Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6358

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (1):** 1539-1546 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Status of Bullock Carts and Comparative Evaluation of Different types of Cart available in Chhattisgarh Plains

Nikhil Kumar Patre*, M. Quasim, Mithlesh Kumarand and Ashutosh Tripathi

Indira Gandhi KrishiVishwavidyalaya, Krishak Nagar, Raipur, 492012, Chhattisgarh, India

*Corresponding Author E-mail: nikhil.patre1991@gmail.com

Received: 16.01.2018 | Revised: 22.02.2018 | Accepted: 25.02.2018

ABSTRACT

Bullock-cart is a major source of transportation of commodities from one place to another in rural area. About 68%of the total agricultural produce in the Chhattisgarh is still carried away through animal drawn vehicles every year.Chhattisgarh state consists of three zones i.e. Chhattisgarh Plain, Bastar Plateau, Northern hills zone,that occupies 51.0%, 28.0% and 21.0% of the geographical area, respectively.For this particular study Chhattisgarh Plain zone was selected. Chhattisgarh plains consist of total 14 districts out of which 8 districts were selected for this study.In each district three blocks were selected for the case study. Highest average number of bullock carts has been using in Rajnandgaon i.e. 58157 and lowest in Mungeli i.e.7261 district. The performance of IFIW cart was found best among all four types of carts used for the testing at 1100 kg load it has lowest draft, power requirement and wheel slippage was 35.22 kg, 0.39 kW, 0.88 % respectively and highest speed was 2.99 km/hr. Lowest performance was found in WFWW cart at the 1100 kg load. It has highest draft, power requirement and wheel slippage 45.64 kg, 0.50 kW, 1.63 % respectively and lowest speed 2.76 km/hr among all types of carts. It was found that in each cart as the load was increased simultaneously draft requirement and power requirement was also increased and speed and slippage was decreased.

Key words: *Bullock-cart, Animal drawn vehicles, Draft requirement, Power requirement, Wheel slippage.*

INTRODUCTION

Bullock cart is one of the most important media for the transportation of goods in the Indian villages. It is primarily used for the transport of all kinds of agricultural and domestic goods, and predominantly used as an input to agricultural operations. They not only carry agricultural commodities from village to market areas but also material (bags), sugarcane, water, wood, manure etc. from home to farm and farm to home. In urban areas bullock cart is also used for transport of cement, passenger, iron, bricks etc. The average speed of the bullock cart is about 5 km/hr. The bullock cart has therefore got a huge role to play in rural India with special reference to the small and marginal farmers having bullocks for various farm operations.

Cite this article: Patre, N.K., Quasim, M., Kumar, M. and Tripathi, A., Status of Bullock Carts and Comparative Evaluation of Different types of Cart available in Chhattisgarh Plains, *Int. J. Pure App. Biosci.* **6(1):** 1539-1546 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6358

