All India Coordinated Research Project on

Increased Utilization of Animal Energy with Enhanced system efficiency

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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, management of draught animals with value added feed, sanitation and health control measures and efficient utilization of animal by-products.

Cooperating Centres = 09

UAE Centre	Started in
CIAE Bhopal	1987-88
MPUAT Udaipur	1987-88
UAS Raichur	1987-88
GBPUAT Pant Nagar	1987-88
IGKV Raipur	2001-02
OUAT, Bhubaneshwar	2001-02
MAU Parbhani	2009-10
CAE & PHT Gangtok	2009-10
NRC on Equines, Hissar	2009-10

Status of draught animal power and its relevance

- **Animal energy is sustainable, as animals derive their energy for work from feed and fodder available from agricultural production**
- **India possess first draught breeds of cattle in the world. At present there are 22 pure breeds and four dual purpose breeds of bullocks in India. (Nagauri, Malvi, Khillari, Haryana, Ongole, Red Kandhari, Khillar, Gaolao, Deoni and Dangi etc.**
- **Draft animal population is 49.69 million in India (Livestock Census, 2012). Bullocks are the major draught animal in India having a population of 44.48 million. They are used for farm operations, transport as well as stationary operations.**
- **The command area of a pair of draught animal is about 2.5 ha and thus draught animal command 62.0 million ha of the net sown area of the country (approximately 44% of the net sown area**
- **The equivalent power available is estimated as 12.18 Million kW from 48.73 million bovines in 2011-12.**

Major types of draught animals in India and their population (in million)

Sl No.	Type of draught animal(s)	1997-98	2003-04	2007-08	2011-12
1	Bullock	55.76	54.32	49.70	44.48
2	Buffalo	6.80	5.84	4.93	4.09
3	Camel	0.91	0.03	0.39	0.29
4	Yak	0.03	0.15	0.06	0.05
5	Mithun	0.08	0.75	0.15	0.17
6	Horse and poney	0.83	0.18	0.21	0.25
7	Mules	0.22	0.65	0.10	0.15
8	Donkeys	0.88	0.63	0.30	0.21
Total		65.51	62.55	55.85	49.69

Livestock Census 1997-98, 2007, 2007-08 and 2011-12

State-wise draught population (in nos) and acreage per draught animal pair (ha/animal pair)

State	2011-12	
	Population	ha/animal- pair
Andhra Pradesh	3137350	7.09
Arunachal Pradesh	250778	1.31
Assam	3021658	1.81
Bihar	943865	2.76
Chhattisgarh	4216006	2.26
Goa	13729	20.54
Gujarat	2487684	7.59
Haryana	379918	18.56
Himachal Pradesh	579797	1.91
Jammu & Kashmir	600089	2.49
Jharkhand	4055551	0.89
Karnataka	2298738	9.06
Kerala	9294	474.71
Madhya Pradesh	6124680	4.79

State	2011-12	
	Population	ha/animal - pair
Maharashtra	5915192	6.00
Manipur	63441	4.41
Meghalaya	114540	4.02
Mizoram	7045	26.69
Nagaland	61298	0.98
Odisha	4562566	2.56
Punjab	340957	25.01
Rajasthan	2002794	15.84
Sikkim	25025	7.59
Tamil Nadu	604804	17.54
Tripura	173527	3.23
Uttar Pradesh	4092854	8.61
Uttarakhand	731060	2.10
West Bengal	2989637	3.62

Acreage per draught animal pair availability in States (ha/animal- pair) in 2012

Draught animal density ha/animal- pair	No of states	States
1.5 -2.5 (high draught animal power intensity)	8	Arunachal Pradesh, Assam, Chhattisgarh, Jammu & Kashmir, Jharkhand, Nagaland, Himachal Pradesh and Uttarkhand
2.5-5.0 (Medium draught animal power intensity)	7	Bihar, Odisha, West Bengal, Madhya Pradesh, Manipur, Meghalaya and Tripura
5.0-10.0 (Low draught animal power intensity	6	Maharastra, Andhra Pradesh, Gujarat, Karnataka, Sikkim, and Uttar Pradesh
> 10.0 (Very low draught animal power intensity)	7	Haryana, Kerala, Mizoram, Punjab, Goa, Rajsthan and Tamil Nadu

➢The DAP although has potential to generate annually 21924 million kWh energy (at 1800 working hrs per year) but due to declining use (350 working hour/year) the power availability has been limited to 4263 million kWh

➢Draft animals (working animals) play a dominant role in our rural economy

❖On the use of bullock carts in India –numbering 12 million carts in 2014, are estimated to be in service transporting about 6 billion tonnes of freight per year, compared to this the Indian Railways, loading of about 1010 million tonnes in 2012-13, (According to Government of India Statistics, The Hitavada, News Paper dated 31/05/2015)

❖12 million bullock carts in our country provide employment to an estimated 20 million people – bullock cart operators and repairs

❖ Rs. 72,000/- crore investment rests on the shoulder of bullocks of our country (each cart costs Rs. 20,000/- to build and a pair of bullocks Rs. 40,000/- at a minimum)

➢Draught animals produce about 40 billion tonnes of manure- Encouraging organic farming

ADVANTAGES OF DAP UTILIZATION

- Appropriate farming system for small and marginal farmers
- Only feasible source of energy for agricultural work in hilly areas.
- Low investment
- Non- requirement of skilled labourers
- Crop waste and by-product utilization
- Facilitates organic farming
- Avoids soil compaction
- Attachment to cattle from socio-religious point of view
- Renewable and sustainable farm power sources

REPLACEMENT OF DAP BY TRACTORS IN INDIA

- Total no. of farm holdings :120 million
- Net cultivable area :160 million ha
- Cropping intensity :1.30
- Total cultivable area :208 million ha
- Total no. of DAP :49.69 million
- Total input power from DAP :26.32 million hp
- No. of tractors to replace DAP :7,50,000 (0.75 million) (35hp/tractor)
- Annual average sale of tractor : 4,00,000 per annum
- Approximate year for replacement : 2 years

ENVIRONMENTAL PROTECTION AND SAVING OF FOSSIL FUELS BY DRAUGHT ANIMALS

- **Replacement of tractor (number): 0.75 million**
- **Diesel consumption =2.78 million tonnes (diesel consumption rate per tractor per year= 3.25 tonnes) (average fuel consumption = 120 gm/bhp-hr and average annual use of tractor 1000 hours)**
- **Carbon dioxide release to environment = 8.35 million tonnes (1 kg diesel releases 3 kg of carbon dioxide)**
- **By saving 50 % of diesel by draught animals in India, the amount saved per year = Rs. 5500 crores**
- **Prevents emission of greenhouse gases**
- **Crop waste and agril. by-products utilized by animals**
- **Animal facilitates organic farming**

Development of Equipment/ Instrumentation system for Draughtability Studies and other Research Purposes.

