

Assessment and Requirement of Farm Mechanization : A Case Study

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ABSTRACT

*The present research work was carried out at Central Demonstration Farm, Dr. PDKV, Akola. The data for the study were collected for the years 2008-09, 2009-10 and 2010-11. The power available for the actual cultivable area was found to be 0.746 kW, 0.291 kW and 0.268 kW for the year 2008-09, 2009-10 and 2010-11 respectively. The power available for the gross total area was found to be 0.276 kW, 0.268 kW and 0.253 kW for the year 2008-09, 2009-10 and 2010-11 respectively. The farm machineries and implements in working (non working) was found to be 51 (10), 42 (22) and 40 (24) for the year 2008-09, 2009-10 and 2010-11 respectively. The cumulative cultivable area for the Kharif and Rabi season was found to be 620.20, 1843.39 and 1950.45 including *Jatropha* and social forestry for the year 2008-09, 2009-10 and 2010-11 respectively. The mechanization requirement for the year 2010-11 for various field operation were observed to be 38.47 %, 96.64 %, 29.27%, 75.72 %, 63.05 % and 57.26 % respectively. The tractors (45 hp) requirement for the various field operations for the year 2009-10 and 2010-11 was found to be 08 and 11 respectively.*

Key words: Field capacities; Farm mechanization;

The farming scenario of Indian agriculture is changing day by day. Initially (just after independence) Indian agriculture attributes as bullock based farming practices. Government of India has initiated various schemes to rebuild the farming system to adopt the advance science and technological practices in farming. The Indian scenario relating to use of farm machineries in various region differ significantly from each other. The use of machine in farming greatly depends on the soil type and the crop grown in the particular soil. Based on such argument many research and development agencies impart in development of soil and crop specific farm machineries and implements in India. The mechanization refers as the use of farm machineries in crop production operations as land preparation, residue management, plant protection, harvesting, threshing, on farm value addition of crop and use of power for the various operation viz, irrigation etc (Karale et al, 2008).

The adoption of machine in farming operation is increasing day by day as it resulted in saving of cost of production and increasing net income of the farmers (Singh, 2006). The farming operations are labour

intensive. Even though population of India is more, there is acute shortage of manpower for farming operations. The operational cost of human energy is more as compared to the machine energy in farming (Karale et al, 2008, Khambalkar et al 2010). The use of machine in farming operations have resulted in sustainable growth with lowering the cost of operation. In present situation, mechanization is in increasing demand. Farmers and policy makers and developmental agencies now realize that for increasing production and productivity at reduced unit cost of production, free of arduous labour, agricultural mechanization is essential (Gitau et al, 2010). The Central Demonstration Farm (CDF), Wani Rambhapur was established during the year 1969-70 on area of 2031.83 ha under the administration of Dr. Panjabrao Deshmukh Agricultural University (Dr. PDKV), Akola. The main objective of CDF is to implement the important seed production programme of major crops of various stages such as breeder, foundation, certified and truthful etc,. The whole farm is divided into 16 blocks for the convenience and smooth working of various farm activities. Adoption of modern,

mechanized and beneficial farm practices and precision in decision making in agriculture is the key for successful implementation of seed production programme. The soils at CDF, Wani Rambhapur are mostly heavy to medium textured and good fertility status to harvest better crop yields. However, its potential couldn't be fully exploit due to traditional farming practices. This farm is lacking various important modern farm machineries and implements. University has provided different types of vehicles including farm tractors and farm implements to complete the farm related operations and activities in time. Being large farm, the mechanization is necessary for effective and efficient use of inputs and its economics. An attempt was made to evaluate the present status of farm mechanization of the CDF with in view to suggest the future requirement of mechanization.

