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Quantification of farm mechanization status in Kanker district of Chhattisgarh, India

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■ **ABSTRACT :** Investigation on farm mechanization status of Kanker district Chhattisgarh was carried out for sustainable crop production. District falls in Chhattisgarh plains and Bastar plateau of agro climatic zones of Chhattisgarh having average rainfall varies from 1400 mm to 1500 mm where 90 % rainfall during the June to October. The total net sown area of the district is 2.37 lakh ha with cropping intensity around 122 %. To known the status of farm mechanization, level of mechanization was found out by considering available farm power sources namely human, animal and mechanical. A stratified multistage sampling design was applied considering block as a first stage, village as a second stage and cultivators are the final stage of the sampling. From Kanker district of Chhattisgarh. The 30 villages were selected from each seven block of Kanker district using Probability Proportional to Size (of Village). Then from each village, 10 cultivators were selected using random sampling. Primary data were collected from 300 cultivators from 30 villages. After selection of variables, a standard questionnaire was prepared to collect primary data. Average value of power availability, farm power consumption and present mechanization level is significantly highest in high productive blocks namely Charama, Kanker, Koilibeda in comparison to other four low productive blocks *i.e.* Antagarh, Bhanupratappur, Durgkondal and Narharpur block, respectively. Draft animal power available in study area was 0.41 bullock-pair per ha. The command area available per unit of power source for the marginal, small, medium and large farmers was 0.70, 2.01, 3.50 and 11.33 ha/bullock pair with over all availability of 2.42 ha per bullock-pair. However, tractor and power tiller manage the overall command area of 40.43 ha per tractor and 165.38 ha per power tiller. The mechanization level of Kanker district was found 1.37 kW ha^{-1}.

■ **KEY WORDS :** Farm power demand supply gap, Mechanization level, Power availability

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Economy of Kanker district is agriculture based in which marginal and small cultivators constituted about 70.53 per cent land holding. Kanker district is a land of paddy located in the southern part of Chhattisgarh state (20° 06'20" N and 80° 40'81" E, 502 m above mean sea level). District is tribal dominated area with less resource availability in sense of agricultural enterprises adoption and productivity. Total net sown area of the district is 2.37 lakh ha among this only 0.52 lakh ha and 0.18 lakh ha is the net irrigated area in *Kharif* and *Rabi* season, respectively. The cropping intensity of around 122 % and average rainfall of the district varies between from 1400 mm to 1500 mm. A maximum temperature was noted 44^0C in the summer season and

minimum 10^0C in the winter season.

In modern era, agricultural mechanization draws a major controversy that it is considered as the application of mechanical power technology, particularly tractors. However, three main levels of mechanization technologies need consideration: human power, animal power and mechanical power technologies, with varying degrees of sophistication within each level (Rijk, 1989), on the basis of capacity to do work, costs, and precision and effectiveness (Morris, 1985). Agricultural mechanization technology further varies from location to location and crop to crop. Thus the quality of inputs of mechanization, and consequently land and labour productivity may differ considerably (Gifford and Rijk, 1980). So, mechanization planning requires the quantification of level of mechanization for each crop production. Several authors developed different methods to quantify the level of mechanization based on power or energy availability, and its impact in agricultural and labour productivity. Hence the study was carried to know the status of farm mechanization which is helpful to increase cropping intensity and production of food grain in the district.

METHODOLOGY

A stratified multistage sampling design was applied considering block as a first stage, village as a second stage and cultivators are the final stage of the sampling.. from Kanker district of Chhattisgarh. The 30 villages were selected from each seven block of Kanker district using Probability Proportional to Size (of Village). Then from each village, 10 cultivators were selected using random sampling. Primary data were collected from 300 cultivators from 30 villages to represent the district. (Yadav *et al.,* 2013). After selection of variables, a standard questionnaire was prepared to collect primary data. As mechanization is a multi-dimensional concept, thus the following indices were evaluated to study the mechanization status in target region. To study the mechanization status of Kanker district of Chhattisgarh, many variables were selected based on requirements to estimate level of mechanization (power availability), availability of hand tools, and annual use of tractor, farm power consumption of major crops *i.e.* paddy, maize, wheat, respectively and farm power demand supply gap.