Karangkar *et al.*[5] reported that draught animals are an important source of power for millions of developing country farmers. Lakshmanan[4], reported about rural transport, i.e., transport from the farms to the markets by bullock carts over market roads, constitutes a weak link in the food transporting system in India. The weakness in the link arises from the bad conditions of rural roads which are particularly unserviceable during the rainy season. The bullock cart, which is used for about 70% of the total produce transported, still thrives, and is likely to continue to play its role in rural transport.Singh[6] showed that with the modernization of agriculture, the use of mechanical power in agriculture has increased but draught animal power (DAP) continues to be used on Indian farms due to small holdings and hill agriculture. More than 55% of the total cultivated area is still being managed by using draught animals as against about 20% by tractors. India possessed the finest breeds of draught animals. Bullocks, buffaloes and camels are the major draught animals for field operations. Horses, mules, donkeys, yak and mithun are the pack animals for transport. In Chhattisgarh Bullock cart is also known as 'Gada'. Bullock cart is a part and parcel of the rural economy. Even today in state more than half of the population is living in villages, most of the villages are still facing the problem of good roads in such areas bullock cart plays an important role in the transportation of their agricultural products. According to Directorate of land record, Chhattisgarh, 4.3 lakh carts are still in operation. In some parts of the country, few carts have been partially converted with metallic parts or used pneumatic tyres for better and smooth travel. Yadav *et al.*[8] suggested a suitable design keeping the overall cost within the approachable limits of peasant farmers of Orissa stated of India. Deshpande and Ojha[1] developedanimproved ox-cart based on survey and testing of traditional andpneumatic-tyred carts. Deshpande[2] improved puncture less rubber-tyred ox-cart was developed as an alternative to the existing pneumatic tyred cart in order to overcome certain problems faced by pneumatic carts apart from high initial cost. Ghosal *et al.*[3] studied the performance of an improved single bullock operated steel cart of 0.5 ton capacity, designed by Institute of Steel Development and Growth (INSDAG) Kolkata, India, based on the following parameters, *viz*., pay load (kg), draft (N), forward speed (meters/ second), power output (kW), wheel slippage (%), and fatigue score on two types of roads (tar road and earthen road) in rural Odisha. Singh *et al*[7]. A pneumatic wheeled ox-cart was developed based on most common dimensionsand payload capacity of conventional wooden wheel carts used in urban and ruralareas of central India. As the draught performance mainly depends upon the load, road, angle of pull, traction to wheel etc. To overcome the shortcoming of the traditional carts and also to reduce the drudgery of animal during transportation by cart, a good study is required of the local carts of Chhattisgarh plains region for the up-gradation in the existing bullock cart. The main objective of the present study is to study the status of bullock carts and comparative evaluation of different types of cart available in Chhattisgarh plains.

MATERIAL AND METHODS

Study Area

Chhattisgarh state consists of three zones i.e. Chhattisgarh Plain, Bastar Plateau, Northern hills zone, that occupies 51.0%, 28.0% and 21.0% of the geographical area, respectively. For this particular study Chhattisgarh Plain zone was selected showing in Fig.1.Chhattisgarh plains consist of total 14 districts out of which 8 districts were selected for this study *i.e.* Raipur, Bilaspur, Kabirdham, Rajnandgaon, Mahasamund, Dhamtari, Durg and Balodabazar. These districts shows a representativecover of the region. Therefore, the districts were selected for the case study. In each district three blocks were selected for the case study.

