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Utilization of bullock animal power and constraints faced by farmers in Hingoli district

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Abstract
The place of bullock animal power on farms in tropical agriculture is discussed. In some areas of the world bullock animal power is traditional, in others it is a relatively new technology. The present study was conducted in Hingoli district of Marathwada region of Maharashtra. It is one of the eight districts of Marathwada. It is located at eastern site of Maharashtra state. On average 65.41 farmer had their own bullock pair for agricultural operation. The study showed that farmers used draft animals for ploughing, harrowing, Drilling, intercultural, operation and transportation. 61.66% of the farmers used draft animals for ploughing, 60.00% for harrowing, 57.66% for Drilling, 60.41% for intercultural operation and 58.75% for transportation. Highest bullock pair average annual working days was recorded in marginal farmers i.e. 79.78±8.38 days. Major constraints reported by farmer are 80.00 per cent farmers opined that farming with bullock pair and bullock drawn implement become time consuming leads to more expenditure. Major suggestion reported by farmers are 92.91 per cent farmers suggested that cost of newly innovated implement should be affordable.

Keywords: Bullock, power, utilization, marginal farmer, constraints, suggestions

Introduction
Livestock sector alone contributes nearly 25.6 per cent of value of output at current price of total output in agricultural, fishing and forestry sector. The overall contribution of livestock sector in total GDP is nearly 4.11 at current price during 2012-2013. There are 190.9 million cattle out of which nearly 151.17 million indigenous and 39.73 million crossbreds (Anonymous 2012) [5]. The use of DAP varies from one area to another depending on the historical background, farmers attitudes and incidence of livestock disease (Kumwenda, 2000) [10]. Agricultural Engineering branch (AGSE) reported that even in highly developed European Union, animal power remains important in Spain, Portugal and Greece where farms are of small size and in the United States Amish farmers run their farms profitably using only animal power. Guthega *et al.* (2007) [9] reported that use of DAP resulted in higher yields at a higher economic efficiency of smallholder maize producers in central Kenya. DAP in India: The Working Group on Animal Husbandry and Dairying, 11thfive- year plan (2007- 12) reported Zebu cattle (*Bos indicus*) and buffalo (*Bubalus bubalis*) were major sources of draught animals in India. Fully-grown Zebu draught cattle provide 0.5 HP and one draught cattle pair cultivates about 0.33 ha land in six hours of working per day.

Materials and methods
The present study was conducted in Hingoli district of Marathwada region of Maharashtra. The multistage sampling technique was used to select district, tahsils, and village. The present study was conducted in Hingoli district of Marathwada region of Maharashtra. There are total five tahsils in Hingoli district out of which four tahsil Basmat, Aundha, Shengaon, Kalmnuri were selected purposively. From each taluka five villages were selected. Randomly 3 farmers from each category of (a) marginal, (b) small, (c) medium and (d) large were selected from each village. Thus, data of 240 farmers were collected and recorded by taking interview.

Result and discussion
Status of bullock in different categories of farmers
The present study availability of bullock pair in various categories of farmers was assessed and data is given in Table 1.that only 63.33 per cent farmers from marginal categories have their own bullocks, while remaining small, medium and large categories of farmer possessed bullocks having 41.66, 75.00 and 81.66 per cent, respectively.

On an average about 65.41 per cent farmer have their own bullocks for agricultural operation. Status of bullock in different categories of farmer in present investigation are similar well in accordance with the earlier worker by Wagh (2015) [17] and Gadekar *et al.* (2017a) [7]. It was also observed that few farmers were having single bullocks and used them on sharing basis.

Table 1: Status of bullock pair in different categories of farmer

Cate. of farmer\Blocks	Marginal		Small		Medium		Large			Total
	Possess bullocks	Haveno bullocks	Possess bullocks	Have No Bullocks	Possess bullocks	Haven obul locks	Possess bullocks	Haven obul locks	Possess bullocks	Haven obul locks
Block – I	05	10	04	11	15	00	14	01	38 (63.33)	22 (26.66)
Block-II	12	03	09	06	11	04	10	05	42 (70.00)	18 (30.00)
Block-III	10	05	05	10	07	08	14	01	36 (60.00)	24 (40.00)
Block-IV	11	04	07	08	12	03	11	04	41 (68.33)	19 (36.66)
Total	38 (63.33)	22 (36.66)	25 (41.66)	35 (58.33)	45 (75.00)	15 (25.00)	49 (81.66)	11 (18.34)	157 (65.41)	83 (34.59)

