

An effect of farm mechanization on Indian agriculture with respect to rice yield.

Un efecto de la mecanización agrícola en la agricultura india con respecto a la
producción de arroz

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ABSTRACT

The state of Indian agriculture has progressed a lot since the beginning of green revolution which led to the use of present day modern agricultural farm machineries and equipment's. Along with this the supplier of the various inputs for several agricultural process has also seen a rising trend for the past decades. As a result, it has increased the production and productivity of agricultural crops to a great extent. This research paper has tried to find out the relationship and effect of the use of agricultural machinery which includes tractors and other farm equipment on rice productivity. For this purpose, it has used time series data and a simple regression model. The paper concludes by a policy recommendation and formulation of a technique or method to provide farm machinery by applying the principle of PDS system in India to tractor distribution system to those farmers who cannot afford it due to lack of money.

Keywords: Farm Mechanization, Indian Agriculture, Rice Production, Tractorisation, Tractor Distribution

RESUMEN

El estado de la agricultura india ha progresado mucho desde el comienzo de la revolución verde que condujo al uso de maquinarias y equipos agrícolas modernos de hoy en día. Junto con esto, el proveedor de los diversos insumos para varios procesos agrícolas también ha visto una tendencia al alza en las últimas décadas. Como resultado, ha aumentado en gran medida la producción y la productividad de los cultivos agrícolas. Este trabajo de investigación ha tratado de averiguar la relación y el efecto del uso de maquinaria agrícola que incluye tractores y otros equipos agrícolas en la productividad del arroz. Para ello, ha utilizado datos de series temporales y un modelo de regresión simple. El documento concluye con una recomendación de política y la formulación de una técnica o método para proporcionar maquinaria agrícola mediante la aplicación del principio del sistema PDS en India al

sistema de distribución de tractores para aquellos agricultores que no pueden permitírselo debido a la falta de dinero.

Palabras clave: Mecanización agrícola, agricultura india, producción de arroz, tractorización, distribución de tractores

INTRODUCTION

According to Das (2012) it is very much necessary to figure out the challenges at the present time and to meet the expectations and aspirations from agriculture to formulate and implement the long-term strategies for agricultural mechanization till 2020. The study further points out there would be 1.8% annual growth rate in population and it would increase up to 230.81 million till 2020. In order to feed such a large population and to become self-sufficient, the food grain has to be increased 70 million tonnes annually. To achieve this target this will require productivity level to be increased from 21.57 q/ha to 35.00 q/ha by 2020 and the same amount of quantity has to be increased in all other crops and items. "India is the world's biggest producer of milk, heartbeats and jute, and positions as the second biggest maker of rice, wheat, sugarcane, groundnut, vegetables, products of the soil. It is likewise one of the main makers of flavours, fish, poultry, animals and ranch crops. Worth \$ 2.1 trillion, India is the world's third biggest economy after the US and China. India's monetary development in monetary year 2018 is relied upon to quicken to 6.75 percent in 2018 on improved execution in both industry and administrations. India is the world's 6th biggest economy by ostensible GDP and the third-biggest by buying power equality (PPP). The nation positions 139th in per capita GDP (ostensible) with \$2,134 and 122nd in per capita GDP (PPP) with \$7,783 starting at 2018 (World Bank information). Agribusiness represented 23% of GDP, and utilized 59% of the nation's absolute labour force in 2016.[146] Agriculture, with its associated areas, is the biggest wellspring of vocations in India. 70% of its country families actually rely basically upon horticulture for their job, with 82 percent of ranchers being little and minimal. In 2017-18, absolute food grain creation was assessed at 275 million tons (MT). India is the biggest maker (25% of worldwide creation), shopper (27% of world utilization) and shipper (14%) of heartbeats on the planet. India's yearly milk creation was 165 MT (2017-18), making India the biggest maker of milk, jute and beats, and with world's second-biggest steers populace 190 million in 2012.[153] It is the second-biggest maker of rice, wheat, sugarcane, cotton and groundnuts, just as the second-biggest leafy foods maker, representing 10.9% and 8.6% of the world leafy foods creation, separately". The significance of Indian agribusiness and its creation and profitability can be acknowledged by the way that it needs to take care of 135.26 crore (2018) individuals consistently and populace development pace of India is 1.0 % in 2018. The commitment of agrarian area in the economy. is that it utilizes half of the Indian labour force and contributes 17-18% in GDP (Food and Agriculture Organization of the United Nations). Agriculture as the backbone of Indian economy has been heard by most of us most of the time because of its important role in developing the economy. There is a huge potential for the growth of Indian food industry because of its increasing contribution to world food trade especially with the increasing food industry. The food and grocery market of India is the world's sixth largest market in the world and it contributes to 70% of the total sale. It also