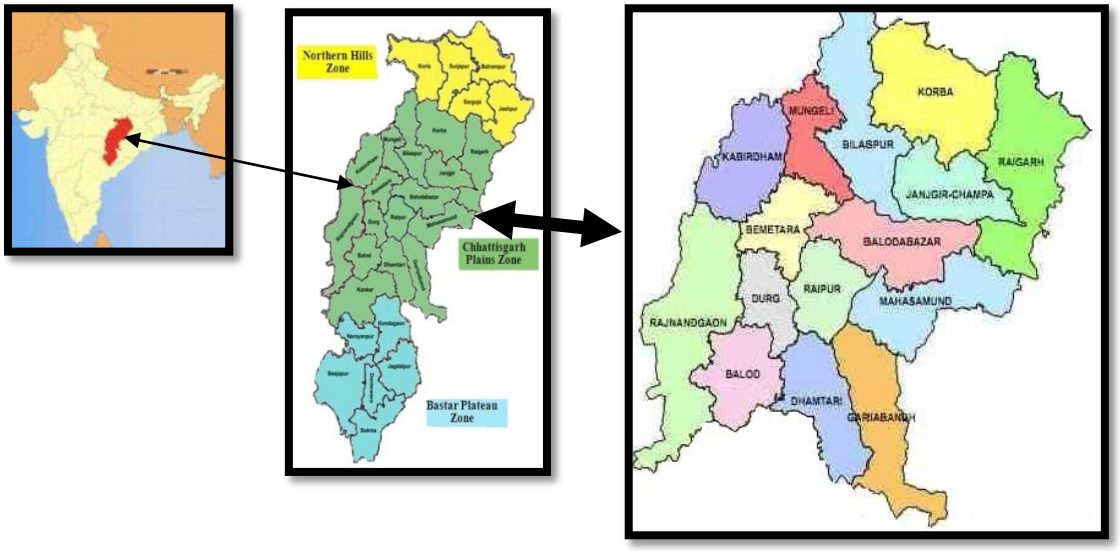

Fig.1: Location of the study area

Performance Evaluation of the Bullock Carts

The Performance evaluations of bullock carts have been completed in the Borid village of Arang block were four different types of bullock cart were tested. These carts were tested on plain concrete road of village for a pair of local bullock of non-descript breed. The performance evaluation of the bullock carts were studied by running the cart for a distance of 500 m at no load and 500 kg, 700 kg, 900 kg and 1100 kg loading conditions. The weight of operator and pay load are considered while testing.

Selection of the bullock carts

For the performance evaluation four types of bullock carts are selected which are iron frame with iron wheel type, wooden frame with wooden wheel type, iron frame with wooden wheel type and wooden frame with wooden wheel type showing in Fig. 2to Fig. 5 and in Table 1.

Table 1: Types of carts selected for the performance testing and materials of construction

S. N.	Type of cart	Materials of the cart
1	Wooden frame and wooden wheels (WFWW)	Wood (except iron axle)
2	Iron frame and iron wheels (IFIW)	Iron
3	Wooden frame and iron wheels (WFIW)	Wood and iron
4	Iron frame and wooden wheels (IFWF)	Wood and iron

Fig. 2: Iron frame with iron wheels type cartFig. 3. Iron frame with wooden wheels type cart

Fig. 4: Wooden frame with wooden wheels

Fig. 5: Wooden frame with wooden wheels

Weight of the cart

Weight of the carts is measured by weighing the cart in the weighing machine showing in Fig. 6.and Table 2.

Fig. 6: Weighing the bullock carts

Table 2: Weight of the carts used for performance evaluation

S. No.	Type of cart	Weight, kg
1.	Wooden frame and wooden wheels	340
2.	Iron frame and iron wheels	310
3.	Wooden frame and iron wheels	320
4.	Iron frame and wooden wheels	350

RESULTS AND DISCUSSION

Number of bullock carts in Chhattisgarh plains

The number of bullock carts in the Chhattisgarh plains region is presented in Fig. 7.shows that highest average number of bullock carts were using in Rajnandgaon, followed by Balodabazar, Janjgir-champa, Bilaspur, Mahasamund, Balod, Raipur, Bemetara, Durg, Dhamtari, Kabirdham, Gariyaband, Korba and Mungeli districts of Chhattisgarh plains region.

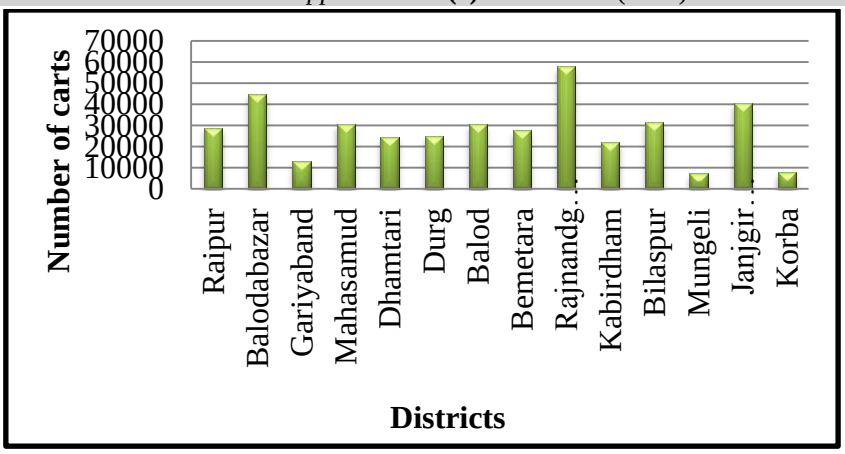

Fig. 7: District wise average number of bullock carts

Annual use of cart

Table 3. shows overall on an average 75 days per hectare land; bullock cart was used for different purposes in a year. In Kharif, Rabi and Zaid (summer) 28, 30 and 17 days respectively for one hectare land bullock cart was utilized for different purposes.

