RESEARCH ARTICLE

Influence of Ageing and Regional Differences on Draught Performance of Umblachery Cattle

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Abstract

An attempt was made to assess the effects of aging, regional differences, and draught load applied on draught potential of Umblachery cattle, an important draught breed of South India. Age had a highly significant effect ($p < 0.01$) on all morphometric traits, stride length, and significant effect ($p < 0.05$) on pulse rate after work. The middle age group (5.0–7.5 years) with more substantial stride length was identified as the critical productive age group for draught ability. Regional differences had a highly significant ($p < 0.01$) influence on stride length, horsepower, and a significant effect ($p < 0.05$) on pulse rate after work. The optimum draught load with which Umblachery breed could give uniform and maximum power output was found to be around 75 to 78 kg.

Keywords: Aging, Draught ability, Optimum draft load, Regional variations, Umblachery

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Introduction

Draught animal power (DAP) is a sustainable, eco-friendly, and renewable resource of energy worldwide. Besides being highly persistent and important among small-scale farmers and local transport systems in developing countries, it is continuously diversifying in developed countries. Shisode *et al.* (2010) estimated that DAP saved 20 million tonnes of petroleum per year in India. Well-managed animal power is an excellent clean energy alternative for coal and natural gas, yet it remains as a forgotten solution. Also, with the upcoming effects of global warming, the risk of increased rainfall and rise in sea level, draught animals that are able to maintain thermal balance, best suited for wet ploughing and that can produce a better work output is the need of the hour. Ensuring the economic viability of maintaining draught animals by the farmers is of utmost importance. Aging is a sequential change in the life cycle that is associated with significant systemic changes in the body and affects the physical performances. Rautaray (1987) opined that draught performance of bullocks cannot be generalized from one soil-climatic situation to another and emphasized on the need to study the influence of climate in work output. Singh and Singh (2009) identified the age group of 4.5–12 years to be critical to derive maximum work output in four Malvi cattle and four crossbred oxen under farming conditions. Hence, we made an attempt to determine the productive age of Umblachery bullocks in terms of draught ability, the optimum draft load that can be applied to obtain continuous maximum output, and the impact of regional differences.

Materials and methods

The Umblachery cattle breed, one of the significant draught breed of South India distributed in its native tract of Thanjavur, Thiruvarur and Nagapattinam districts of Tamil Nadu, was chosen for the study. Minimum and maximum temperatures recorded in these districts were 20.83 and 37.48, 26.39 and 35.19, and 24.60 and 32.00 °C, respectively (www.tnenvis.nic.in). Similarly, the rainfall received during the south-west and north-east rainy seasons in these districts were 303.1 and 953.2, 532.5 and 1118.8, and 250.5 and 969.2 mm, respectively.

To assess the draught performance of the cattle parameters like speed of ploughing, stride length, and horsepower generated during ploughing were recorded in 86 bullocks (43 pairs) to estimate the draught power. The speed of walking was calculated by measuring the time taken to cover a particular distance (varied from 15 to 60 m according to the partitioning of paddy fields), and stride length was measured by dividing the distance covered with the number

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of strides taken. Horsepower generated was estimated using the technique described by Maurya and Devadattum (1982). The pull (in kg) was directly measured using spring balance. The draught was calculated by multiplying the pull in kg by Cosθ, where Cosθ is the angle the beam of plow makes with the horizontal ground. The formula used was Horsepower = (Draught x Speed m/s)/75. One horsepower is equivalent to 746 watts.

In addition, physiological parameters *viz*. pulse rate, respiration rate and rectal temperature were also recorded in animals before and after work. Morphometric traits like chest girth, body length, height at withers and body weight were also measured in 112 bullocks.

Age of the bullocks was classified into three classes as, young age - group I (2.5 to 4.5 years); middle age - group II (5.0 to 7.5 years); and old age - group III (8 to 12 years). Region was considered a fixed effect for all the traits measured. Bodyweight was included as a covariate for all characteristics. The intersection curve was drawn with speed, draught load, and horsepower, to understand the effect of drought load on power output. Single trait analyses were done by fitting a general linear model (GLM) to study the effects of age and regional differences on each trait. Pair-wise comparison for sub-class means were done by Tukey and Duncan's Multiple Range Tests (Snedecor and Cochran, 1989).

Results and discussion

The results of a least-squares analysis of variance for the effects of age and regional differences on morphometric, physiological, and draught ability parameters are given in Tables 1, 2, and 3, respectively.