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

Bullock animal intensity (ha/animal pair) in different categories farmers

Bullock animal intensity (ha/animal pair) in different categories of farmers Bullock animal intensity defined as inverse of bullock animal pair per unit net area i.e. average area to be cultivated by a pair of animals (ha/animal pair). This has been expressed to access the average availability of bullock animal in different categories of farmer in surveyed area and result are presented in Table 2.categories of farmer in surveyed area and result are presented in Table 2. Data pertinent to the bullock animal intensity in surveyed area reveals that acreage per bullock animal pair was highest in large farmer (9.59 ± 1.62 ha. per animal pair) followed by medium (3.33 ± 0.30 ha. per animal pair), small (1.67 ±0.012 ha. per animal pair) whereas lowest in marginal farmer (0.78 ± 0.043 ha. per animal pair).

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

Categories\Block	Marginal	Small	Medium	Large	Average
B–I	0.70±0.045(05)	1.85 ± 0.058(04)	2.50± 0.068(15)	12.40 ± 1.46(14)	4.36± 0.40(38)
B-II	0.65 ± 0.037(12)	1.70 ± 0.09(09)	3.50 ± 0.83(11)	8.33 ± 3.31(10)	3.54 ± 1.06(42)
B-III	0.85 ± 0.013(10)	1.40 ± 0.03(05)	3.40 ± 0.23(07)	10.40 ± 1.28(14)	4.01± 0.38(36)
B-IV	0.90 ± 0.080(11)	1.71 ± 0.32(07)	3.90 ± 0.083(12)	7.24 ± 0.45(11)	3.45± 0.23(41)
Mean	0.78 ± 0.043(38)	1.67 ± 0.012(25)	3.33 ± 0.30(45)	9.59 ± 1.62(49)	3.87 ±0.59(157)

(**Note:** Figures in parenthesis indicates the no. of farmers having own bullock 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 1999a)[16]. But the present findings were more than optimum. Acreage per drought animal pair in India was 3.67 ha per animal pair, whereas in Maharashtra was 5.10 ha per animal pair in 1992 reported by Singh 1999[a] [16]. Therefore, in present investigation of Hingoli district the acreage per draught animal pair (3.87 ± 0.59 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. The results were agreed with those of Wagh (2015) [17].

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. Sources are presented in Table 3. From Table 3. It was observed that, out of total respondent on an average 61.66 per cent of total farmers were ploughing by own bullock pair only. In case of individual categories of farmer, 81.66 per cent large farmers followed by 70.00 per cent medium, 58.33 per cent marginal and 36.66 per cent small farmers rely on own bullock pair only. None of the farmer had taken source of hired bullock power whereas; tractor power and combine (bullock + tractor) utilized by 35.83 and 2.6 per cent, respectively of total respondent farmers. Harrowing operation was carried out by only own bullock pair power observed in 60.00 per cent overall farmer respondents, followed by 34.16 per cent overall farmers completed the operation with the help of tractor. Whereas 4.58 per cent of the total farmers rely on hired bullock pair source and 1.26 per cent used tractor and bullock power combined source of energy. Most of farmer depends on animal power energy source for harrowing operation. This might be due to that this operation is comparatively lighter operation than ploughing so available energy source was preferred. Operation like drilling was completed by the farmers using different energy sources like own bullock pairs, hired bullock pairs, tractor and bullock or tractor contributed as 36.66, 60.00, 23.33 and 16.66 per cent, respectively. Intercultural operations completed by the farmers using different energy sources like own bullock pairs, hired bullock pairs, and bullock or tractor which contributed to 60.41, 4.58 and 35.01 per cent, respectively. None of the farmer had taken source of tractor power for intercultural operations. Transportation operation carried out by the farmer using different sources like own bullock pairs, hired bullock pairs, tractor and bullock or tractor which contributed to 58.75, 5.41, 3.33 and 2.6 per cent, respectively. For threshing operations none of the respondent was found utilizing own bullock pairs, hired bullock pairs, and bullock or tractor energy for threshing of farm produce, but threshing operations completed the farmers by using thresher machine.

