FIELD LEVEL STUDY ON THE BUFFALO BULLOCK: AN EXCELLENT DRAUGHT ANIMAL

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ABSTRACT

In the dry arid region of Birbhum district of West Bengal, excessive water scarcity, soil structure and texture makes cultivation very much restricted. Fodder production is a luxury here. So it is very hard to maintain high producing stocks. The only viable option is the propagation of draught animals of elite germplasm, which are very hardy and disease resistant to a great extent and can thrive on less feed and fodder, resulting in lowered feeding and maintenance cost. Out of the total of livestock, draught animals comprise about 14.77% in this district, out of which 75.80 % are bullocks (cattle) and 24.19% are buffalo bullocks. The present study was conducted on 810 buffalo bullocks randomly choosen from farmers' doorsteps covering four blocks of Birbhum district of West Bengal. The region lies at the border of Jharkhand state. The average temperature in the summer is 40^{o}C and in winter about 15^{o}C, and the average rainfall is about 1430 mm. Buffalo bullocks were characterized by a heart girth of 72.15 ± 0.43 cm, a body weight of 489.6 ± 7.12 kg, a weight carrying capacity for a pair of bullock of 18.2 ± 0.65 kg, a distance travelled per day of 72.0 ± 0.57 km, a speed of travelling of 9.00 ± 0.04 km/h, a working period during agriculture (approx 4 months in a year) of 8.0 ± 0.05 h and at other times of 9.5 ± 0.06 h, a working year of 12 months, an average cost of feeding of Rs. 38.5 ± 0.61 per bullock, a working area ploughed of 1805.976 ±15.483 sq m, and a speed of ploughing of 5.2 ± 0.02 km/h. Buffaloes are very good draft animals with the capability of carrying loads of more than twice those of bullocks. Compared to cattle bullocks, buffalo bullocks can travel longer distances for the whole night around 10-12 h with rest periods of 1-2 h. Buffaloes can work round the year. Although the feed cost is higher than cattle due to more DM intake, buffalo can thrive on more fibrous feed, and their efficiency of energy utilization is far better. However, buffalo bullocks are slow in working efficiency. Buffaloes are observed to be most resistant to diseases, specifically systemic infectious diseases (only 13.39%) compared to other animals, namely goat (36.28), sheep (51.37) and cattle (29.17). One of the most interesting observations is that a negligible number of buffaloes under study had systemic infection in terms of febrile reactions or any type of contagious disease, especially FMD in winter. Since the buffaloes in this area are utilized for draught purposes, the majority of the buffalo bullocks reported wounds (16.96%) caused by ploughs during working, pain in the leg due to mechanical trauma (15.17%)

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and yoke gall (9.82%) due to mechanical injury caused by ploughing and carting. However due to excessive mechanical work, most of the buffaloes reported hypoglycaemia and nutritional (vitamin and mineral) deficiency (15.17%) which is more in summer (17.44%). Buffalo bullocks should be given due recognition considering their load bearing capacity in those remote areas and power of resistance to common diseases. However in national breed upgrading programmes, artificial insemination and selection have been stressed for animals with better milk yield, giving no scope for propagation of draught animals with excellent germ plasm, imparting extreme risk which may result in extinction of this treasure in near future. This possess the scope for immediate conservation of the germ plasm of draught animals as a source of renewable source of energy and select best draught buffalo bullocks by marker assisted selection.

Keywords: buffalo bullock, *Bubalus bubalis*, draught animal, India

INTRODUCTION

Despite motorization on all fronts the use of draught animal power (DAP) is still often more economic than the use of machinery and vehicles, especially in small-scale agriculture and in remote areas. Animals are produced and maintained locally and don't require the infrastructure needed for motorization. Moreover when the value of machines are likely to be depreciated over time, animals may appreciate because of growth. The principal environmental advantage of DAP compared with mechanization is that DAP relies on bio-energy for its creation, maintenance and functioning instead of fossil energy. So DAP provides the renewable source of energy (FAO, 1994).