Table 3: Season wise use pattern of bullock carts in C.G. Plains region

Season	Days of use / ha land
Kharif	28
Rabi	30
Zaid	17

Performance Evaluation of Bullock Carts

The performance evaluation of the bullock carts was conducted for a run of 500 m distance at different payloads such as no payload and at payloads of 500 kg, 700 kg and 1100 kg payload on plain concrete road. Different observations such as draft, speed, wheel slippage,and power requirement were recorded.The result of the performance evaluations discussed and presented in Table 4. to 7.

Performance evaluation of iron frame with iron wheels type cart

The results of the performance evaluation of IFIW bullock cart on concrete road have been presented in Table 4.

Table 4: Performance of iron frame with iron wheels type cart

S. No.	Payload, Kg	Average Draft ,kg	Average Speed km/h	Average Power requirement, kW	Average wheel slippage (%)
1	Tare (310+60)	17.56	4.10	0.20	2.30
2	500	22.00	3.85	0.23	2.15
3	700	25.57	3.60	0.25	1.74
4	900	29.14	3.31	0.27	1.52
5	1100	35.22	2.99	0.29	0.88
	SE(m)	0.39	0.07	-	0.02
	CD at 5%	1.19	0.21	-	0.07
	CV %	2.98	3.88	-	2.66

The table shows that for iron wheel with iron frame type of cart the draft at tare weight was found 17.56 kg, speed 4.10 km/h, power requirement 0.20 kW and wheel slippage was found 2.37%. At 500 kg payload draft was 22.00 kg, speed 3.85 km/h, power requirement

0.23 kW and wheel slippage was 2.15%. For 700 kg payload draft was 25.57 kg, speed was 3.60 km/h, power requirement was 0.25 kW and wheel slippage was 1.74 %, for 900 kg payload draught, speed, power requirement, and wheel slippage were found 29.14 kg, 3.31 km/h, 0.27 kW and 1.52% respectively. Similarly for 1100 kg payload draught, speed, power requirement, and wheel slippage was 35.22 kg,2.99 km/h, 0.29 kW and 0.88 percent respectively.It was found that as the payloadincreased from tare weight to 1100 kg draft was increased from 17.56to 35.22 kg, average speed decreased from 4.10 to 2.99 km/h, power requirements increased from 0.20to 0.27 kW and average wheel slippage decreased from 2.37 to 0.88%.Theperformance evaluation of these bullock cart revealed that there was significant change in the draught, speed and wheel slippage of the cart at different payloads. The results also revealed that as the payload was increased average draft and average power requirement increased as well as average speed and wheel slippage were decreased with the increase in payload.

Performance evaluation of wooden frame with iron wheel type cart

The results of performance evaluation of wooden frame with iron wheels type carton plain concrete road have been presented in Table 5.

Table 5: Performance of wooden frame with iron wheels type cart

S. No.	Payload, kg	Average Draft, kg	Average Speed, km/h	Average Power requirement, kW	Average Wheel slippage (%)
1	Tare (320+60)	18.50	3.96	0.20	2.51
2	500	23.51	3.78	0.25	2.30
3	700	30.49	3.31	0.28	2.05
4	900	35.03	3.13	0.30	1.73
5	1100	39.85	2.89	0.32	1.09
SE(m)		0.74	0.05	-	0.03
CD at 5%		2.28	0.15	-	0.12
CV		5.02	2.89	-	3.94