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

	A) By own bullock pair						B) By Hired bullock pair				
Sr. No.	**Categories\Operations**	**Marginal**	**Small**	**Medium**	**Large**	**Total**	**Marginal**	**Small**	**Medium**	**Large**	**Total**
1	Ploughing	35 (58.33)	22 (36.66)	42 (70.00)	49 (81.66)	148 (61.66)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)
2	Harrowing	34 (56.66)	23 (38.33)	40 (66.66)	47 (78.33)	144 (60.00)	03 (05.00)	02 (3.33)	04 (6.66)	02 (3.33)	11 (4.58)
3	Drilling	32 (76.66)	19 (31.66)	40 (66.66)	46 (76.66)	137 (57.08)	04 (6.66)	05 (8.33)	05 (8.33)	04 (6.66)	18 (7.5)
4	Intercultural	34 (56.66)	23 (38.33)	41 (68.33)	47 (73.33)	145 (60.41)	03 (5.00)	02 (3.33)	04 (6.66)	02 (3.33)	11 (4.58)
5	Transportation	35 (58.33)	19 (31.66)	41 (68.33)	46 (76.66)	141 (58.75)	02 (3.33)	04 (6.66)	03 (5.00)	04 (6.66)	13 (5.41)
6	Threshing	00 (00)	00 (00)	00 (00)	00 (00)	00 (00.00)	00 (00)	00 (00)	00 (00)	00 (00)	00 (00)

	C) By tractor						D) By Bullock + Tractor				
Sr. No.	**Categories\Operations**	**Marginal**	**Small**	**Medium**	**Large**	**Total**	**Marginal**	**Small**	**Medium**	**Large**	**Total**
1	Ploughing	22 (36.66)	37 (61.66)	16 (26.66)	11 (18.33)	86 (35.83)	03 (5.00)	01 (1.66)	02 (3.33)	00 (00.00)	06 (2.6)
2	Harrowing	21 (35.00)	35 (58.33)	15 (25.00)	11 (18.33)	82 (34.16)	02 (3.33)	00 (00.00)	01 (1.66)	00 (00.00)	03 (1.26)
3	Drilling	22 (36.66)	36 (60.00)	14 (23.33)	10 (16.66)	82 (34.16)	02 (3.33)	00 (0.00)	01 (1.66)	00 (00.00)	03 (1.26)
4	Intercultural	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	23 (10.00)	35 (58.33)	15 (25.00)	11 (18.33)	84 (35.01)
5	Transportation	22 (36.66)	33 (55.00)	15 (25.00)	10 (16.66)	80 (33.33)	01 (1.66)	04 (6.66)	01 (1.66)	00 (0.00)	06 (2.6)
6	Threshing	00 (00.00)	00 (00.00)	00 (0.00)	00 (0.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)

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

Total working and non-working days of bullock pairs

The various agricultural operation 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. Data regarding this is presented in Table 4. (a) Highest bullock pair average annual working days was recorded in large categories farmer i.e. 118.66 ± 8.18 days, followed by medium, small and marginal categories were 101.52 ± 6.13, 81.14 ± 6.7 and 79.78 ± 8.38 days, respectively. While that of non-working days of bullock pairs from marginal, small, medium and large categories farmers were 285.23 ± 8.38, 284.84 ± 6.7, 262.23 ± 6.13 and 246.35 ± 8.18 days, respectively. Working days recorded in present study from 118.66 to 79.78 days (i.e. highest in large farmers and lowest marginal farmers). These findings are well corroborated with the reports of Shanmungam (1993) [15] he reported that in crop production, bullock pairs were employed for 60 to 86 days per year, which increased with farm size. Haque *et al.* (2000) [12] also reported working periods of bullock animals ranged from three to five months annually. Mishra and Pandey (2000)[13] also reported that the bullocks have been use on an average 18.2 days during *Karif* and 39.5 days in *rabbi* season for ploughing/ cultivation. Wagh (2015) [17] and Gadekar *et al.* (2017a) [7] also reported similar findings with the present study. 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. (b).