METHODOLOGY

This section presents the details of the study area, crop growing pattern, area under cultivation, farm implement and machinery available, tractor and the field operation. Central Demonstration Farm (CDF block) is located in Vani Rambhapur on national highway no. 6 at the distance of 20 km from the Akola city. This CDF block is controlled and administrated by Dr. Panjabrao Deshmukh Agricultural University, Akola. It covers an area of 2031.83 ha. CDF block has soil with good fertility but it has to face the abnormalities of weather. In 2009-2010 the total rainfall received was only 579.92 mm in 46 rainy days. The erratic and uneven distribution of rainfall is the major problem of this block which hampers the various important physiological processes and results into stunted growth, delayed and less flowering, lesser numbers of bolls and pods etc. along with the serious damage caused by the heavy infestation of the insects, pests, and diseases resulting in reduction in the yields of different crops to a considerable extent. The major strength of CDF Wani-Rambhapur is availability of land i.e. 2031.83 ha. at one location. The land is divided in various small blocks for smooth and effective control and supervision of farm activities. There are total 16 blocks in CDF Wani- Rambhapur. Each block is independent in all respect and has its own farm office. *Farm mechanization status:* Most farm machinery impacts include a complementary package of effective practices, including such inputs as new seed, fertilizer technology, new cultural techniques of farming, modern farming implements and changes in the timing of

operations. Typically, however, improvements in technology also increase the productivity of capital and alter the technological rates of substitution of capital for manpower, reducing the amount of capital that is necessary to replace a unit of manpower at particular levels of output. Other innovations make it possible to reduce the amount of manpower in relation to land needed to produce specified levels of output. The data of last consecutive three years has been taken into consideration for the assessment purpose. Not only to assess the gap in mechanization but also to study the improvement in the farm mechanization in last three years. Some parameters were taken into consideration for analyzing the mechanization status which consisted methods of farming, implements and machinery used, etc. The data collected was used for finding out the gap in mechanization.

Data collection and machinery assessment : The data regarding availability of farm implements and machineries was collected through the survey of all the sixteen blocks. This collected data was further divided according to working and non working status of the implements (*Tooy and Murase, 2007*). The collected data included available tractors and different farm machineries. Different implements and machineries in collected data are as follows:

- 1) Tillage implements
 - Ploughs
 - Land levelers
 - Disc harrows
 - Rotavator
 - Cultivators
 - Scrapers
- 2) Sowing implements
 - BBF marker-cum-seed drill
 - Seed drills
- 3) Intercultural operation
 - Weeders and hoes
 - Sprayers
- 4) Harvesting implements
 - Threshers

Theory for analysis : The farm mechanization status of the studied area was determined by calculating the various field performance parameters of the farm machineries and implements. The field performance parameter like field capacity (actual and theoretical), field efficiency (actual and theoretical), were determined by considering the average working width of the farm implements and the average of actual performance on the field during various field operations.

Actual area covered by machine : Actual area covered by all implements was calculated by the following formula;

Actual area covered = $X_1 \times X_2 \times X_3 \times X_4$

Where:

X_1 = Actual field capacity

X_2 = working hours

X_3 = No. of working implements

X_4 = No. of days of operation

Farm mechanization requirement : The mechanization requirement of study area was determined considering the concept of machinery and mechanical power utilized over the land cultivated. The mechanization requirement has been find out with the simpler relation with actual machinery and mechanical power used to cultivate the land which is actually available in the particular season/ year (Ibrahim et al, 2010; Morteza et al, 2010).

The mathematically relationship have been formulated as below;

$$\text{FMR}(\%) = 100 - \left(\frac{\text{Actual area covered by machine}}{\text{Actual area under cultivation}} \times 100 \right)$$

FMR= Farm mechanization requirement

Requirement of machinery and power : The machinery and the power required for the uncovered cultivated area have been determined over the consideration of the actual field capacity of the implements, numbers of working days considered in the seasons and the working hours (Olaoye and Rotimi, 2010; Reheleh et al, 2010). The mathematically relationship have been formulated as below;

$$\text{No. of IR} = \frac{\text{UCA}}{\text{AFC} \times \text{No. of WD} \times \text{No. of WH}}$$

No. of IR = No. of implements required

UCA = Uncovered cultivated area

AFC = Actual field capacity

No. of WD = No. of working days

No. of WH = No. of working hours

RESULTS AND DISCUSSION

This section present the results of the work carried out in the study area. The mechanization status and the machinery operation were considered as the ploughing, land preparation through rotavator, cultivator, spraying of the crop and the sowing in both seasons i.e., rainy and winter.

