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Present scenario of draught animal power utilization in Aurangabad district

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Abstract
The study was conducted in Aurangabad district of Marathwada region of Maharashtra state. On average 72.50 % farmer had their own Bullock pair for agricultural operation. All the farmers used bullock pair for their tillage operations and transportation. The study showed that farmers used draft animals for, ploughing, harrowing, Drilling, intercultural operation and transportation. 24.58% of the farmers used draft animals for ploughing, 46.25% for harrowing, 53.75% for Drilling, 60% for intercultural operation and 60.62% for transportation. The data revels that there were significant ($p > 0.05$) differences in working days of bullocks recorded in marginal farmers (62.8 days) over small (56.40), medium (53.64) and large farmers (52.21), whereas working days recorded in small, medium and large farmers were at par with each other. It can be concluded from present investigation that, the status of bullock pair ownership is declining particularly in marginal and small farmers due to fragmentation of land holding and slowly it is making towards medium and large farmers group. Mechanical energy was being accepted for hard and heavy tillage operations as well as threshing operation instead of animal energy where as drilling, intercultural, transportation operations are carried out by animal energy though they were time consuming.

Keywords: Draft animal power, Agricultural operation and Draught animal intensity.

Introduction
Bullock is an important source of draught power, manure for crop production and fuel for domestic use. Thus, by minimizing use of non-renewable energy, livestock make a positive contribution to the economic development. Livestock sector is an important source of income for the farmers and rural poor people, in terms of milk production, draft energy and self employment. The growth in the livestock subsector is expected to contribute to poverty alleviation, as the livestock elements are largely concentrated among the marginal, small farmers and by the landless families. Whatever developmental work took place in draught animal power (DAP) utilization, attitude of farmer towards draught animal play an important role in the efficient utilization of bullocks in farming practices. When the farmers have positive attitude towards the utilization of draught bullocks in agriculture, then only the actual utilization of the animals can be achieved. The use of DAP varies from one area to another depending on the historical background, farmers attitudes and incidence of livestock disease (Kumwenda 2000) [4].

Materials and methods
The present study was conducted in Aurangabad district of Marathwada region of Maharashtra state. The multistage sampling technique was used to select district, tahsils, and village. There are total nine tahsils in Aurangabad district out of which four tahsils i.e., Aurangabad, Paithan, Sillod and Vaijapur were selected purposively. From each tahsils five villages were selected. In each selected village 12 farmers were selected in different categories (land holding) of farmers i.e. Randomly 3 farmers from each category of (a) marginal (less than land 1 ha.), (b) small (between land 1-2 ha.), (c) medium (between land 2-4 ha.) and (d) large (more than land 4 ha.) categories of farmers. Thus data of 240 farmers were collected and recorded by taking interview.

Results and discussion
Status of bullock pair in different categories of farmers
In present study availability of bullock pair in various categories of farmers was assessed and data is presented in Table 1.
As per study only 31.67 per cent farmers from marginal categories had their own bullocks, while remaining small, medium and large categories of farmers possessed own bullocks as 73.33, 88.33 and 96.67 per cent, respectively.

On an average about 72.50 per cent farmer had their own bullocks for agricultural operation in surveyed area. It was found that 68.33, 26.67, 11.67 and 3.33 per cent marginal, small, medium and large categories of farmers, respectively did not own bullocks. Therefore, these farmers depend on custom hiring of either tractors or bullocks. The results also confiemed with Saxena, (1995) [7] who reported that utilization bullocks by owner household in Naman village of Gujarat state that out of the 15 bullock-owning sample households, there households did not use their bullocks for either their own work or for hiring out, they kept their bullocks for sale and met their requirement of bullock's power from the hired ones, of the remaining 12 bullocks owning sample households with their 17 bullocks.