CIAE Loading Car

Braking effect is developed in the rear wheels through hydraulic pressure system causing resistance in movement and exerting load on the loading car to pull it

CIAE Animal Treadmill

Portable Animal Weighing Machine

Draughtability of Animals

Animal	Breed	Sustained draft load capacity, % body weight
Bullocks	Malvi	10-12
	Nagori	14
	Khillari	16
	Hariana	10-12
	Mottu	8-11
	Local bullocks of Madhya Pradesh	10-12
	Local bullocks of Allahabad Region	10-12
	Local bullocks of Raichur Region	12
	Local bullocks of Chhatisgarh	10-12
	Local bullocks of Orrissa	9-12
	Local bullocks of Assam	10-12

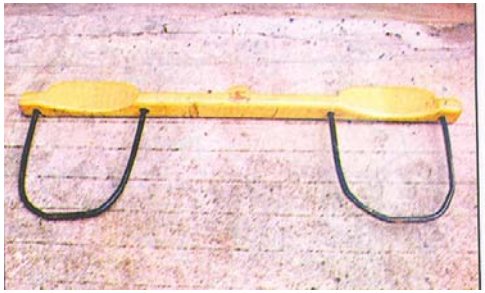
Draughtability of Animals

Animal	Breed	Sustained draft load capacity, % body weight
Buffaloes	He buffaloes of Uttarakhand and West Uttar Pradesh	12-14
	Swamp buffaloes of Assam	12-14
Donkey	Kathiawad	32
Mule	Allahabad	29
Camels	Bikaneri	18

Development of package of improved animal drawn implements matching to draughtability of animals in different regions.

Development of Yokes and Harnesses

Allahabad and CIAE single Animal harness



CIAE modified

Allahabad yoke

Pant Nagar collar harness for Buffaloes

Suitable for animals of Jharkhand state

Harness for pair of donkeys

Pant hill Yoke

OUAT Yoke

Yoke fabricated from composite material

IMPROVED YOKE

- Light in weight
- 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
- Area coverage increased by 7-8 % in tillage over local yoke

Work Rest Cycle for Draught Animals

Bullocks	Malvi and local breeds of Central India	4h work+2h rest+ 3h work
	Kenkatha, Nagori and Haryana breeds	(a) 2h work+ 1h rest+ 2h work+ 1h rest+ 2h work. (b) 3h work+ 1h rest+ 3h work.
Camel	2h work+ 1h rest+ 2h work+ 1h rest + 2h work.	
Buffaloes	Swamp buffaloes of Assam	4h work+ 2h rest+ 3h work.
	He-buffaloes of Chattisgarh	3h work+ 1h rest+ 3h work.
Donkey	Kathiawad	2h work+ 2h rest+ 2h work.
Mules	(a) 2h work+ 1h rest+ 2h work+ 1h rest+ 1h work. (b) 3h work+ 1 ½ h rest+ 2h work.	

Practices followed by farmers in different agricultural operations in hill agriculture

1. Ploughing

2. Leveling by use of Dade

3. Paddy transplanting

4. Threshing

5. cleaning

6. Transporting

Mechanization Gaps

A. To increase command area with a pair of bullock following equipments can be used

1. **Animal drawn improved wedge plough**
2. **Animal drawn clod crusher-leveler-planker-puddler**
3. **Animal drawn improved 2/3 row cultivator**
4. **Animal drawn 2 row seed drill/zero till drill**
5. **Animal drawn two row maize planter**
6. **Animal drawn ferti-hoe**

B. Lack of improved gadgets for pack load transport in steep hills. Mostly using yak and ponies.

C. Insufficient/ adequate local artisans.

D. Nutritive feeds to be introduced for higher draft requirements.

E. Improved cattle shelters for safety and hygiene of animals and animal operators (farmers).

F. Inadequate financing opportunity to the farmers.

Improved Technologies in Hill Agriculture

Animal drawn implements

1. Three tine cultivator

2. Wedge plough

3. Leveller cum planker

4. Helical blade puddler

5. Two row Z-Till Drill

6. Maize planter

Traditional plough (Wooden)

- Width:100 mm,
- Work rate: 0.015 hectare per hour
- Average draft: 45 kg with a depth of operation of 110 mm)
- cost of operation :Rs.2500/ha
- Self life: 1-2 years

Improved wedge plough

- Unit Price: Rs 800/-
- Weight: 12 kg
- Work rate: 0.02 ha/h
- Average draft: 40 kg corresponding to the depth of operation of 100 mm
- Cost of operation :Rs.2000/ha

Net saving in cost of operation : Rs. 500/- per ha

Improved wedge plough in operation in dry and wet condition

Traditional puddling practice by use of *dande*

Weight: 15 kg

Size: 680 mm

Average draft : 60 kg

- Animal drawn improved helical blade
- Work rate: 820 sq. m/h
- Draft :was found 40.5 kg

Pant Hill Yoke

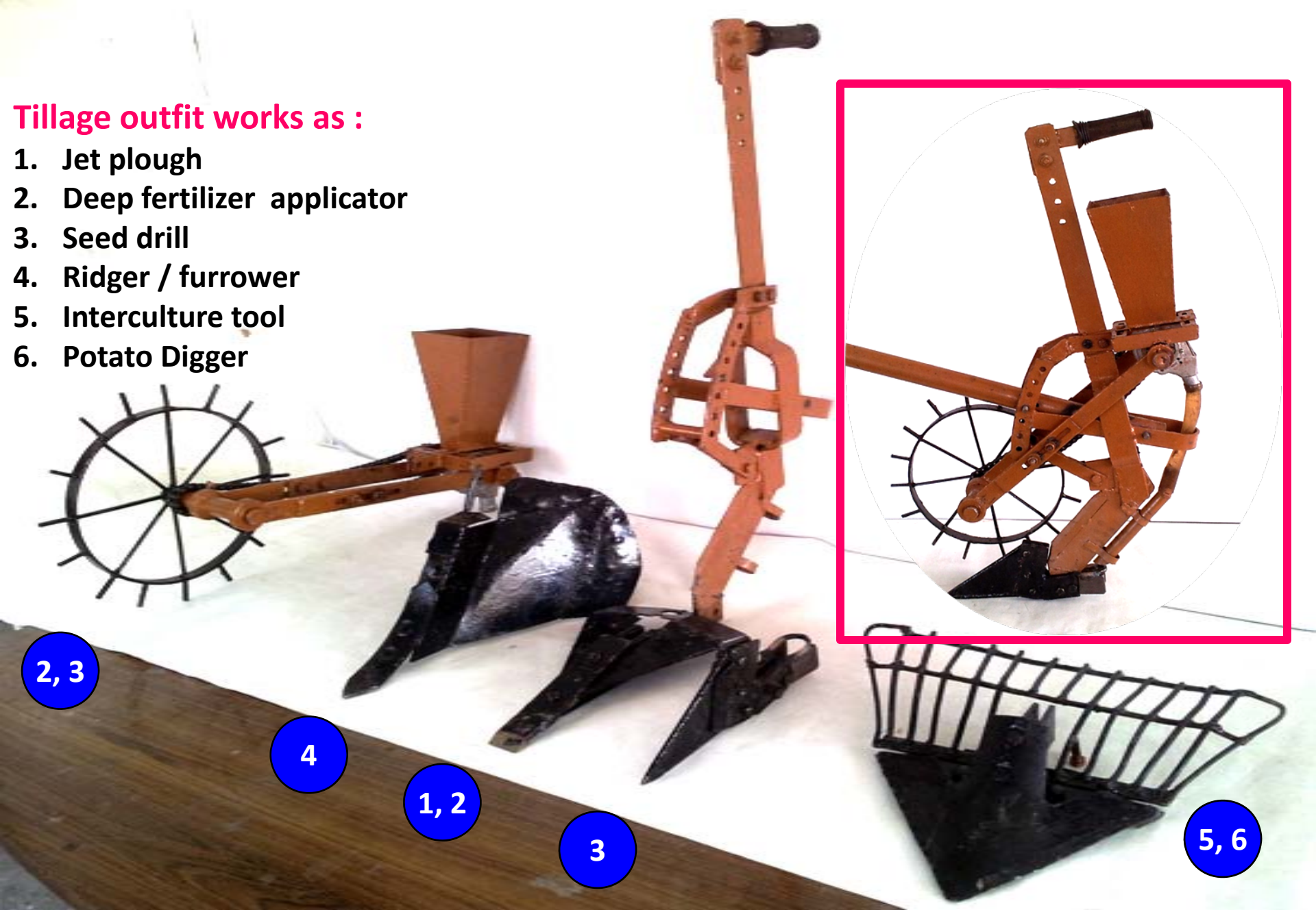
40 % increase in contact area and 15 % more draft capacity of bullocks