Status of tractor power : The status of tractor power available at the study area has been determined by visiting the study locale and personnel interaction with the concern staff. The details regarding the number of tractor available at the CDF is given in Table 1. The number of tractor available (working and non working)

is assessed for the year 2008-09, 2009-10 and 2010-11. It is observed that the actual power available to the total cultivable area was 1.0 hp, 0.39 hp and 0.36 hp for the year 2008-09 to 2010-11 respectively. The total numbers of tractors in working conditions was found to be 14, 16 and 15 for the year 2008-09 to 2010-11 respectively.

Status of farm implements and machinery: The status regarding the availability of farm implements and machineries was assessed at CDF Wanirambhapur for the duration 2008-09, 2009-10 and 2010-11. The information of tractor operated machines like plough, cultivator, seed drill, rotavator, sprayers were collected. The gathered information is depicted in Table 2. The percent of machines working and non working condition of the CDF is depicted in Table 2. It was observed that the machines in working trends was declined from 84 per cent to 63 per cent from 2008-09 to 2010-11. It is observed that most of the machines on the farm were non-working which has to repair properly.

Crop situation in Kharif and Rabi season of CDF : The crop grown in CDF during 2008-09 to 2010-11 is shown in Table 3. It is found that most of the crop was grown in kharif season as compared to Rabi seasons.

It is found that cultivable area have shown increasing trend from 2008-09 to 2010-11. It was observed that near about 90 to 94 per cent land was under cultivation including Jatropha and social forestry.

Mechanization status and future requirements: The mechanization status of the CDF Wanirambhapur was evaluated using present farm implements and tractor available to cover various farm operations. By considering various field parameters the evaluation of mechanization status and requirement were determined (Table 4). The above figures were determined by considering the average value of field operation, days available during one year, actual average hour operation per day. The actual field capacity was considered by taking average values of various implements available of different size and working width operated on various rating of tractor available at CDF. These factors were used to determine the actual scenario of the farm mechanization of the CDF Wanirambhapur.

Mechanization status and requirement: The mechanization status in the present study of CDF was determined for the year 2009-10 and 2010-11. The results obtained by considering the factor considered and the

Table 1. Scenario of tractor power available at CDF

Name of tractor	Power rating (hp)	2008-2009			2009-2010			2010-2011		
		Total nos.	Work-ing	Non Working	Total nos.	Work-ing	Non Working	Total nos.	Work-ing	Non Working
Massy Fergusson		35	05	03	02	05	03	02	05	02 03
Indo Farm	40	01	01	00	01	01	00	01	01	00
Farm Trac	50	05	05	00	05	05	00	04	04	00
John Deere	50	01	01	00	03	03	00	04	04	00
Ford 3610	45	04	02	02	04	02	02	02	02	00
Mahindra	45	02	02	00	02	02	00	02	02	00
Total			18	14	04	20	16	04	18	15
Total actual cultivable area, ha		620.50			1843.39			1894.73		
Total Power available (hp)		625			725			690		
Total power available per actual cultivable area (hp/ha; kW/ha)		1.00/0.746			0.39/0.291			0.36/0.268		
Total power available per total gross area (hp/ha; kW/ha)		0.37/0.276			0.36/0.268			0.34/0.253		