Level of mechanization (farm power availability) :

Farm power is an essential input in agricultural production system to operate different types of equipment for timely field completion of agricultural works to increase productivity and maintain sustainability of farm. The mobile power is used for different field jobs like land preparation, sowing, weeding, spraying and harvesting etc., whereas stationary power is used for lifting water, operating irrigation equipment, threshing, cleaning and grading of agricultural produce. The main sources of mobile power are human, draught animal, tractors and power tiller where as the source of stationary power is oil engines and electric motors.

Farm power availability was also calculated for Kanker district of Chhattisgarh using the following notation.

Farm power availability (kW ha$^{-1.}$) = {(Number of agricultural Worker × 0.05) + (Number of draught animal × 0.38) + (Number of tractors × 26.1) + (Number of power tillers × 5.6) + (Number of electric motor × 3.7) + (Number of diesel engine × 5.6)} / Available cultivated land in ha.

Source: Mechanization and Technology Division, Department of Agriculture, Cooperation and Farmers Welfare Ministry of Agriculture and Farmers Welfare, MoAFW

$$\text{Power availability (kW ha}^{-1.}) = \frac{\text{Total power}}{\text{Net cultivated area}} \quad ..(1)$$

Where, Total power is the sum of total mobile power plus total stationary power available in the study area.

Net cultivated area of target region includes numbers of tractor, power tiller, combine harvester, bullocks, agricultural workers, diesel engines and electric pump.

Farm power demand supply gap :

The farm power demand supply gap was calculated in terms of number of tractor units required for ensuring a power availability of 1.61 kW ha$^{-1.}$. With a trend of continuous decrease in human power and increase in tractor power contribution to over all farm power availability, the projected share of tractor power for ensuring an availability of 1.61 kW ha$^{-1.}$ was calculated for the year 2022. For 1.65 kW ha$^{-1.}$ tractor power availability the demand supply gap of tractor units was assessed for all the blocks of study as following.

Power demand supply gap = (Number of available tractors - number of required tractors)

Number of required tractors = Area x 1.65/26.1

Where, 26.1 is the average power (kW) taken for tractor (Mechanization and technology division MoAFW)

RESULTS AND DISCUSSION

The major source of power in agriculture was animal power, the availability of power was 0.39 bullock-pair per ha in LPBs (*i.e.* Antagarh, Bhanupratappur, Durgkondal and Narharpur) and 0.44 bullock-pair per ha in HPBs (Charama, Kanker and Koilebeda). The command area available per unit of power source for the marginal, small, medium and large farmers was 0.70, 2.49, 3.47 and 11.99 ha/bullock pair in LPBs and 0.71,1.53,3.53 and 10.67 ha/bullock pair in HPBs, respectively with over all availability of 2.56 ha per bullock-pair and 2.28 ha per bullock-pair. However, tractor and power tiller manage the overall command area of 44.09 ha per tractor and 220.43 ha per power tiller in LPBs where whereas in HPBs, 36.78 ha per tractor and 110.34 ha per power tiller. The data revealed that the power available was less for timely operations with all the categories of farmers.

Traditional hand tools like spade, clod hammer, hand hoe, hand rake, kudali, pick axe and sickle were used mostly for tilling, weeding and harvesting. Most of the farmers were having a number of tilling, weeding and harvesting /cutting tools in the range of 1.10 to 2.87, 1.49 to 3.00 and 2.19 to 3.62 per family, respectively. At present the major equipment used with bullock power was indigenous plough, biasi plough, clod breaker, planter and bar harrow out of which the most common equipment was indigenous plough, About 65 % of the farming families were possessing indigenous plough. The bullock pair was utilized mostly for ploughing and planking for about 142 and 145 hours per year in LPBs and HPBs, respectively. Improved hand tools like serrated sickle, maize sheller, knapsack sprayer and chaff cutter were used to some extent (less than 0.72 numbers per family) by the farmers in each of the zones.

