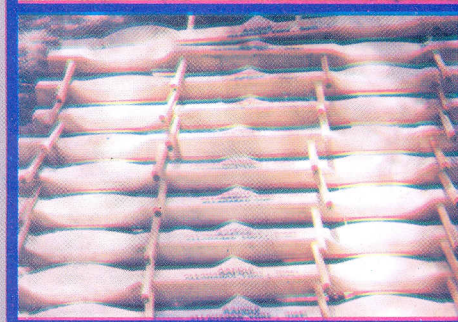
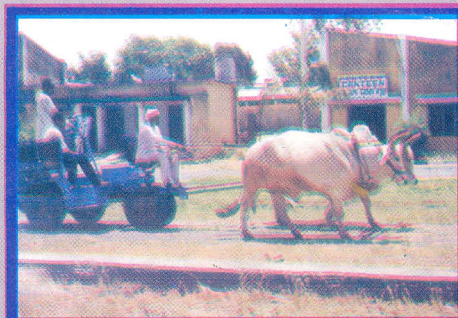


# All India Coordinated Research Project on Increased Utilization of Animal Energy with Enhanced System Efficiency

at a glance



MAY 2002

CO-ORDINATING CELL, AICRP ON UAE

**CENTRAL INSTITUTE OF AGRICULTURAL ENGINEERING**

Nabi Bagh, Berasia Road, Bhopal - 462038, India

**ALL INDIA CO-ORDINATED RESEARCH PROJECT ON  
INCREASED UTILIZATION OF ANIMAL ENERGY WITH  
ENHANCED SYSTEM EFFICIENCY**

*at a glance*



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**Nabibagh, Berasia Road, Bhopal - 462 038 (MP) India**

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# ALL INDIA CO-ORDINATED RESEARCH PROJECT ON INCREASED UTILIZATION OF ANIMAL ENERGY WITH ENHANCED SYSTEM EFFICIENCY

## INTRODUCTION

Indian farming system basically consists of small and scattered holdings. In spite of rapid growth of agricultural mechanization in recent years, the draught animals are available as progenies of milch animals and they continue to be the major power source for small and marginal farmers. Particularly, in the hilly regions and on marginal, small and semi medium farms upto 4 ha, the draught animals are expected to remain as a major power source for at least next 25-30 years. The population and annual use of draught animals is declining, due to adoption of mechanical and electrical power units in agriculture and development of road transport and power run irrigation systems. Presently, the total population of the draught animals is about 68 million in the country. The draught animals are contributing about 27,000 Mega Watt of power (which is about 27% of the total installed electricity generation capacity of the country).

Leaving aside Punjab, Haryana and Western U.P., where the tractors are used in good numbers, the draught animals are still the main source of farm power in the other parts of country. About 60-65% of the total cultivated area is being still managed by draught animals as against about 18% by tractors; therefore, draught animals are expected to continue to remain a major source of farm power.

With a view to increase annual utilization and over all efficiency of draught animals an Ad-hoc Project from AP cess fund in the name of Co-ordinated Research Programme on Increased Utilization of Animal Energy with Enhanced System Efficiency was started in January, 1985. Since 1st July, 1987, it became a regular All India Co-ordinated Research

Project on Utilization of Animal Energy with Enhanced System Efficiency, during the VIth Plan at a total cost of Rs. 55.27 lakhs of which 47.91 lakhs was ICAR Share. The project continued during VIIIth Plan (1992-97) with the total outlay of Rs. 192.18 lakhs, out of which Rs. 160.00 lakhs was ICAR Share. The Project also continued during IXth Plan (1997-2002) at a total cost of Rs. 416.30 lakhs, out of which Rs. 342.16 lakhs was ICAR Share and is likely to continue during Xth Plan with some additional centres. During IXth Plan centre at Punjab Agricultural University, Ludhiana was shifted to Orissa University of Agricultural & Technology, Bhubaneswar and centre at Krishi Vigyan Kendra, Rewari to Indira Gandhi Krishi Vishwa Vidyalaya, Raipur and one new centre was established at Assam Agricultural University, Jorhat in the North Eastern region.