- **Weight. : 3 kg (Pant Yoke)**
  : 7-8 kg (Local)
- **Cost : Rs. 500/-**

Pant-ICAR Six-in-one Animal Drawn Tillage Outfit

Tillage outfit works as :

1. Jet plough
2. Deep fertilizer applicator
3. Seed drill
4. Ridger / furrower
5. Interculture tool
6. Potato Digger



Operation of Tillage Outfit at farmers field in Sikkim

Cost of package Rs.8500/-

CIAE Bullock drawn blade harrow, Field capacity- 0.07 ha/h

M.B. Plough (100 mm) for primary tillage operation at Ranchi

Blade harrow in farmer's field at Raichur

MAU Stubble Collector for cotton crop

Width 165 cm

Field capacity, 0.043 ha/h

Camel drawn seed drill

Donkey for tillage

Mule for tillage

Animal drawn lug wheel puddler

CIAE Bhopal Design
Width- 1.2 m
Field capacity- 0.10 ha/h

OUAT Bhubaneshwar design
Width- 0.9 m
Field capacity- 0.08 ha/h

BAU Ranchi design **Puddler**
Field capacity : 0.10 ha/h

CAE &PHT Gantok design puddler
Field capacity: 0.06 ha/h

Development and evaluation of bullock drawn ridge type drum seeder

Particulars	8-row drum seeder
Row to row distance, mm	186.0
Draft, N	450
Actual field capacity, ha/h	0.18
Field efficiency	68.25
Operational cost, Rs/ha	118/-

- Developed a package of animal drawn implements (Tendua plough, clod breaker cum puddler and biasi plough) for he-buffaloes

Tendua plough

Particulars	Modified biasi plough	Tendua plough	clod breaker
Draught, N	620	772.3	636
Effective Field Capacity, ha/h	0.16	0.017	0.34
Field Efficiency, %	70	74.34	72.34

clod breaker cum puddler

- Centre has manufactured and supplied 2500 baisi plough to farmers in Chhattisgarh State

Biasi plough

One & 5 – Row seed cum fertilizer drill for sowing of ground nut and green gram green gram crops

Single row seed drill

Five row Seed-cum-fertilizer drill

Groundnut was sown with seed cum fertilizer drill

Particulars	One Row seed-cum fertilizer drill	5-row seed-cum fertilizer drill
Draft, N	286 (6.82 % of the body weight bullocks)	357 (8.50% of the body weight bullocks)
Actual field capacity, ha/h	0.042	0.130
Field efficiency, (%)	72.64	61.54
Total savings against local practice (Rs./ha)	2101.70	2540.00

Development of animal drawn multi-crop seed drill

Particulars	5-row seed drill
Crop	**Wheat**
Row to row distance, mm	200-220
Draft, N	220
Actual field capacity, ha/h	0.24
Field efficiency, %	**82.76**

Development of animal drawn seed drill for inter-cropping.

Particulars	4-row seed drill
Draft, N	230
Actual field capacity, ha/h	0.41
Field efficiency, %	**82.0**

Development of a package of animal drawn implements for garlic cultivation

Three row garlic planter

Particulars	3-row garlic planter
Draft, N	450
Actual field capacity, ha/h	0.06 to 0.08
Operational cost, Rs/ha	725/-
Saving in Time , %	90

Garlic digger and digged garlic bulbs

1 hour (h) Work (W) - ½ h Rest (R) - 1 h W - ½ h R - 1 h W - ½ h R - 1 h W

Draft, N		683.50
Field capacity, ha/h:		0.08- 0.10
Digging efficiency, %	:	86
Cost of operation, Rs/ha	:	392.50
Saving in cost, Rs/ha	:	3825/-
Saving in energy MJ/ha	:	175.70

Adoption of package of animal drawn implements for conservation agriculture under Soya bean wheat and Soya bean gram crop rotation

Zero-till

Minimum till

Conventional

Particulars	Zero-till	Minimum till	Conventional practice
Total cost, Rs./ha	5832/-	6693/-	7769/
Energy expenditure, MJ/ha	4604	4667	5084

CA with no-tillage practice saved 25% cost and 10% energy as compared to conventional tillage

Mechanization of unit operations of root crops (potato and ginger) cultivation on terraces for animal based farming system

CAE&PHT centre developed potato digger

Weight, kg	**:10**
Field capacity, ha/h	**: 0.03**
The digging efficiency, %	: 93
Saving in cost, %	:60

Adoption of suitable implement package for Mustard cultivation in Assam

No. of rows	Four
Field capacity, ha/h	0.28
Weight, kg	47.0
Draft, N	450
Working depth, mm	1.5-2.0
Operating cost, Rs./ha	55.00

Design Development and Performance Evaluation of Bullock Drawn Cotton Planter cum Fertilizer Drill

Row to row distance, mm	900
depth of operation, mm	40
Draft, N	650
Actual field capacity, ha/h	0.37

The row to row distance can be changed easily by sliding the tyne from 90, 105,120 and 135 cm which was recommended for cotton planting.

