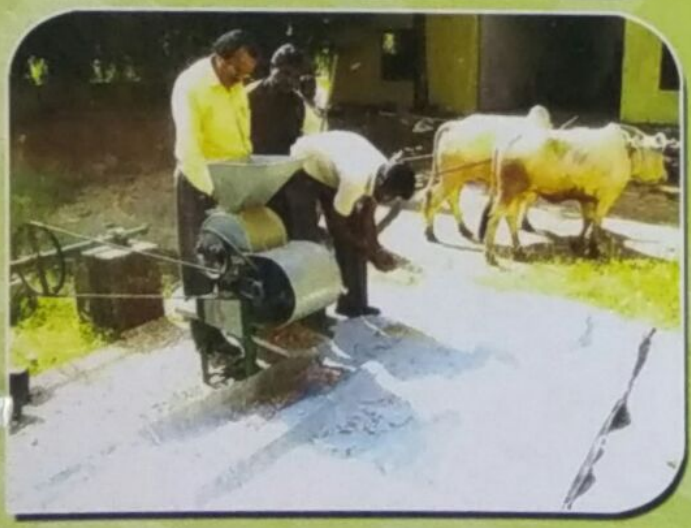
UAE/2012

ACHIEVEMENTS

ALL INDIA COORDINATED RESEARCH PROJECT ON UTILIZATION OF ANIMAL ENERGY WITH ENHANCED SYSTEM EFFICIENCY



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DEPARTMENT OF FARM MACHINERY AND POWER
COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY, OUAT,
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BACKGROUND INFORMATION OF THE PROJECT

Draught animal power has been traditionally the main source of power in Indian agriculture. Draught animal are mainly used for tillage operations as well as transport in rural areas especially for short distances. During the last decade there has been a rapid growth of power operated and self propelled machinery in agriculture. As a result, many of animal operated technologies became obsolete causing animal based farming operations uneconomical. This resulted in a sharp decrease (22.5 %) of draught animals from 72 million in 1997 to 55.8 million in 2007. Two factors have prevented drastic decline of draught animals. One has been the socio-religious factor which prevents open slaughtering of cattle and secondly, with increase in human population there has been the division of land holdings resulting in increase in number of small and marginal farmers. On the other hand, rising cost of diesel and electricity have resulted in significant increase in the cost of operation of power operated machinery. For small and marginal farmers, except for primary tillage operations, all other farm operations can be economically carried out by animal operated machinery as compared to power operated machinery. Draught animals are used for tillage, sowing, planting, weeding, inter-culture, earthing, plant protection and digging operations. They are the major source of farm power for small and marginal farmers of our country who possess nearly 80 % of the operational holdings with about 30 % of the total cultivable area.

Small and marginal farmers are poor, risk minimiser and cannot afford to purchase or hire costly power operated machinery. They are even reluctant to adopt improved animal drawn implements. Thus, although a large number of improved animal drawn implements have been developed in the country, only few have actually been adopted by farmers.

Considering the above situation, there is a need for systematic studies on all aspects of draught animal power. In order to utilize animal energy effectively and economically all aspects of draught animals need to be looked into. Besides improved yokes and implements, the food and nutrition, health and housing also need to be attended to so that the draught animals are able to give maximum power output without fatigue and health hazards. In order to improve the economics of draught animal power, it is necessary to increase the annual utilization of animals and also to utilize by-products such as animal dung and urine for making useful products. In short, a systems approach is necessary for effective and economic utilization of animal energy.

With the above background, the All India Coordinated Research Project on Increased Utilization of Animal Energy with Enhanced System Efficiency (AICRP on UAE) started in July 1987 with the Coordinating Cell at CIAE, Bhopal and seven Cooperating Centres situated at CIAE Bhopal, PAU Ludhiana, KVK Rewari, UAS Raichur, MPUAT Udaipur, GBPUAT Pantnagar and SHIATS Allahabad. During 2001-2002, PAU Ludhiana Centre was shifted to OUAT Bhubaneswar and KVK Rewari Centre was shifted to IGKV, Raipur and a new centre was started at AAU, Jorhat. During 2009-10, four new centres were started at MAU, Parbhani, BAU, Ranchi, CAE & PHT, Gangtok and NRC on Equines, Hissar. In Odisha, the AICRP on UAE started functioning in College of Agricultural Engineering and Technology, OUAT, Bhubaneswar from August 2001.