contributes 32% in the whole country in terms of food market. It holds fifth 5th rank for production, consumption and export of food processed market. The agricultural food grain production in the year 2018-19 was recorded 283.37 million tonnes. The government also aimed to raise this quantity to 291.1 million tonnes in the next year. India ranks second in terms of fruit produce in the world and horticulture production in the year 2018-19 was estimated 313.9 million metric tonnes. Agricultural export also increased to 38.54 billion US\$ in FY19. Along with this there is also huge scope for the use and growth of modern farm machineries and equipment's which can lead to higher growth and productivity in the Indian agricultural sector. In India tractor constitute the major portion among the tools used in agricultural activities in almost all the states of the country which and its share consist of 10-15% of the total farm equipment market and it has 7% global market share in which 80 contribution is made by tractor. The main players involved in manufacturing tractors are Eicher Motors, Gujarat Tractors, TAFE Ltd. Escorts Tractors Ltd, Mahindra & Mahindra. Till now India haven't become self-sufficient in tractor production and still imports from countries like USA, U.K, Germany, France, Belarus etc. India is a country where the majority of farmers are marginal and small farmers which require small farm machines which can be easily used in small area of land. There are many industries which manufactures mini tractors which can be easily used by small farmers. These industries are Mahindra, Swaraj, Sonalika, Eicher, Massey Ferguson etc. In order to sow seeds farmers can use seed drillers which are provided by companies such as John Deere SD 1013, Khedut seed drill 13, Land force seed cum SDD13, Mahindra seed drillSDCT11, Vishwakarma seed drill VSD13 etc.

In spite of the above statistics provided about the agricultural achievements regarding production of food grains and exports of these agricultural products the Indian agriculture is not free from problems. Although India became food self-sufficient country after green revolution the recent developments has shown and projected decline in food grains in the coming future. The CRISIL Agency has projected a of decline in India's kharif food grain production in 2019 a record high of three consecutive years According to an article published in Times of India population of India will increase to 1.5 billion by 2030 and to 1.66 billion in 2050. In order to order to feed such a large population food production should also increase simultaneously. There is a great need to increase the agricultural production and productivity to match up with the increasing population of the country in order to feed each and every mouth of the country. This can be possible with the utilization and implementation of heavy mechanization and modernization of the agriculture sector of the country.

LITERATURE REVIEWS

Goyal et al (2014) conducted a study in the state of Punjab, Haryana and Western Uttar Pradesh to assess the impact of mechanization on agricultural productivity. The study revealed that there was an increase in the level of productivity when mechanical power, improved tools and equipment was available. Gajri et al (2002) found an increase agricultural productivity due to increase in crop cultivation area which was possible because of the precision achieved with agronomical operations as a result of farm mechanization. The green revolution was successful in India