Adoption of bullock drawn equipment for conservation tillage and residue Management

Bullock drawn zero till drill for sowing of sorghum

Row to row distance, mm	**600**
Soil moisture content, %	12.6
Effective field capacity, ha/h	0.18
Power output, kW	0.43
Cost of operation Rs/ha	306.70

UAS, Raichur bullock drawn engine operated high clearance sprayer for cotton and pigeon Pea

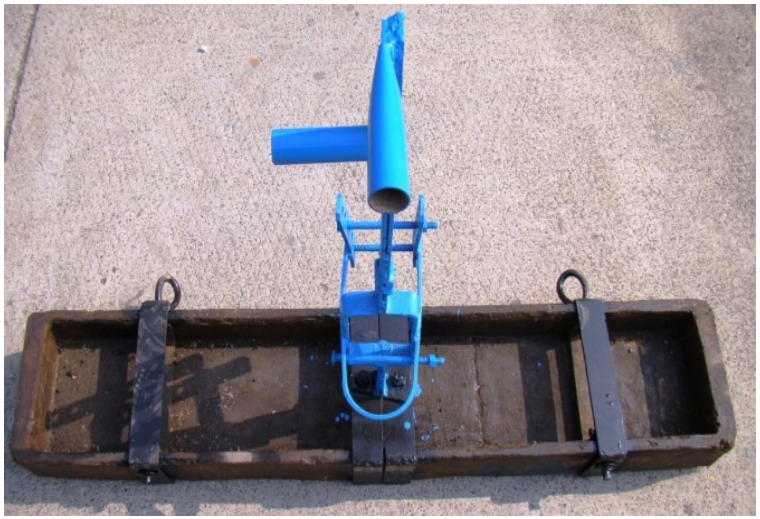
CIAE, bullock drawn sprayer for Cotton and other crops

14 nozzles at spacing of 45 cm
Field capacity : 1.2 ha/h
Discharge : 9.97 l/m

Parbhani Centre bullock drawn traction sprayer in saff flower & sorghum

Designed yoke using composite material has 40.57% lesser weight as compared to wooden yoke and has strength more than 3 times

Yoke made of composite material



Fabricated composite material patella

Testing of animal drawn patella

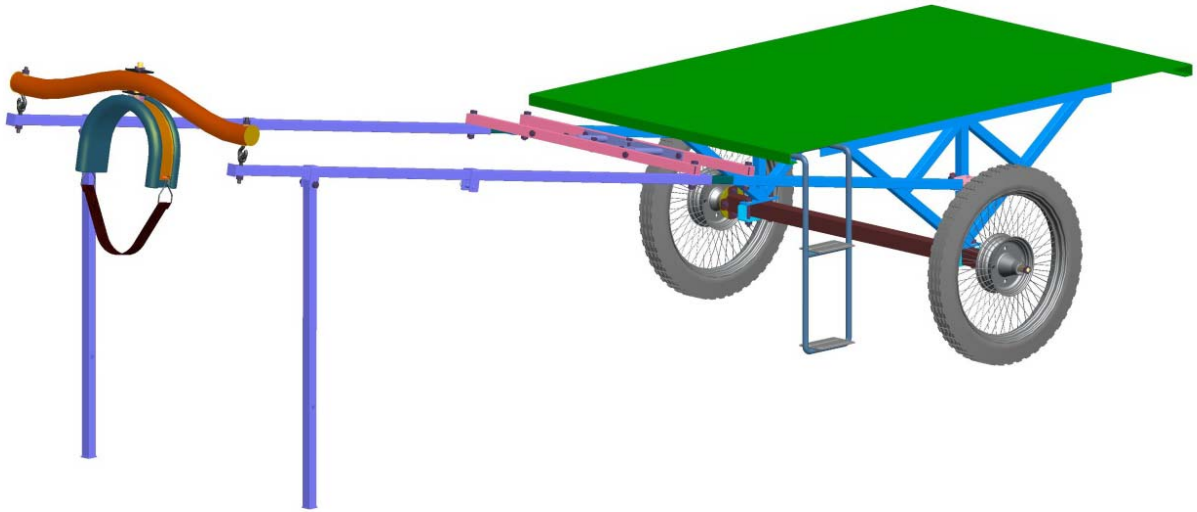
Model-I : CIAE, PNEUMATIC WHEEL BULLOCK CART

Draft force	1069, 1066 and 1060 N at payloads of 2.5, 1.5. 1.0 tonne on tar road, earthen road and harvested field
Power	0.58, 0.60 and 0.58 kW at payloads of 2.5, 1.5. 1.0 tonne on tar road, earthen road and harvested field
Body size	2400mm x 1400 mm x 800 mm
Ground clearance	350 mm
Axle	45 x 45 mm2 : ADV axle with taper roller bearing and hub
Brake	Shoe type
Track width	1200 mm
Cost	Rs 14,000 approx

Model-ii :CIAE , SINGLE BULLOCK PNEUMATIC WHEEL CART

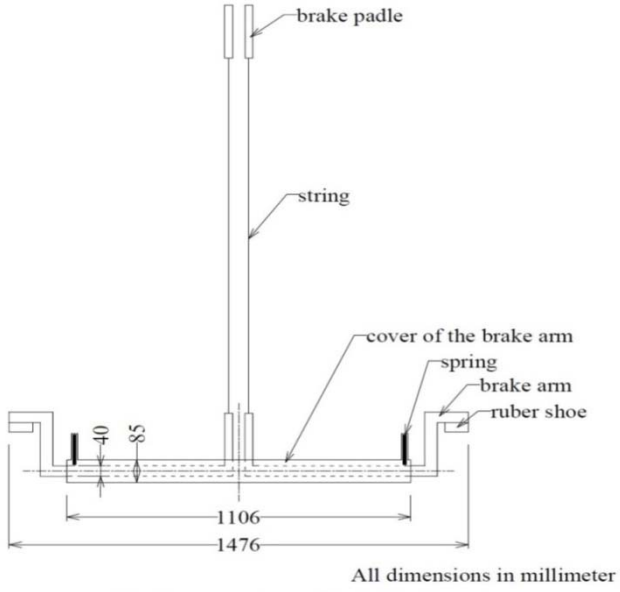
Draft force	480 N at payload of 1250 kg on tar road
Power	0.30 kW at payload of 1250 kg on tar road
Body size	4325mm x 1520 mm x 1372 mm
Axle	45 x 45 mm^2 : ADV axle with taper roller bearing and hub
Track width	1200 mm
Pneumatic wheel	6-16-PR (wheel dia. 0.70 - 0.80 m

CIAE, bullock cart, light weight having pneumatic wheel
Capacity : 1.0 tonne Capacity
Source of power : Single bullock
Pneumatic wheel : 0.60m wheel dia, size : 3.25 x 19
Body size : 4325mm x 1520 mm x 1372 mm