Table 2. Scenario of farm implements and machineries at CDF

Equipments	2008-2009			2009-2010			2010-2011		
	Total nos.	Work-ing	Non Working	Total nos.	Work-ing	Non Working	Total nos.	Work-ing	Non Working
M.B. plough									
Parag	5	5	0	5	04	01	05	04	01
Trimurti	7	6	1	7	06	01	07	06	01
Desi	2	1	1	2	00	02	02	00	02
Total	14	12	02	14	10	04	14	10	04
<i>Cultivator</i>									
11-tyne	05	04	01	05	04	01	05	04	01
9-tyne	03	02	01	03	02	01	03	02	01
5-tyne	05	03	02	05	04	01	05	03	02
3-tyne	02	02	0	02	01	01	02	02	00
Total	15	11	04	15	11	04	15	11	04
Pasa (5 tyne)	4	4	0	04	04	00	04	04	00
Disc harrow	4	4	0	04	03	01	04	02	02
Scraper	3	1	2	03	00	03	03	00	03
Rotavator	3	3	0	03	02	01	03	01	02
<i>Boom sprayer</i>									
Tractor operated	02	02	00	02	02	00	02	02	00
Bullock operated	01	01	00	01	01	00	01	01	00
Total	03	03	00	03	03	00	03	03	00
<i>Seed drill</i>									
Patidar	02	02	00	02	02	00	02	02	00
Ludhiyana	01	01	00	01	01	00	01	01	00
Seed cum ferti drill	03	02	01	03	00	03	03	00	03
Seed drill with BBF	-	-	-	01	01	00	01	01	00
Seed drill with two men operated	05	04	01	05	02	03	05	02	03
Adjustable seed drill patidar	-	-	-	02	02	00	02	02	00
Total	11	09	02	14	08	06	14	08	06
Tractor operatorridger (1-furrow)	1	1	0	01	01	00	01	01	00
Thresher	3	1	2	03	00	03	03	00	03
Gross Total	61 (100)	51 (84)	10 (16)	64 (100)	42 (66)	22 (33)	64 (100)	40 (63)	24 (37)

Table 3: Scenario of crop grown in Kharif and Rabi season at CDF

Crops	2008-09		2009-10		2010-11	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
Sorghum	14.40	-	31.30	2.00	15.90	-
Bajra	40.70	-	95.10	-	15.20	15.0
Cotton	118.70	-	344.68	-	246.58	-
Ground Nut	9.80	-	0.80	-	9.60	-
Sunflower	12.60	-	16.40	-	1.00	-
Mustard	-	-	-	5.30	-	6.00
Sesamum	4.00	23.10	1.20	-	-	6.00
Lathyrus	-	-	-	0.40	-	-
Linseed	-	-	-	0.40	-	-
Safflower	-	74.20	-	76.30	-	127.0
Soybean	231.20	-	306.30	-	451.42	-
Gram	-	12.00	-	276.12	-	451.8
Greengram	7.00	-	89.20	-	72.70	-
Blackgram	20.60	-	76.25	-	78.60	-
Pigeonpea	26.00	-	130.32	14.00	80.20	-
Maize 0.00	-	3.40	-	1.90	-	-
Sunhemp	12.50	-	10.60	-	14.00	-
Dhaincha	0.50	-	8.00	-	1.80	-
Jute	6.00	-	91.00	-	80.55	-
Castor	4.00	-	4.60	-	5.00	-
Chilli	0.20	-	0.60	-	0.80	-
Clusterbean	3.00	-	1.10	-	0.60	-
Bhendi	-	-	-	-	1.10	-
Onion	-	-	-	-	-	1.00
Cow pea	-	-	-	-	0.45	-
Ridggourd	-	-	-	-	0.43	-
Wheat	-	-	-	-	-	81.50
Jatropha	-	-	227.22	-	152.02	-
Social	-	31.00	-	32.30	-	-
Forestry	-	-	-	-	-	-
Sub total	511.20	109.30	1468.87	374.52	1265.15	688.3
Grand total, ha	620.20		1843.39		1950.45	
% of total area available	25.16		90.76		95.99	

actual machineries available at the farm are presented in Table 5 for the year 2009-10.

It was found that the present mechanization status of the various operation viz ploughing, land preparation by rotavator, land preparation by cultivator, crop inter culture, crop spraying by tractor and bullock sprayer and sowing of crop were observed to be 54.93 %, 12.34%, 78.94 %, 27.33%, 36.04% and 47.70% respectively. The mechanization requirement of the farm was determined by considering the actual area covered by the machine with the actual cultivable area of the farm. The data presented in the Table 5 represent the mechanization requirement of the farm. It calculated mechanization requirement of the various operation viz ploughing, land preparation by rotavator, land preparation by cultivator, crop inter culture , crop spraying by tractor and bullock sprayer and sowing of crop were observed to be 45.07%, 87.66%, 21.06%, 72.67%, 63.96% and 52.30% respectively.

The results obtained by considering the operational factors and the actual machineries available at the farm are presented in Table 6 for the year 2010-11.