The population of draught animals is decreasing at an alarming rate. The reason is that in our national breed upgrading programmes, no emphasis has been given to DAP. However, in some places emphasis has been given to dual purpose breeds. Animal traction is the use of animals [cattle (bulls, oxen and cows), donkeys, mules, horses, camels, water buffaloes, etc], to assist farmers in carrying out their tasks (Simalenga and Joubert, 1997). Draught animal power is used in agriculture for ploughing, harrowing, planting, ridging, weeding, mowing and harvesting; in transport, for pulling carts and loads over a surface, logging and carrying loads (pack animals); in irrigation for driving water-pumps and pulling water from wells; in the building industry, for assisting in earth moving for road works, for carrying bricks, etc and to provide power for the operation of stationary implements such as threshing machines, grain mills and food processing machines.

In West Bengal, the total buffalo population is 764,000. The total buffalo population has decreased by 8.42% in West Bengal, whereas in India, the buffalo population has increased by 1.84% (Livestock Census, 2007). So this is an alarming trend, and conservation needs immediate attention in West Bengal. In the dry arid region of Birbhum district of West Bengal, excessive water scarcity, soil structure and texture makes cultivation very much restricted. Fodder production is a luxury here. So it is very hard to maintain high milk producing animals. The only viable option is the propagation of draught animals of elite germplasm, which are very hardy and disease resistant to a great extent and can thrive on less and coarser feed and fodder resulting in lowered feeding and maintenance cost. Buffaloes are maintained in extensive production systems. Draught animal power being a renewable

source of energy forms the basis for use in the future instead of mechanization or use of motor vehicle.

Thus the present study was undertaken with the objective of phenotypic characterization, draughtability and disease resistance study of buffalo bullocks along with socioeconomic impact on farmers.

MATERIALS AND METHODS

Animals

The present study was conducted on 810 randomly chosen buffalo bullocks from farmers' herds as draught animals from four adjacent blocks (Dubrajpur, Khoyrasole, Rajnagar and Suri-1) of Birbhum district of West Bengal within similar agroclimatic region. The animals were maintained under an extensive system of management on small farms, with a maximum of two buffaloes, on natural grasses and in communal paddocks during the rainy season. Agricultural by-products are used for feeding (basal feed as paddy straw). They are offered a negligible amount of rice gruel and vegetable wastes during the time of heavy load. The animals were maintained by marginal farmers utilizing family labour with minimum investment and reared with simple and traditional technology.

Agro-climatic conditions

The region lies at the border of Jharkhand and has an average temperature in summer of 37^{o}C and in winter of 11.2^{o}C and an average rainfall is about 1430.5 mm (Mishra, 2006). The region is classified as dry-arid, so due to excessive water scarcity, grazing land is very much restricted and fodder cultivation is extremely difficult.

Phenotypic traits

The traits under consideration were heart girth, body weight, height at withers, km travelled per day, average weight carrying capacity for a pair of bullock, speed of travelling, working period during agriculture (approx 4 months in a year), months of work during the year, average cost of feeding per animal, working area ploughed, distance travelled per day for a pair of bullocks and speed of ploughing. The heart girth and height at withers were measured manually using tape; body weight was estimated from heart girth. Draught traits were obtained from door to door survey of the owners' houses incooperation with veterinary hospitals and local practitioners.

RESULTS AND DISCUSSION

Animal traction forms the basis of agriculture in these four blocks of Birbhum district. In four blocks, 60.71% of total buffalo were used for draught purposes in terms of ploughing or in cart pulling. In Khoyrasole, Dubrajpur, Rajnagar and Suri-I block, the percentage of total buffalo used for draught purposes were 50.03, 77.6, 38.11, 57.3 percent, respectively (Table 1). In Dubrajpur block, the highest percentage of draught animals was present. Hence draughtability forms the basis of agriculture in Dubrajpur along with other blocks. In these areas, on contrast to 141 tractors and 15 agricultural power tillers, the total number of animal driven ploughs used for ploughing were 33,397 comprising of 9,587 wooden ploughs and 23,810 steel ploughs (Table 1). The highest number of buffalo driven animal carts were present in Dubrajpur block. Hence animal traction forms the major factor controlling the livelihood and economy of the poor people. Animal carts were utilized for the transportation of coal from adjacent coal mines and transportation of agricultural products and by-products from the nearby fields. Photographs of

draught buffaloes were visualized as sick buffaloes in confinement and being examined before treatment (Figure 1, 3 and 4) and buffaloes with bullock cart (Figure 2 and 5).

