

# Animal Energy and Its Applications



Course: Rural Energy System; RDL – 722



- Animals are holistic source of rural energy - decentralized, locally producible, renewable and environment friendly.
- Long tradition of the use of animal power, only affected in a major way by the introduction of fossil fuel.
- Major deficiency in the use of animal power is that of slow speed and poor efficiency of transmission.
- Thus, there is very strong need for improvising the speed and efficiency of utilization of animal power by improvised technologies.
- This will also open up tremendous potential for rural industries.

## **Draught Animal Power- “Present Status”**

- **Present population – 68 million**
- **27000 MW power contribution which is almost 31 % of total electricity generation capacity.**
- **60-65 % of the total cultivated area is still managed by draught animals**
- **Against 18 % by tractors**
- **Replacement rate option with tractor – 10 bullock/tractor**
- **Present population equivalent to 35 hp tractors – 6.8 million tractors ( Existing tractors – 2.22 million)**
- **Annual saving of diesel due to draught animals – Approx. 22.12 million tonnes worth Rs. 33792 crores**
- **Present market value of draught animals – 40,800 crores**

# Continue

- Present value of animal carts 14.3 million @ Rs. 12000/- per cart – Rs 17,160 crores
- 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
- Provide by products – hide skin, bone, horn etc. – Approx. Rs. 100 crores/ year

# Increased Utilization of Animal Energy with Enhanced System Efficiency

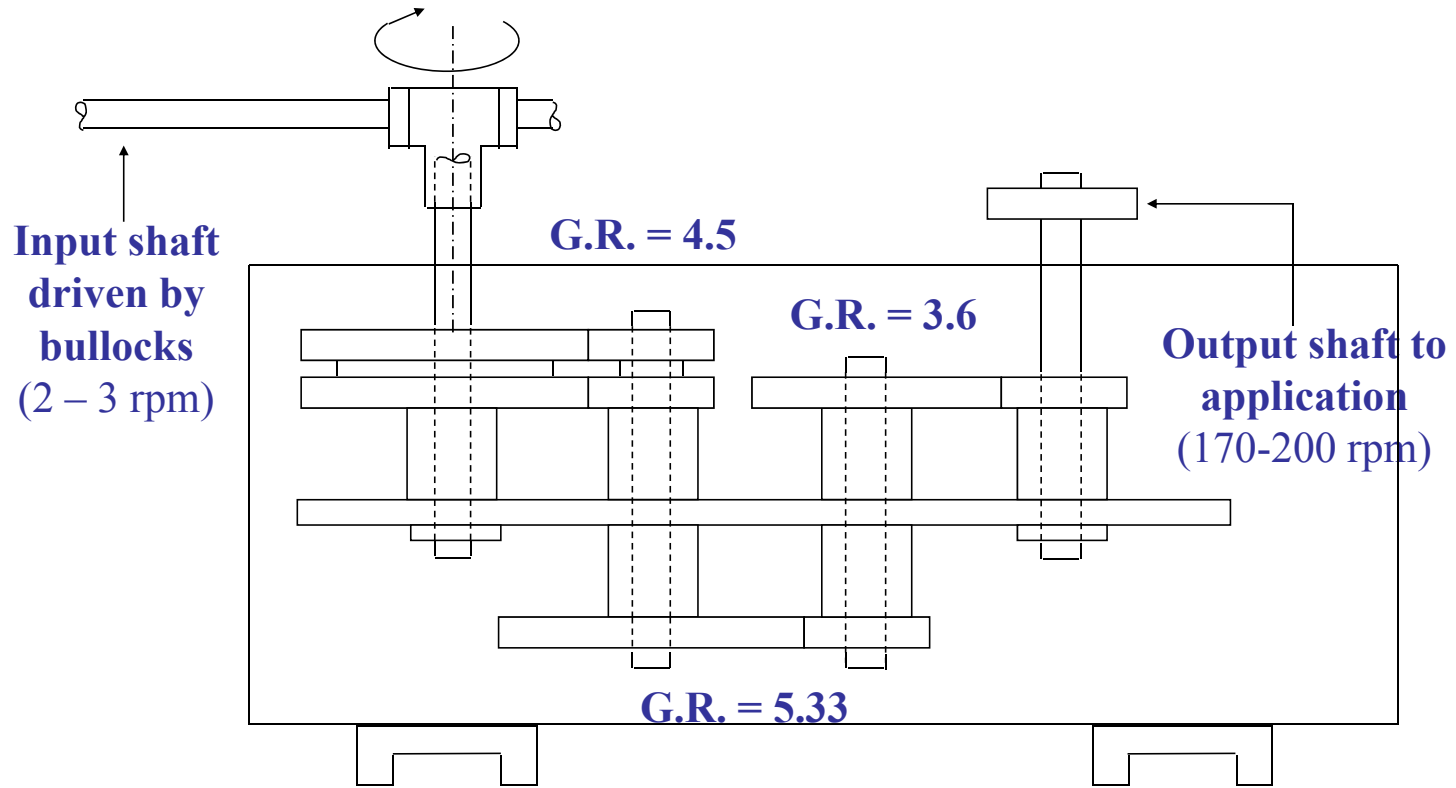
- Comforts and outputs of the draught animals could be increased from the 30% to 70% or even more by adopting improved yokes and harness matching implements and by following proper work rest cycles for different types of animals
- It can save a large quantity of petroleum products
- As a result of adoption of mechanical power in agriculture and development of road transport and irrigation system role of draught animals is however declining. Their annual use is also going down.