It was found that the present mechanization status of the various operation viz ploughing, land preparation by rotavator, land preparation by cultivator, crop inter culture, crop spraying by tractor and bullock sprayer and sowing of crop were observed to be 61.53%, 5.36%, 70.73%, 24.48%, 36.65% and 42.74% respectively. The mechanization requirement of the farm was determined by considering the actual area covered by the machine with the actual cultivable area of

Table 4. Factors consider for the evaluation of mechanization status and requirement

S. No.	Operations	Days of operation	Operation hours/day	Actual average field capacity (ha/h)	Area of operation with respect to crop considered
1	Ploughing	50	07	0.19	Actual
2	Land preparation by Rotavator	15	07	0.22	Actual
3	Land preparation (cultivator)	65	07	0.50	Double of actual
4	Crop inter-cultural operation /cultivator	45	07	0.50	Four time of actual
5	<i>Spraying of crops</i>				
	Tractor sprayer	30	07	2.0	Actual/ double/triple/
	Bullock sprayer	30	06	0.45	four times
6	Sowing of crops	30	07	0.45	Actual

Table 5. Mechanization status and requirement for the 1585.17 ha of land in 2009-2010

Operation/ area	Actual Area under cultivation (ha)	Theoretical field capacity (ha/hr)	Actual field capacity (ha/hr)	Theoretical area covered (ha)	Actual Area covered by machine (ha)	Un-covered cultivated area (ha)	Actual mechani- zation on (%)	Mechani- zation - requirement (%)
Ploughing	1210.65	0.27	0.19	945.00	665.00	545.65	54.93	45.07
Land preparation by Rotavator	374.52	0.378	0.22	79.38	46.20	328.32	12.34	87.66
Land preparation (cultivator)	3170.34 {(1210.65 + 374.5) × 2 Times}	0.54	0.50	2702.70	2502.50	667.84	78.94	21.06
Crop inter-cultural operation (cultivator)	6340.68 (1585.17 × 4 time)	0.54	0.50	1871.10	1732.50	4608.10	27.33	72.67
<i>Crop spraying</i>								
Tractor sprayer	2555.65	3.52	2.0	1478.40	840 + 81 = 921	1634.65	36.04	63.96
Bullock sprayer	-	0.75	0.45	315.00				
Crops sowing	1585.17	0.58	0.45	974.40	756.00	829.17	47.70	52.30
Tractor available (nos.)					16			

Table 6. Mechanization status and requirement for 1769.13 ha of land in 2010-11

Operation/ area	Actual Area under cultivation (ha)	Theoretical field capacity (ha/hr)	Actual field capacity (ha/hr)	Theoretical area covered (ha)	Actual Area covered by machine (ha)	Un-covered cultivated area (ha)	Actual mechani- zation on (%)	Mechani- zation - requirement (%)
Ploughing	1080.83	0.27	0.19	945.00	665.00	415.83	61.53	38.47
Land preparation by Rotavator	688.30	0.378	0.22	39.69	23.10	665.20	5.36	96.64
Land preparation (cultivator)	3538.26 {(1080.833 + 688.30) × 2 Times}	0.54	0.50	2702.70	2502.50	1035.76	70.73	29.27
Crop inter-cultural operation (cultivator)	7076.52 (1769.13 × 4 time)	0.54	0.50	1871.10	1732.50	5344.02	24.48	75.72
<i>Crop spraying</i>								
Tractor sprayer	2492.88	3.52	2.0	1478.40	840 + 81 = 921	1571.88	36.65	63.05
Bullock sprayer		0.75	0.45	315.00				
Sowing of crops	1769.13	0.58	0.45	974.40	756.00	1013.13	42.74	57.26
Tractor available (nos.)				15				

the farm. The data presented in the Table 6 represent the mechanization requirement of the farm during 2010-11. The calculated mechanization requirement of the various operation viz ploughing, land preparation by rotavator, land preparation by cultivator, crop inter

culture, crop spraying by tractor and bullock sprayer and sowing of crop were observed to be 38.47%, 96.64%, 29.27%, 75.52%, 63.05% and 57.26% respectively.