The table shows that the draft at tare weight was found 18.50 kg, speed was 3.96 km/h, power requirement was 0.20 kW and wheel slippage was found 2.51%. At 500 kg payload draft was 23.51 kg, speed 3.78 km/h, power requirement 0.25 kW and wheel slippage was 2.30%. For 700 kg payload draft was 30.49 kg, speed was 3.31 km/h, power requirement was 0.28 kW and wheel slippage was 2.05 %, for 900 kg payload draught, speed, power requirement, and wheel slippage was found 35.03 kg, 3.13 km/h, 0.30 kW and 1.73% respectively. Similarly for 1100 kg payload draught, speed, power requirement, and wheel slippage was 39.85 kg, 2.89 km/h, 0.32 kW and 1.09 percent respectively.

The table shows that the average draft increased from 18.50 to 39.85 kg, speed decreased from 3.96 to 2.89 km/h, power requirement increased from 0.20 to 0.32 kW and wheel slippage decreased from 2.51 to 1.09% when the payload increased from tare weight to 1100 kg.

The performance evaluation of these bullock cart revealed that there was significant change in the draught, speed and wheel slippage of the cart at different payloads. The results also revealed that as the payload was increased average draft and average power requirement increased as well as average speed and wheel slippage were decreased with the increase in payload.

Performance evaluation of iron frame with wooden wheel type cart

The results of performance evaluation of the iron frame with wooden wheel type cart on the concrete plain road have been presented in Table 6.

Table 6: Performance of iron frame with wooden wheels type cart

S. No.	Payload, kg	Average Draft ,kg	Average Speed km/h	Average Power requirement, kW	Average Wheel slippage (%)
1	Tare (350+60)	21.71	3.90	0.23	3.02
2	500	26.34	3.71	0.27	2.39
3	700	32.94	3.20	0.29	2.17
4	900	37.25	3.06	0.31	1.80
5	1100	43.75	2.84	0.34	1.53
SE(m)		0.97	0.06	-	0.05
CD at 5%		2.99	0.17	-	0.15
CV		5.99	3.38	-	4.49

The table 6 shows that the draft at tare weight was found 21.71 kg, speed was 3.90 km/h, power requirement was 0.23 kW and wheel slippage was found 3.02%. At 500 kg payload draft was 26.34 kg, speed 3.71 km/h, power requirement 0.27 kW and wheel slippage was 2.17%. For 700 kg payload draft was 32.94 kg, speed was 3.20 km/h, power requirement was 0.29 kW and wheel slippage was 2.17 %, for 900 kg payload draught, speed, power requirement, and wheel slippage was found 37.25 kg, 3.06 km/h, 0.31 kW and 1.80% respectively. Similarly for 1100 kg payload draught, speed, power requirement, and wheel slippage was 43.75 kg,2.84 km/h, 0.34 kW and 1.53% respectively For IFWW type cart the average draughts were found to increase from 21.71 to 43.75 kg when payloads increased from tare weight to 1100 kg. The average speeds were found to decrease from 3.90 to 2.84 km/h, for the same payload. Similarly, the power requirements increased from 0.23 to 0.34 kW when payloads increased from tare weight to 1100 kg. The average wheel slippage percentage decreased from 3.02 to 1.53 when payloads increased from tare weight to 1100 kg.

Performance evaluation of wooden frame with wooden wheel type cart

The results on performance evaluation of the wooden frame with wooden wheel type cart on plain concrete road have been presented in Table 7.

