Farm Power in India

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ABSTRACT

Agriculture modernization in India has happened mostly because of Mechanization of almost all farm activities. States such as Punjab, Haryana, Tamil nadu and Western region of Uttar Pradesh has achieved high levels of land productivity because of the availability of mechanical power and improved equipments. Tractor growth in India in terms of production and sale was increased many folds. During the span of last 53 years, a tractor could be found after every 27 ha cultivated area. The results of the multiple studies confirm that in those States where agricultural mechanization has made good progress, its benefits are being shared by all farmers irrespective of the size of their operational holdings and whether they own tractors and machinery or not. The farm power availability in India has increased from 0.30kW to 2.02 kW from 1960-61 to 2013-2014 respectively.

Over the years there is a major shift of using mechanical and electrical power in farm activities than that of animal power. 92.30% farm power source was from animal sources in 1960-61 period, but in 2013-14 the contribution of animal sources was reduced to about 11.80% and that of mechanical and electrical sources of power increased from 7.70% in 1960-61 to about 88.20% in 2013-14. Over the years the contribution of animal source of power, especially that of draught animals, has been going down drastically. This shows that the additional need of farm power is being met through mechanical and electrical sources. Productivity and unit power availability are directly correlated. It is also evident that farm power input has to be increased further to achieve higher food grains production, the composition of farm power from different sources to be properly balanced to meet of its timely requirements for various farm operations. Mechanization of cultivation of various crops has also shown a study increase over the years as the power availability on the farm increased.

Key words: Animal power, mechanical power, farm power availability, mechanization

INTRODUCTION

Revolutionary increase in agricultural production of India is due to the technological improvements in Indian agriculture since 1965 having brought about. When compared with growth rate of population, the growth rate of food grain production particularly in case of wheat and rice was much higher. The country was facing ship to mouth situation has now become not only self-sufficient but also a net exporter of food grains. India witnessed unprecedented growth in agriculture that helped country to graduate from hunger to self-sufficiency in food grains by increasing the food grain productivity from 0.636 t/ha in year 1965-66 to 2.111 t/ha in 2013-14, resulting for export with surplus (Table 1).

Table 1.Cropping intensity and Power availability to Indian Farmers

Year	Cropping intensity (%)	Food grain Productivity (t/ha)	Power Available (kW/ha)	Power per unit Production (kW/t)	Net sown area per tractor (ha)
1965-66	114.00	0.636	0.32	0.50	2162
1975-76	120.30	0.944	0.48	0.51	487
1985-86	126.80	1.184	0.73	0.62	174
1995-96	130.80	1.499	1.05	0.70	82
2005-06	135.90	1.715	1.49	0.87	45
2010-11	140.50	1.930	1.78	0.92	34
2011-12	141.50	2.079	1.87	0.90	31
2012-13	140.90	2.129	1.94	0.91	29
2013-14	142.00	2.111	202	0.96	27

This growth is because of the agricultural technology during green revolution period, which is well backed-up by agricultural scientists and agricultural engineering, supported by positive Government policy, liberal public funding for agricultural research and development and matchless work of farmers and manufacturers of agricultural machinery. The increased use of purchased inputs in agriculture necessitated to raise their use efficiencies though mechanization of various farm operations. The factors that justify the strengthening of farm mechanization in the country can be numerous. The farm mechanization is dependent mainly upon the size of land holding, sources and availability of farm power. The timeliness of operations has assumed greater significant in obtaining optimal yields from different crops, which has been possible by way of mechanization (Singh, 2007). The quality and precision of the operations are equally significant for realizing higher yields. The various operations such as land leveling, irrigation, sowing and planting, use of fertilizers, plant protection, harvesting and threshing need a high degree of precision to increase the efficiency of the inputs and reduce the farm losses.