Total use of tractor in the study area was 900 hours

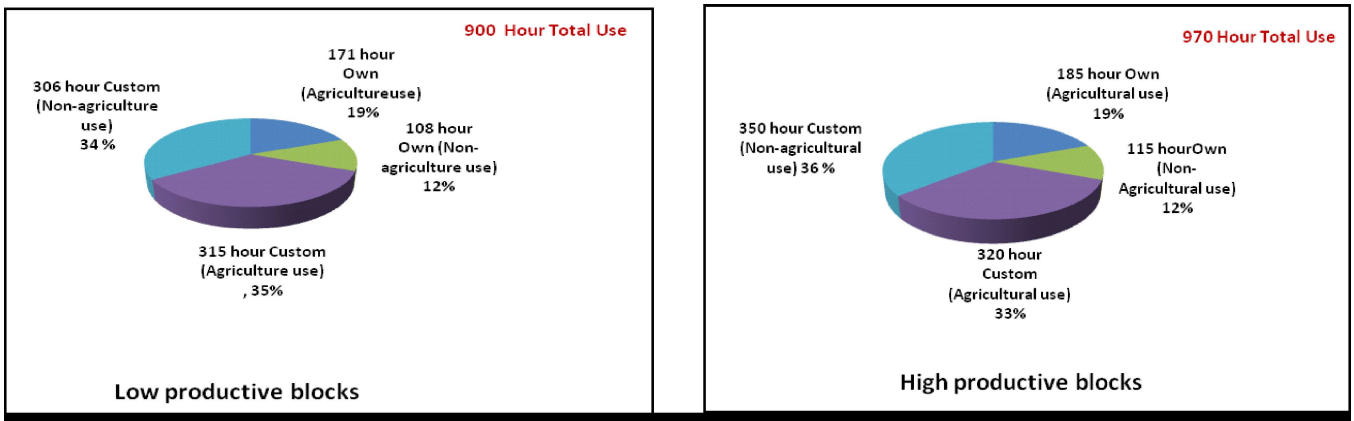

Fig. 1: Blocks wise tractor use for agricultural/non-agricultural operations

Table 1: Mechanical power available in the study area

Sr. No.	Sub-District	Tractor			Electric motor			Diesel engine			Power tiller			Available power (kW ha^{-1})
		No	Power, kW	Avg. power	No	Power, kW	Avg. power	No	Power, kW	Avg. power	No	Power, kW	Avg. power	
1.	Antagarh	1	26.1	26.10	02	5.96	2.98	3	8.20	2.73	0	0	0	0.47
2.	Bhanupratappur	1	22.37	22.37	04	13.42	3.35	4	13.42	3.35	0	0	0	0.75
3.	Durgkondal	1	26.1	26.10	04	10.44	2.61	5	14.17	2.83	1	7.46	7.46	1.06
4.	Narharpur	2	55.93	29.83	02	9.69	4.84	3	9.61	3.20	0	0	0	0.68
6.	Charama	1	29.83	24.23	05	16.40	3.28	7	23.12	3.30	0	0	0	1.41
7.	Kanker	2	63.38	31.69	05	19.76	3.95	8	25.35	3.17	1	7.46	7.46	1.95
8.	Koilebeda	3	94.94	31.65	07	22.74	3.25	10	33.18	3.12	1	7.46	7.46	1.16
	Total	11	318.65	28.97	29	98.41	3.39	40	127.05	3.18	3	22.38	7.46	1.05
	Mean		45.52	27.96		14.06	3.47		18.15	3.10		3.20	3.20	1.07

per year in LPBs and 970 hours per year in HPBs for doing both agricultural and non-agricultural operations of own-uses and custom hiring basis, respectively. On custom basis utilization of tractor was found 315 hour and 306 hour for agricultural and non agricultural work in low productive blocks. In case of high productive blocks utilization of tractor on custom basis was 320 hour and 350 hour for agriculture and non agriculture work per year. Tractor utilization was 69 % more for custom hiring for agricultural and non-agricultural jobs as shown in Fig. 1.