Table 1: Status of bullocks in different categories of farmer

Cate. of farmer / Blocks	Marginal		Small		Medium		Large		Total	
	Possess bullocks	Have no bullocks	Possess bullocks	Have no bullocks	Possess bullocks	Have no bullocks	Possess bullocks	Have no bullocks	Possess bullocks	Have no bullocks
Block– I	04	11	13	02	13	02	14	01	44 (73.33)	16 (26.67)
Block-II	05	10	10	05	13	02	15	00	43 (71.67)	17 (28.33)
Block-III	06	09	10	05	14	01	15	00	45 (75.00)	15 (25.00)
Block-IV	04	11	11	04	13	02	14	01	42 (70.00)	18 (30.00)
Total	19 (31.67)	41 (68.33)	44 (73.33)	16 (26.67)	53 (88.33)	07 (11.67)	58 (96.67)	02 (3.33)	174 (72.50)	66 (27.50)

Note: n=60 for each category of farmer, Total N= 240, figures in parenthesis indicates the percentage to the total

Draught animal intensity (ha/animal pair) in different categories of farmers

Draught animal intensity is defined as inverse of draught animal pair per unit net area i.e. average area to be cultivated by a pair of animal (ha/animal pair). This has been expressed to access the average availability of draught animal in different categories of farmer in present study and results are documented in Table 2.

Table 2: Draught animal intensity (ha/animal pair) in different categories of farmers

Categories / Block	Marginal	Small	Medium	Large	Average
B–I	0.85 ± 0.05 (04)	1.66 ± 0.07 (13)	3.13 ± 0.16 (13)	7.07 ± 0.80 (14)	3.18 ± 0.73 (44)
B-II	0.96 ± 0.02 (05)	1.68 ± 0.07 (10)	2.98 ± 0.16 (13)	5.99 ± 0.67 (15)	2.90 ± 0.59 (43)
B-III	0.76 ± 0.60 (06)	1.60 ± 0.09 (10)	2.81 ± 0.16 (14)	5.37 ± 0.45 (15)	2.64 ± 0.53 (45)
B-IV	0.90 ± 0.03 (04)	1.81 ± 0.06 (11)	2.95 ± 0.16 (13)	6.02 ± 1.09 (14)	2.92 ± 0.59 (42)
Mean	0.87 ± 0.02 (19)	1.69 ± 0.02 (44)	2.97 ± 0.03 (53)	6.11 ± 0.18 (58)	2.91 ±0.60 (174)

Note: Figures in parenthesis indicates the no. of farmers having own bullock pair.

Acreage per draught animal pair was highest in large farmer (6.11 ± 0.18 ha. Per animal pair) followed by medium (2.97 ± 0.03ha. Per animal pair), small (1.69 ±0.02ha. per animal pair) and lowest in marginal farmers (0.87 ± 0.02ha. per animal pair).

To ensure timelines in field operations, usually 1.5-2.5 ha per animal pair is considered reasonable command area on net area basis (Singh, 1999) [8]. But the present findings were more than optimum average. Acreage per draught animal pair in India was 3.67 ha /animal pair, whereas, in Maharashtra it was 5.10 ha per animal pair in 1992 (Singh, 1999) [8]. Therefore, in present investigation of Aurangabad district the acreage per draught animal pair (2.90 ± 0.60 ha/ animal pair) was low as compared to state and India level average. It might be due to fragmentation of land very fast since last two decades. Mali, (2014) [5] also recorded similar observations in Latur district as draught animal intensity (ha/animal pair) in marginal, small, medium and large as 0.71 ± 0.05, 1.60± 0.03, 3.20 ± 0.07 and 6.27 ± 0.27 ha. per animal pair. Singh, (1999) [10] reported acreage per draught animal pair as 1.61, 2.93, 4.64, 7.89, 15.84 and 4.14 ha per animal pair in marginal, small, semi medium, medium, large and overall respectively.

Various agricultural operations carried out by using different source of energy

The data pertaining to the agricultural operations carried out by using different energy sources is presented in Table 3.

Ploughing Operation

The ploughing operation is basic tillage operation for land cultivation which requires more energy. In Indian agriculture ploughing is performed by bullock power and tractor power.

It was clear that the marginal, small, medium and large categories of farmer utilized own bullocks for ploughing as 26.67, 33.33, 16.67 and 21.67 per cent, respectively. On an average 24.58 per cent of farmers conduct ploughing operation by using own bullocks. Number of farmer from marginal, small, medium and large categories of farmers utilized tractor for ploughing was 73.33, 66.67, 78.33 and 70.00 per cent, respectively. An average 72.08 per cent farmer used tractor power for ploughing operation. Not a single marginal and small farmer utilized tractor and bullock energy

combine for ploughing. However medium and large farmers used this combine source for ploughing as 5.00 and 8.33 per cent, respectively. An average 3.33 per cent farmer used tractor and bullock energy combine for ploughing operation. Tyagi *et al.,* (2010) [11] also observed similar trend that the contribution of tractor power was more compared to share of animal power in total power availability in India. The increasing trend of utilization of tractor energy in agricultural operation may be due to faster acceptability of tractor by the Indian farmers for various agricultural operations.