because of the adoption of tractorization. The research further points out that there was a reduction in the cost of cultivating crops, labour needs and drudgery as a result increased the savings of the farmers, and also led to the increase in cropping intensity (Bector et al, 2008). Verma (2005) found the yield of those farms which adopted tractors was more than the farms which didn't adopted tractors in crops such as sugarcane and potato. Mechanization is much needed in order to modernize agriculture (Vasta, 2013). The region of Eastern Uttar Pradesh has seen an increase in the adoption and use of tractors in the past 10 years and power tiller use was also gaining importance (Singh 200a; 200b; Singh 2004). (Mandal; Maity; Sarkar 2013) found that more than 60,000 tractors and power tillers was sold on an average annually in the state of Uttar Pradesh. Nair (2002) conducted a study in the state of Uttar Pradesh. The study found that the implements used by farmers such as custom hiring of tractors, threshers, and other power machines is gaining importance. Nagaraj et al (2013) conducted a research in Tungabhadra project region in the state of Karnataka to find out the knowledge and the adoption level of farm mechanization of the farmers who grew paddy in the Raichur district. The research included 120 samples from 6 villages in the Sindhanur and Manvi taluks of the district. The study revealed that about (45.00%) almost half of the sample had overall knowledge of the mechanization process. About (42.50%) of the sample belonged to the medium level group of adoption. Only about 15% of the framers who cultivated paddy had the skill to operate the transplanters. High majority of farmers had the knowledge of implements such as cage wheel, sprayers, power tillers, mouldboard plough, puddler, harrow, and cultivator and their use. Surendra Singh (2008) outlined the status of farm mechanization in India. The study reported that bullocks, horses and other drought animals along with human labour and machine power were the main constituent in the farming process. The research further mentions the farmers were forced to implement and mechanize their farms due to the shortage of labour and growing smaller land holdings leading to the rise of multinational agricultural implement companies into Indian market. The study also predicted 5%compound rate of increase in the agricultural equipment market from 2006 to 2011 which could increase up to 8 billion. Chin Sango (2007) conducted a study in Bundra district in Mashonaland in the central province on the sustainable agriculture and food security with the help of farm mechanization. The research revealed that the programme was very much influenced with the land policy which was prevalent and the available technical efficiency in agricultural activity. According to the study the most crucial factors which positively determined the use of tractors were household size, access to extension services and crop production. The factors which negatively affected the use of machineries in agriculture were education, land area cultivated and stoniness. On an average there was a difference of 64% of technical efficiency between the adopter and non-adopter of machines. Pankaj Kumar et al (2011) conducted a study in the Punjab district of Jalandhar. The research revealed how paddy was transplanted with the help of machines by the cooperative societies. His research reported that the total area of land about 170 acres was transplanted with the help of machines during 2009 and 2010 which increased up to 365 acres. There was total number of 14 transplanter which was purchased by the cooperative societies. The research further mentions that the main reasons why farmers were not willing to adopt these transplanters was due to its high purchasing cost and technical knowledge required for operating the machines. Dash et al (2004) in his study in the Karnal district of

Haryana found about various farm equipment used in agriculture. These were tractors below 26.12 kw (35 hp), electric motors below 3.73 (kw), and diesel engines above 5.6kw (7.5 hp) were mainly used. The different agricultural activities in which tractors were used included 58% for own work, 42% for custom hiring, 41.91% for seedbed preparation, 26.14% for transplantation and 20.25% for threshing. Only 427 hours on an average tractor were used annually. Alam (2001) conducted a study in 88 villages and zillas in the state of U.P. The research revealed that 60% of the total cropped area was cultivated with help of machine power. This was done for all the crops cultivated. The farmers who had small size land holdings mostly preferred the use of machine power for cultivating crops. The study further shows a decreasing trend in use of animal power because of less availability and 46% of the famers had no drought animal. Chaudhary et al (2005) suggested that self-propelled rice transplanter as a better alternative for the use of planting seeds than manually. His research further mentions that the use of rice planter generated a net profit of Rs 1145.81 and Rs 1318.50 per ha when used for 300 and 500 hours annually. This analysis was done where the average size of land holding of the farmers was less than 5 ha. The study also shows that the use of self-propelled rice transplanter could only be economical when it was only for custom self-propelled rice transplantation.

METHODOLOGY

Data: This study has used secondary data which has been collected from Department of Agriculture, Cooperation & Farmers Welfare and also from Directorate of Economics and Statistics DAC&FW, Department of Fertilizer & Department of Agriculture, Cooperation & Farmers Welfare

Variables: In this study there are three variables which are rice yield, sale of tractors, and consumption of fertilizer. Rice yield has been used as the dependent variable and sale of tractors and consumption of fertilizer are the independent variables.

Model: A model is an equation which helps to explain the relationship between the dependent variable as a function of the independent variable. In others words it shows the changes in the dependent variable as result of the change in the independent variable.

Parameters: A parameter is a numerical quantity which influences the result the result of the mathematical equation and is usually remains constant in the equation.