Table 1 shows the distribution of power sources in selected blocks of Kanker district. It was observed from data that average size of tractor in the district was 28.97 kW, Power tiller, 7.46 kW, electric motor, 3.39 kW and diesel engine 3.18 kW. In Kanker farmers used higher size tractors (*i.e.* average upto 31.69 kW) followed by Koilebeda block (*i.e.* average upto 31.65 kW) as compared to other blockss. It may be due to assured irrigation facility that increases the risk bearing capacity of the respondent farmers. Average power availability was found highest in Kanker (*i.e.* 1.95 kW ha^{-1}), followed by Charama (*i.e.*1.41 kW ha^{-1}), Koilebeda (*i.e.*1.16 kW ha^{-1}), Durgkondal (*i.e.*1.06 kW ha^{-1}0, Bhanupatappur (*i.e.* 0.75 kW $ha^{-1.}$), Narharpur (*i.e.* 0.68 kW $ha^{-1.}$) and lowest in Antagarh block (*i.e.* 0.47 kW ha^{-1}).

Farm power consumption:

Farm power consumption of major crops like paddy, maize and wheat was observed during different agricultural operations and it was found was 547.47 man-h ha^{-1}, 162.77 animal-h ha^{-1} and 2.83 machine-h ha^{-1} for paddy, 549.44 man-h ha^{-1}, 107.34 animal-h ha^{-1} and 8.21 machine-h ha^{-1} for maize crop and wheat crop consumed 507.92 man-h ha^{-1}, 116.11 animals-h ha^{-1} and 20.20 machine-h ha^{-1} in LPBs where as in HPBs it was 542.90 man-h ha^{-1}, 171.39 animal-h ha^{-1} and 2.94 machine-h ha^{-1} for paddy and 607.64 man-h ha^{-1}, 118.56 animal-h ha^{-1} and 9.07 machine-h ha^{-1} for maize crop and wheat crop consumed 629.74 man-h ha^{-1}, 126.08 animals-h ha^{-1} and 22.52 machine-h ha^{-1} in HPBs. Mostly human power was engaged in all the crops for performing various operations with indigenous tools. The power consumption was also observed higher in HPBs as compared to LPBs due to different size of plots and requires more time to go from one field to other field.

Farm power demand supply gap :

Table 2 shows the demand and supply gap of tractor units in Kanker which is 65.52% in low productive block

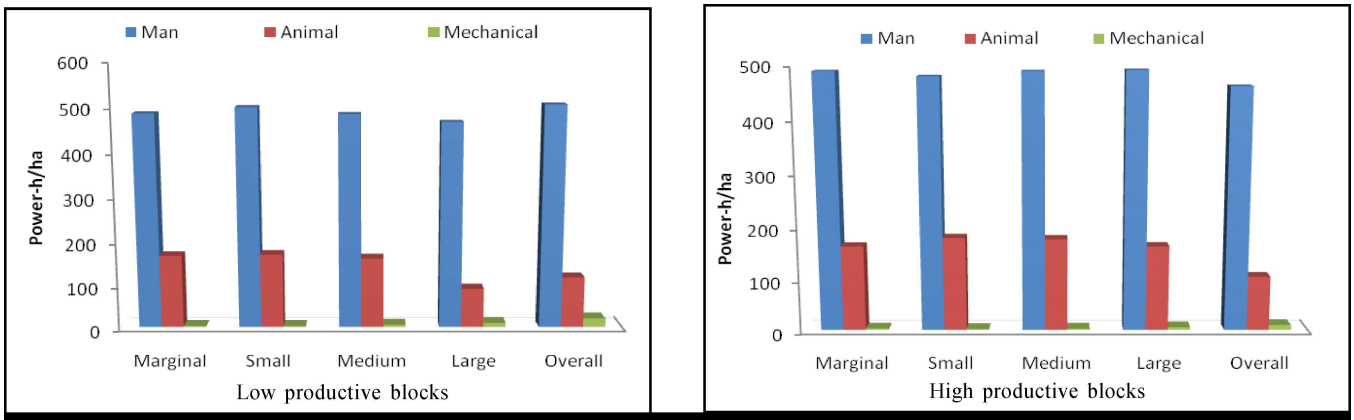

Fig. 2: Power source utilization for paddy crop in low and high productive blocks