Table 3: Various agricultural operations carried out by using different source of energy

Sr. No.	A) By own bullock pair						B) By Hired bullock pair				
	Categories / Operations	Marginal	Small	Medium	Large	Total	Marginal	Small	Medium	Large	Total
1	Ploughing	16 (26.67)	20 (33.33)	10 (16.67)	13 (21.67)	59 (24.58)	00 (00)	00 (00)	00 (00)	00 (00)	00 (00)
2	Harrowing	18 (30.00)	35 (58.33)	35 (58.33)	23 (38.33)	111 (46.25)	21 (35.00)	10 (16.67)	05 (8.33)	03 (5.00)	39 (16.25)
3	Drilling	19 (31.67)	37 (61.67)	40 (66.67)	33 (55.00)	129 (53.75)	39 (65.00)	15 (25.00)	08 (13.33)	04 (6.67)	66 (27.50)
4	Intercultural	19 (31.67)	38 (63.33)	47 (78.33)	40 (66.67)	144 (60.00)	39 (65.00)	16 (26.67)	07 (11.67)	02 (3.33)	64 (26.67)
5	Transportation	19 (31.67)	38 (63.33)	48 (80.00)	40 (66.67)	145 (60.42)	34 (56.66)	12 (20.00)	06 (10.00)	02 (3.33)	54 (22.50)

Sr. No.	C) By tractor						D) By Bullock + Tractor				
	Categories / Operations	Marginal	Small	Medium	Large	Total	Marginal	Small	Medium	Large	Total
1	Ploughing	44 (73.33)	40 (66.67)	47 (78.33)	42 (70.00)	173 (72.08)	00 (00)	00 (00)	03 (5.00)	05 (8.33)	08 (3.33)
2	Harrowing	19 (31.67)	12 (20.00)	12 (20.00)	17 (28.33)	60 (25.00)	02 (3.33)	03 (5.00)	08 (13.33)	17 (28.33)	30 (12.50)
3	Drilling	02 (3.33)	06 (10.00)	06 (10.00)	16 (26.67)	30 (12.50)	00 (0.00)	02 (3.33)	06 (10.00)	07 (11.67)	15 (6.25)
4	Intercultural	00 (0.00)	00 (0.00)	00 (0.00)	00 (0.00)	00 (0.00)	02 (3.33)	06 (10.0)	06 (10.00)	18 (30.0)	32 (13.33)
5	Transportation	07 (11.67)	07 (11.67)	01 (1.67)	11 (18.33)	26 (10.83)	00 (00.00)	03 (5.00)	05 (8.33)	07 (11.67)	15 (6.25)
6	Threshing	00 (00)	03 (5.00)	04 (6.67)	10 (16.67)	17 (7.08)	00 (00)	00 (00)	00 (00)	00 (00)	00 (00)

Note: n=60 for each category of farmers, Total N= 240, figures in parenthesis indicates the percentage to the total

Harrowing Operation

Next to ploughing, clod crushing and harrowing are important operations and helpful for better seed bed preparation. The study showed that the harrowing operation carried using own bullock energy by different categories of farmer as 30.00, 58.33, 58.33 and 38.33 per cent in marginal, small, medium and large farmer, respectively. The overall percentage of utilization of own bullock energy by farmers for harrowing operation was 46.25 per cent. The overall percentage of utilization of hired bullock energy by farmers for harrowing operation was 16.25 per cent, 12.50 per cent farmers utilized both bullocks and tractor energy and Overall 25.00 per cent farmers were utilized only tractor energy for harrowing operation.

These results are supportive to the observation by Mali, (2014) [5] and More, (2014) [6]. Ulmek, (2012) [12] reported that the use of mechanical power in agriculture has increased but draught animal power (DAP) continuous to be used an Indian farms due to small holdings and hill agriculture, more than 55.00 per cent of the total cultivable area is still being managed by using draught animal as against about 20.00 per cent by tractor.