The productivity of farms depends largely on the availability and judicious use of farm power by the farmers. Agricultural implements, equipments and machines enable the farmers to employ the power judiciously for production purposes. Availability of adequate farm power is very essential for timely farm operations especially fields under turn system of irrigation for increasing production and productivity and handling the crop produce to reduce losses. With the increase in intensity of cropping the turnaround time is drastically reduced and it is not possible to harvest and thresh the standing crop, on one hand, and prepare seed bed and do timely sowing operations of subsequent crop, on the other hand, in the limited time available, unless adequate farm power and matching implement is available. Similarly for precision farming, increasing area under irrigation, conservation tillage, straw management and diversification in agriculture, more power is required.

The contribution of agricultural mechanization has been well recognized in enhancing the production together with irrigation, biological and chemical inputs of high yielding seed varieties, fertilizers, pesticides and mechanical energy.

Constraints in mechanization of small farms

India is primarily an agricultural country with more than 60 per cent of its population being dependent directly or indirectly on agriculture. The Indian agriculture sector has made considerable progress in the last few decades with its large resources of land, water and sunshine. India produces all major crops to meet the requirement of food, fodder, fiber, fuel and inputs for its agricultural industry. India is presently the world's largest producer of pulses and the second largest producer of rice and wheat in the world. The country is also the second largest producer of sugar, after Brazil. The pivotal agency responsible for the development of the agriculture sector in India is the Department of Agriculture and Cooperation under the Ministry of Agriculture, Government of India.

This nodal organization devises national polices and implements national level programmes aimed at achieving rapid agricultural growth through optimum utilization of land, water, soil and plant resources of the country.

Agriculture is expected to grow at 4.6 per cent. Agriculture production of food grains is expected to break the 2011-12 record of 259 million tonnes (MT). More importantly, agricultural profitability has increased over the last decade with record increase in minimum support prices (MSP) for agricultural produce for all covered crops. MSP increase in the past 10 years, between 2004-05 and 2014-15, varies from about 125 per cent for food grains such as wheat and paddy to over 200 per cent for pulses. India is also set to record the highest ever food grain production. The Government of India revised its estimate, stating that the country would collectively produce 264.28 MT of food grain in 2013-14 as compared to 257.13 MT last year. The increase in production of food grains was possible because of use of quality seeds, higher doses of fertilizer and plant protection chemicals coupled with assured irrigation and improved farm tools and equipment. Enhanced food production in the country is required to feed ever increasing population in the country from same or shrinking land resources. This would demand to increased land productivity through timely performance of farm operations, better management of inputs and natural resources and efficient management of crops. Mechanization of farm operations through proper usage of efficient farm machines in this context could play a very important role. Table 2 illustrates the growth of agricultural development in India. India has 159.20 million hectares of cultivable land owned by more than 137.80 million farmers with average land holding size of 1.16 ha/farmer, 32% of total land is owned by medium to large group of farmers. Medium and large farmers could easily go in for usage of improved agricultural machinery either on ownership or on custom hire basis (CHC). Small farmers find it difficult to adopt mechanization due to their limited resources and contribute to low productivity of land as they depend more on traditional equipment and methods of crop cultivation. 68% of land resources are with semi-medium, small and marginal farmers, they have important role to play in higher agricultural production. Mechanization of agriculture of small farmers could be promoted by extending the benefits of improved agricultural machines to them through custom hire services (CHC) and co-operative movements with governmental efforts and development of entrepreneurs for providing custom services at

affordable rates. The Government of India adopted several initiatives to develop agriculture and there by the Indian economy, has many programmes for this sector's continuous growth. Rashtriya Krishi Vikas Yojana (RKVY); National Food Security Mission (NFSM); National Horticulture Mission (NHM); Gramin Bhandaran Yojana; Integrated Scheme of Oilseeds, Pulses, Oil palm, and Maize (ISOPOM), and lately the Sub-Mission on Agricultural Mechanization (SMAM) etc are some of the important such programs by the government.

