Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6359

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (1):** 1552-1557 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Comparative Performance of Bullock Carts at Different Payload Condition

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

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

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

Received: 18.01.2018 | Revised: 23.02.2018 | Accepted: 28.02.2018

ABSTRACT

The effect of different payloads tested ranging from tare weight to 1100 kg for four different carts i.e. iron frame with iron wheel(IFIW), wooden frame with iron wheel (WFIW), iron frame with iron wheels(IFWW) and wooden frame with wooden wheels(WFWW) on concrete road. The minimum draft was found in IFIW at tare and 1100 kg was 17.56 and 35.22 kg. Similarly, maximum was found in WFWW at tare and 1100 kg was 22.45 and 45.64 kg. The WFIW and IFWW type carts have the results between the IFIW and WFWW type cart.As the payloads were increased simultaneously the draft was increased. IFIW type has lowest draft at all payloads and highest draft was found in WFWW type cart at all payloads. The maximum speedwas found in IFIW type at tare and payload 1100 kg payload was 4.10 km/h and 2.99 km/h. Similarly,minimum speedwas found in WFWW type at tare and payload 1100 kg payload was 3.67 km/h and 2.76km/h. The WFIW and IFWW type carts have the results between the IFIW and WFWW type cart. It was found that WFWW type has lowest speed at all payloads, followed by IFIW type, WFIW type and highest speed was found in IFIW type bullock cat at all payloads.The maximum power requirement was found 0.32 kW in WFWW type cart for the tare payload condition and for the same payload power requirement is minimum 0.27 kW in IFIW cart. As the payload was increasing the power requirement was also increasing in each cart. WFWW cart has the maximum power requirement at 1100 kg payload while IFIW has the minimum 0.39 kW that is the lowest than the all carts.The highest power requirement was found in WFWW type cart and lowest in IFIW type bullock cart.Slippage was found maximum 3.36 % at tare payload in WFWW type cart and at same payload minimum in 2.30 % in IFIW cart. At maximum payload condition IFIW cart has the minimum slippage 0.88 % and maximum slippage was found in 1.63 % for the same payload condition in WFWW. Remaining two carts WFIW and IFIW have the result between the IFIW and WFWW type cart. The highest wheel slippage was found in WFWW type bullock cart, whereas in IFIW type cart wheel slippage was lowest.

Key words: *Payload, draft, speed, power, slippage.*

INTRODUCTION

Animals are the largest contributor of farm power in India and probably the only source of power for marginal, small and even medium farmers who account for more than 80% of the total agricultural land holdings and 40% of the cultivated area. About 67%of energy input in the farming enterprise comes from animal sources, 23% from human exertion and remaining 10%from fossils.

Cite this article: Patre, N.K., Quasim, M., Kumar, M. and Tripathi, A., Comparative Performance of Bullock Carts at Different Payload Condition, *Int. J. Pure App. Biosci.* **6(1):** 1552-1557 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6359

Singh[10] 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. We could not completely replace animal power because of the poor socio-economic status of farmers, small fragmentary land holding and high rate of mechanization and due to the introduction of the tractor, power tiller, engines etc. Karangkar *et al.*[4] reported that draught animals are an important source of power for millions of developing country farmers. One of the important uses of the animal power is in the transportation of agricultural commodities. Pritchard[5] reported that for thousands of years, animals had been used to transport people and goods and to provide draught power for agricultural work. Sandge[8] observed that bullock can drag a conventional cart weighing 750 kg and an improved Jyoti cart weighing 2000 kg with the same pull, 51 (500N). Also, concluded that the life span of work animals by reducing the burden of heavy draft. Raghavan *et. al.*[7] carried out an engineering analysis of the design of two wheel bullock carts with the aid of a mathematical model. Yadav *et. al.*[11] suggested a suitable design keeping the overall cost within the approachable limits of peasant farmers of Orissa stated of India. Rao[6] computed the energy consumption in rural transportation, taking into account the energy embodied in vehicles or bullocks, as well as the fuels or feeds and food (of operators). The bullock cart transport consumes over four times more energy than vehicles. Adarsha *et. al.*[1] designed a cart with the idea to combine the good features of the traditional wooden carts and operational efficiency of improved pneumatic tyre carts. Agravat[2] disclosed about a cart with tilting mechanism comprising amain chassis, supported on a front wheel axle and a rear wheel axle, pairs of wheels being mounted on the axles. 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.*[10] developed a pneumatic wheeled ox-cart based on most common dimensions and payload capacity of conventional wooden wheel carts used in urban and rural areas of central India. The objective of the present study is to compare the performance of bullock carts at different payload conditions.

