

Design, development of animal drawn multipurpose tool carrier suitable for non-descript breed of bullocks of Chhattisgarh

ANAND GAUTAM, S.V. JOGDAND AND VINAY KUMAR NAYAK

Received : 14.12.2012; Revised : 22.02.2013; Accepted : 18.03.2013

See end of the Paper for authors' affiliation

Correspondence to:

ANAND GAUTAM

School of Energy Studies for Agriculture, Punjab Agricultural University, LUDHIANA (PUNJAB) INDIA
Email :
aanand.gautam@gmail.com

■ **ABSTRACT** : MPT was developed to prepare seed bed in dry and wet soil condition and to perform various other agricultural operations. The average field capacity of above attachments *i.e.* cultivator (with Shovel) and seed drill for dry field was found to be 0.1385 and 0.1558 ha/h. It gave higher field capacity (1 ha/day) with additional saving in the cost of operation. The operational cost of MPT cultivator (with Shovel) and seed drill were found minimum 551.54 and 695.18 Rs. /ha, respectively in comparison to Tendua plough. The use of MPT was much economical than the traditional method the fabrication cost of MPT with attachments (Cultivator with shovel and seed -drill) was about Rs.7800.00.

■ **KEY WORDS** : Multipurpose tool carrier, Non-descript breed of bullocks

■ **HOW TO CITE THIS PAPER** : Gautam, Anand, Jogdand, S.V. and Nayak, Vinay Kumar (2013). Design, development of animal drawn multipurpose tool carrier suitable for non-descript breed of bullocks of Chhattisgarh. *Internat. J. Agric. Engg.*, 6(1) : 142-145.

In Chhattisgarh, on an average 80 per cent farmers belonging to marginal and small category, have less than 2 hectare land holding with low annual income resulting in low purchase capacity of improved costly machinery or tractor and therefore, they are dependent on the animals for tillage, sowing and weeding operations. Power developed by an average pair of bullocks is about 1 hp for usual farm work and the farmer has to use different implements matching to the draught capacity of animals for different farm operations. Changing implement for every specific operation causes inconvenience and investment of extra money. Multipurpose tool carrier is a good alternative for this problem. Various field operations can be performed with the help of a multipurpose tool carrier (MPT) without investing much amount and time. Preparation of seed bed is a specialised task, which requires skill, time, energy and labour in addition to different soil manipulating implements. Various animal drawn implements have been introduced in this region but, are not largely used by the farmers. Development of an animal drawn MPT could be a solution to low use of implements under animal farming system. Use of MPT may increase the quality of seedbed as well as efficiency of operation by saving time and labour. This may further increase the annual utilization of draught animals by performing various tasks on the farm. Different types of MPTs have been developed in many parts of the country based on localized requirements like type of soil, crop, climatic

conditions and draught capacity of animals. The bullocks used for farm operations in Chhattisgarh are mostly of non-descript breed with small and medium size and hence, with low draught capacity. The MPTs developed in other parts may not be suitable for these bullocks. Hence, there is a need to develop a multipurpose tool carrier matching to the draught capacity of non-descript bullocks of this region and suiting to the local needs.

■ METHODOLOGY

The machine conceived consisted of a tool frame, tynes, furrow openers, hitching system and depth control system. Design of different components of the machine was prepared keeping in view the draught-ability of local bullocks, animal drawn implements being manufactured at the centre and used by the farmers in this region. In this implement, row to row distance can be adjusted according to crops requirements in all operations and two people can easily handled this implement. Performance of multipurpose tool carrier was evaluated for secondary tillage, sowing and weeding operation. Observation of pull, operating time and turning time in each bed were recorded for all operations. Pull was measured with a spring type dynamometer attached to the beam. The field performance of multipurpose tool carrier was compared on the basis of draft requirement, actual field capacity, field efficiency and travel speed of the bullock.

The implement consisted of mainframe and hitching system, cultivator tynes, depth adjustment arrangement, seed metering mechanism, power transmission unit: Ground wheel, chain and sprocket, seed and fertilizer metering shaft, seed and fertilizer box. The locally available suitable materials were used for different components. Mild steel, C 30 angle iron, size 35x35x5 mm was used for the frame and hitch; whereas GI pipe was used for beam. Tynes were made using MS flat iron of size 50 x 8 mm and desired curvature was given to the tynes by forging method and heat treatment. The main frame was strengthened by joining the two angle iron pieces edge to edge, making square cross section and joined together by welding so that enough strength can be obtained to withstand the load encountered in actual field condition during the tillage, sowing and weeding operation. Number of holes (size 10.5 mm) was drilled at a spacing of 50 mm in this frame to accommodate the tynes at different desired spacing as per the requirement. There were attachments to the implement as specified in Table A. A schematic of the implement with sowing

attachment is shown in Plate A.