Table 2: Growth of agricultural development in India

Pre-Green Revolution Period (before 1965)	**Green Revolution Period (1965 – 1975)**	**Post Green Revolution Period (1975 onwards)**
Farming by traditional methods	HYVs, fertilizer, irrigation, chemical inputs	Use of more scientific methods/ machinery/ implements/ precision agriculture
Farm power availability was about 0.27 kW/ha	Farm power availability was about 0.47 kW/ha	Present farm power availability is about 2.02 kW/ha
Share of animal power sources was 98%	Decreased to 62%	Decreased to 11.8%
Low productivity of food grain (0.58 t/ha)	Productivity increased to 0.95 t/ha	Present productivity about 2.11 t/ha
Enhanced production through increase in cultivated area	Enhanced production/ productivity through adoption of HYVs, fertilizer, irrigation and chemical inputs	Enhanced production/ productivity through adoption of improved farm machines / implements / precision in addition to adoption of other agricultural inputs

POWER SOURCES ON INDIAN FARM

The various sources of power available on the Indian farm for doing various mobile and stationary agricultural operations are mobile power like human (men, women, children), Draught animals (bullocks, buffaloes, camels, horses and ponies, mules and donkeys), tractors, power tillers and self-propelled machines (combines, dozers, reapers, sprayers etc.); and stationary power i.e. diesel/oil engines (for pump sets, threshers, sprayers and other stationary operations) and electric motors (for pump sets, threshers, sprayers and other stationary operations).

Agriculture has been the main occupation of the rural people and largely dependent on use of animal power sources. Human energy is predominantly used for all operations in agriculture. Before green revolution, animal energy had been widely used for various farm operations like primary and secondary tillage, seedbed preparation, sowing, inter-cultivation, harvesting, threshing and transportation to and from the field.

A number of job opportunities in urban areas and the natural drudgery associated with agricultural operations like always working under direct sunlight have set in a trend of rural youths preferring to take up other

profession than agriculture. But in specific situations like hill agriculture, plantations, tea industry etc principal source of energy is human energy. Human power is the only source of energy in specialized operations such as rice transplanting, harvesting of cotton, horticultural and plantation crops etc. Mechanization process in India thus, did not follow the process of creating surplus labour from agricultural sector for consumption in the industrial sector, as had been in the cases of developed countries. Tables 3 and 4 illustrate the population and power of agricultural workers during the period 1960-61 to 2013-14.

Table 3: Farm Power sources in India

Year		1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2011-12	2012-13	2013-14
Population of farm power sources, million	**Agricultural Workers**	131.1	125.7	148.0	185.3	234.1	263.0	266.0	269.2	272.0
	Draft animal power	80.4	82.6	73.4	70.9	60.3	53.50	53.0	52.8	52.0
	Tractors	0.037	0.168	0.531	1.192	2.531	4.207	4.553	4.858	5.237
	Power tillers	0	0.0096	0.016	0.032	0.114	0.321	0.362	0.402	0.440
	Diesel engines	0.23	1.70	2.88	4.80	5.90	8.20	8.30	8.35	8.45
	Electric motors	0.20	1.60	3.35	8.07	13.25	16.50	16.70	16.80	17.00

Table 4: Power available from different sources in India

Year		1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2011-12	2012-13	2013-14
Power available from different power sources, million kW sources, million	**Agricultural Workers**	5.8	6.21	7.46	9.17	10.7	13.15	13.30	13.46	13.60
	Draft animal power	30.6	31.39	27.89	26.94	22.9	20.33	20.14	20.06	19.76
	Tractors	1.00	4.38	13.86	31.11	66.06	109.8	118.2	126.8	136.7
	Power tillers	0	0.054	0.091	0.181	0.642	1.799	2.028	2.252	2.469
	Diesel engines	1.298	9.52	16.13	26.88	34.86	45.92	46.48	46.76	47.32
	Electric motors	0.74	5.92	12.39	29.86	49.03	61.05	61.79	62.16	62.90