## **MANDATE OF THE PROJECT**

This project broadly aims to study the status and scope of various draught animals in different regions and develop mechanically efficient matching equipment to increase versatility of draught animals as a source of farm power and perform the job with improved system efficiency in crop production and post harvest operations without detrimental effect on health of the draught animals or the operators.

## **OBJECTIVES OF THE PROJECT**

The major objectives of the project are:

- To develop standard techniques and instrumentation for precise measurement of animal draft power in field and laboratory.
- To survey status of draught animals and their utilization in relation to production agriculture and post harvest requirements and identification of unit operations having potential animal use and animal - equipment system components needing improvement.
- To determine the machine and characteristics coefficient of animal equipment-terrain system.

- To design, develop and evaluate yoking and harnessing systems for different draught animals used in singles, pairs and team.
- To optimise animal machine systems for agricultural operations.
- To design, develop and evaluate animal based transport system for different regions.
- To develop and evaluate animal draft application systems for operations like inter-culture, chemical application, harvesting, auxiliary engine assisted operations like rotary tilling and development of efficient mechanical systems for conversion and use of animal power for in rotary power applications like water lifting, threshing, winnowing etc.
- Operational research on improved utilization of animal draft power.

## **CO-ORDINATING CELL & CO-OPERATING CENTRES**

### **A) Co-ordinating Cell**

The Co-ordinating Cell of the project is located at the Central Institute of Agricultural Engineering, Nabibagh, Berasia Road, Bhopal - 462 038.

### **B) Co-operating Centres**

Presently the Project is having eight Cooperating centres.

## **LOCATION OF CENTRES**

### **a) ICAR Institute based**

Central Institute of Agricultural Engineering, Bhopal - 462 038 (Madhya Pradesh).

### **b) Agricultural University based**

- Orissa University of Agriculture & Technology, Bhubaneshwar - 751003 (Orissa)

- ii. GB Pant University of Agriculture & Technology, Pantnagar-263145 (Uttaranchal).
- iii. College of Technology & Agricultural Engineering, Udaipur (Maharana Pratap Agriculture and Technology University, Udaipur – 313001 (Rajasthan).
- iv. College of Agricultural Engineering, Raichur (University of Agricultural Sciences, Dharwad) - 584101 (Karnataka).
- v. Indira Gandhi Krishi Vishwa Vidhyalaya, Raipur- 492 012 (Chattisgarh).
- vi. Assam Agricultural University, Jorhat-785013 (Assam).
- vii. Allahabad Agricultural Deemed University, Allahabad–211007 (Uttar Pradesh).

## CENTREWISE DRAUGHT ANIMALS BREED

These centres have been working on different animals /breeds as per Table-1.

**Table-1 : Animals/breeds being studied at different centres**

Centre	Animals and their breeds
CIAE, Bhopal	Malvi and local breed bullocks
OUAT, Bhubaneswar	Bullocks (small size and local breed)
GBPUAT, Pantnagar	Buffaloes/ hill bullocks
CTAE, Udaipur	Camels and donkeys
AEC, Raichur	Khillari bullocks and donkeys
AADU, Allahabad	Haryana and local breed bullocks and mules
IGKVV, Raipur	Bullocks (Draught breed and local breed)
AAU, Jorhat	Bullocks (Siri and local breed)

## ECONOMIC IMPORTANCE OF DRAUGHT ANIMALS

Economic importance of Indian draught animals is shown in Table-2.