The isometric view of developed MPT is shown in Fig. A and overall dimensions are shown in Fig. B. The developed MPT was tested for dimensional as well as material required.

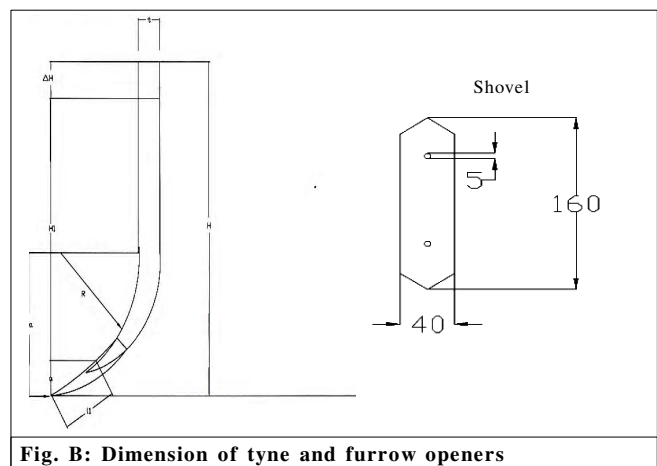
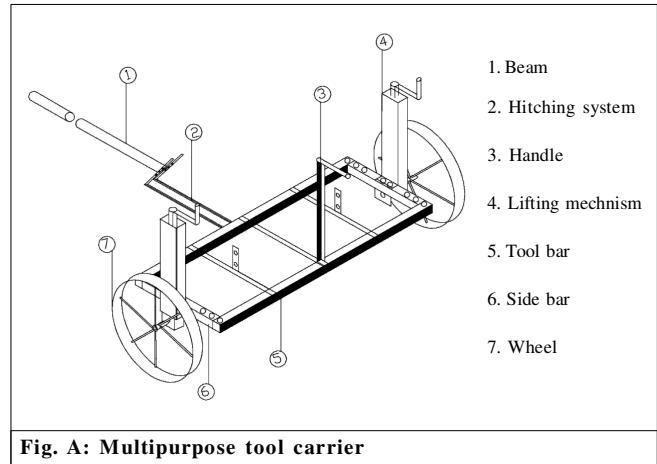


Table A: Salient features of MPT and its components

Sr. No.	Particulars	Details
1.	Overall dimension (L x B x H)mm	: 1050 x 420 x 950
2.	Type of transport wheel	: Iron wheel
3.	Number of transport wheel	: 2
4.	Length of beam, mm	: 225
5.	Diameter of transport wheel, mm	: 400
6.	Width of transport wheel, mm	: 65
7.	Cultivator-Tyne(W x T x H),mm	: 40 x 10 x 400
8.	Furrow opener (Width of Shovel), mm	: 40
9.	Seed drill	
	Metering mechanism	: Fluted roller
	No. of rows	: 3
	Seed cum fertilizer box (L x B x H), mm	: 600 x 300 x 200
	Power transmission system to seed-drill	: Ground wheel and chain, sprocket assembly
10.	Cost, Rs.	: 7800.00

RESULTS AND DISCUSSION

Field trials of the MPT along with Tendua iron plough were conducted at FAE IGKV, Raipur for seedbed preparation, sowing, intercultural operations. From the results (Table 1) it can be seen that the MPT was more efficient over Tendua iron plough. Economic analysis shows that the MPT could provide an effective low cost alternative machinery system, especially when high initial investment on machinery is a major constraint in the adoption of the improved technology. The purchase prices show that MPT may be regarded as low cost machine than the Tendua iron plough. Mayande *et al.* (1985) reported that a pair of bullocks having 500 kg weight per bullocks can consistently generate the power in the range of 1.4-1.8 kW at the walking speed range of 3.1-3.8 km per hour operations with wheeled tool carriers.

The average field efficiency of the MPT cultivator with shovel and Tendua plough was found to be 67.37 and 76.92 per cent, respectively. The MPT operated implements showed lower field efficiency than the Tendua plough because time loss in turning at the row ends and removing the clogging was higher for MPT as compared to the Tendua plough. In spite of lower field efficiency, both MPT attachments showed higher field capacity than Tendua plough, and could cultivate larger area than it in unit time. The effective field capacity for

behind MPT seed-drill sowing operation and the Tendua plough was found to be 0.1558 and 0.050 ha/h, respectively, where as theoretical field capacity was found to be 0.2053 and 0.0659 ha/h same for all four crops from the effective and theoretical field capacity, the field efficiency of MPT seed-drill and behind the plough was found to be 85.88 per cent and 85.63 per cent, respectively. Field efficiency for different weeding methods is shown in Table 1. It shows that the highest field efficiency 83.78 per cent was observed under MPT weeder and 72.67 per cent was observed under cycle wheel hoe. The MPT-weeder was found to be with the highest field capacity among the manually operated cycle wheel hoe.