While the population of agricultural workers as percentage of rural population has gone down from about 69.4% in 1951 to about 55% in 2012 but in absolute terms, due to increase in overall population, the number of

agricultural workers available in rural areas has increased from 131.1 million in 1960-61 to 272 million in 2013-14 and thereby registered an annual compound growth rate of 1.38% during the last 53 years. These agricultural workers are engaged in different farm operations and depend on agriculture for their livelihood, even when they are not fully employed throughout the year. Due to too much involvement of labour in different farm operations, the cost of production of most of the crops in our country is quite high as compared to developed countries. Human power availability for agriculture had been 0.043 kW/ha in 1960-61 and reached to 0.096 kW/ha in 2013-14 registered an annual compound growth rate of 1.53% during the previous 53 years of time, Fig. 1. Share of agricultural workers in total power availability in1960-61 was 14.7% reduced to 4.66% in 2013- 14 (Fig. 2). Time series trend suggests that share of power from agricultural workers to total power available will further reduced in near future.

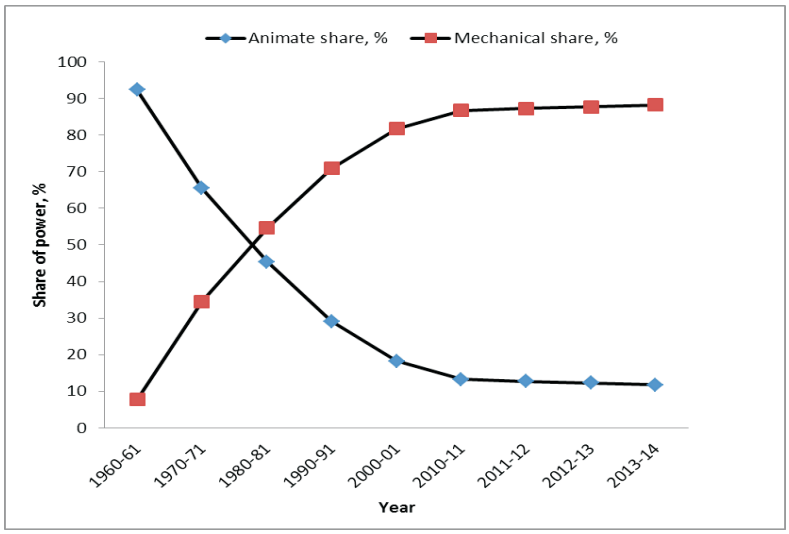

Fig. 1: Animate and mechanical power scenario in Indian agriculture

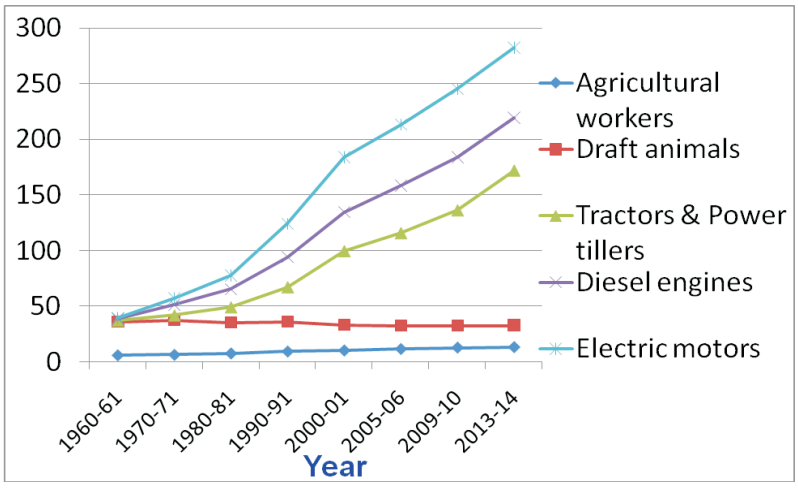

Fig. 2: Power available from different power sources on Indian farms

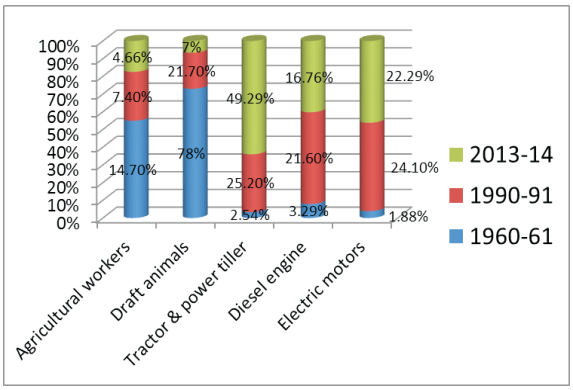

Fig. 3: Share of different power sources in total power availability

Draught animal power, available mainly as progenies of milch animals, has long remained an important source of tractive energy for production agriculture, rural agro-processing and transport in India and other developing countries of Asia, Africa and Latin America. Traditional agriculture in India largely depended upon this power source for farm operations like tillage, sowing, weeding, water lifting, threshing (by animal trampling), oil extraction, sugarcane crushing and transport.

With modernization of agriculture production systems and use of mechanical power sources, draught animal use has drastically reduced in power intensive operations as water lifting, oil extraction and threshing. The choice of farm power to be used for an operation is largely decided by the available time period, alternatives available (including custom hiring services) and associated economics. In sloppy hill region sand on small farms machines like tractor or combine are difficult to operate and thus power source. Increased cost of maintenance of animals has also brought in compulsions among the farmers to reduce draught animal ownership as far as practicable. Apart from the economic importance, livestock still continues to have symbiotic bond with rural people.