Performance parameters of bullock cart

Draft

Draft is calculated for a local pair and for different carts on plain concrete road. Pull is measured with the help of dynamometer attached between yoke and fixed platform shown in Fig 1. Draft was calculated from the multiplication of pull into angle made by animal with the cart in the direction of travel.

$$D = P \cos \theta$$

Where, D = Draft in kg; P= Pull in kg; θ = Angle of pull with respect to horizontal.

Fig. 1: Measurement of draft

Speed

Speed is measured for a travel of 500 m distance at different loads ranging from 500 kg to 1100 kg. Speed is calculated with the help of following formula:

$$\text{Speed } (S) = \frac{D}{T} \times 3.6$$

Where, S = Speed, km/hr; D = Distance traveled, m;T = Time required, second;3.6 = Conversion factor for km/hr.

Horse power

Horse power is the multiplication of draft and speed. The draft varies with the draught animals and type of the carts.

$$\text{Horse power (hp)} = \frac{D \times S}{75}$$

Where, D = Draft developed, kg; S = Speed of bullock cart, m/s.

Wheel slippage

Wheel slippage is measured by counting the revolution of the cart at loading condition and without loading condition and it is calculated by following formula:

$$\text{Wheel slippage, \%} = \frac{100\,(N1 - N2)}{N1}$$

Where, N_1= number of revolutions of the driving wheels for a given distance under load, N_2= number of revolutions of the driving wheels for the same distance at no load.

RESULTS AND DISCUSSION

Average draft requirement of bullock carts at different payload condition

The minimum draft 17.56 kg at tare payload was found in IFIW type cart and maximum draft at same payload was found 22.45 kg. At maximum payload 1100 kg minimum draft 35.22 kg was found in IFIW type cart and maximum draft was found 45.64 kg for WFWW type cart. The WFIW and IFWW type carts have the results between the IFIW and WFWW type cart. The effect of different payloads ranging from tare weight to 1100 kg for four different carts i.e. iron frame with iron wheel(IFIW), wooden frame with iron wheel (WFIW), iron frame with iron wheels(IFWW) and wooden frame with wooden wheels(WFWW) on concrete road draft requirement have been shown in Fig 2. The figure shows that as the payloads were increased simultaneously the draft was increased. IFIW type has lowest draft at all payloads and highest draft was found in WFWW type cart at all payloads. WFIW and IFIW type bullock have results between the two carts.

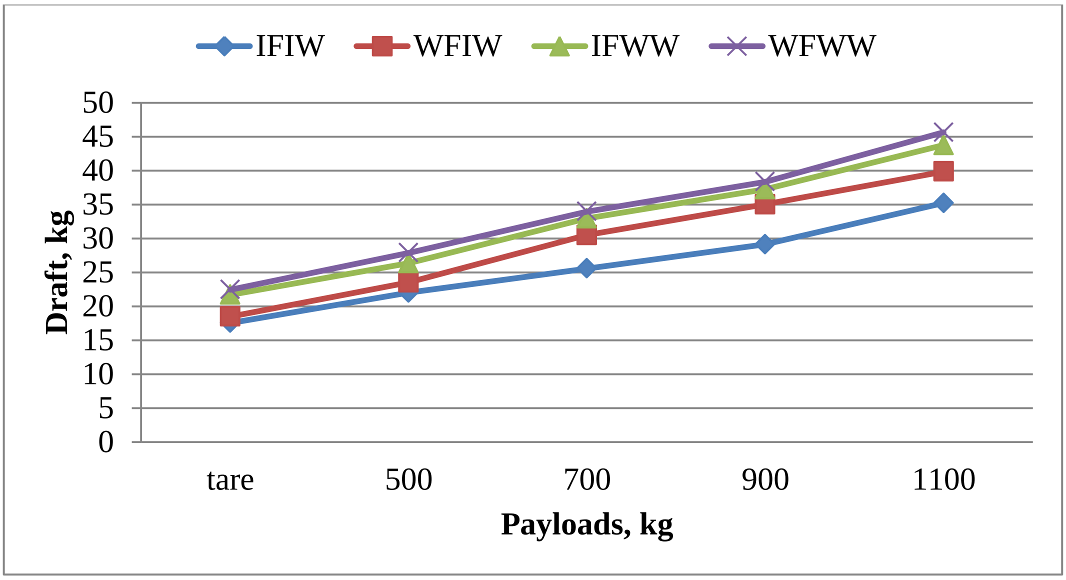

Fig. 2: Effect of payload on draft for different bullock carts

Average speed of bullock carts at different payload condition

Average speed of bullock carts at different payload conditions i.e. tare, 500, 700, 900 and 1100 kg have been shown in Fig3.The maximum speed at tare payload 4.10 km/h was found in IFIW type cart and minimum speed at same payload was found 3.67 km/h. At maximum payload 1100 kg minimum speed 2.99 km/h was found in IFIW type cart and maximum speed was found 2.76km/h for WFWW type cart. The WFIW and IFWW type carts have the results between the IFIW and WFWW type cart. From the graph it was found that WFWW type has lowest speed at all payloads, followed by IFIW type, WFIW type and highest speed was found in IFIW type bullock cat at all payloads.