Table 4a): Working and non-working days of bullock pairs

Categories\ Block	Marginal		Small		Medium			Large	Mean	
	Working Days	Non-Working days	Working days	Non-working days	Working Days	Non-Working days	Working days	Non-working days	Working days	Non-Working days
B I	91.30±4.02 (05)	273±4.02 (05)	66.5±4.02 (04)	298.5±4.02 (04)	95.02±9.2 (15)	264.98±9.2 (15)	93.30±11.00 (14)	271±11.00 (14)	79.78±8.38 (38)	285.23±8.38 (38)
B II	83.10±6.08 (12)	281.9± 6.08 (12)	73.20±7.5 (09)	291.8±7.5 (09)	110.05±3.2 (11)	244.95±3.2 (11)	108±9.3 (10)	257±9.3 (10)	81.14±6.7 (42)	284.84±6.7 (42)
B III	78.40±10.00 (10)	286.6. ± 10.00 (10)	88.32±4.3 (05)	271.68±4.3 (05)	80.70± 8.01 (07)	284.3±8.01 (07)	130±2.12 (14)	235±2.12 (14)	101.52±6.13 (36)	262.23±6.13 (36)
B IV	66.3±2.01 (11)	293.7±2.01 (11)	71.2±5.70 (07)	272.4±5.70 (07)	120.30±3.3 (12)	244.7±3.3 (12)	143.32±10.3 (11)	221.68±10.3 (11)	118.66±8.18 (41)	246.35±4.87 (41)
Mean	79.78±8.38 (38)	285.23±8.38 (38)	81.14±6.7 (25)	284.84±6.7 (25)	101.52±6.13 (45)	262.23±6.13 (45)	118.66±8.18 (49)	246±8.18 (49)	95.28±8.18 (157)	269.72±4.87 (157)

(**Note:** Number in parenthesis indicates no. of bullock pair owner)

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

Parameter\Cate. of farmer	Working days	Non-working days
Marginal	79.78^{a}	285.23^{a}
Small	80.14^{a}	284.84^{a}
Medium	101.52^{ab}	262.23^{ab}
Large	118.66^{b}	246.35^{b}
SE ±	8.135	8.077
CD at 5%	25.06	24.8911
Grand Mean	95.28	269.72

(Significant (p<0.05) differences are shown having different superscripts within a column)The 4 (b) revels significant (P<0.05) difference in working and non-working days of bullock pair between marginal, small and medium categories of farmers, whereas working and non-working days in large farmers were significant (P<0.05) with marginal and small farmer and at par with medium farmer. The working days and non-working days recorded in present study was contradictory with the result of Wagh (2015) [17] and Gadekar *et al.* (2017a) [7], they reported highest working days in marginal farmer and lowest in large farmers. Akila and Chander (2009) [2, 3] that the lean day for small farmer were 144.46 days, 208.84 days for medium farmer and 318.39 days for large farmer.

Constraints for utilization of bullock animals under existing field condition

Farmers facing the problems in keeping and maintenance of bullock pair as well as their utilization were assessed and data regarding same is presented in Table 5. From Table 5.out of

total respondents 34.59 per cent farmers were not bullock pair owner and 65.41 per cent farmers were cultivating their land with possessing bullock pair. These both types of farmers were facing to some extent same constraints in utilization of bullock animal power. 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 it is observed that, out of total respondent 80.00 per cent farmers opined that farming with bullock pair and bullock drawn implement become time consuming leads to more expenditure. The second constraint was opined by 77.08 per cent total respondents as maintenance of bullock pair and charges of hired labour throughout year are not affordable. Out of total respondents 62.08 per cent farmer opined the insufficient availability of land for bullock pair this constraint at 3rd rank. Non availability of sufficient work to hired labour with maintaining bullock pair throughout year of 4th rank was opined by 57.91 per cent of total respondents. Price of the bullock-pairs gets increased constraint with 57.09 per cent respondents by 5th rank. Availability of land is sufficient but for keeping maintenance of bullock pair is higher becomes a constraint opined by 42.05 per cent respondent by 6th rank. Maintenance of bullock pair is possible but non availability of hired labour throughout year this constraint was reported by 31.25 per cent respondent farmers. Maintenance of bullock pair is possible but work efficiency of hired labour throughout year is not satisfactory constraints observed in 22.05 per cent of total respondent farmers having last rank. Late start of monsoon, long dry spell, early withdrawal of monsoon or reduction in number of rainy days were some constraints regarding rainfall, a natural source essential for farming. Either one of them is disturbing the planning of most of the rainfed farmers. Under such varied situation every farmer has to sustain with adoption of accurate and timely operations but available resources with all farmers were not at optimum level. Secondly, farming with animal and human worker's efficiency require not only more time for completion of various operations comparatively than mechanical power but also leads to more expensive. Day by day cost of feed, fodder, medicines and veterinary services is increasing and wages of hired labour also at inclining rate were some of serious issues faced by farmers. This might be the reason to some extent for adoption of practice particularly in rainfed farming to cultivate the land by hiring required bullock, labour and mechanical power as and when necessary. Constraints observed in present study were in supporting with Wagh (2015) [17] and Gadekar *et al.* (2017b) [8]. Bhoite and Deokar (2004) [6] who reported constraints in draught animal power utilization as need to design and develop efficient cart to improve draft ability and to reduce health hazards of the draft animals, limitation of land availability to grow fodder crops for feeding the animals and draft animals were used for a short period only in a year during farm operations but they have to feed for entire period.

