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Unveiling Role of Agricultural Mechanization in Improving Production and Yield

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ABSTRACT: India is the 2nd biggest country in the world on the parameter of population and more than 50% of population engaged in agricultural practices. Agricultural mechanisation entails the use of farm equipment & implements and power sources in order to reduce draft animal and human labour, enhance cropping intensity, precision, and timeliness of crop input utilisation, and diminish damages at various phases of crop production. Thus the ultimate goal of mechanization's is to increase overall productivity and production at the lowest possible cost and without amplifies the human inconvenience. The Green Revolution in India is considered as one of the greatest attainment of the 20th century in promoting agricultural mechanisation in enhancing production. The main objective of this paper is to identify the influence of agriculture mechanization in India majorly after green revolution. A huge boost in farm power availability, food production, and economics has resulted from agricultural mechanisation. Farm power availability is expected to reach 4.0 kW/ha in 2022 from 0.25 kW/ha in 1951. Crop production also increases up to a new record of 784.63 million tonnes in 2020-21 from 170.21 million tonnes in 1950-51. Apart from this tractor and power miller sales increased by 3.65 and 2.17 times, respectively, in 2019-20 compared to 2004-05. Nevertheless, there is need to enhance the knowledge of cultivars and build Farm Machinery Training & Testing Institutes and Custom Hiring Service Centres (CHC) in remote areas.

Keywords: Mechanization, Farm power availability, Productivity, Power tiller.

INTRODUCTION

The 2nd biggest populace within side the world is of India, that is characterised via way of means often in depth variety in climate, flora, fauna, land use, socioeconomic conditions, and topography (Hinz *et al.*, 2020). India occupies 2.4% of the world's terrestrial area and 4% of water, on the other hand it needs to sustain 17% of the biosphere's population and 15% of livestock (Anonymous, 2021b). "As per the Land Use Statistics 2016-17, the country's overall topographical area with a reported net sown area is 328.7 million hectares and 139.4 million hectares, respectively.200.2 million hectares is the gross cropped area of India with 143.6% cropping intensity. In the overall geographical area there is 42.4% sown net area and the net irrigated land is 68.6 million hectares" (Anonymous, 2021a). 54.6% of the entire personnel of Indian economic system is enrolled in agricultural and allied sector activities and debts for 17.8% in 2019-20 of the India's Gross Value Added (GVA). Given the significance of the agriculture region, Government of India has taken many initiatives for its improvement in a sustainable way (Anonymous, 2021a). There are lots of initiative taken by the GOI to promote agriculture and farm mechanization like Rashtriya Krishi Vikas Yojana (RKVY), Mission for Integrated Development of Horticulture(MIDH), National Food Security Mission (NFSM), National Horticulture Mission (NHM), Gramin Bhandaran Yojana (GBY), Sub-mission on Agricultural Mechanization (Anonymous, 2021a; NABARD, 2018; Mehta *et al*., 2019).

Mechanization at the system level is one of the most important aspects required to reform agriculture. The whole world has made significant progress in field preparation by using tractors with matching implements for ploughing and puddling. The green revolution in India began in the mid-1960s resulted in a surge in labour demand and showed notable growth in agronomy of India. It led to increased seasonal and permanent migration, primarily from Eastern India and the initiation of the use of tractors and threshers (Binswanger, 1986; Gupta *et al.*, 2017). Agriculture Mechanization has a vital involvement to modern agriculture to increase production and productivity of fertilizers, seeds, chemicals & pesticides and natural resources like soil nutrients, water, etc. besides reducing human chore and the price of cultivation. It also helps in developing the welfare and ease of the agricultural cultivators (Anonymous, 2021a). Mechanization improves labour efficiency and increases farm output per worker. The most significant effect of mechanisation has been a massive improvement in productivity per farm worker, overall production and production per hectare have increased significantly. The assessment research of India revealed that the mechanization has inclusively optimistic influence on cultivation as it upsurges the productivity