MANDATE

To improve utilization efficiency and economic viability of draught animals in Indian agriculture by developing mechanically efficient matching equipment and gadgets to increase versatility of their use as source of farm power with improved system efficiency, improved management of draught animals with value added feed, sanitation and health control measures and efficient utilization of animal by-products.

OBJECTIVES

1. To survey the status of draft animals and their utilization in relation to production in agriculture and post harvest requirement and identification of unit operation having potential animal use and animal equipment system components needing improvement.
2. To study the draftability and work-rest-cycle of local bullocks to optimize animal-machine system for agricultural operations.
3. Survey on feeding and management practices followed by local farmers and to study the effect of dietary energy on draftability of bullocks.
4. To develop suitable harness system to enhance power output.
5. To design and develop improved implements as per the draftability of animals to increase the bullock power efficiency and utilization.
6. To design, develop and evaluate the improved animal transport system.
7. To develop and evaluate draft animal application system for operations like interculture and development/ feasibility trial of conversion and use of animals for high speed rotary mode application for threshing, winnowing, chaff cutting and agro-processing operations.
8. FLD/ ORP trials of improved bullock drawn implements in farmers' field.

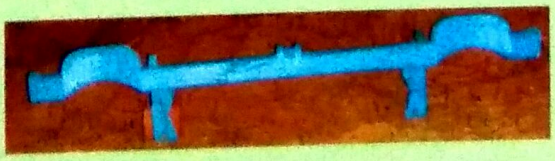
INTRODUCTION

Odisha is situated in the east coast of India extending over a geographical area of 15.57 m ha with 6.18 m ha under cultivation. In Odisha, around 79 % of farmers are under the small and marginal categories and they possess about 40 % of the total cultivable land. The numbers of operational holdings are nearly 40.67 lakhs with a cropping intensity of 160 %. The average size of holding is about 1.5 ha. Due to small and scattered land holdings, the farmers mainly depend on draft animals for performing various agricultural operations. The poor economic condition of the farmers restricts the use of tractor and powertiller drawn implements. Bullock drawn implements need to be improved and popularized to meet the requirements of the small and marginal farmers of the state of Odisha.

The most common agricultural operations performed by the bullocks are ploughing, leveling, puddling, threshing and carting. The average annual use of bullocks in our state is around 200-250 hours where as their potential annual use is about 800 hours. In order to overcome the higher feeding and management cost of bullocks, the annual use of bullocks needs to be increased by introducing suitable matching implements. Hence, to increase the versatility of draft animals as a source of farm power and to reduce the economic burden of keeping them, matching implements should be developed in order to perform the job with improved system efficiency in crop production and post harvest operations without detrimental effect on the animals. Some of the improved bullock drawn implements have been developed and popularized in the scheme looking into the draftability of the bullocks in the state of Odisha and these are as follows;

1. DEVELOPMENT OF SOME IMPROVED BULLOCK DRAWN IMPLEMENTS

1.1 OUAT YOKE



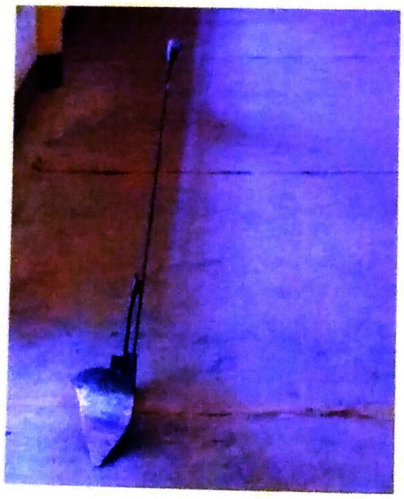
SALIENT FINDINGS

- Length of OUAT yoke: 1550 mm (5'2")
- Weight: 5-6kg.
- Made of Gambhari wood, light in weight, durable and available in coastal, inland and hilly districts of Odisha