Draughtability of buffalo bullock

Buffalo bullock were observed to travel longer distance for the whole night around 10-12 h with rest periods of 1-2 h (Table 1). Buffalo bullocks (18.2 ± 0.65 kg) were observed to be very good draft animals with the capability of carrying loads of more than twice those of cattle bullocks (8.38 ± 0.19 kg) (Table 1). Buffalo bullocks were observed to travel at much higher speeds (9.0± 0.04 km/h) than cattle bullocks (Table 1).

This region is based on rain-fed agriculture. Agriculture is practiced once a year for approximately 4 months . During agriculture, buffalo bullocks (8.0 ± 0.05 h) can work for longer periods compared to cattle bullocks (Table 1). During other times, bullocks were utilized for pulling bullock carts. Buffalo bullocks can pull cart for a longer time per day (9.5 ± 0.06 h) compared to cattle bullocks (Table 1). A remarkable characteristic of buffalo bullocks observedwas that buffalo bullocks were able to work round the year, whereas the cattle bullocks could work for 6.73 ± 0.16 months during the year.

Other workers have also reported that buffaloes were superior to other draught animals in wet or waterlogged conditions, such as in muddy paddy fields. They can also be used for cart haulage, carrying heavier loads than cattle. In view of the working capacity of buffalo, they have been referred as the "*Living tractor of the east"*. In all the rice growing countries of Southeast Asia, the buffalo is used for ploughing mud fields. The large hooves, flexible foot joints, slow but deliberate working attitude is ideal for working in the deep mud of rice fields (Khan and Niamatullah, 2010). Singh and Barwal (2010) also agreed with the present estimation that buffalo can pull loads more than 6 times of its own body weight, but its usual load carrying capacity is 1-5 to 2.0 tones i.e. 3 to 4 times of its body weight. These loads it can pull for 2-3 h continuously and for 6-8 h in a day during winter and 5-6 h in a day during summer with rest in between.

However, buffalo bullocks are slightly slower in working efficiency compared to cattle bullock, as evident from speed of ploughing (Table 1). However the total work output of buffalo was much superior to cattle. It is evident from Table 1 that working area ploughed per day for buffalo (1805.976 ±15.483 sq meters) was higher than that of cattle.

Body parameters of buffalo bullocks as draught animals

Buffalo bullocks were found to be much more robust and of higher body weight (489.6 ± 7.12 kg) compared to cattle bullocks (Table 3). The body sizes of buffalo bullock were observed to be much greater (183.26 ±1.09 cm) than cattle bullock (150.83 ± 1.12 cm) as evident from their heart girth. Average height at withers of the buffalo (133.34 ± 0.95 cm) was observed to be much higher than that of the cattle bullock.

The average body weight of male (Murrah) buffalo was 550 kg and the average height at withers for the male was observed to be 1.42 meters (Singh and Barwal, 2010). Hence it is evident that the buffaloes reared in these areas were not of the Murrah breed of buffalo. It indicates the need for formulating strategy for immediate breed conservation of this excellent draught power.

Economic efficiency of buffalo bullocks

Although feed cost of buffaloes (Rs. 38.5 ± 0.61) was observed to be higher than that of cattle (Rs. 29.95 ± 0.4) due to more DM intake, but

buffaloes can thrive on more fibrous feed and their efficiency of energy utilization is far better.

Another important observation was that most of the buffaloes reared in these regions were castrated male animals. Thus it creates problem in individual selection of buffalo for draught purpose and breeding.

Efficient converter of low quality feed

Buffaloes can utilize less digestible feeds (e.g. rice straw, maize stovers, sugar-cane bagasse etc) better than cattle to thrive. This makes buffaloes easy to maintain using locally available roughage and crop residues. The feeding habits of buffaloes and cattle differ from each other. Buffaloes can consume poor quality pasture or feedand can gain or at least maintain their body weight under long periods of under feeding which may often last over 5-7 months in many Asian countries (Khan and Niamatullah, 2010). The superiority of buffaloes over cattle in digestibility and efficiency of utilization of feed nutrients is manifested only when then two species are fed only low plane of nutrition with course roughages as the main source of energy. Cockrill (1968) and Gilani (1980) reported that the digestibility of wheat straw cellulose was 24.3% for cattle and 30.7% for buffalo.

