elsewhere in the country. There is a need to innovate custom service or a rental model by institutionalization for high cost farm machinery and can be adopted by private players or Governmental organizations in major production hubs. The quality manufacturing and after sales support for farm machinery are also needed for reliability of farm machinery.

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