Evaluation in progress

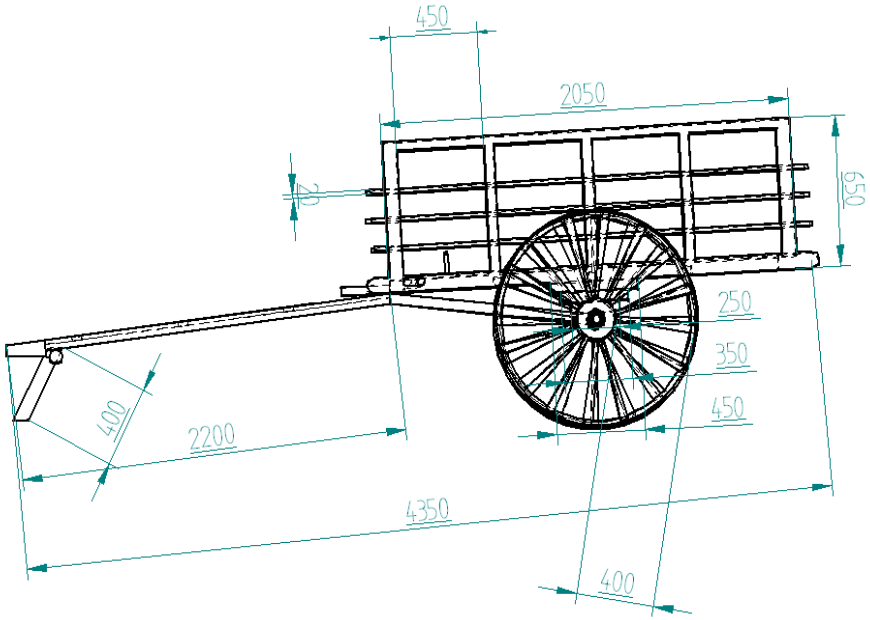
BAU, Ranchi, Bullock cart

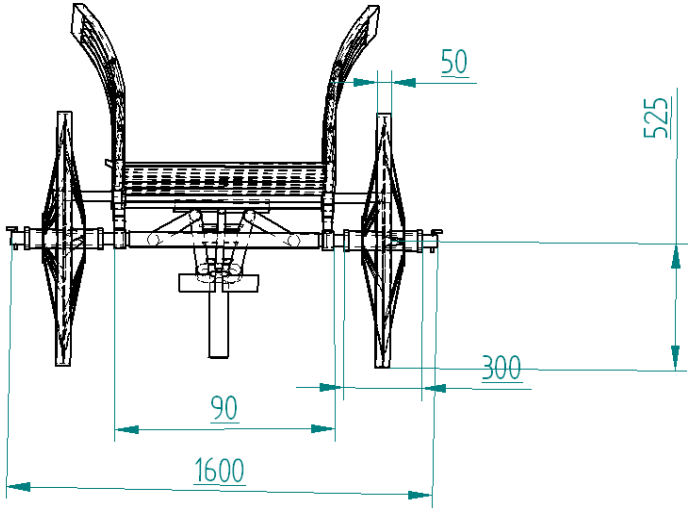


Brake system

Total weight : 90 kg
Draft : 350 N for tar road
400 N for kachha road

Bullock Cart designed by MAU, Parbhani





Part name	Size (mm)
Platform	900×2050
Frame	2050×500
Pushing bar	45×30
Wheel	1050
Wheel shaft	300×60
Axle	1600×50
Supporting channel	450×350×250×60
Side bar	500×50×4
Operator seat	450×250×30
Wheel plate	200×5
Spokes	400×50×4
Rim	1050×10
Beam	3300×80
Hub	350×75×10
Rope tying bar	300×15

Pneumatic wheel steel bullock cart (0.70 tones capacity), OUAT, Bhubaneswar

Components	Dimension
Wheel diameter (mm)	600
Platform size (mm x mm)	1900 x 1220
Length of cart (from rear to yoke) (mm)	3700
Ground clearance (mm)	650
Distance between wheels (mm)	1000
Pay load carrying capacity, tonne	0.70
Weight (kg)	113
Wheel bearing	Roller type
Shock absorber	Spring type
Brake	Shoe type
Cost (Rs.)	25,000

Studies on physiological responses of mules during ploughing (NRC on Equines, Hissar)

Design and development of saddle with harnessing system for pack load transport in hilly areas using Yak and other animals

- Saddle of composite materials used for pack load using by yak during transport of materials in hilly areas, developed by GBPUAT, Pant Nagar .
- The maximum pack load of 120 kg on yak could be used to travel 5.5km distance in two hour duration at steep slope of 60 degree.
- Developed saddle was able to take 30% more load over traditional saddle
- Users told that Yak rearing farmers will get 25% higher profit with using newly developed saddle of composite material

Saddle used by army for pony on steep slope

Traditional saddle at Derang, Arunachal Pradesh

Wooden saddle at Sikkim

Study for use of Mithun as draught animals at NRC Mithun, Jharanapani, Nagaland

Test trial of Mithun by using Collar harness

Physiological parameters:

Weight : 466 Kg, age : 5 years

Test trials: 30 minutes

increase of

Pulse rate/ min (30.23%),

Respiration rate/min (54.83%)

Body temperature (3.20%)

- **Depth of ploughing: 80 mm.**
- **Draft :26 kg**
- **Speed : 2.39 km/h**
- **F C: 0.036 ha/h**
- **Field efficiency : 75%**

Test trial of mithun by using Bamboo yoke

Physiological parameters:

Weight : 408 kg and 466 kg

Age : 5 years

Test trials: 30 minutes

increase of

Pulse rate/ min (20-33.7%),

Respiration rate/min (57.14-65%)

Body temperature (2.8-3.10 %)

- Depth of ploughing: 100 mm.
- Draft :28 kg
- Speed : 2.98 km/h
- F C: 0.040 ha/h
- Field efficiency : 75%