Enrich soil fertility

Buffaloes improve soil structure and fertility while treading paddy fields. Each year, an adult buffalo produces 4 to 6 tonnes of wet manure plus additional urine as bio-fertilizer to the land. This reduces or eliminates the need for chemical fertilizers as well as provides essential soil humus which chemicals cannot provide.

Secure socio-economic status of farmers

Buffaloes are often used as cash savings and can be sold when needs arise (school fees, marriage, crop failure, debts etc). Thus, these animals ensure socio-economic security for these marginal farmers.

Disease resistant traits of buffalo bullock

Buffaloes are observed to be most resistant to common diseases (Table 4); specifically systemic infectious diseases (only 13.39%) compared to other species namely goat (36.28%), sheep (51.37%) and cattle (29.17%). Since the buffaloes in this area are utilized for draught purpose, the majority of the buffalo bullocks reported in veterinary hospitals have wounds (16.96%) caused by ploughing or during working, and pains in leg due to mechanical trauma (15.17%) and yoke-gall (9.82%) due to mechanical injury caused by ploughing and carting. However due to excessive mechanical work, buffaloes report hypoglycaemia and nutritional (vitamin-mineral) deficiency (15.17%) which is more severe during summer (17.44%).

Among the diseases, buffaloes suffered mostly from parasitic infestation, particularly in this area. An interesting observation was that none of the buffaloes under the study were affected by lung worm infestation and nasal granuloma (Table 5). Among the buffalo bullocks, digestive or ruminal disturbances in terms of ruminal acidosis, bloat, indigestion, non-specific diarrhoea were much less prevalent (Table 4). When the diseases were classified based on season as in winter and summer, it was observed that none of the animals suffered from ruminal disturbances in winter (Table 6). In addition of the advantage to buffalo of having large size muzzle and high mobility of tongue enable the buffaloto achieve a high rate of intake of forage and crop residue **(**McDowell *et al*., 1995). Further, greater weight of rumen in buffalo harbours a larger microbial population indicating better conversion of forage. Rumen asidosis is seldom observed in buffaloes due to their high rate of saliva secretion and thus maintaining rumen pH in a better way.

None of the buffaloes suffered from ectoparasites in winter (Table 6). One of the most interesting observations is that, negligible number of buffaloes under study had systemic infection in terms of fever or any type of contagious disease, especially FMD in winter (Table 6). Localized eye and ear infestation was found to be highest in buffaloes (Figure 4). The reason for this may be that buffaloes have the practice of wallowing in water. Localized ear infection may result due to penetration of infected water into the ear.

Nutritional deficiency, especially in terms of vitamin A deficiency and phosphorus deficiency, was observed to be very common in these areas. Around 15.17% of the draught buffaloes were reported to suffer from vitamin-mineral deficiency (Table 4). Because the area is extremely dry , fodder cultivation is very much restricted in these areas. The animals' diets become deficient in vitamin A due to lack of green fodder. Samples from local feed and soil revealed deficiency in phosphorus. The animals becomes weak and debilitated. Supplementation with vitamin-mineral mixture improved the condition. This demands special emphasis on supplementation of area specific mineral mixture fortified with vitamins.

Similar reports were available regarding disease resistance of buffalo. Lameness and pink eye (due to vitamin A deficiency) were unknown in buffalo (Annon, 2012). In earlier observations (Pal and Chaterjee, 2010a) the disease resistance of buffaloes was already established.

Future scope for selection of buffalo as draught animals

Since draught buffaloes are castrated males, it is quite impossible to propagate the germplasm of the best draught buffaloes. Hence individual selection is not effective. Sib selection and selection based on pedigree were also not very practicable since only the female animals can reproduced; males are castrated for the purpose of draughtability. Maintaining females for the purpose of draughtability instead of milk production is quite impracticable and not viable. Experimental evidence has suggested that draught capacity and meat characteristics have a negative correlation with dairy traits (Khan and Niamatullah, 2010).