Age-Associated Influence

Our study contributes to understanding the productive age group of bullocks. Data show that morphometric parameters, body length, chest girth, height, and body weight increase with age and all the parameters were significantly higher in age group II and III as compared to age group I. Age group had highly significant ($p < 0.01$) effect on all the morphometric traits, with animals below 4.5 years of age having lower values

Table 1: Least-squares means of morphometric traits in Umblachery bullocks (Mean ± SE)

Effects	*n*	*Body length (cm)*	*Chest girth (cm)*	*Height at withers (cm)*	*Body weight (kg)*
Overall mean (μ)	112	120.21 ± 0.89	151.92 ± 1.04	123.94 ± 0.72	273.4 ± 5.08
Region		NS	NS	NS	NS
Thanjavur	36	120.67 ± 1.45	152.47 ± 1.69	125.97 ± 1.16	276.00 ± 8.23
Thiruvarur	44	119.52 ± 1.46	151.91 ± 1.70	123.31 ± 1.17	272.67 ± 8.30
Nagapattinam	32	120.43 ± 1.41	151.40 ± 1.65	122.54 ± 1.13	271.52 ± 8.02
Age		**	**	**	**
2.5 to 4.5 years (Group I)	51	116.44^{a} ± 1.15	141.19^{a} ± 1.34	118.60^{a} ± 0.92	227.41^{a} ± 6.54
5 to7.5 years (Group II)	47	120.77^{b} ± 1.19	156.43^{b} ± 1.39	125.24^{b} ± 0.96	288.35^{b} ± 6.76
8 to 12 years (Group III)	14	123.42^{b} ± 2.25	158.15^{b} ± 2.62	127.99^{b} ± 1.81	304.43^{b} ± 12.78

n - Number of observations; *Significant ($p < 0.05$); **Highly significant ($P < 0.01$); NS - Not significant
Means with at least one common superscript within classes do not differ significantly.

Table 2: Least-squares means of physiological parameters in Umblachery bullocks before and after ploughing (mean ± SE)

	Heart rate (/min)		*Pulse rate (/min)*		*Respiration rate (/min)*		*Rectal temperature (˚C)*	
Effects	*Before work*	*After work*	*Before work*	*After work*	*Before work*	*After work*	*Before work*	*After work*
Overall mean (μ)	77.51 ± 2.44 (96)	90.01 ± 2.44 (94)	74.02 ± 2.15 (66)	86.31 ± 2.19 (62)	23.56 ± 0.72 (92)	29.18 ± 1.06 (94)	38.4 ± 0.1 (78)	39.3 ± 0.1 (72)
Region/Dist	NS	NS	NS	*	NS	NS	NS	NS
Thanjavur	72.65 ± 4.21 (26)	85.80 ± 4.10 (28)	74.61 ± 3.47 (25)	79.10^{a} ± 3.59 (23)	24.55 ± 1.27 (24)	31.37 ± 1.77 (28)	38.6 ± 0.1 (23)	39.3 ± 0.1 (23)
Thiruvarur	82.36 ± 3.88 (38)	93.82 ± 4.02 (34)	73.17 ± 3.75 (25)	85.93^{ab} ± 3.87 (23)	22.74 ± 1.15 (36)	27.52 ± 1.74 (34)	38.4 ± 0.11 (33)	39.4 ± 0.1 (28)
Nagapattinam	77.51 ± 3.48 (32)	90.40 ± 3.48 (32)	74.28 ± 4.04 (16)	93.88^{b} ± 4.07 (16)	23.40 ± 1.01 (32)	28.65 ± 1.50 (32)	38.4 ± 0.11 (22)	39.3 ± 0.1 (21)
Age	NS	NS	NS	*	NS	NS	NS	NS
2.5 to 4.5 years (Group I)	78.37 ± 2.92 (47)	91.97 ± 3.01 (43)	78.03 ± 2.78 (34)	91.97^{b} ± 2.89 (31)	24.23 ± 0.88 (45)	28.99 ± 1.30 (43)	38.6 ± 0.1 (38)	39.3 ± 0.1 (38)
5 to7.5 years (Group II)	76.34 ± 3.24 (37)	88.68 ± 3.18 (39)	68.76 ± 3.52 (22)	80.77^{a} ± 3.61 (21)	22.32 ± 0.97 (35)	29.48 ± 1.37 (39)	38.4 ± 0.1 (32)	39.1 ± 0.1 (28)
8 to 12 years (Group III)	77.81 ± 6.12 (12)	89.37 ± 6.13 (12)	75.28 ± 5.49 (10)	86.18^{a} ± 5.53 (10)	24.14 ± 1.79 (12)	29.08 ± 2.65 (12)	38.4 ± 0.2 (8)	39.5 ± 0.2 (8)

Figures in parentheses indicate number of observations; *Significant ($p < 0.05$); NS–Not significant.
Means with at least one common superscript within classes do not differ significantly.