# Different Modes of Utilization of Draught Animal Power

1. Efficient conversion of the natural animal movement into high speed rotation to drive common gadgets
2. Efficient utilization of tractive effort of animals- Design of animal drawn tractor

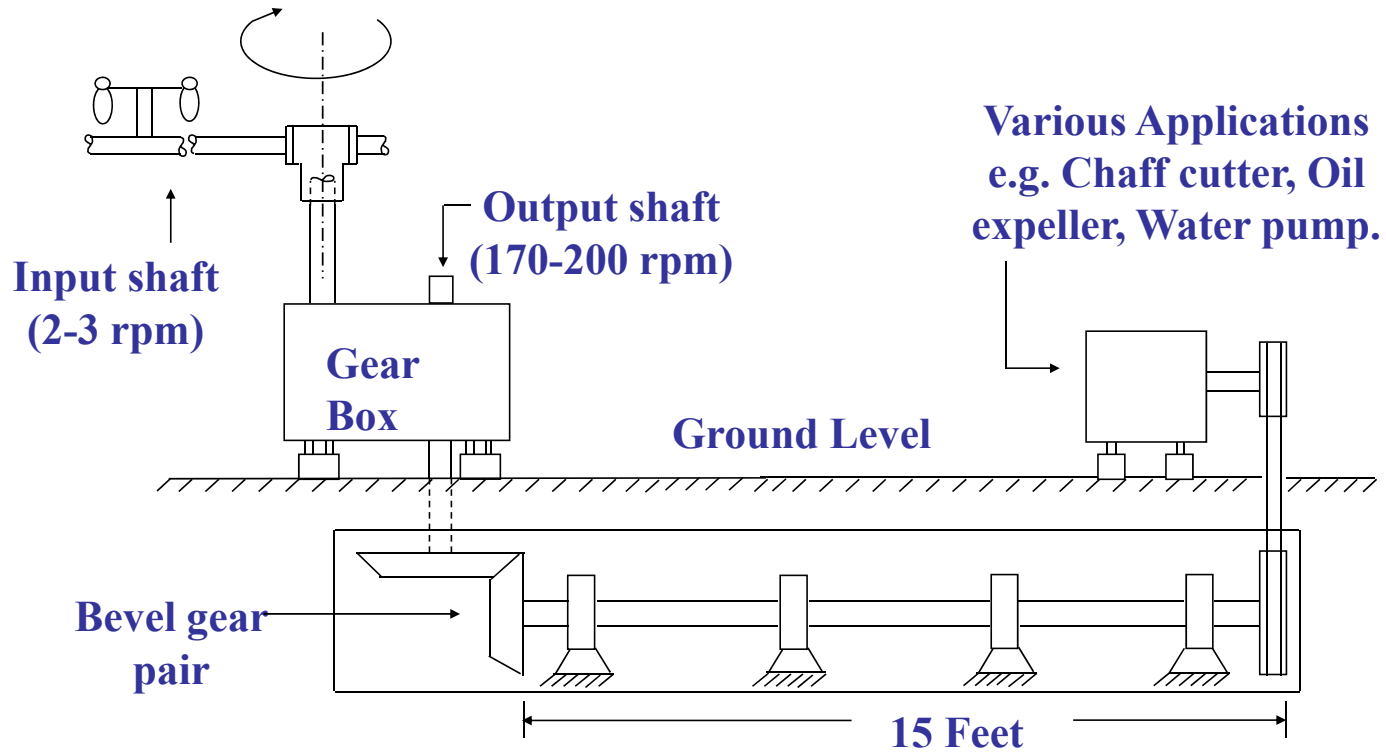
# An Overview of the Status of ADPM

- **Alternative design of gear box and attachment of applications.**
- **Salient features of the work done by:**
  - IIT Delhi**
  - R. S. Singh, Varanasi**
  - Central Institute of Agricultural Engineering, Bhopal**
  - Kanpur Gaushala Society, Kanpur**
  - U. A. E., Raichur, and**
  - Others**



## Modified Gear Box





## **Installation of Modified Gear Box at Site**

# Animal Driven Prime Mover Coupled With Application



# Applications Attached With ADPM

- **Chaff Cutter**
- **Water Pump**
- **Oil Expellers**
- **Flour Mills**
- **Agitator**

# Rotary Animal Driven Prime Mover for RI Application



## Salient Features:

- Rotational motion of animal is utilized.
- Clutch is used to control the speed.

## Specifications:

- Type: Step up Gear Box having Helical Gears
- Input rpm: 2-3 rpm
- Output rpm: 250 rpm @ 1.5 h.p.
- Gear Ratio: 1: 85
- Cost: Rs. 26000



## Site Demonstration

## Bullock Drawn Generator Developed by Kanpur Goshala



## Comparison of the various ADPM Designs

<b>Comparison of the various designs available</b> Various prototypes available	Arrangement of Shaft	Speed (rpm)	Power developed (h.p.)	Efficiency
Kanpur Goshala Society	Horizontal	600	N.A.	N.A.
IIT Delhi – by Mr. R.S.Singh	Vertical	750	1.0	66.66%
CIAE, Bhopal	Vertical	200-250	1.0	57.14%
UAE, Raichur	Vertical	300	0.41	34.16%

# Main Issues for Discussions

- Which design of gear box are robust, efficient and field worthy?
- What are the desirable system configurations of ADPM integrating various applications.
- Need for providing clutch, free wheel and other safety devices.