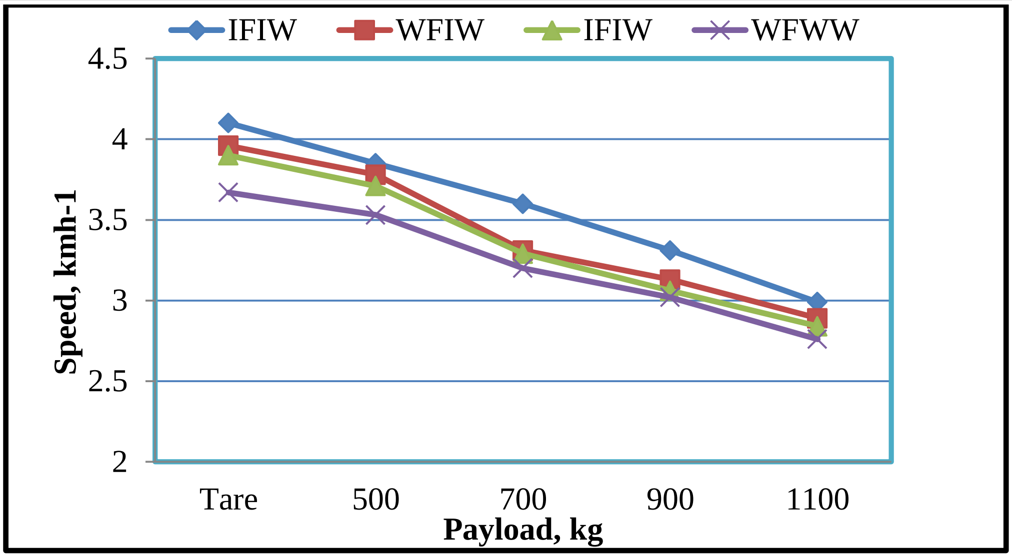

Fig. 3: Effect of payload on speed for different bullock carts

Average power requirement of bullock carts at different payload condition

The maximum power requirement was found 0.32 kW in WFWW type cart for the tare payload condition and for the same payload power requirement is minimum 0.27 kW in IFIW cart as shown in Fig 4. As the payload was increasing the power requirement was also increasing in each cart. WFWW cart has the maximum power requirement at 1100 kg payload while IFIWW has the minimum 0.39 kW that is the lowest than the all carts. The graph shows the effect of payloads on the power requirement of the carts. The highest power requirement was found in WFWW type cart and lowest in IFIW type bullock cart.