by17.9% and seed germination by 14.1%. Likewise, it helped in preserving about 33.33 % of operations time, reduction of labour requirements by 30%, drop in seed rate by 11%. Similarly, it reduces weed instances, diesel intake, and fertilizer necessity by 26.6, 22.4 and 12.7%, respectively (Press information bureau, 2021a). However, total number of worked hours and the number of farmers and farm employees has decreased dramatically. In 2010, the portion of metropolitan people was 30%, it was predicted that in 2030 this will increase approximately by 40% and in 2045 by 50%. The percent-age of agricultural workers to total workers decreased from 59.1% in 1991 to 54.6% in 2011 and is reported to be 41.49% in 2020 of which 45% is women workers. It has been estimated that this will continue to decrease in upcoming years (Agarwal *et al*., 2017; Hinz *et al*., 2020; Press information bureau, 2020; Trading economics, 2021).

Modern agricultural technologies or farm mechanization is likely more profitable on larger farms (Foster *et al.*, 2017], whereas about 85 % of the overall terrestrial area in India are in marginal and small size groups which require special attention for mechanization (Anonymous, 2021a). Hence, the speed of agricultural mechanization needs to be accelerated through the establishment of the new Farm Machinery Training & Testing Institutes for remote areas (Anonymous, 2017). This study reviews the effect of agriculture mechanization on trend of production of crop, farm power availability in order to lessen the cost of agronomic production, increase productivity and profit in order to double the income of farmers by the end of the year 2022.

Impact of Farm Equipment on Agricultural Mechanization: Agricultural Mechanization refers to the development and deployment of machines that can replace human and animal power in agricultural activities. Agricultural mechanization in the twentieth century changes the way of farming. Machines likes tractors, harvesters, combines etc., have allowed farmers to raise their production along with reducing their need on a large workforce. Agricultural mechanisation, in other terms, is the practice of utilizing equipment, machinery, and tools to increase agricultural yield (Verma, 2006). In 1914 Tractors were first familiarized by the British government in India for recovering land and clearing bush and shrub plots. In India, the tractor industry has grown particularly rapidly in the last 50 years, specifically subsequently in the early 1990s, when Indian industrial sectors became liberalized (Bhattarai *et al*., 2018). At present, mechanisation is being adopted by Indian farmers at a higher rate than in the past. Although tractor sales in India are not the only indicator of farm mechanisation, but they do reflect it to a large extent. The Indian tractor industry has grown to become one of the world's largest industries which accounting for around one-third of worldwide tractor manufacturing (NABARD, 2018). In 1961, the manufacturing of power tillers started. The power tillers are accessible for upland and wetland cultivating conditions. The stroll behind power tillers are machines which can perform a large portion of the work which tractors can perform with low power limits and generally models planned are of two wheelers in particular, this make it of minimal expense. Power tiller can maneuver rotary, puddler, leveler, trailers, plow disc, thresher, water pumps, etc. It's very small tilling breadth make it more beneficial to work in between rows of the crops.

Power tiller introduction happens together with that of agricultural tractors nevertheless, tractors gained large market place as are more efficient for providing more contented work environment to the cultivators and appropriate upland work (Nikhade *et al.*, 2020). Power tiller and tractor played a significant contribution in increasing the gross cropped area. When the green revolution started the number of tractors increases, in 1960, there was 37,000 tractors in India, which led to 5,811,000 in 2012/13. Apart from this number of power tiller has also been elevated from 9,600 in 1970 to 321,700 in 2012/13 (Bhattarai *et al*., 2018). Presently, India is the world's largest tractor market, buying > 90 % of the 660,000 tractors it produces per year. The annual market size of tractors sold in India is more than US$5 billion per year (Bhattarai *et al*., 2018; Tractor and Mechanization Association, 2015). The sale of tractors in India was only 3,877 units in 1961-62 and reached to all time high of 785,059 units (202 times) in 2019-20 (Senthilkumar *et al*., 2017). Apart, power tiller sales reaches to 46,476 units in 2019-20 (Anonymous, 2021a) (Table 1).

There are many more equipment which have been stared to be used in India such as tractor operated diesel harrow, tractor operated cultivator and rotavator, straw reaper, potato digger and horticultural tools (power operated), manual seed drill/seed cum fertilizer drill, manually operated plant protection equipment, tractor drawn seed cum fertilizer drill, tractor operated levellers, animal drawn seed cum fertilizer drill, animal drawn leveller, power operated plant protection equipment, drip and sprinkler equipment (NABARD, 2018).