Table 3: Least-squares means of draughtability parameters measured in Umblachery bullocks during ploughing

Effects	*Stride length (m)*		*Speed (m/s)*		*Horse power (hp)*	
	n	*Mean ± SE*	*n*	*Mean ± SE*	*n*	*Mean ± SE*
Overall mean (μ)	86	1.20 ± 0.21	86	0.95 ± 0.03	86	0.39 ± 0.04
Region		**		NS		**
Thanjavur	28	1.26^{b} ± 0.21	28	0.96 ± 0.05	28	0.53^{b} ± 0.06
Thiruvarur	30	1.28^{b} ± 0.39	30	0.95 ± 0.05	30	0.47^{b} ± 0.06
Nagapattinam	28	1.06^{a} ± 0.40	28	0.93 ± 0.05	28	0.18^{a} ± 0.06
Age		**		NS		NS
2.5 to 4.5 years (Group I)	41	1.19^{b} ± 0.31	36	0.95 ± 0.04	36	0.31 ± 0.05
5 to7.5 years (Group II)	33	1.29^{b} ± 0.35	38	0.96 ± 0.04	38	0.38 ± 0.05
8 to 12 years (Group III)	12	1.02^{a} ± 0.06	12	0.93 ± 0.08	12	0.49 ± 0.09

n–Number of observations; hp - one hp is equivalent to 746 watt
**Highly significant ($p < 0.01$); NS – Not significant.
Means with at least one common superscript within classes do not differ significantly.

of body length (116.44 ± 1.15 cm), chest girth (141.19 ± 1.34 cm), height at withers (118.60 ± 0.92 cm) and body weight (227.41 ± 6.54 kg) compared to those above 5 years (Groups II and III).

Bullocks belonging to younger age had significantly ($p < 0.05$) higher pulse rate after work than other age groups. Singh *et al*. (2009) identified an increase in respiration rate, pulse rate, and body temperature in Malvi bullocks after work. Vinoo *et al*. (2010) identified the influence of age group on the percent increase in respiration rate and rectal temperature in Ongole bullocks after work, which were not found to be influenced by age in this study.

The stride length in Umblachery bullocks was highly significantly ($p < 0.01$) influenced by the age. Bullocks of 2.5 to 7.5 years of age (Groups I and II) were found to have a greater stride length than the bullocks above eight years of age. There was no influence of age on speed or horse-power. Stride length is positively correlated with increased speed and horse power (Devi *et al.* 2017) signifying the increased work efficiency of middle age group bullocks. Singh and Singh (2009) recorded that speed of bullocks (Malvi and Red Sindhi X Jersey) ($n = 4$) decreased with increase of age. They reported the critical age group of bullocks to derive maximum work output as 4.5 to 12 years.

Impact of Regional Differences

As the bullocks belonging to three different regions were included in the study, regional influences on draughtability were also analyzed. Region had a highly significant ($p < 0.05$) effect on pulse rate after work. The bullocks belonging to Nagapattinam district, a coastal region, were having higher pulse rate after work than the bullocks belonging to other two non-coastal regions. Region also had a highly significant ($p < 0.01$) influence on stride length and horse power but not on speed. Bullocks belonging to coastal district had shorter stride length of 1.06 ± 0.40 m and horse power of 0.18 ± 0.06 (~134.3 watt) than those in other two districts, whereas bullocks belonging to Thanjavur district had a horse power of 0.53 ± 0.06 (~395.4 watt).Among the three regions, the bullocks belonging to Nagapattinam district were found to have significantly shorter stride length and lesser horse power than other two regions (Thanjavur and Thiruvarur). Particularly, the bullocks belonging to Thanjavur region had better draught animals with bullocks giving the highest mean horse power of 0.53 ± 0.06 (~395.4 watt). The poor performance of the bullocks belonging to the coastal region (closer to Bay of Bengal) could be due to the effect of humidity that exert additional stress to the thermo-regulatory system of the animal. Variations due to region was also noticed in pulse rate after work. However, lower output of an animal is also a complex trait that depends on various factors like duration of work, climate, soil moisture, type of agricultural operations, load applied, and speed (Bhattacharya and Singh, 1987). Hence, further investigation of the individual environmental factors affecting draughtability is recommended.