The cost of operation was compared with the animal drawn Tendua plough. It is presented in Table 2. It is revealed from the table that the cultivator saves 553.89 Rs/ha as compared to Tendua Plough. The cultivator attached with MPT (Shovel) saves 59.60 times as compared to Tendua plough. The unit cost of the prototype bullock drawn seed-drill attachment for MPT was calculated by calculating the cost of different assemblies. The estimated operating cost of the MPT- seed drill came out to be 349.22 Rs/ha and 1044.40 Rs./ha for behind the plough. Thus, MPT with seed drill attachment could save 695.18 Rs./ha. as compared to sowing behind the plough. In addition to this MPT could save 67.83

Table 1 : Field performance of multipurpose tool carrier

Particular	Ploughing		Sowing paddy		Weeding	
	Tendua	MPT shovel	Tandua	MPT seed-drill	Cycle wheel hoe	MPT
Moisture content, (%)	21.02		22.43			
Size of implement,(cm)	15	60	15	60	15	60
Average depth of operation,(cm)	6.50	6.10	6.50	6.10	4.10	6.00
Travel speed of bullock(km/h)	3.33	2.90	3.39	2.96	2	2.33
Effective field capacity, (ha/hr)	0.0565	0.1385	0.0566	0.1558	0.025	0.1156
Theoretical field capacity, (ha/hr)	0.065	0.2	0.0659	0.2053	0.0344	0.14
Field efficiency (%)	76.92	67.37	85.88	85.63	72.67	83.78
Draft requirement,(kgf)	57.12	60.1	57.41	62.49	72.67	83.78
Power requirement,(kW)	0.44	0.53	0.44	0.58	0.45	--
Cost of cultivation,(Rs/ha)	932.12	380.58	932.50	309.53	1044.40	375.14

Table 2: Economic comparison of MPT

Description	Ploughing		Sowing paddy		Weeding	
	MPT-shovel	Tendua plough	MPT seed-drill	Tenda plough	MPT-shovel	Cycle wheel-hoe
Investment cost, Rs.	4954.00	1680.00	6684.00	1680.00	4954.00	820
Weight, kg	50	22.5	50.00	22.5	50	12.00
Cost of operation, Rs/h	52.52	52.22	54.41	52.22	52.52	26.11
Operating time, h/ha	7.24	17.85	5.68	17.66	8.65	40.00
Operating cost, Rs/ha	380.58	932.12	349.22	1044.40	375.14	1044.40
Cost saving, Rs/ha	551.54	-	695.18	-	3531.11	2861.85
Time saving, %	59.60	-	67.83	-	-	-

per cent time over the traditional practice. Table 2 depicts the comparative cost of weeding by different methods. Cost of weeding by MPT weeder (Rs. 375/-) is more than 2.5 times of cycle wheel-hoe (Rs. 1044.40/-). This variation is due to higher field capacity of MPT implement as it is driven by animals.

Conclusion :

The MPT developed under the present investigation worked satisfactorily for secondary tillage, sowing and weeding operations with different attachments for different operations. The performance of the MPT was found better than the corresponding traditional practices. This implement could save time, increased the efficiency and quality of operation. This implement is a versatile implement and can be used for several field operations by changing the attached implement only. The draught of all the tested implements was below the draught capacity of local bullocks, evaluated under the AICRP on UAE in the previous years, and hence, the implements tested under this experiment may be operated in large fields for longer duration.

Authors' affiliations:

S.V. JOGDAND AND VINAY KUMAR NAYAK, Faculty of Agricultural Engineering, Indira Gandhi Krishi Vishwavidyalaya, RAIPUR (C.G.) INDIA (Email: nayak_vinay25@yahoo.co.in)

■ REFERENCES

Mayande, V. M., Bansal, R.K. and Single, R.D. (1985). Performance of various animal drawn wheels tool carrier systems. *J. Agric. Engg. ISAE*, **22(2)**:27-39

Rajput, D. S. (1987). Scope of multipurpose wheeled tool carriers in increasing work output of draught animal power. In Utilization and economics of draught animal power. Proceeding of the National Seminar on Status of Animal Energy Utilization. Central Institute of Agricultural Engineering (CIAE), Bhopal, India. Technical Bulletin CIAE/87/51, pp. 188-191.

Verma, B.B. and Mishra, B.P. (2006). A prototype implement named Animal Drawn Tillage Cart (ADTC). M.Tech. Thesis, Faculty of Agricultural Engineering, Indira Gandhi Krishi Vishwavidyalaya, Raipur, C.G. (INDIA).

—————***—————