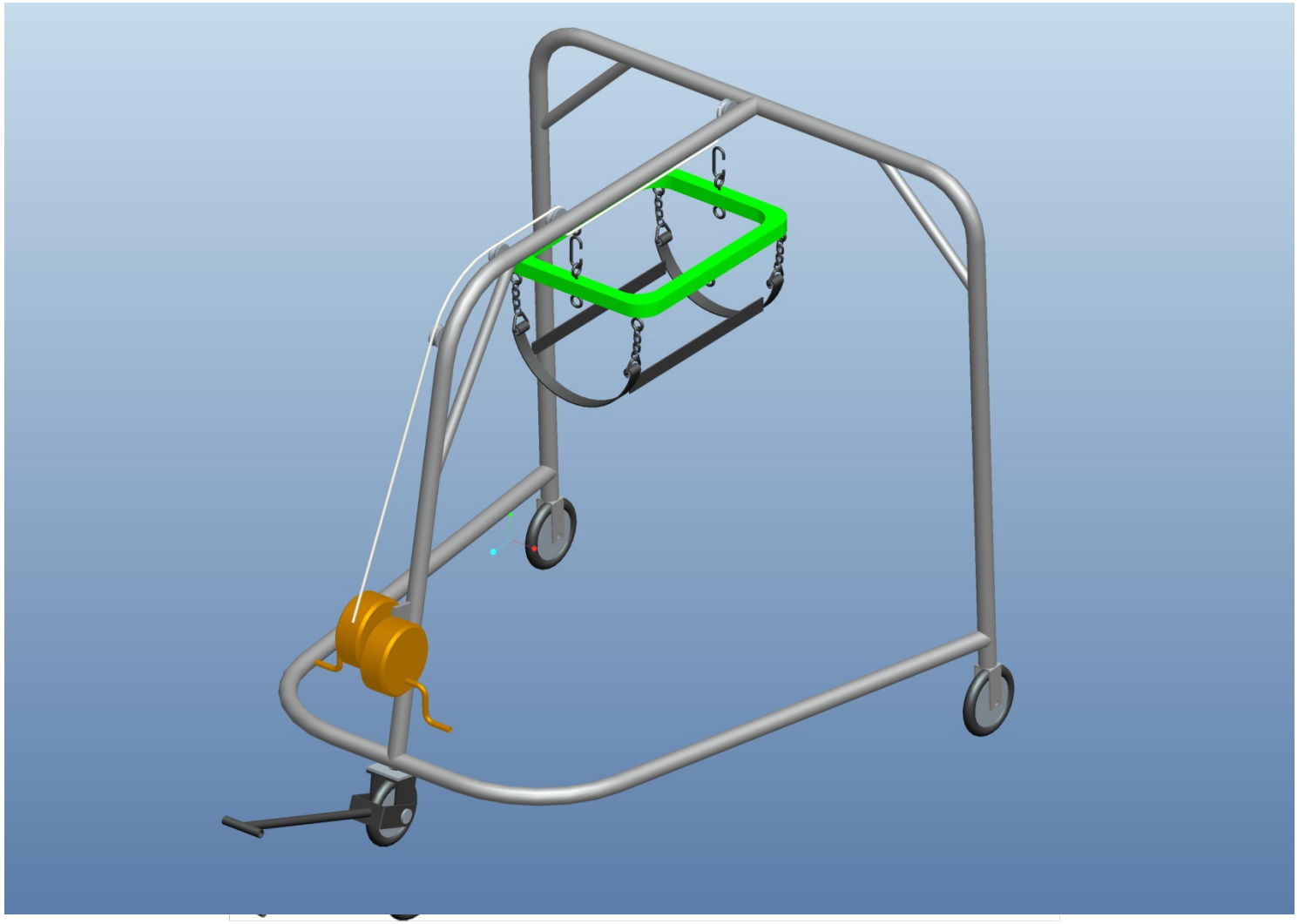
Donkey drawn steel cart

Use of donkey and mule for farm operations and Rotary systems for agro-processing