Linear regression is an equation which shows the relationship between a dependent and independent variable in a same direction or a straight line. The equation of linear regression is as follows:

$$y = mx + c$$

Were,

y is the dependent variable which is forecasted or estimated in the equation

x is the independent variable, the changes in which determines the changes in the dependent variable. This is the variable which we can control, manipulate, modify or can make changes in it. It is the also called the input variable.

m is the slope of the equation which shows the line or angle. It is denoted by the symbol B (beta).

c is the intercept which is a constant which tells the value of dependent variable when the independent variable is 0 (zero).

Multiple linear regression model: It is a model in which has an independent variable and has more than one dependent variable. In this model there is a single straight line which tells the relationship between the dependent and the independent variable. Multiple regression model is mainly used when there are more than one independent variable and the researcher have to find the relative effect of these multiple independent variables on the dependent variable. This regression is also help to detect any anomalies or outliers involved in the model.

MODELING AND ANALYSIS

Table 1.

Year	Rice yield (kg/hectare)
2004	1984
2005	2102
2006	2131
2007	2202
2008	2178
2009	2125
2010	2239
2011	2393
2012	2461
2013	2416
2014	2391
2015	2400
2016	2494
2017	2576
2018	2659

Note: Directorate of Economics and Statistics, DAC&FW

Table 2.

Year	Tractor sales (thousand)
2004	248
2005	296
2006	353
2007	347
2008	343
2009	394
2010	545
2011	535
2012	591
2013	697
2014	681
2015	571
2016	662
2017	797
2018	890

Note: Department of Agriculture, Cooperation and Farmers Welfare.

Table 3.

Year	Consumption of fertilizers (lakh tonnes)
2004	11713.9
2005	12723.3
2006	13772.9
2007	14419.1
2008	15090.5
2009	15580
2010	16558.2
2011	17300.3
2012	16820.9
2013	16750.1
2014	16945.4
2015	17372.3
2016	16735.4
2017	16958
2018	17628.2

Note: Department of Fertilizer, Department of Agriculture, Cooperation & Farmers Welfare

RESULTS AND DISCUSSION

Dependent Variable: RICE_YIELD
 Method: Least Squares
 Date: 02/12/21 Time: 19:36
 Sample: 2004 2018
 Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1577.674	194.0430	8.130535	0.0000
TRACTOR_SALES	0.000797	0.000154	5.171017	0.0002
CONSUMPTION_OF_FERTILIZERS	0.020082	0.016364	1.227179	0.2433
R-squared	0.920590	Mean dependent var	2316.733	
Adjusted R-squared	0.907355	S.D. dependent var	194.7993	
S.E. of regression	59.29217	Akaike info criterion	11.17969	
Sum squared resid	42186.74	Schwarz criterion	11.32130	
Log likelihood	-80.84766	Hannan-Quinn criter.	11.17818	
F-statistic	69.55762	Durbin-Watson stat	1.676150	
Prob(F-statistic)	0.000000			

The multiple regression analysis performed shows p value 0.0002 which less than 0.01 which is highly significant at 1% level which means that there is a strong relationship between rice yield and the sale of tractors. The R-squared and the adjusted R-squared value is also showing 92% and 90% respectively for tractor sales and rice yield which means that the model is a good model and there is a relationship between sale of tractors and rice yield. The results for other variable which is consumption of fertilizers is not significant in the regression analysis.

On the basis of the result hence the policy recommendation for this research is that by applying the principle of public distribution system in India for various food grains the same concept can be applied to farmers distribution of tractors. The distribution will work in the manner that the various state government will purchase the tractors and will distribute it to various districts, the district heads will again redistribute the tractors to the respective different village heads the farmers of those villages can take and use the tractors for various agricultural activities. In this way the government should make arrangements for the availability of tractors to the farmers.

CONCLUSION

The previous existing literature also showed that mechanization in agriculture played a significant role in the production and productivity of agricultural crops. The result of this study also shows that there exists a relationship between sale of tractors and rice production. The use of tractors in agriculture process leads to increase in productivity of rice. Hence it is suggested and recommended that the government should make some arrangements in providing these agricultural machines(tractors) to those farmers who cannot afford them. There has been projection made that till 2050 India will become the most populous country in the world. Hence it is necessary

to increase the production and productivity of various agricultural crops at the same rate to feed such a large population of a country. In order to increase the production and productivity of various agricultural crops the mechanization and modernization of agriculture sector is very much needed in the country. Hence the government of the country should work on formulating and implementing policies regarding the mechanization process of the country.

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