**Table- 2: Economic importance of draught animals.**

Sl. No.	Present population	Approx 68 million equivalent to 27.0 million, MW
1	Area cultivated (60-65%)	Approx. 79-87 million ha
2	Replacement rate option with tractor	10 bullocks/tractor
3	Present population equivalent to 35 hp tractors	6.8 million tractors (The existing population of tractor is 2.22 million)
4	Annual saving of diesel due to use of draught animals	Approx. 22.12 million tonnes worth Rs. 33,792 crores at the prevailing subsidized rate
5	Present market value of draught animals @ Rs. 12,000/- per pair	Rs. 40,800 crores
6	Investments on animal drawn equipment @ Rs.5000/- per pair of animal	Rs. 17,000 crores
7	Present value of animal carts 14.3 million @ Rs. 12,000/- per cart	Rs. 17,160 crores
8	Replacement value of existing draught animals, implements and carts by 6.8 million tractors and equipment @ Rs. 3.5 lakh/ tractor and set of equipment	Rs. 23,800 crores Draught animals provide approx. 93 million tonnes of dry dung/year Approx. Rs. 5000 crores/year. Raw material for biogas plants
9	Save 4.7 million tonnes of fire wood/year	Approx. 500 crores/year
10	Provide by-products—hide skin, bone, horn etc.	Approx. Rs. 100 crores/year



## SALIENT RESEARCH ACHIEVEMENTS

- i. Animal loading car was designed, developed and evaluated by Bhopal centre. Twelve units of CIAE Animal Loading Cars were supplied to all the centres of UAE Scheme and one each to NRC on Camel, Bikaner, NDU&T Kumarganj, Faizabad, IGKVV, Jagadapur and NDRI, Bangalore. These units are working very satisfactorily at all these places, for draughtability studies. More demands have come from R&D organisations for supply of loading car. The prototype production of 10 units of animal loading car is in progress at PPC, CIAE, Bhopal.



**Fig. 1** Draftability studies on a pair of bullocks



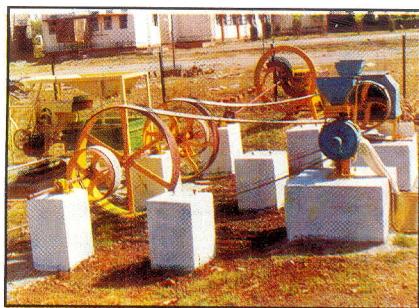
**Fig. 2** Draftability studies on buffalo

- ii. Animal tread mill has been designed and developed by Bhopal centre. Three units of CIAE animal tread mill have been supplied to Allahabad centre, IVRI, Izzatnagar and NRC on Equine, Hissar.



**Fig. 3** : Bullock on tread mill

- iii. To increase the annual utilization of the draught animals specially during off season animal operated agro-processing units have been installed at different villages, for operation of number of agro-processing machines. Use of animals in rotary mode operation for operating number of agro-processing machines and for generating electricity have been demonstrated to farmers of different villages.



**Fig. 4: Various agro-processing machines in rotary mode of operation**



**Fig.5: Demonstration of rotary mode operation with a pair of bullock**

- iv. Improved yokes and harnesses were developed at all the centres of the project. Nagpuri yoke, Allahabad type 3 padded collar harness, Pantnagar hill yoke, Pantnagar three padded collar harness and Allahabad yoke have shown advantage over the local wooden yoke. These yokes and harnesses were demonstrated and distributed during ORP/FLD programme. The acceptance of Allahabad yoke was found better over the collar harnesses. Allahabad yoke and Pantnagar yoke (Hill and Tarai) have shown advantage over Nagpuri yoke and are ready for commercialisation. Pantnagar hill yoke for large and small animals are also ready for commercialisation.