Field operation of OUAT yoke

- Distribution of load is uniform over the neck and hump of bullock instead of point loading in case of local yoke
- Contact area at the neck and hump increased by 40-50 % over local yoke
- Field capacity increased by 7-8 % in tillage over local yoke
- Cost per piece Rs. 900-1000/- in the year 2010-11
- Suitable for small and medium size bullocks of Odisha

1.2 OUAT MOULD BOARD (MB) PLOUGH



Field operation of OUAT MB plough

SALIENT FINDINGS

- Working width: 100 mm
- Weight: 4.8 kg (without beam)
- Draft requirement: 43 kg. (422 N) (10% Body, Wt. of a pair of small bullocks (420-430 kg.)
- Speed of operation: 1.96 kmph
- Field capacity: 0.016 ha/h (62.5 h/ha)
- Cost of implement: Rs. 445
- Cost of operation: Rs. 1298/ha
- Benefits over traditional plough (F.C. 0.011 ha/h) (90.00 h/ha)
  - Saving of time h/ha: 27.50
  - Saving in cost/ha: Rs. 350
- Suitable for small size bullocks of Odisha

1.3 OUAT IRON PLOUGH

SALIENT FINDINGS

- Working width: 300 mm
- Weight: 9.8 kg (without beam)
- Draft requirement: 45-50 kg. (442-491 N)
- Speed of operation: 1.87 kmph
- Field capacity: 0.044 ha/h (23.00 h/ha)
- Mean clod diameter: 46 mm
- Cost of implement: Rs. 1000
- Cost of operation: Rs. 460/ha
- Comparative performance over four disc harrow (F.C. 0.047 ha/h, 21.00 h/ha)
  - Area coverage: 7.00% (less in iron plough)
  - Saving of time: 2.00 h/ha (more in iron plough)
  - Saving in cost: Rs. 45/ha (less in iron plough)
- Suitable for small and medium size bullocks of Odisha for secondary tillage operation

Field operation of OUAT iron plough

1.4 OUAT PUDDLER

SALIENT FINDINGS

- Working width: 760 mm
- Weight: 41 kg (without operator)
- Draft requirement: 50-55 kg. (490-540 N)
- Field capacity: 0.087 ha/h (12.00 h/ha)
- Puddling Index: 40-45 %
- Cost: Rs. 4000

Field operation of OUAT Puddler

- Cost of operation: Rs. 275/ha
- Benefits over MB Plough (F.C. 0.02ha/h, 50.00 h/ha)
  - Area coverage: 335% (more in OUAT Puddler)
  - Saving of time: 38.0 h/ha (less in OUAT Puddler)
  - Saving in cost: Rs.1025/ha (less in OUAT Puddler)
  - Puddling Index: 20 % (more in OUAT puddler)
- Suitable for both small and medium size Bullocks of Odisha for puddling operation

1.5 TWO-ROW INCLINED PLATE PLANTER

Sowing of groundnut

SALIENT FINDINGS

- Working width: 300 600 mm
- Weight: 34 kg
- Draft requirement: 45-50 kg. (441-491 N)
- Speed of operation: 1.65 kmph
- Field capacity: 0.06 ha/h (16.66 h/ha)
- Cost of implement: Rs. 7500
- Cost of operation: Rs. 300/ha
- Benefits over sowing behind plough (F.C. 0.03ha/h, 33.00 h/ha)
  - Saving of time: 16 h/ha
  - Saving in cost: Rs. 800/ha
- Suitable for coarse seeds like maize, groundnut, pea, soyabean, pulses, mustard etc.
- Suitable for medium size bullocks of Odisha

2. BULLOCK POWER UTILIZATION THROUGH MECHANICAL ROTARY GEAR SYSTEM

2.1 MULTI CROP THRESHER OF 800 MM WORKING WIDTH

Paddy threshing in rotary mode

SALIENT FINDINGS

- Draft: 420N (7% body weight of a pair of medium bullocks)
- Output of thresher for paddy: 140 kg/h
- Cost of threshing in rotary mode: Rs. 32/quintal
- Cost of threshing with electric motor: Rs. 20/quintal
- Cost of threshing in bullock treading: Rs. 35/quintal