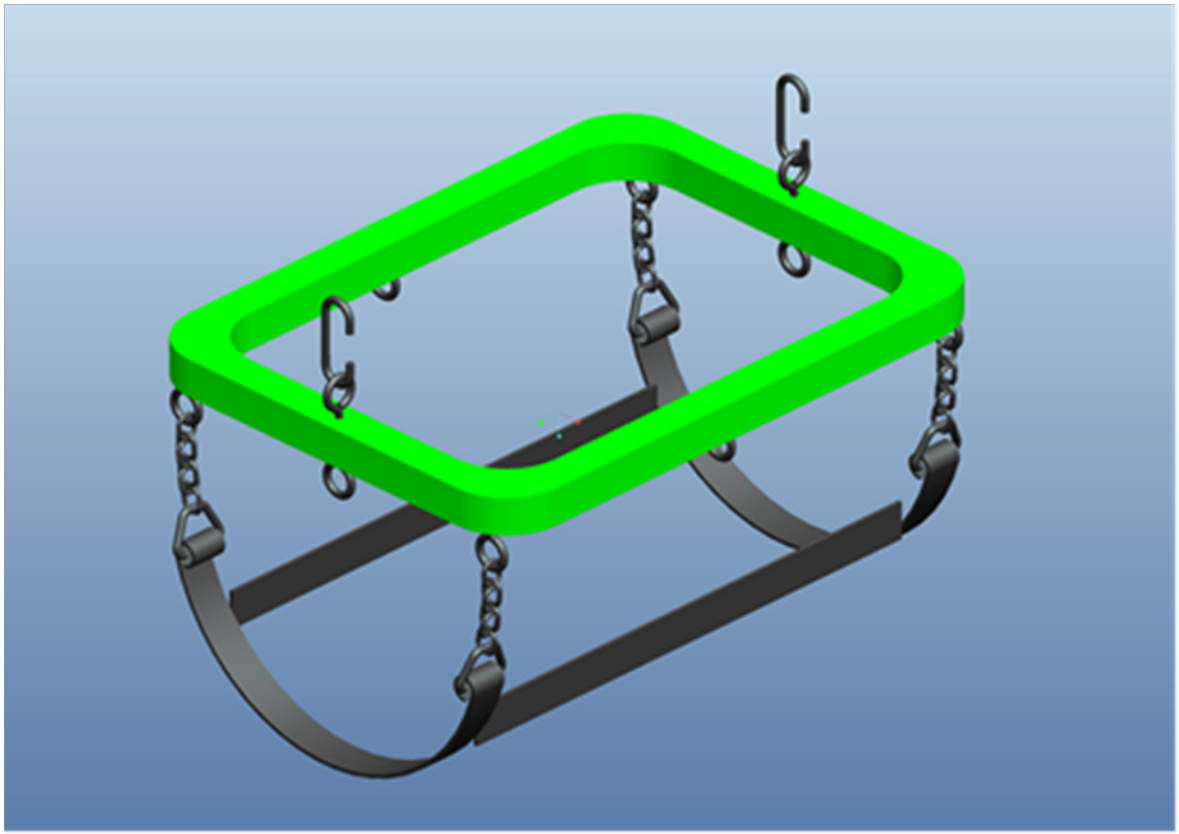
Daisy lifter

Recumbent Animal

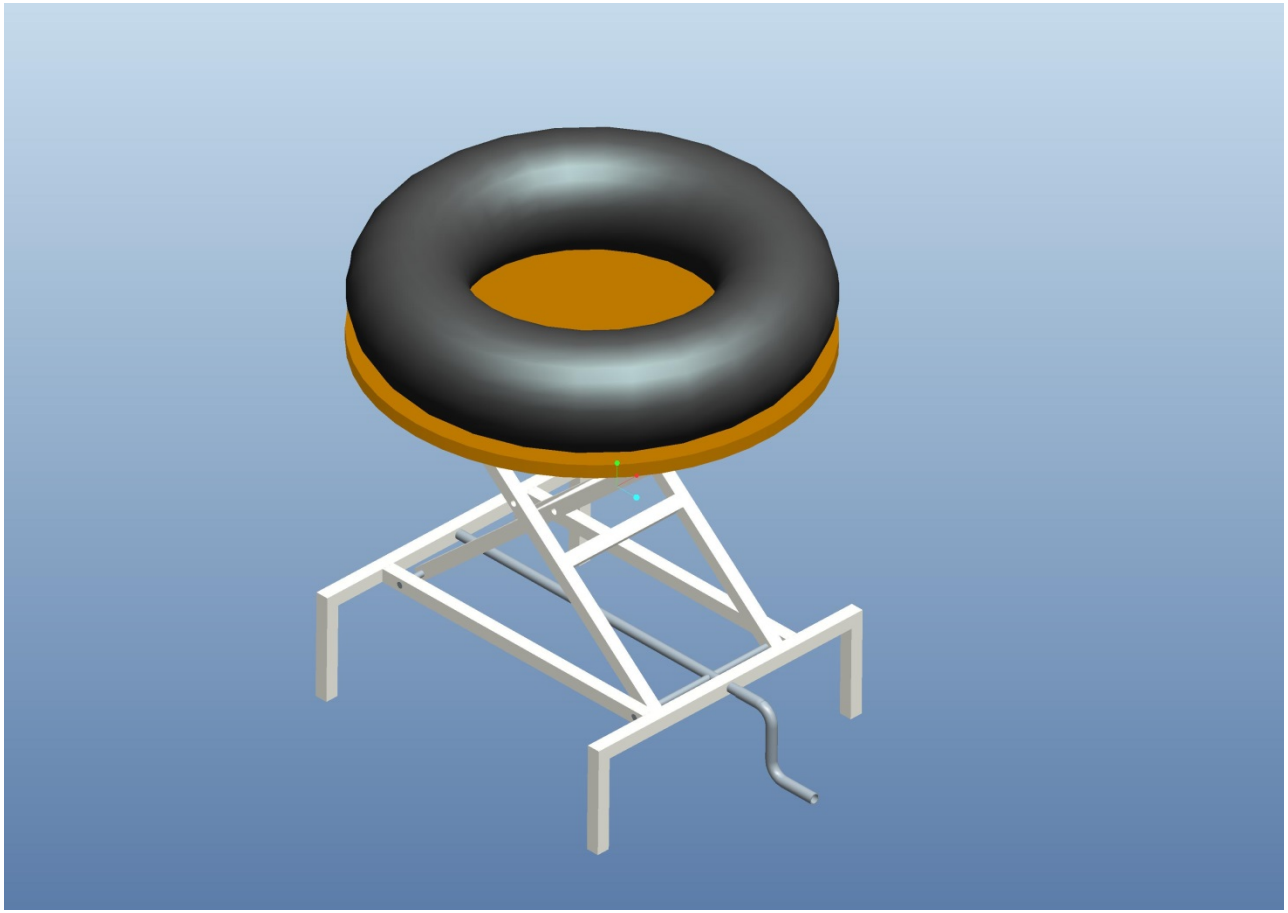
Conceptual drawing of Animal Lifting Device

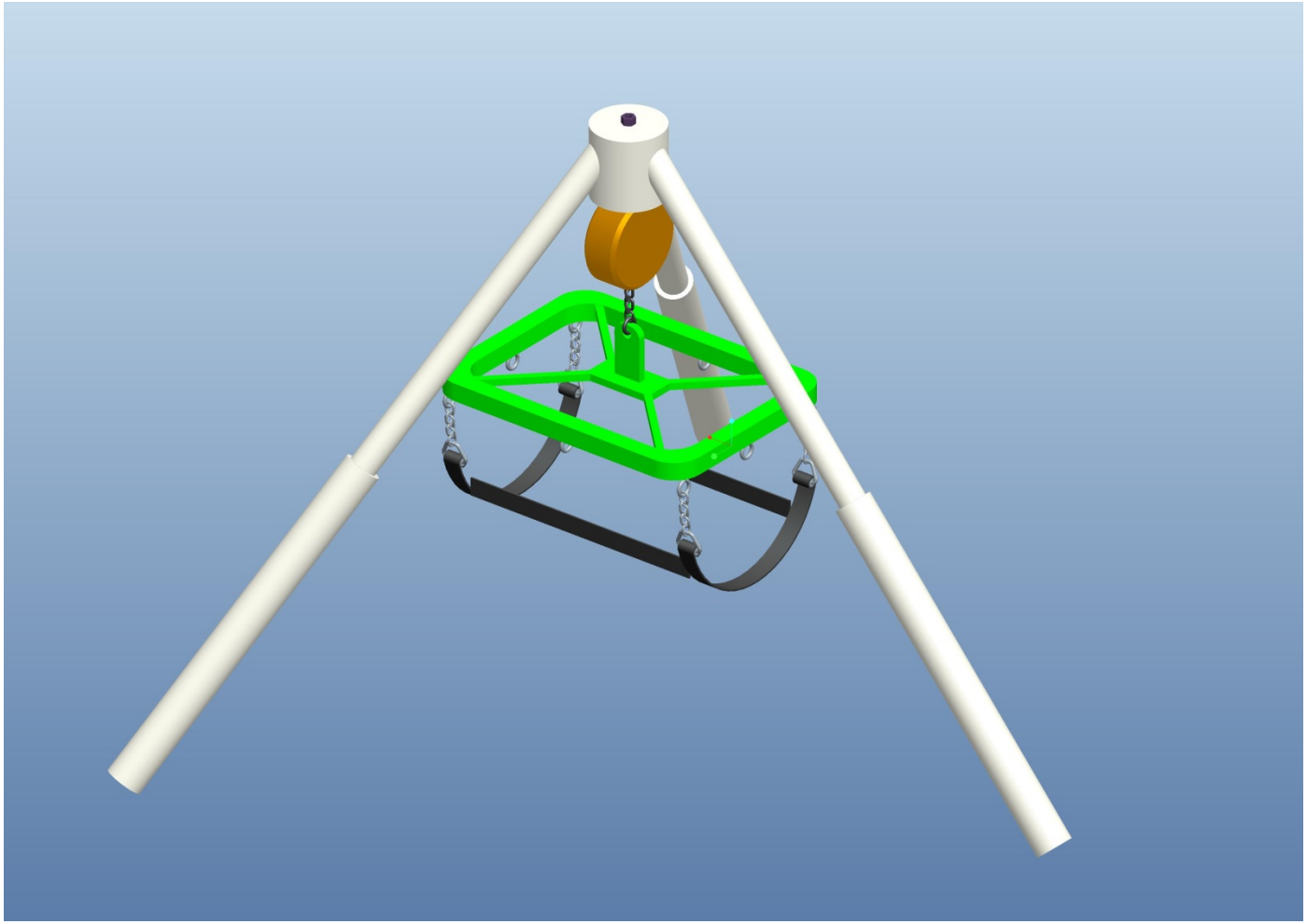


Lifter



Adjustable resting Table





Nutritive feed and fodder for draught animals

- Results of some feeding trials using principle of using locally available material for formulating nutritive and low cost rations are:
  - Gram straw supplemented with high energy concentrate mixture (75% TDN) was recommended for feeding of draught camel for better nutrient intake, utilization and draught performance.
  - Feeding of probiotcs with or without urea treatment of poor grade roughages was recommended for optimum utilization of the nutrients and better draught performance of cross-bred male

Survey of structures for animal shelter (OUAT Bhubaneshwar, UAS, Raichur and AAU Jorhat

Survey of bullock sheds was carried out in coastal Odisha.