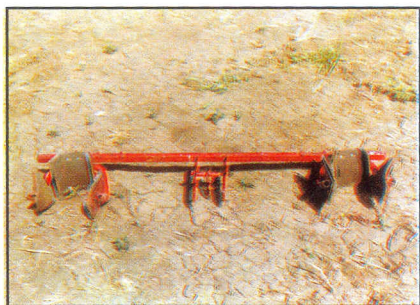


Fig. 6: View of Allahabad three padded double bullock collar harness

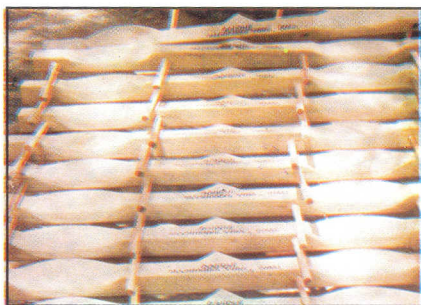


Fig. 7: Prototype production of Allahabad yoke for FLD

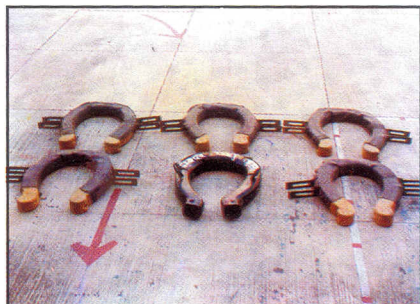


Fig.8: Pantnagar adjustable collar harness



Fig.9: Prototype production of Pantnagar hill yoke for FLD



Fig. 10: Distribution of Allahabad yoke to farmers under ORP/FLD



Fig. 11: Distribution of Nagpuri yoke under ORP/FLD

- v. Two wheeled bullock cart has been developed and standardized by Bhopal centre for two tonne pay load capacity and is ready for commercialisation. Five prototypes of improved bullock carts were already fabricated and supplied/sold to the users.

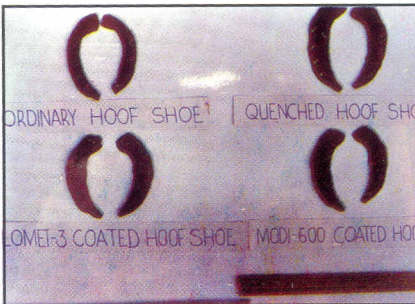


**Fig. 12: Performance testing of CIAE two wheeled bullock cart**



**Fig. 13: Testing of CIAE two wheeled bullock cart**

- vi. Pantnagar centre has identified different mild steel hard surfacing options spot welding with electrodes and wear resistance powders coating suitable for increasing hardness of the surface of the hoof shoes after weld depositing/coating. Using these improved hardened hoof shoes, the frequency of the shoeing was reduced considerably and thus, saving the money. Animals were found comfortable with improved hoof shoes.



**Fig. 14: View of improved hoof shoe**

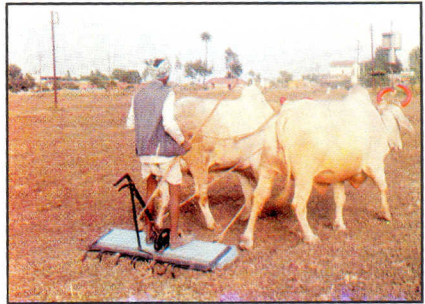


**Fig. 15: Hoof shoeing of Bullock**

- vii. Fatigue score card and work-rest-schedule for camels and donkeys have been evaluated and finalized at Udaipur centre.
- viii. Findings of Bench mark survey on utilisation of Animal Energy in different regions and cost of feeding and maintenance data have been released for information to persons concerned and extension.
- ix. Assessment of draft capacity of animals in sustained working has been done at all the centres and based on the results the best suited work rest schedule for bullocks, buffaloes, camels and donkeys has been finalized and the same has been released for extension and persons concerned. Findings of draughtability studies on crossbreed bullocks have also been released for extension. Based on the results of these studies, matching implements were developed. Findings of load carrying capacity of pack animals have also been released for extension.
- x. Identification / development of matching implements package for the identified animals of the centre for crop production in the area was done by all the centres of the project. Trials of existing equipment have shown that there is good scope of increasing the sizes of implements by 30-50%. to match and fully utilize the draught power available from the animals.