Draught animals, particularly bullocks, are still the predominant source of mobile power on about 60% of the cultivated area consisting of about 85 million ha. They are very versatile and dependable source of power and are used in sun and rain under muddy and rough field conditions. They are born and reared in the village system and maintained on the feed and fodder available locally. They are ideal for rural transport where proper roads are not available.

They reduce dependence on mechanical sources of power and save scarce petroleum products. Their dung and urine are also used as indirect source of energy-farmyard manure, biogas. They also help in maintaining ecological balance. Draught animals as by-product of milch animals; will continue to be available for draught purposes in future also. About 40-50 years back most of the farm operations, water lifting, rural transport, oil extraction, sugarcane crushing, chaff cutting etc, were being done using draught animals only. But with the modernization of agriculture, development of concrete roads connecting village and availability of electricity in villages, most of the jobs earlier being done using draught animals, except field operations, are now being done using other convenient and cheaper options i.e. electricity and diesel. Over the years the annual use of draught animals is going down. While earlier a pair of animals was being used for about 1200-1800 hours annually, their average annual use has

now come down to about 300-500 hour only, that too for tillage, sowing, weeding and rural transport. Table 3, which shows that the population of draught animals during the last 40 years has been going down. This declining trend of draught power was more visible especially in those states where the demand of tractors and power tillers has gone high. It has been observed that on an average a tractor is replacing about 5 pairs and power tiller about 2 pairs of animals. Draught animal population, mainly derived from bovines, was 80.40 million in 1960-61 and reduced to 52 million by 2013-14 with a negative annual compound growth rate of -0.82% during the period of 53 years. Share of draught animal power was 78% of the total farm power in 1960-61 reduced to 7% only in 2013-14.