2.2 MULTI CROP THRESHER OF 1200 MM WORKING WIDTH

Paddy threshing in rotary mode

SALIENT FINDINGS

- Draft: 600N (9.8% body weight of a pair of medium bullocks)
- Output of thresher for paddy: 230 kg/h
- Cost of threshing in rotary mode: Rs. 33/quintal
- Cost of threshing with electric motor: Rs. 21/quintal
- Cost of threshing in bullock treading: Rs. 32/quintal

2.3 MULTI CROP THRESHER CUM WINNOWER OF 720 MM DIAMETER

Paddy winnowing in rotary mode

SALIENT FINDINGS

- Draft: 290N (4.7% body weight of a pair of medium bullocks)
- Output of winnower for paddy : 400 kg/h
- Cost of winnowing in rotary mode: Rs. 15/quintal
- Cost of winnowing with electric motor: Rs. 9.0/quintal

2.4 CHAFF CUTTER OF 740 MM DIAMETER

Chaff cutting in rotary mode

SALIENT FINDINGS

- Draft: 650 N (10% body weight of a pair of medium bullocks)
- Output of chaff cutter: 150 kg/h
- Cost of chaff cutting in rotary mode: Rs. 27/quintal
- Cost of chaff cutting with electric motor: Rs. 17/quintal

2.5 MINI DHAL MILL

Dhal Milling in rotary mode

SALIENT FINDINGS

- Draft: 640N (10.5% body weight of a pair of medium bullocks)
- Output of dhal milling: 60 kg/h
- Cost of dhal milling in rotary mode: Rs. 80/quintal
- Cost of dhal milling with electric motor: Rs. 50/quintal

2.6 GROUNDNUT DECORTICATOR

Groundnut decortication in rotary mode

SALIENT FINDINGS

- Draft: 670N (11% body weight of a pair of medium bullocks)
- Output of decorticator for groundnut: 50 kg/h
- Cost of decortications cum cleaning in rotary mode:

  Rs. 115/quintal
- Cost of decortications cum cleaning with electric motor: Rs. 65/quintal

3. STEEL BULLOCK CART

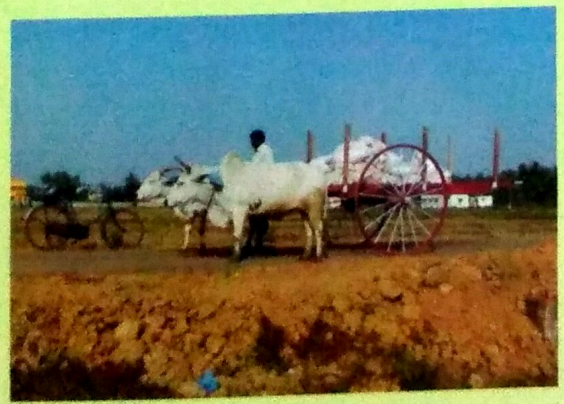
Steel cart of 2.0 tonnes capacity pulled by two bullocks

Steel cart of 0.5 tonne capacity pulled by one bullock

SALIENT FINDINGS

- Cart is designed to carry two times the load than existing wooden cart by a pair of medium bullocks
- Bearing are provided at wheels to reduce pulling force
- Brakes are provided for easier control of cart by operator
- Instead of solid platform, platforms with opening to minimize weight of cart
- Rectangular section of platform offers freedom to increase area without increasing width
- Yokes are from wood instead of iron to reduce injury to bullock
- Steel wheel with rubber liner suitable for different roads
- Low cost, durable and lighter weight than wooden cart