The only viable option is marker assisted selection (MAS). Like milk production, draughtability seems to be polygenic in inheritance. The growth hormone (GH) gene, the leptin gene and the genes controlling other disease resistant traits like the CD14 gene may act as candidate genes for draughtability. Since the trait of draughtability is one of the most neglected traits so far, the candidate genes for draughtability have not been identified till date. Since draughtability is dependant on body physique and since growth hormone controls this, the GH gene is a promising candidate gene. Studies on the GH gene (Pal and Chatterjee, 2010b) had already established the fact. Other genes coding for body growth as growth hormone receptor (Othman *et al*., 2012), GH releasing hormone (RajaMurugan *et al*., 2007), IGF-I (Fatima *et al*., 2009) etc may also act as candidate genes for draughtability. Research on the CD14 gene, responsible for disease resistance on buffalo has also been conducted (Pal, 2006). Other genes responsible for disease resistance includes defensin (Mossallam *et al*., 2011), lactoferrin (Kathiravan, 2009) etc may also act as candidate genes. Genes preventing environmental stress like HSP70 gene coding for heat shock protein is also related to draughtability as buffaloes are subjected to less environmental stress, especially heat stress while working. Moreover, due to the dark coat colour of buffaloes, they are subjected to more heat stress. HSP70 proten is well reported to protect

Table 1. An overview of draughtability of buffalo bullocks in four blocks of Birbhum district (As per 17th Livestock Census, 2003).

Blocks of Birbhum district under study	Number of draught buffalo	Total male buffalo	Total buffalo population	No. of Wooden plough	No. of steel plough	Animal cart	Agricultural tractor	Agricultural power tiller
Khoyrasole	2082	2705	4161	2437	7171	5404	18	0
Dubrajpur	4424	4817	5701	1377	9361	9069	71	3
Rajnagar Block	808	1136	2120	2526	5786	3473	33	10
Suri-I	667	791	1164	3247	1492	2754	19	2
Total	**7981**	**9449**	**13146**	**9587**	**23810**	**20700**	**141**	**15**

Table 2. Draughtability of buffalo bullocks.

	km travelled per day	Average weight carrying capacity for a pair of bullocks (kg)	Speed of traveling (km/h)	Working period during agriculture (h)	working period other than during agriculture (h)	months of work during the year	working area ploughed per day (sq m)	speed of ploughing (km/h)
Cattle	4.98 ± 0.084	8.38 ± 0.19	5.98 ± 0.06	6.0 ± 0.242	7.01 ± 0.00	6.73 ± 0.16	1569.30 ± 24.85	5.28 ± 0.03
Buffalo	72.0 ± 0.57	18.2 ± 0.65	9.00 ± 0.04	8.0 ± 0.05	9.5 ± 0.06	12	1805.976 ±15.483	5.2 ± 0.02

Table 3. Phenotypic body parameters of buffalo bullock.

	Heart girth (cm)	Body weight (kg)	Height at Withers (cm)
Cattle	150.83 ± 1.12	298.42 ± 4.66	100.50 ± 1.05
Buffalo	183.26 ±1.09	489.6 ± 7.12	133.34 ± 0.95

Table 4. Comparative disease incidences of buffalo with other species, Figures indicate percentage of animals suffering from diseases.

Sl no.	Disease incidences	Goat	Sheep	Cattle bullock	Buffalo bullock
1	**Systemic infection (includes high temperature,…)**	36.28	51.37	29.17	13.39
2	**Wound (Fresh, maggoted or ulcerated)**	6.89	7.33	9.97	16.96
3	**Total parasitic infestation**	26.09	11.92	41.78	21.41
4	**Blood protozoan disease**			0.58	
5	**Digestive/ruminal disturbances**	5.74		6.15	2.67
6	**Nutritional deficiency(Vit A & others)**	7.96	11.0	7.33	15.17
7	**Localized eye/ear infection**	2.05	2.75	2.35	4.46

Table 5. Parasitic infestation of buffalo bullocks compared to cattle bullock indicated in percentage.