Table 1: Sale of Tractor and Power tiller (2004-2020).

Year	Tractor Sales	Power Tiller Sales
2004-05	2,47,531	17,481
2005-06	2,96,080	22,303
2006-07	3,52,835	24,791
2007-08	3,46,501	26,135
2008-09	3,42,836	35,294
2009-10	3,93,836	38,794
2010-11	5,45,109	55,100
2011-12	5,35,210	60,000
2012-13	5,90,672	47,000
2013-14	6,96,828	56,000
2014-15	5,51,463	46,000
2015-16	6,26,839	48,882
2016-17	5,80,000	45,200
2017-18	7,96,873	51,680
2018-19	8,97,548	51,523
2019-20	7,85,059	46,476

Impact of Agriculture mechanization: The impact of agriculture mechanization on various parameters is discussed in the following section.

On Farm Power Availability: Animate (draft and humans) and inanimate sources (diesel engines), tractors, and electric motors are the primary source of

farm power (Senthilkumar *et al*., 2017). Farm power availability in kW/ha is "No. of agricultural Worker × 0.05 + Number of draught animal × 0.38 + No. of Tractors × 26.1+ Number of Power tillers × 5.6 + No. of electric motor × 3.7 + Number of diesel engine × 5.6) ÷ Available cultivated land in ha" (Anonymous, 2021b). Indian farms have a variety of assets of power available on the Indian farm for performing various mobile and stationary processes are mobile power *viz*. human (male, female, children), draft animals as buffaloes, bullocks, camels, donkeys, horses, mules and ponies; tractors, power tillers and self-propelled machines like combines, dozers, reapers, sprayers etc.; and stationary power viz. diesel/oil engines and electric motors. The productiveness of farms substantially relies upon the availability and appropriate use of agricultural energy by the farmers. Agricultural machines and implements allow the farmers to appoint the energy prudently for manufacturing purposes (Verma, 2006). As an analytic measurement there is the inclination in the farm power availability in kilowatt or horsepower per hectare (Table 2 and Fig. 1).

Table 2: Farm Power Availability (1951-2022).

Year	Farm Power Availability (kW/ha)
1951	0.25
1961	0.31
1971	0.35
1981	0.63
1991	0.92
2001	1.35
2010	1.66
2014	1.84
2017	2.02
2022 (estimate)	4.00

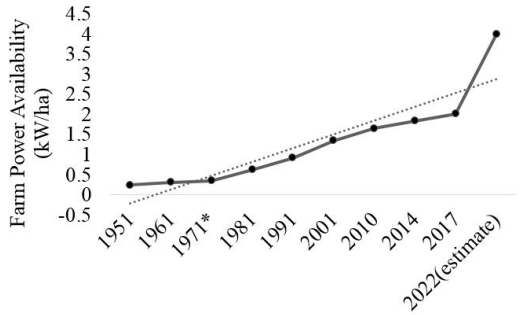

Fig. 1. Trend of Farm Power Availability (kW/ha)
*Commencement years of Green revolution in India.

Average availability of farm power for the agronomical ranges of India is improved from 1951 to 2016-17 by 0.25 kW/ha-2.02 kW/ha which has been projected to rise up to 4.00 kW/ha in 2022 which is 16 times (Department of agriculture & farmer's welfare, Gulati, *et al.,* 2020).