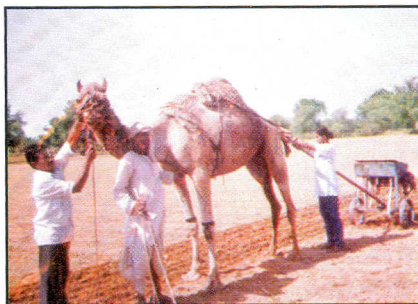
**Fig. 16:Weeder with a pair of bullocks**



**Fig. 17: Harrow patela with Pair of bullocks**



**Fig. 18: Seed-cum-fertilizer drill with pair of bullocks**



**Fig. 19: Seed-cum-fertilizer drill with a camel**

- xi. At Allahabad centre a sub-soiler was designed and developed which worked satisfactorily upto a depth of 300 mm and draft exerted by sub-soiler in ploughed land was within the draft capacity of a pair of bullocks. The sub-soiler is ready for commercialisation.
- xii. Allahabad centre has also designed and developed a low cost bullock drawn multipurpose tool bar for primary and secondary tillage operations. Suitable implements for tillage were also developed for multipurpose tool bar. MB Plough of different sizes (150, 175 and 200 mm) and cultivator (3, 4 & 5 tyne) along with sub-soiler and desi plough and seeding attachment to cultivator were developed.

### **IMPORTANT RESEARCH PROGRAMMES IN PROGRESS**

Activity-wise important research programmes in progress are shown in the Table-3.

**Table-3 : Ongoing research activities of the project**

Activity	Research Programme
Harnessing system	Performance evaluation and comparison of improved yokes and harnesses and study on variation in physical parameters of the draught animal
Matching implements	Development, comparative evaluation, testing and demonstration of matching implements
Weighing of animals	Development and evaluation of portable electronic load measuring device
Front line demonstration	Hardened hoof shoes, improved yokes and harnesses, improved bullock carts, agro-processing complexes and matching implements
Operational Research Project	Improved bullock cart, yokes and harnesses, matching implements, agro-processing complex and hoof shoe technology
Development of implements	Animal operated zero till drill and Multi-row intercultural tools
Rotary mode of operation	ORP and FLD of bullock / camel/ donkey/ buffalo based agro-processing complex
Feeding and management	Study on effects of diets of varying energy protein ratio on performance of draught animals
Multi-pair animal system	Evaluation of multi-pair animal system for field operation using different breeds
Draftability studies	Assessment of draftability of draught animals of new breeds and working out of work-rest-schedule
Feasibility studies	Testing and modification of reaper for feasibility trial studies

### **FUTURE THRUST OF THE PROJECT**

- Generation of information about draftability on all the major Indian breeds of cattle and buffaloes.
- Large scale demonstration, ORP, FLD and popularisation of improved animal drawn implements, improved yokes and harnesses, hoof shoe technology and animal carts in various parts

of the country and saturation of few villages with UAE technologies.

- Improvement in existing animal-drawn equipment based on implement mechanics, animal bio-mechanics and other related factors so as to have more output and increased efficiency without jeopardizing animal health.
- Development of new equipment / equipment systems for increased utilization of draught animals.
- Establishment of physiological norms for continuous working of animals for reducing drudgery to animals and mankind.
- Techno-economic and social acceptance studies of various new technologies developed in the project.
- Research information and dissemination for benefit of the research workers in the country.
- Organization of training programmes on advance instrumentation/ computer based data processing, proper operation, care, maintenance, repair and promotion of improved animals drawn implements.
- Use of animals in pairs (similar and different type / breed).
- Development of package of implements for raised bed cultivation.
- Development of a matrix relationship between agro climatic (e.g. soil, rainfall, crops) parameters, various field operations, draft requirement, animal characteristics and equipment systems.
- Adoption of hand tools for use with draught animals for vegetable cultivation, horticulture and hill agriculture.
- Identification of energy efficient draught animal and promoting their uses.