Draught animal power availability in India decreased from 0.229 to 0.224 kW/ha between 1960 and 1970. The power availability further reduced to 0.200 kW/ ha in 1980, 0.162 kW/ha in 2000 and 0.14 kW/ha by 2013-14. For meeting the increased demand of mobile power for timely farm operations and increased intensity of cropping (Table 1), additional power is available mainly from tractors and power tillers. Self-propelled reapers and combines also provide mobile power specially for harvesting operations. India presently is the largest manufacturer of tractor in the world. There are more than 23 manufacturers of tractors in the country producing about 65 models of tractors in different hp ranges. Tractor population in India has grown from 0.037 million in 1960-61 to 5.237 million units in the year 2013-14 at an annual compound growth rate of about 10 per cent during the last 53 years. Farm power availability from tractor has consequently increased from 0.007 kW/ha in 1960 to 0.218 kW/ha in 1990 at an annual compound growth rate of 12.14%. The growth rate in the next decade decreased to 8%. Farm power availability in the year 2000 was 0.47 kW/ha, reaching to 0.97 kW/ha in 2013-14 at an overall growth rate of 9.80% during the last 53 years. Power tiller, or two-wheel tractor, came in India with import of two units from Japan in 1961.There are mainly 2 manufacturers of power tillers in the country producing about 6 models in the range of 5.97-8.95 kW (8-12 hp). In addition to them there are many others who are importing power tillers and selling in the country. Contribution of tractors and power tillers was only 2.54% of the total farm power in 1960-61 increased to about 50% in 2013-14. Sale of tractors and power tillers has constantly increased during last 10 years with some exceptions. Stationary power sources in agriculture comprise of diesel engines and electric motors used for irrigation equipment, operating threshers and other stationary machines. Diesel engine and electric motor are widely used by the farmers mainly for lifting irrigation water, apart from operating stationary farm machines like threshers and chaff cutters. The populations of these prime movers have increased tremendously since the green revolution. Diesel engine population in the country increased about 37 times between 1960-61 and 2013-14, while the annual compound growth rate had been 10.66% during the period 1960-61 to 1990-91, with increased availability of electricity it reduced to 7.04% during the period of 1990-91 to 2013-14.

Farm power from diesel engines increased from 0.009 kW/ha in 1960-61 to 0.247 kW/ha in 2000-01 and 0.335 kW/ha in 2013-14, registered an annual compound growth rate of about 7% during the last 53 years. The rural electrification programme launched by the Government of India in the mid-sixties undertaken through the Rural Electrification Corporation has helped in making available electricity to 18.5 per cent villages in 1970-71 and increased to 100% villages by 2004-05. Preferential supply to rural sector at subsidized price has led to rapid increase in use of electric motors in the agricultural sector. Electric motor population thus increased 85 times

between 1960-61 and 2013-14 at an impressive annual compound growth rate of 8.7%. Farm power availability consequently increased exponentially from 0.005 kW/ha to 0.445 kW/ha with an annual compound growth rate of about 8.74% during the same period. For adoption of higher level of technology to perform complex operations within time constraints and with comfort and dignity to the operators, mechanical power becomes essential. Thus, the extent of use of mechanical power serves as an indicator of acceptance of higher level of technology on farms. Over the years the shift has been towards the use of mechanical and electrical sources of power, while in 1960-61 about 92.30% farm power was coming from animal sources. In 2013-14 the contribution of animal sources of power reduced to about 11.80% and that of mechanical and electrical sources of power increased from 7.70% in 1960-61 to about power availability. It was 114% with power availability of 0.32 kW/ha during 1965-66 that increased to about 141 per cent with increase in power availability of 2.02 kW/ha in 2013-14. Net sown area per tractor shows the reverse trend during the same period, which observed 2162 ha/tractor in 1965-66 reduced to 27 ha/tractor in 2013-14. Between 1960-61 and 2013-14, the growth rate in power was 3.81% to reach 2.02 kW/ha.

CONCLUSIONS

The source of farm power includes human, animal, tractors, power tillers, diesel engine and electric motor. Knowledge and information about the availability and quantity of these power sources is very essential in planning and prediction of farm mechanization as this directly and indirectly provides vast potential for manufacturers, entrepreneurs, sales and repair etc. In India the availability of farm power has increased from about 0.30 kW/ha in 1960-61 to about 2.02 kW/ha in 2013-14. Last five decades has seen the shift of Farm Power towards the use of mechanical and electrical sources of power. The contribution of animal sources of power is reduced to about 11.80% from 92.30% from 1960-61 to 2013-14 and that of mechanical and electrical sources of power increased to about 88.20%. Food grains productivity is positively correlated with unit power availability. More mechanical power sources coupled with matching farm machineries and equipments will definitely prove that the additional requirement of food grains in future will be met easily.

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