On Food Production and Yield: Farm mechanisation not only maximises the use of resources such as land, labour, and water, but it also saves time and lowers drudgery for farmers. This efficient use of time, labour, and resources allows multicropping and timely crop planting, resulting to increase the yield. The production of food grain has increased substantially after mechanization starts in India. Record food grain productivity has been being estimated in 2021 with 303.34 million tonnes, followed by rice 120.32 million tonnes and wheat 109.24 million tonnes. Apart from that maize with 30.16 million tonnes, gram with 11.62 million tonnes, groundnut with 10.15 million tonnes and rapeseed & mustard with 10.43 million tonnes tend to have record estimated production in 2020-21 (Press information bureau 2021b). It was witnessed that tractor farms are believed to have higher rice, wheat and sugarcane yields and higher total yields per hectare compared to farms without a tractor (Senthilkumar *et al.*, 2017). From 1950 to 2021 the crop production and yield showed significant increases. There is 14.1% increase in the productivity of seed germination and 17.9% appraisal in cultivation productivity by 17.9% (Press information bureau 2021a). The food grain production has been predictable increase by 83.24%, and yield by 77.54% since 1950-2020. Sugar cane rises from 57.05 million tonnes to 397.66 million tonnes and its yield raises to 778.93 from 334.22 Quintal/ hectare. More detail given in Table 3 and Fig. 2, 3, 4.

Thus, the efficient use of farm machinery can help to increase productivity and yield, conduct agricultural operations in a timely manner, and allow farmers to quickly rotate crops on the same plot of land. By planting second season crops or multiple crops on the same land, planting intensity can be increased and agricultural land can become more commercially viable. Mechanization also helps in dairy, and fishing industries (NABARD, 2018).

Table 3: Crop production in India from 1950-21 (Million Tonnes).

Year	Food grains	Rice	Wheat	Nutri Cereals	Pulses	Oilseeds	Sugarcane	Cotton	Jute & Mesta
1950-51	50.82	20.58	6.46	15.38	8.41	5.16	57.05	3.04	3.31
1960-61	82.02	34.58	11.00	23.74	12.7	6.98	110.00	5.60	5.26
1970-71	108.42	42.22	23.83	30.55	11.82	9.63	126.37	4.76	6.19
1980-81	129.59	53.63	36.31	29.02	10.63	9.37	154.25	7.01	8.16
1990-91	176.39	74.29	55.14	32.70	14.26	18.61	241.05	9.84	9.23
2000-01	196.81	84.98	69.68	31.08	11.08	18.44	295.96	9.52	10.56
2010-11	244.49	95.98	86.87	43.40	18.24	32.48	342.38	33.00	10.62
2011-12	259.29	105.30	94.88	42.01	17.09	29.80	361.04	35.20	11.40
2012-13	257.13	105.23	93.51	40.04	18.34	30.94	341.20	34.22	10.93
2013-14	265.04	106.65	95.85	43.29	19.25	32.75	352.14	35.90	11.68
2014-15	252.02	105.48	86.53	42.86	17.15	27.51	362.33	34.80	11.13
2015-16	251.57	104.41	92.29	38.52	16.35	25.25	348.45	30.01	10.52
2016-17	275.68	110.15	92.29	44.19	22.95	32.10	306.72	33.09	10.52
2017- 18	285.00	112.80	99.90	47.00	25.4	31.50	379.90	32.80	10.00
2018- 19	285.20	116.50	103.6	43.10	22.1	31.50	405.40	28.00	9.80
2019- 20	296.60	118.40	107.6	47.50	23.2	33.40	355.70	35.50	9.90
2020-21 (estimate)	303.34	120.32	109.24	49.36	24.42	37.31	397.66	36.54	9.78

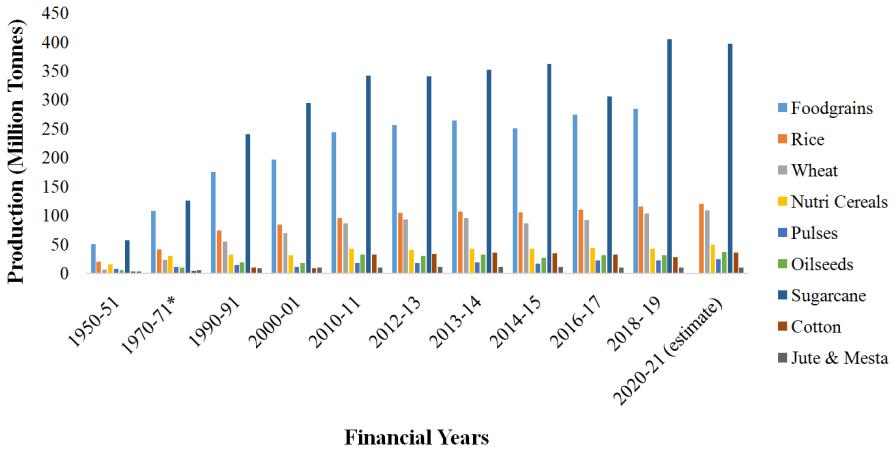

Fig. 2. Crop production trend from 1950-2021 *Commencement years of Green revolution in India.