Drilling Operation

Drilling is important and critical operation in crop production. Distance between row to raw and optimum plant population is to be maintained by proper drilling. Drilling is carried out by applying bullock power as well as by mechanized power equipments. It was seen that by using own bullock's energy in drilling operation the percentage of different categories of farmers i.e. marginal, small, medium and large as 31.67, 61.67, 66.67 and 55.00 per cent, respectively. The overall percentage of utilization of bullock energy by farmers drilling operation was 53.75 per cent. The overall percentage of utilization of hired bullock energy by farmers drilling operation was 27.50 per cent. Overall 6.25 per cent farmer's utilized bullock as well as tractor energy for drilling operations and Overall 12.50 per cent farmers were utilized only tractor energy for drilling operation. Mali, (2014) [5] and More, (2014) [6] also observed more or less similar trend regarding the utilization of different energy sources for drilling operation in Latur and Parbhani district, respectively.

Intercultural Operation

Intercultural operations have unique importance to create suitable condition after emergence to harvesting. Weeding, hoeing, light earthing up, opening furrows in between two crop line and top dressing like works comes under intercultural operations. It was revealed that in marginal categories 31.67 per cent of farmers conduct intercultural operations by using their own bullock energy. Whereas small category contribute 63.33 per cent, medium 78.33 per cent and large category 66.67 per cent and average intercultural operation carried out by using own bullock energy are 60.00 per cent. An average about 26.67 per cent of respondents completes the intercultural operation by using hired bullock energy. Overall 13.33 per cent farmer's utilized bullock as well as tractor energy for intercultural operations.

Gajendra Sing and Gyanendra Singh, (1996) [9], observed that traditionally, earthing operation in potato, Sugarcane and other crops is performed using khurpy, spade or country plough. Now bullock operated cultivator furrower, bund former and ridger are available which are effective and cover more area. Sexena, (1995) [7] reported that the most of the sample farmers in Naman village of Gujarat utilized bullock power only for intercultural operation in various crops.

Transportation

Transportation of harvested raw farm produce, from farm to threshing yard, for the threshing and farm to market yard and other minor transportation were carried by farmers. It was seen that transportation operation carried out with the help of own bullock energy i.e. other than tractor; i.e. marginal categories 31.67 per cent, small category 63.33per cent, medium category 80.00 per cent and large category 66.67 per cent. Commonly use of bullock energy for transportation in surveyed village they were about 60.62 per cent. An average about 22.50 per cent of respondents was used hired bullock energy for transportation. An average about 10.83 per cent of farmers were depend solve on tractors to carry the transport operation. Overall 6.25 per cent farmer's utilized bullock as well as tractor energy for transportation operations Akila and Chander, (2009) [1] reported similar trend in small (25.71%), medium (35.17%), large farmers (4.29%) and the overall farmers (21.9%) utilizing their bullocks for carting mainly for transportation.

Total working and non-working days of bullock pairs

The various agricultural operations carried out by farmers with source of animal energy particularly by own bullock pair either for own land cultivation or bullock pair given to other on hired basis was considered for calculation of total working and non working days in a year.

The data on total working and non working days of bullock pair in a year under different categories of farmer were complied, tabulated and subjected to unequal CRD and results are presented in Table 4. Highest bullock pair average annual working days was recorded in marginal category farmers i.e. 62.85 ± 3.28 days, followed by small, medium and large categories which were 56.40 ± 5.96, 53.64 ± 4.11 and 52.21 ± 4.59 days, respectively. While that of non-working days of bullock pairs from marginal, small, medium and large categories farmers were 302.15 ± 3.28, 308.59 ± 5.96, 311.36 ± 4.11 and 312.78 ± 4.59 days respectively. Overall working and non-working days of bullocks recorded as 56.21 ± 4.43 and 308.73 ± 4.43 days, respectively.

Table 4: Average working and non- working days of bullock pairs in different categories of farmers

Parameter / Cate. of farmer	Working days	Non- working days
Marginal	62.8[a]	302.15 [b]
Small	56.40[b]	308.59 [a]
Medium	53.64 [b]	311.36 [a]
Large	52.21 [b]	312.78 [a]
SE ±	1.47	1.43
CD at 5 %	4.54	4.42
Grand Mean	56.21	308.73

Means having different superscripts shows significant differences

The Table 4 revels that there were significant (p>0.05) differences in working days of bullocks recorded in marginal farmers (62.8 days) over small(56.40),medium (53.64) and large farmers (52.21), whereas working days recorded in small, medium and lare farmers were at par with each other. The working and non-working days recorded in present study was more or less similar with Mali, (2014) [2] and More, (2014) [6]. Saxena, (1995) [7] who reported utilization of pair of bullocks in India at the district level varies from 44 to 185 days in year.