Assessment of farm machinery requirement: The farm machinery requirement for the uncovered

Table 7. Farm implements and tractor requirement during 2009-10 and 2010-11

Operation	2009-10			2010-11		
	Un-covered cultivated area (ha)	Required implements (nos)	Required tractors (nos)	Un-covered cultivated area (ha)	Required implements (nos)	Required tractors (nos)
Ploughing	545.65	8	8	415.83	6	6
Land preparation by Rotavator	328.32	14	14	665.20	29	29
Land preparation (cultivator)	667.84	3	3	1035.76	5	5
Crop inter-cultural operation (cultivator)	4608.1	29	8	5344.02	34	8
Crop spraying	1715.65	4	4	1652.88	4	4
Crop sowing	829.17	9	9	1013.13	11	11
Average tractor requirement (nos) up to 45 hp			8			11

cultivable land of the CDF Wanirambhapur for the year 2009-10 and 2010-11 were determined.

The requirement of additional farm implements and tractor were determined by considering the average actual field capacity of implements and the uncovered cultivable area of the 2009-10 and 2010-11 for factors considered in Table 2. The Table 7 represent requirement of farm machineries and tractor for the considered duration of various operations. It was observed that nearly 08 and 11 tractors were additionally required for the actual land under cultivation for the various field operations. It is found that majorly crop inter-cultural operation require farm implements in large quantum to mechanize the field operation. Similarly sowing of crop requires huge amount of seed drill/planters to achieve mechanization in the sowing. The analysis showed that spraying of crop has been greatly influence as huge number of land was uncovered by the tractor and bullock sprayers. To achieve the mechanical application of spraying in the crop near about four additional sprayers were required during 2009-10 and 2010-11. Overall, it is seen that there is a need of huge amount of farm implements and tractors to mechanized the selected operation of the uncover cultivated land.

CONCLUSION

In present era of modernization farming practices are still lacking innovation approaches for the various crop growing operation. Application of energy may result in high yield and precision in the farming. The application of farm implements and machineries provide the timeliness in uncertain farming of India. The

measurement of application level of implements is the critical task. An attempt has been made to measure the level of farm mechanization of the selected land and requirement of the machinery input for the particular operation. The field operation for the study were considered as land preparation by plough, land preparation by rotavator (particularly winter), land preparation by cultivator, inter-cultural operation in the growing crops, crop protection by sprayers and the sowing of crop in rainy and winter (Kharif and Rabi) season of the of selected area. Based on the present machinery available and the land under cultivation with and with machineries average theoretical field capacities of the various field machines were determined. The actual average field capacities were calculated for the various field operations. The power available for the actual cultivable area was found to be 0.746 kW, 0.291 kW and 0.268 kW for the year 2008-09, 2009-10 and 2010-11 respectively with the power available for the gross total area was found to be 0.276 kW, 0.268 kW and 0.253 kW for the year 2008-09, 2009-10 and 2010-11 respectively. The farm machineries and implements in working (non working) was found to be 51 (10), 42 (22) and 40 (24) for the year 2008-09, 2009-10 and 2010-11 respectively. The cumulative cultivable area for the Kharif and Rabi season was found to be 620.20, 1843.39 and 1950.45 including Jatropha and social forestry for the year 2008-09, 2009-10 and 2010-11 respectively. The mechanization requirement for the year 2009-10 for various field operation viz ploughing, land preparation by rotavator, land preparation by cultivator, crop inter-cultural, crop spraying and the sowing of crop were

observed to be 45.07 %, 87.66%, 21.06%, 72.67%, 63.96% and 52.30% respectively. The mechanization requirement for the year 2010-11 for various field operation viz ploughing, land preparation by rotavator, land preparation by cultivator, crop intercultural, crop spraying and the sowing of crop were observed to be 38.47%, 96.64%, 29.27%, 75.72%, 63.05% and 57.26% respectively. The tractors requirement for the various

field operations for the year 2009-10 and 2010-11 was found to be 08 and 11 respectively. Overall study exposed that measurement of farm mechanization and the requirement is the function of number of farm implements available with the power sources to the target land of cultivation.

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