3.1 TWO WHEELED STEEL CART (2.0 TONNES CAPACITY) PULLED BY TWO BULLOCKS

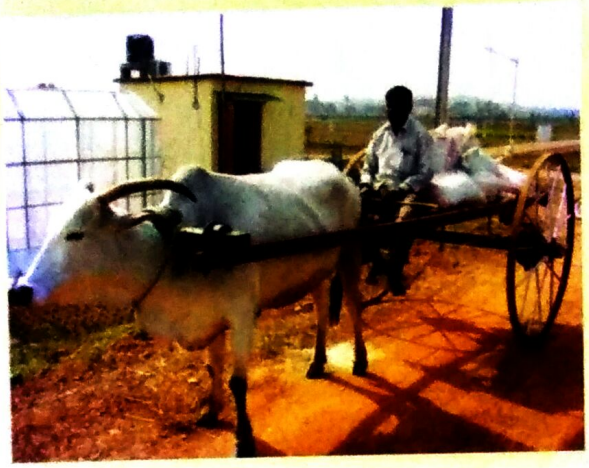


Field evaluation of steel cart

SALIENT FINDINGS

- Maximum pay load on tar road: 2300 kg
- Maximum pay load on kuchha road: 2200 kg
- Draft at maximum pay load: 685 N (11 % body weight)
- Time of carrying load continuously without fatigue: 3 h
- Weight: 280 kg
- Cost: Rs. 17,000/-

3.2 TWO WHEELED STEEL CART (0.5 TONNE CAPACITY) PULLED BY ONE BULLOCK



Field evaluation of steel cart

SALIENT FINDINGS

- Maximum pay load on tar road: 1000 kg
- Maximum pay load on kuchha road: 900 kg
- Draft at maximum pay load: 380 N (12 % body weight)
- Time of carrying load continuously without fatigue: 3 h
- Weight: 205 kg
- Cost: Rs. 14,000/-

4. DEMONSTRATIONS OF BULLOCK DRAWN IMPLEMENTS CONDUCTED IN ODISHA DURING 2002-2012

Sl. No.	Name of the implements demonstrated	Name of the district where demonstrations conducted	Total number of demonstrations	Total No. of farmers/ beneficiaries participated
1.	OUAT Yoke	Cuttack, Khurda, Keonjhar, Ganjam, Sundergarh, Koraput, Balasore, Puri, Dhenkanal, Mayurbhanja	58	2300
2.	Hardened hoof shoe	Cuttack, Khurda	11	605
3.	OUAT MB plough	Koraput	72	2300

4	Puddler 99	Cuttack, Khurda	8	240
5.	OUAT Puddler	Cuttack, Khurda, Keonjhar, Ganjam, Jajpur, Balasore, Puri, Dhenkanal, Mayurbhanja	84	3780
6.	Six disc harrow	Cuttack, Khurda	14	770
7.	Four disc harrow	Cuttack, Khurda	26	780
8.	Zero till seed drill	OUAT Central Farm (Khurda)	6	48
9.	Inclined plate planter (Groundnut)	Cuttack, Jajpur, Nayagarh, Sundergarh, Dhenkanal, Keonjhar, Puri, Balasore	68	2720
10.	Inter culture plough	Cuttack, Khurda	18	724
11.	Groundnut digger	Cuttack, Khurda, Dhenkanal, Balasore, Puri, Jajpur, Nayagarh	46	2530
12	Potato digger	Cuttack, Khurda	22	660
Total	**12**	**12**	**433**	**17,457**

5. PUBLICATIONS

5.1 RESEARCH ARTICLES

1. Behera, B. K, S. Swain, D. Behera and A. K. Mohapatra, 2006. *Study on draftability of non-descript bullocks of Orissa.* J. of Agricultural Engineering, ISAE, New Delhi.Vol. 43 (1): 35 41.

2. Behera, D, B. K, Behera, S. Swain and A. K. Mohapatra, 2006. *Draught animal status in Orissa and its utilization pattern in few selected villages.* J. of Agricultural Engineering To-Day, ISAE, New Delhi. Vol. 30 (5, 6): 1-6.

3. Behera, D, A. K. Mohapatra, B. K. Behera A. K. Goel and R. C. Dash, 2006. *Animal based farming with improved tools and implements for sustainable agriculture.* J. Extension Education, Vol. XI (1&2): 142-149.

4. Mohapatra, A. K, B. K, Behera, D. Behera and S. Swain, 2007. *Economics of crop productions in bullock farming system in Orissa a case study.* J. of Agricultural Engineering To-Day, ISAE, New Delhi. Vol. 31 (3 & 4): 26-29.