Table 5: Constraints in utilization of bullock animal power

Sr. No.	Constraints	Marginal (n= 60)	Small (n= 60)	Medium (n= 60)	Large (n= 60)	Total (N= 240)	Rank
1	Insufficient availability of land for bullock pairs.	53 (88.33)	52 (86.66)	32 (53.33)	12 (20.00)	149 (62.08)	III
2	Price of the bullock-pairs gets increased.	56 (93.33)	42 (70.00)	23 (38.33)	18 (30.00)	139 (57.09)	V
3	Availability of land is sufficient but for keeping maintenance of bullock pair is higher.	02 (3.33)	20 (33.33)	38 (63.33)	42 (70.00)	102 (42.05)	VI
4	Maintenance of bullock pair and charges of hired labour throughout year are not affordable.	53 (88.33)	48 (80.00)	32 (53.33)	52 (86.66)	185 (77.08)	II
5	Farming with bullock pair and bullock drawn implement become time consuming leads to more expenditure.	41 (68.33)	45 (75.00)	49 (81.66)	57 (95.00)	192 (80.00)	I
6	Maintenance of bullock pair is possible but non availability of hired labour throughout year.	09 (15.00)	12 (20.00)	33 (55.00)	21 (35.00)	75 (31.25)	VII
7	Non availability of sufficient work to hired labour with maintaining bullock pair throughout year.	44 (73.33)	29 (48.33)	38 (63.33)	28 (46.66)	139 (57.91)	IV
8	Maintenance of bullock pair is possible but work efficiency of hired labour throughout year is not satisfactory.	11 (18.33)	07 (11.66)	23 (11.66)	13 (21.66)	54 (22.05)	VIII

(**Note:** Figure in parenthesis indicates the percentage to the total.)

Suggestions from farmers regarding efficient utilization of bullock animal power

In present investigation suggestions from respondent farmers regarding efficient utilization of bullock animal power were invited and data regarding same is presented in Table 6. From Table 6. it was observed that, 92.91 per cent farmers suggested that cost of newly innovated implement should be affordable; this suggestion was ranked 1st. Whereas, 2nd rank suggestion was with minimum/minor changes/ fittings single implement useful for many operations, this suggestion was reported by 90.00 per cent respondents. Innovated machines, implements should be repaired by local workers, this suggestion was reported at third rank by 87.5 per cent total respondents. For intercultural operations single bullock drawn implement should be innovated, this suggestion was reported at fourth rank by 78.75 per cent total respondents. To create the implement according to size and drafting capacity of bullock this opinion pointed by 50.83 per cent respondents. Out of total 44.58 per cent respondents suggested to create bullock drawn machine for crop harvesting and threshing. To create new animal power operated spraying machine this suggestion was suggested by 41.25 per cent total respondent farmers and having last ranked. More or less similar findings were also observed by Wagh (2015) [17] and Gadekar *et al.* (2017a) [7].

Table 6: Suggestions given by farmers for increasing utilization of bullock animal power in the farm operation

Sr. No.	Suggestions	Marginal (n=60)	Small (n=60)	Medium (n=60)	Large (n=60)	Total (N=60)	Rank
1	To create single bullock drawn implements for intercultural operations.	53 (88.33)	52 (53.33)	48 (80.00)	36 (60.00)	189 (78.75)	IV
2	To create the implements according to size and drafting capacity of bullock.	29 (48.33)	32 (88.33)	23 (38.33)	38 (63.33)	122 (50.83)	V
3	With minimum/ minor changes/ fittings single implement useful for many operations.	48 (80.00)	55 (91.66)	56 (93.33)	57 (95.00)	216 (90.00)	II
4	Newly innovated implement should be repaired by local workers.	49 (81.66)	49 (81.66)	53 (88.33)	59 (98.33)	210 (87.5)	III
5	Cost of newly innovated implement should be affordable.	56 (93.33)	53 (88.33)	59 (98.33)	48 (80.00)	223 (92.91)	I
6	To create new animal power operated spraying machine.	21 (35.00)	18 (30.00)	23 (38.33)	55 (92.66)	99 (41.25)	VII
7	To create bullock drawn machine for crop harvesting and threshing.	18 (30.00)	12 (20.00)	33 (55.00)	44 (44.58)	107 (44.58)	VI

(**Note:** Figure in parenthesis indicates the percentage to the total.)

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