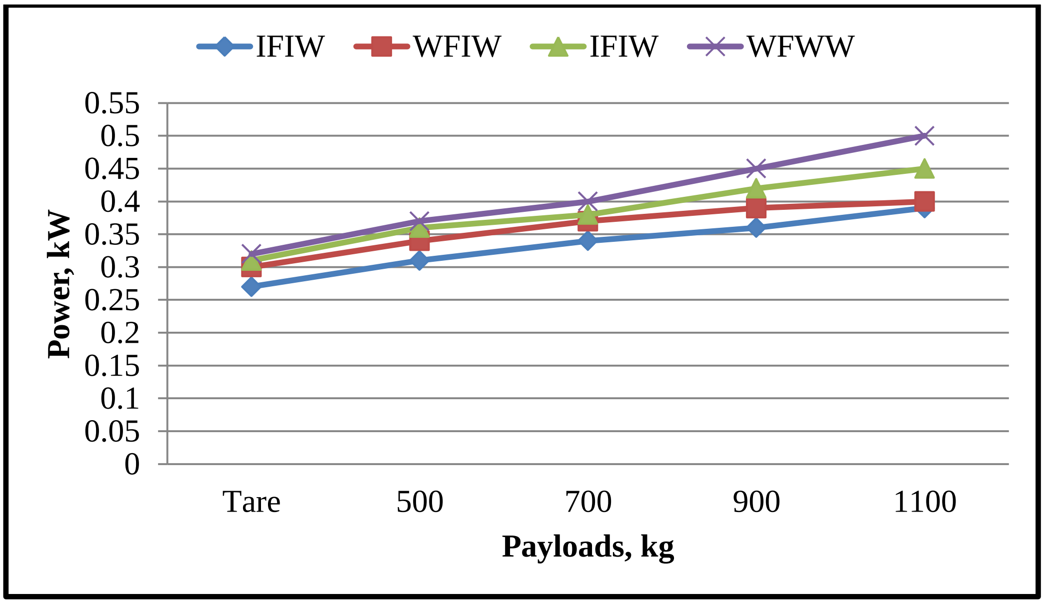

Fig. 4: Effect of payload on power requirement

Average wheel slippage of bullock carts at different payload condition

Slippage was found maximum 3.36 % at tare payload in WFWW type cart and at same payload minimum in 2.30 % in IFIW cart as shown in Fig 5. At maximum payload condition IFIW cart has the minimum slippage 0.88 % and maximum slippage was found in 1.63 % for the same payload condition. Remaining two carts WFIW and IFIW have the result between the IFIW and WFWW type cart. The graph shows the effect of payloads on the wheel slippage of bullock carts, highest wheel slippage was found in WFWW type bullock cart whereas in IFIW type cart wheel slippage was lowest. The figure also shows that as the payload was increased the wheel slippage reduces in all type of bullock cart.

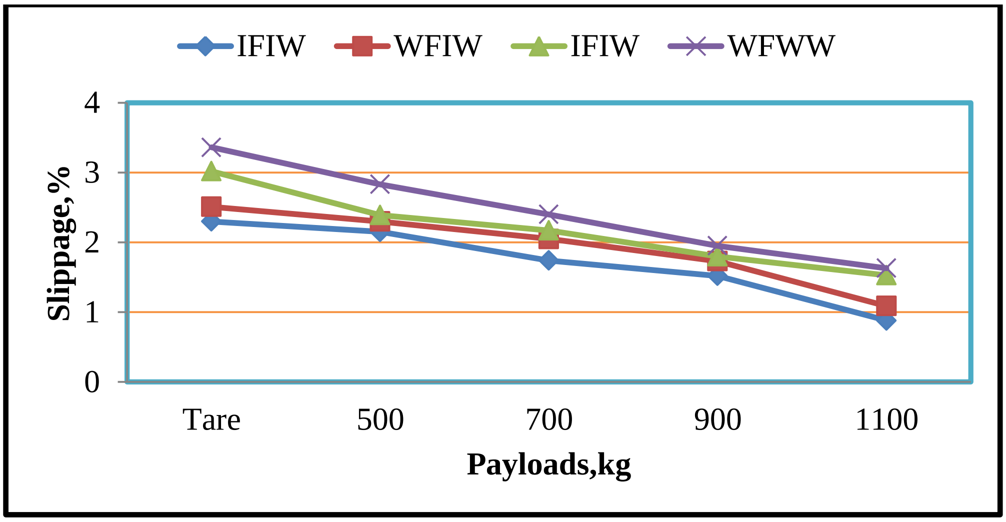

Fig. 5: Variation in wheel slippage with payloads

CONCLUSIONS

The maximum speed was found in IFIW type at 1100 kg payload was 2.99 km/h. Similarly, minimum speed was found in WFWW type was 2.76km/h. It was found that WFWW type has lowest speed at all payloads, followed by IFIW type, WFIW type and highest speed was found in IFIW type bullock cat at all payloads condition. The maximum and minimum power requirement was found 0.32 and 0.27 kW in WFWW and IFIW type cart at tare payload condition. As the payload was increasing the power requirement was also increasing in each cart. At maximum payload condition IFIW cart has the minimum slippage 0.88 % and maximum slippage was found in 1.63 % for the same payload condition in WFWW. From the results it shows that as the payload was increases the wheel slippage reduces in all type of bullock cart.

REFERENCES

1. Adarsha, M. S., Harsha, H. D. and Kurup, T. N. K., Rubberized steel wheel carts–an innovative design for better use of animal energy in rural India, 28-32 (2003).
2. Agravat, A. B., A four wheeled cart with tilting mechanism. Indian Patent No. 194420 (2009).
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. Karangkar, L. M. and Patil R. A. Draught ability of bullocks: A review. Journal of Animal Sciences, **78(9):** 1002-1018 (2008).
5. Pritchard, J. C., Animal traction and transport in the 21st century: Getting the priorities right. *The Veterinary Journal*, **186:**271–274 (2010).
6. Rao, A.R., Energy consumption in rural transportation in India. Energy. **10(5):** 681–682 (1985).
7. Raghavan, M. R. and Nagendra, H. R., A study on bullock carts. Part 1. Engineering analysis of the two-wheel bullock cart design. **2(4):** 435- 449 (1979).
8. Sandge, R.P., Modifications and improvements of indigenous bullock cart. Annual Report of Pune Centre presented in Z R C Workshop at Jabalpur.
9. Singh, G., Draught animal energy research in India. Proceedings of an ATNESA Workshop, South Africa, 315-323 (1978).

10. Singh, R.C., Dubey, U.C. and Singh, C.D., Standardization and performance evaluation of a pneumatic wheeled ox-cart for Central India. Central Institute of Agricultural Engineering Bhopal, India – 462038 (2014).
11. 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).