5. Behera, D, B. K, Behera, A. K. Mohapatra, A.K.Goel and S. Swain, 2007. *Performance evaluation of bullock-drawn zero-till drill for pulse crop.* J. of Research, OUAT, Vol.25 (2): 79-84.

6. Behera, D, B. K, Behera, A. K. Mohapatra and S. Swain, 2007. *Study on utilization and wear pattern of local hoof shoes.* J. of Research, OUAT, Vol. 25 (1): 92-98.

7. Behera, B. K, D. Behera A. K. Mohapatra, S.Swain and A. K. Goel, 2008. *Performance Evaluation of a Bullock Drawn Groundnut Digger.* Environment and Ecology, Vol.26 (3A): 1226-1229.

8. Behera, B. K., A.K. Mahapatra, D. Behera and S. Swain, 2008. *Draught performance of bullocks with different yokes.* Draught Animal News, University of Edinburgh, UK. Vol. 46: 24-29.

9. Behera, B. K, A. K. Mohapatra, D. Behera and S. Swain, *Effect of Draft and Season on Physiological Responses of Bullocks.* J. of Agricultural Engineering, ISAE, New Delhi. 2008, Vol. 45 (2): 33-39.

10. Mohapatra, A. K, D. Behera, B. K, Behera, S. Swain and A. K. Goel. Effect of dietary energy levels on power output of bullocks in summer season. Indian Journal of Animal Research, 2009, Vol.43 (1): 22-26.

11. Behera, B. K, D. Behera, A. K. Mohapatra and S. Swain. Assessment of draughtability of bullocks of Orissa in test track and field condition. The Indian Journal of Animal Sciences, ICAR, 2009, Vol. 79 (1):63-67.

12. Ghosal, M.K. D.Behera and A.K.Mohapatra. Utilization of bullock power through mechanical gear system for doing various agricultural post harvest operations. Research Journal of Agricultural Sciences 2011. 2(3): 620-622.

13. Ghosal, M.K., D.Behera and A.K.Mohapatra. Performance evaluation of an improved two wheel steel bullock cart (2.0 tones capacity) for transport of agricultural produce in an agricultural farm. Journal of Agricultural Sciences 2011. 2(3): 518-521.

14. Mohapatra, A.K., D.Behera, B.Behera and M.K.Ghosal. Comparative economics of animal based traditional and improved farming practices in paddy groundnut cropping system-a case study. Accepted in J. of Research, OUAT, Bhubaneswar vide letter no. 18/23-10-10.

15. Ghosal, M.K., D.Behera and A.K.Mohapatra. Sustainability of utilizing bullock power through mechanical gear system for chaff cutting operation. Animal Science Reporter. Accepted for publication in October 2012, Volume 6, No. 4.

16. Ghosal, M.K., D.Behera and A.K.Mohapatra. Performance evaluation of an improved single bullock operated steel cart (0.5 ton capacity) for sustainable rural transport. Animal Science Reporter. Accepted for publication in October 2012, Volume 6, No. 4.

5.2 EXTENSION BULLETIN/LEAFLETS

1. Draught animal status of Orissa (Bulletin No. 01/UAE/CAET/2004)
2. Bullock drawn implements in Orissa (Bulletin No. 02/UAE/CAET/2004)
3. OUAT Puddler (Bulletin No. 02/UAE/CAET/2007)
4. OUAT Mould Board plough (Bulletin No. 03/UAE/CAET/2008)

5.3 SUCCESS STORIES

1. Animal Drawn OUAT Iron Plough: Success Story. Published by All India Coordinated Research project on Increased Utilization on Animal Energy With Enhanced System Efficiency, Central Institute of Agricultural Engineering, Bhopal. Bulletin No. CIAE/UAE/2011/87. 2011.
2. A small farmer became an entrepreneur: Success Story. Published by All India Coordinated Research project on Increased Utilization on Animal Energy With Enhanced System Efficiency, Central Institute of Agricultural Engineering, Bhopal. Bulletin No. CIAE/UAE/2011/88. 2011.

5.4 TV TALKS

1. TV programme on OUAT yoke
2. TV programme on OUAT puddler

Telecasted by the Door Darshan, Bhubaneswar in Krushi Darshan Programme in August, 2008.

For further information please contact
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