Table 2 : Demand and supply gap of tractor unit

Sr. No.	Particular	Low productive block					High productive block				Kanker district
		Antagarh	Bhanupratappur	Durgkondal	Narharpur	Total	Charama	Kanker	Koilebeda	Total	
1.	Total cultivable Area (ha)	30838	38909	27282	39171	136200	26911	31200	54650	112761	248961
2.	Existing tractor (No)	648	860	582	869	2959	668	801	1183	2652	5611
3.	Required tractor (No)	1943	2451	1719	2468	8581	1695	1966	3443	7104	15685
4.	Demand supply gap (%)	66.65	64.91	66.14	64.79	65.52	60.59	59.26	65.64	62.67	64.23

and 62.67% in high productive block, respectively. In Kanker district overall farm power demand supply gap was found to be 64.23%, in which Antagarh block was found highest demand supply gap of farm power 66.65 % followed by Durgkondal, Koilebeda, Bhanupratappur, Narharpur, Charama and Kanker block *i.e.* 66.14%, 65. 64%,64.91%,64.79%, 60.59% and 59.26 %, respectively.

In Kanker district the major source of power in agriculture was animal power, the availability of power was 0.41 bullock-pair per ha. The command area available per unit of power source for the marginal, small, medium and large farmers was 0.70, 2.01, 3.50 and 11.33 ha/ bullock pair with over all availability of 2.42 ha per bullock-pair. However, tractor and power tiller manage the overall command area of 40.43 ha per tractor and 165.38 ha per power tiller. Farm power availability and mechanization level was observed highest in high productive blocks in comparison to low productive blocks but found non-significant. The mechanization level of Kanker district was found 1.37 kW ha^{-1} .which is less as compared to state as well as national level. The data revealed that the power available was less for timely operations with all the categories of farmers. This investigation has emerged that there is wide scope of improvement in agricultural mechanization in the district which will eventually increase food crop production.

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REFERENCES

Dixit, J., Sharma, S. and Ali, M. (2004). Present status, potential and future needs for mechanization of agricultural operations in Jammu and Kashmir state of India. *Agric.Eng. Int:CIGR J.*, **16** (3):87-96.

Karimi, M. Rafiee, Rajabi Pour, S. A., Khairalipour K. and Shahin, S. (2008) . A pattern to distribute tractor power from the viewpoint of energy case study: Isfahan province in Central Region of Iran American-Eurasian. *J. Agric. & Environ. Sci.,* **3** (4): 526-531.

Maheshwar,T. K. and Tripathi, A. (2019). Quantification of agricultural mechanization status for Etawah district of Uttar Pradesh, India. *Int. J.Curr. Microbiol. App. Sci.,* **8**(5): 659-666.

Mehta,C.R., Chandel,N.S. and Senthilkumar,T. (2014). Status, challenges and strategies for farm mechanization in India. *Agricultural Mechanization in Asia, Africa & Latin America,* **45** (4): 43-50.

Vatsa, D.K. (2003). Mechanizing agriculture in hills of Himachal Pradesh, India : A review. *Agriculture for Sustainable Development,* **1** (1) : 89-93.

Vasta, D.K. and Saraswat, D.C. (2007). Study on plot pattern and farm power utilization for major crops in two agro-climatic zones of hill agriculture. *J. Agricultural Engineering,* **44** (3): 25 - 29.

Yadav, S.N., Chandra, R., Khura, T.K. and Chauhan, N.S. (2001). Energy input-output analysis and mechanization status for cultivation of rice and maize crops in Sikkim. *Ahric. Eng. Int: CIGR J.,* **15** (3) : 108-116.