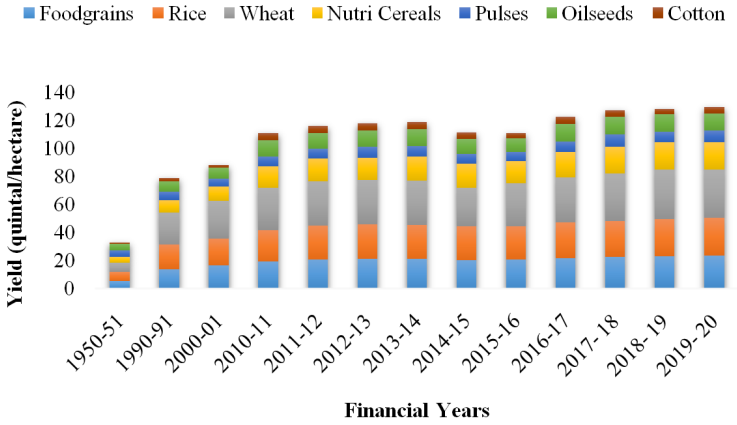

Fig. 3. Crop yield statistics from 1950-2020.

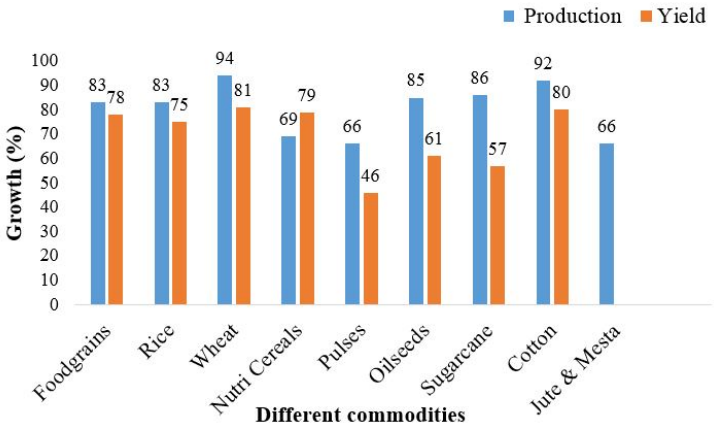

Fig. 4. Percent growth in production and yield of different commodities from 1950-2021.

CONCLUSION AND FUTURE SCOPE

To sum up, farm mechanisation enhanced agricultural production and profitability by increasing the speed with which tasks were completed, the quality of the job performed, and the efficient use of crop inputs. Farm mechanisation, without a doubt, displaced animal power by 60 to 100%. As a result of the manufacture, maintenance, servicing, and sales of tractors, mechanisation increased human labour employment for on-farm and off-farm activities, and improved productivity Agricultural mechanization led India towards, growth of food production, food power availability and has a remarkable impact on Indian Economy. It leads towards quality and quantity of agricultural production and productivity. Various equipment and methods has been introduced to enhance the yield. Numerous employments are provided in several agricultural industries such as management and supervisory employments on the one hand and driving, servicing, repairing of the machines on the other. Many farmers received subsidy without much struggle. Although, the agricultural mechanization practices have been increased in India from last few decades nevertheless it is still behind some countries like the U.S., Brazil, China etc. In India, there are some remote areas where still have negligible mechanization and it

leads to demotivate the youth and becomes the cause of their migration towards urban areas. Training institute and programmes should be arranged in remote areas so that people will learn the science behind agriculture. It should include equipment handling and demonstration, pedological aspects, crop behaviour towards pesticides, fertilizers, increasing income and decrease environmental degradation. Customized equipment should be manufactured for different gender and purposes. Custom Hiring Service Centres (CHC) should be implemented in every state and their district according to their farm area and population.

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Conflict of Interest. None.

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