Table 7: Performance of wooden frame with wooden wheels type cart

S. No.	Payload, kg	Average Draft ,kg	Average Speed km/h	Average Power requirement, kW	Average wheel slippage (%)
1	Tare (350+60)	22.45	3.67	0.23	3.36
2	500	27.88	3.53	0.27	2.83
3	700	33.97	3.29	0.31	2.40
4	900	38.35	3.02	0.32	1.95
5	1100	45.64	2.76	0.35	1.63
SE(m)		0.99	0.04	-	0.05
CD at 5%		3.05	0.12	-	0.17
CV		5.89	2.43	-	4.52

The table 7 shows that the draft at tare weight was found 22.45kg, speed was 3.67km/h, power requirement was 0.23 kW and wheel slippage was found 3.36%. At 500 kg payload draft was 27.88 kg, speed 3.53 km/h, power requirement 0.27 kW and wheel slippage was 2.83%. For 700 kg payload draft was 33.97 kg, speed was 3.29 km/h, power requirement was 0.31 kW and wheel slippage was 2.40 %, for 900 kg payload draught, speed, power requirement, and wheel slippage was found 38.35 kg, 3.02 km/h, 0.32 kW and 1.95% respectively. Similarly for 1100 kg payload draught, speed, power requirement, and wheel slippage was 45.64 kg,2.76 km/h, 0.35 kW and 1.63% respectively The average draft was found to increase from 22.45to 45.64 kg when pay payloads increased from tare weight to

1100 kg on concrete road. The average speeds were found decreased from 3.67to 2.76km/h for the same payloads. Similarly, the power requirements increased from 0.23 to 0.35 kW when pay payloads increased from tare weight to 1100 kg. The average wheel slippage percentage decreased from 3.36 to 163 when pay payloads increased from tare weight to 1100 kg.

CONCLUSIONS

Highest average number of bullock carts has been using in Rajnandgaon i.e. 58157 and lowest in Mungeli i.e.7261 district. The performance of IFIW cart was found best among all four types of carts used for the testing at 1100 kg load it has lowest draft and power requirement and wheel slippage 35.22 kg, 0.29 kW, 0.88 % respectively and highest speed 2.99 kmh^{-1}.Lowest performance was found in WFWW cart at the 1100 kg load. It has highest draft, power requirement and wheel slippage 45.64 kg, 0.34 kW, 1.53 % respectively and lowest speed 2.84 kmh^{-1} among all types of carts. It was found that in each cart as the load was increased simultaneously draft requirement and power requirement was also increased and speed and slippage was decreased. However, the draught of the existing carts is lower than the draught ability of the bullocks and thereby increases their efficiency and carrying capacity of the existing bullock carts. From the modification point of view it is required to increase the carrying capacity of the carts from current average 0.8 tons to 1.5 ton.

REFERENCES

1. Despande, S.D. and Ojha, T.P., Development and evaluation of an improved ox-cart for central India. Journal of Terramechanics, **22(3):** 135–146 (1985).
2. Deshpande, S. D., Punctureless rubber-tyred ox-cart for central India.Bio resource technology, **47(1):** 37-44 (1994).
3. Ghosal, M.K., Behera, D. and Mohapatra A.K., Performance evaluation of an improved single bullock operated steel cart (0.5 ton capacity) for sustainable rural transport. Animal Science Reporter, **6(4):** 131-136 (2012).
4. Lakshmanan, P. P. Economics of modes of transportation of food grains in India. Indian Journal of Agricultural Economics, **23(3):** 14-20 (1969).
5. Karangkar, L. M. and Patil R. A., Draught ability of bullocks: A review. Marathwada agricultural University, Parbhani. Indian Journal of Animal Sciences, **78(9):** 1002-1018 (2008).
6. Singh, G., Draught animal energy research in India. Proceedings of an ATNESA Workshop, South Africa, 315-323 (2000).
7. Singh, R.C., Dubey, U.C. and Singh, C.D., Standardization and performanceevaluation of a pneumatic wheeled ox-cart for Central India. Central Institute of Agricultural Engineering Bhopal, India – 462038 (2014).
8. Yadav, B. G. and Satapathy, G. C., Design of bullock cart for the peasant farmers of Orissa. In Proc. National Seminar on Improvevised Bullock Cart System for Rural roads in India, Rourkela, India, 1-8 (1979).