Constraints for utilization of draught animals under existing field condition

Farmers facing the problems in keeping and maintenance of bullock pair as well as their utilization were assessed. Feedback regarding constraints was taken and total 8 constraints were put forth before them with full freedom of multiple options and data regarding same is presented in Table 5.

It was observed that, out of total respondent 87.50 per cent farmers opined that maintenance of bullock pair with wages of hired labour to be paid in a year are becoming more or some time, it is beyond the affordable limit particularly in rainfed farming at 1st rank. The second constraint was opined by 70.83 per cent total respondents as Price of the bullock-pairs gets increased. Out of total respondents 61.67 per cent farmer raised the constraints at 3rd rank and reported opinion that there is not sufficient work on field to engage hired labour with maintaining bullock pair throughout a year.

Table 5: Constraints in utilization of draught animal power

Sr. No.	Constraints	Marginal	Small	Medium	Large	Total	Rank
1	Insufficient availability of land for bullock pairs	60 (100)	60 (100)	13 (21.66)	08 (13.33)	141 (58.75)	V
2	Price of the bullock-pairs gets increased	60 (100)	55 (91.67)	35 (58.33)	20 (33.33)	170 (70.83)	II
3	Availability of land is sufficient but for keeping maintenance of bullock pair is higher	00 (00)	18 (30.00)	48 (80.00)	55 (91.66)	121 (50.41)	VII
4	Maintenance of bullock pair and charges of hired labour throughout year are not affordable	60 (100)	58 (96.66)	52 (86.66)	40 (66.66)	210 (87.50)	I
5	Farming with bullock pair and bullock drawn implement become time consuming leads to more expenditure	14 (23.33)	22 (36.66)	53 (88.33)	56 (93.33)	145 (60.41)	IV
6	Maintenance of bullock pair is possible but non availability of hired labour throughout year	00 (00)	20 (33.33)	53 (88.33)	58 (96.66)	131 (54.85)	VI
7	Non availability of sufficient work to hired labour with maintaining bullock pair throughout year	58 (96.66)	55 (91.66)	25 (41.66)	10 (16.66)	148 (61.66)	III
8	Maintenance of bullock pair is possible but work efficiency of hired labour throughout year is not satisfactory	00 (00)	08 (13.33)	32 (53.33)	45 (75.00)	85 (35.42)	VIII

Note: n=60 for each category of farmers, Total N= 240, figures in parenthesis indicates the percentage to the total

Farming with bullock pair and bullock drawn implement become time consuming leads to more expenditure, this constraint of 4th rank was opined by 60.61 per cent of total respondents. Sufficient land is not available for keeping bullock pair is constraint with 58.75 per cent respondents by 5th rank. Whereas, maintenance of bullock pair is possible but hired labour is unavailable becomes a constraint opined by 54.85 per cent respondent farmers. Land is sufficient but day by day maintenance of bullock pair become expensive, this constraint reported by 50.41 per cent respondent farmers. Maintenance of bullock pair is possible but work efficiency of hired labour throughout year is not satisfactory constraints observed in 35.42 per cent of total respondent farmers. Kawuyol *et al.,* (2012) [3] also reported the main constraints in utilization of draught animal power as lack of feed resources (65% farmer), lack of village level repair services and spare parts, availability of advanced implements and inadequate training of animals.

Conclusion

It can be concluded from present investigation that, the status of bullock pair ownership is declining particularly in marginal and small farmers due to fragmentation of land holding and slowly it is making towards medium and large farmers group. Mechanical energy was being accepted for hard and heavy tillage operations as well as threshing operation instead of animal energy where as drilling, intercultural, transportation operations are carried out by animal energy though they were time consuming. Acreage per draught animal pair was highest in large farmer followed by medium and small farmers where as lowest in marginal farmer. Constraints in utilization of animal draught power was mostly farming with bullock become time consuming and leads to more expenditure, maintenance cost of bullocks round the year with cost of hired labour are not affordable and increased price of bullock pair.

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