Features were:

- ❖Roof was mostly thatched.
- ❖Roof height varied .
- ❖The air space was less than 110 m^3.
- ❖Walls were mostly wooden stump fencing.
- ❖Ventilation was satisfactory in some designs but insufficient in others.
- ❖Floor was undulating and in most cases without any gradient. Floor space per animal varied from 1.5 to 3.5 sq m. Concrete flooring was rare.
- ❖Urine channels were mostly earthen or brick lined without any gradient

A score card was prepared to evaluate the housing structures. Only 15% of designs were found to be satisfactory, no design was found to fall in good or very good category.

Low cost Animal Housing

UAS Raichur design cattle shed for 4 animals

OUAT Bhubaneshwar design cattle shed

MAU, Parbhani centre kept shade net over the thatch roof in summer and polythene sheet in rainy season

Development of equipment and gadgets for collection of dung and manure for efficient preparation of by-products

- Bags for collection of faeces and urine for male camels were developed.
- A system consisting of platform, strainer, tray and container was developed for collection and separation of dung and urine. This system was installed at Livestock farm, RCA, MPUAT.
- Prototype of portable manure collector developed.

Manure spreader attachment to the bullock cart

IGKV, Raipur

Particular	Values
Field capacity, ha/h	0.27
Field efficiency, %	74
Cost of operation, Rs/ha	382.42
Application rate, kg/ha	17875
Delivery rate, kg/s	0.95

IGKV, Raipur

MAU, Parbhani

Capacity, kg :500
Width of spreading, m :1.1
Draft , N : 637
Field capacity, ha/h : 0.18
Power requirement, kW : 0.46

MAU Parbani

SHIATS, Allahabad

Dung Collector for Animal farms- GBPUAT Pant Nagar

Electric motor operated

Engine operated

- 1.0 hp electric motor as prime over
- Capacity 225 kg

- 1.5 hp petrol engine as prime Mover
- Capacity 105 kg

Animal operated rotary transmission system for operation of Agro- Processing machinery

Equipments	rpm	output, kg/h	Draft, N	Developed by Centre
Garlic bulb breaker	300-310	600-650	280 - 300	MPUAT, Udaipur
Aloe-vera jel extractor	80 - 105	25 -30 kg leaf /h	230-250	MPUAT, Udaipur
Wet Grinder	380 - 420	9	240 - 300	OUAT, Bhubaneswar
Turmeric polisher	200 - 250	80	596- 632	
Dal Mill	660- 710	7.5 – 9.0	336- 490	MAU Parbhani
Chilly Mill	315- 360	7.5 – 9.5	440 - 500	
Seed cleaner cum Grader	290- 327	650 - 700	323 - 360	
Grain Polisher	285- 395	250 – 280	370 - 430	
Paddy thresher	180 -190	148 -196	280 - 350	AAU, Jorhat

Adoption of Chaff cutter, maize dehusker and sheller with rotary system- MPUAT Udaipur

Rotary transmission system Suitable for charging two 12V Batteries- CAIE Bhopal Centre

SHIATS Allahabad

Adoption of Mini Dhal mill with rotary system- OUAT Bhubaneshwar

Agro-processing equipment

Turmeric polisher and Wet grinder in rotary mode , OUAT Bhubaneswar

Seed Cleaner, Grain Polisher, Dal Mill, Chilli unit , Shevai making in rotary mode, **MAU Parbhani**

OPERATION OF PADDY THRESHER BY BULLOCK POWER THROUGH ROTARY MODE

Adoption of commercial animal operated rotary transmission system for electricity generation using low rpm alternator- UAS Raichur

❖The bullock drawn rotary power electricity generation unit for generation of electricity was tested for lighting of lamps ranging from 180 to 1200 W.

❖ The outer bullock got fatigued during four hours of work at 1080 watts loading during first work rest schedule.

❖The outer bullock got fatigued during third hour of work at 1200 watt loading during first work rest schedule.

Performance evaluation of rotary transmission system for electricity generation using low rpm alternator

Promotion of rotary mode of application of ponies/horses for generation of electricity in Imphal, Manipur at KVK Andro (remote Area)

- Battery (35Ah) required 6 hour for full charging.
- The alternator started emitting current at 1265 rpm

Front Line Demonstrations

- **Front Line Demonstrations of animal drawn drum seeder, puddler, seed drill was conducted in eleven districts of Odisha.**
- **Programme was conducted in collaborative of 11 KVKs**
- **Total 684 farmers benefitted by 22 no of demonstrations.**
- **Implements were used in 80.6 ha**




Demonstrations on improved implements at farmer's field in tribal villages of Odisha State

Front line demonstrations of bullock drawn engine operated sprayer for cotton and pigeon pea crops

Demonstration of bullock drawn engine operated sprayer at Raichur District

MAU, Parbhani conducted Front Line Demonstrations on CRIDA Planter, three tyne ferti hoe and stubble collector

Total of 5 FLD was conducted and 18 farmers benefited

Front Line Demonstration of CIRDA Planter, 3 Tyne Hoe and Stubble Collector in various districts of Marathwada

Front Line Demonstration of bullock drawn traction sprayer in saff flower & sorghum crops

CAE &PHT Gantok Centre conducted 15 frontline demonstrations for animal drawn improved implements namely wedge plough and light weight improved peg type puddler. Area covered with improved animal drawn implements was 3380 square meter in 46 terraces

Front Line Demonstration of wedge plough and puddlers in terraces of Gantok

Training of Farmers , Manufacturers and Extension Personnel

- 10 Training Programmes for farmers.
  - 150 farmers participated.
- 5 Training programmes for small scale manufacturers and village artisans
  - 20 artisans and 2 manufacturer attended the training
- 2 Trainings were conducted for Extension personnel of KVK.

Training and Front line demonstration

Training and Front line demonstration conducted in collaboration with KVKs

Field Day by CAE& PHT Gangtok

Technologies developed

- Bullock drawn Engine operated Sprayer
- Bullock operated manure spreader
- Animal operated stubble collector
- **Dung Collector for Animal farms**
- Patella and yoke of composite material
- **Ferti- Hoe (2-3 tyne)**
- **Bullock drawn ridge type drum seeder**
- Baisi plough
- **Animal drawn seed drill for inter-cropping**
- **Development of saddle for Yak**

- Draft animal power continues to be a major source of farm power in India due to small holdings (84.97% holding less than 2 ha), fragmented land patterns and terraced hill sides, Coastal wet lands and desert lands

- Enhanced utilization of draft bullocks will reduce the use of fossil fuel powered machines in agriculture, which reduce green house gas emission, global warming and climate change

Thank you