	Parasitic Worm infestation (Anorexia, diarrhea, colic). Immature Amphistome and Fascioliasis	**Lung worm**	**Hydatid cyst**	**Nasal granoloma**	**Humpsore/Legsore (Stephanofilaria)**	**Ectoparasite**
Cattle Bullock	26.39	0.146	1.2	0.439	7.33	6.27
Buffalo Bullock	12.5		0.89		2.67	5.35

Table 6. Season wise classification of diseases.

	Species	Cattle Bullock		Buffalo bullock	
	Season	**In Winter***	**In Summer****	**In Winter***	**In Summer****
1	**Systemic infection (includes high temperature)**	29.5	25.80		17.44
2	**Wound (Fresh, maggoted or ulcerated)**	13.11	14.74	11.53	18.60
3	**Parasitic Worm infestation Immature Amphistome and Fascioliasis (Anorexia, diarrhea, colic).**	22.95	17.51	23.07	9.3
4	**Lung worm**		0.46		
5	**Nasal granuloma**		1.38		
6	**Humpsore/Legsore (*Stephanofilaria spp.*)**	13.93	9.67	3.8	2.32
7	**Ectoparasite**		1.84		6.97
8	**Blood protozoan disease**		1.38		
9	**Digestive/ruminal disturbances**	15.57	2.76		3.48
10	**Mechanical trauma (Pain in leg)**		10.59	19.23	13.95
11	**Yoke gall**	0.819	3.68	23.07	5.81
12	**Localised ear infection**	2.45	2.3	11.53	2.32
13	**Nutritional deficiency (vit A & others)**	1.63	7.37	7.6	17.44

*Winter (1 st January-15th March and 15th October-31st December)

**Summer (16th March-15th October)

Figure 1. Sick buffaloes in confinement and being examined before treatment.

Figure 2. Buffaloes with bullock cart.

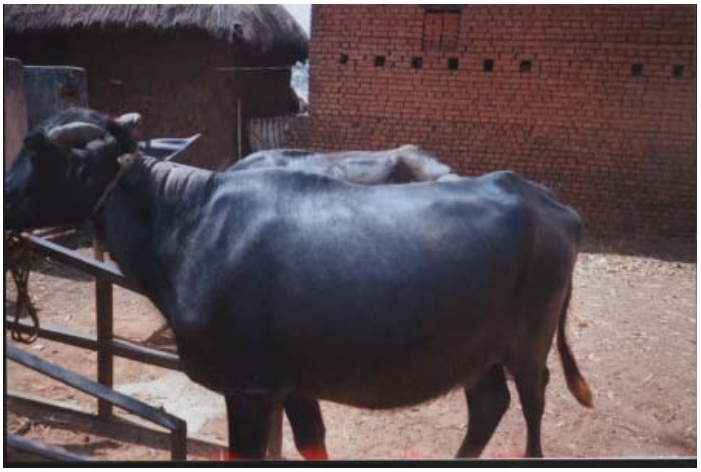

Figure 3. Sick buffaloes in confinement.

Figure 4. Sick buffaloes in confinement and being examined before treatment.

Figure 5. Buffaloes with bullock cart.

cells, tissues, and organs from stress (Kiang and Tsokos, 1998) by promoting the folding of nascent polypeptides and by correcting the misfolding of denatured proteins. Heat shock induced-HSP70 expression has a role in the anti-apoptotic pathway (Sreedhar and Csermely, 2004). The role of HSP70 in buffalo have been established by Madhusudan (2007).

CONCLUSION

Buffalo bullocks may be reckoned as a remarkable draught animal exhibiting disease resistance to the majority of diseases. However little attention has been paid in national breed upgrading programmes (artificial insemination and selection, which have been focused mainly on milch cattle) for propagation of draught animals with excellent germ plasm, imparting extreme risk that may result in the extinction of this treasure in the near future. Here lies the need for immediate conservation of the germ plasm of draught animals as a renewable source of energy. Since castrated male buffaloes are utilized for draught purpose, the scope of conventional selection becomes very much restricted. Marker assisted selection for draughtability needs to be employed after identifying suitable markers.

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