Effect of Draught Load Applied on Draught Performance

As both speed and draught are the functions of horse power, draught load applied has also been included as a variable to find its effect on power output. Interestingly, it was found that speed increased with the increase in draught load up to 78 kg which appears to be the threshold in Umblachery cattle. Our observations corroborate with that of Thakur *et al.* (1987) in buffaloes who proposed that it could be due to the posture of the animal while working at a higher draught. This was contrary to Devadattam and Maurya (1978), Maurya and Devadattam (1982) and Behera *et al.* (2009), as they observed a decrease in speed as the draught load increased. The threshold level of 75 to 78 kg observed in Umblachery cattle is higher when compared to the optimum draught load of 58.9 kg obtained in a pair of Hariana cattle (Devadattum and Maurya, 1978), 28.19 kg in Ongole bullocks (Vinoo *et al*., 2010) and lesser as compared to two Jersey X Red Sindhi crossbred bullocks (83.75 kg) (Maurya and Devadattam, 1982). This also explains the increase in speed with increase in draught

as most of the observations had a draught load of nearly 20 to 40 kg, which was lesser than the inherent potential of Umblachery bullocks as they were able to perform maximum at 75 to 78 kg.

Conclusion

From this study it could be inferred that, age of the bullocks and draught load applied has a greater influence on the power output of the bullocks, with middle age group being identified as a productive age group. Region which encompasses differences in climate, soil, nutrition and management practices is also found to impact draughtability. This study may enhance the understanding of aging and environmental influences on draughtability, which would help in designing the management practices of draught bullocks. It also shows the importance of assessing the threshold potential of livestock used for draught purposes, and educating the farmers accordingly for efficient utilization of draught animal power.

References

Behera, B.K, Behera, D., Mohapatra, A.K. and Swain, S. (2009). Assessment of draughtability of bullocks of Orissa in test track and field conditions. *Indian J. Anim. Sci.,* 79(1): 63-67.

Bhattacharya, N.K. and Singh, K. (1987). Comparison of draftability of crossbred and indigenous cattle and variation in their physiological response during work. *In: Utilisation and Economics of Draught Animal Power,* (Ed.) Srivastava, N.S.L. and Ojha, T.P. CIAE publishing, India. pp. 26-38.

Devadattam, D.S.K. and Maurya, N.L. (1978). Draftability of Hariana bullocks. *Indian J. Dairy Sci.,* 31(2): 121-127.

Devi, M.K., Karthickeyan, S.M.K., Sivaselvam, S.N., Venkataramanan, R. and Tirumurugaan, K.G. (2017). Phenotypic and molecular genetic studies on draughtability in Umblachery breed of cattle. *J. Livestock Biodiversity,* 7: 1-7.

Maurya, N.L. and Devadattam, D.S.K. (1982). Work performance of crossbred bullocks. *Indian J. Dairy Sci.,* 35: 26-30.

Rautaray, S.K. (1987). Work output of bullocks during field operations on black soils. *In: Utilisation and Economics of Draught Animal Power,* (Ed.) Srivastava, N.S.L. and Ojha, T.P. CIAE publishing, India. pp. 69-87.

Singh, R.C. and Singh, J.S. (2009). Effect of age and body size on the work output of Malvi and crossbred oxen. *Indian J. Anim. Sci.,* 79 (8): 850-852.

Shisode, M.G., Bhokare, S.M., Kulkarni, M.D. and Khanvilkar, A.V. (2010). Draught animal power - our nation's wealth. *SMVS' Dairy Year Book*. pp. 31-32.

Snedecor, G.W. and Cochran, W.G. (1989*). Statistical Methods* (8th ed.). Iowa State University Press, Ames, Iowa, USA. pp. 503.

Thakur, T.C., Singh, M.P. and Singh, B. (1987). An investigation on physiological response of Buffaloes at different work-rest cycle in rotary mode of operation. *In: Utilisation and Economics of Draught Animal Power,* (Ed.) Srivastava, N.S.L. and Ojha, T.P. CIAE publishing, India. p.113

Vinoo, R., Rao, G.N., Gupta, B.R. and Rao, K.B. (2010). Estimation of draughtability of Ongole bullocks by different methods. *Tamilnadu J. Vet. Anim. Sci.,* 6 (1): 24-30.