- Pros and cons of using mechanical power vis. a vis. electrical power as ADPM output.
- What are the obstacles in popularizing ADPM.

# About Animal Drawn Tractor

## Salient Features

### Designs Available:

1. **Bhartiya Cattle Resource Development Foundation (Kamdhenu BDT).**
2. **Kanpur Goshala Society (Shekhar BDT)**
3. **CIAE, Bhopal (Multi Purpose Tool)**

**What is the appropriate technology at present and how can it be promoted ?**





# Bullock Drawn Tractor (BDT)

## Salient Features

### 1. Designs Available:

1. **Bhartiya Cattle Resource Development Foundation (Kamdhenu BDT).**
2. **Kanpur Goshala Society (Shekhar BDT)**
3. **CIAE, Bhopal (Multi Purpose Tool)**
  - Three BDTs perform work equivalent to one 30 HP mechanical tractor and three traditional ploughs.
  - One BDT is sufficient for 15-20 acres of land.
  - BDT performs ploughing operations better leading to excellent uniform loosening of soil and combined with organic farming by use of bullock dung and urine, improves land fertility and brings 10% extra production in the first year itself.

## Contd...

- The depth of the ploughing and other operations can be easily adjusted, to suit the type of soil and its condition.
- No smoke and dust as well as noise and vibrations as in the case of a mechanical tractor.
- The attachments coming into contact with the soil will retain the sharp edge for a long time, since selected quality steel is used.

## 2. Totally eco-friendly

- Organic manure and herbicides can be made by the farmer from the dung and urine of the bullocks, leading to lower water consumption, increased microbial activity in the soil.
- Excellent crop sprays such as `Amrit Pani' can be made with the urine of bullocks, using time tested formulations known to our farmers.
- Nation spends Rs 90,000 crores on import of petroleum products every year. 1% saving in use of petroleum fuels like diesel will lead to a saving of Rs 900 crores.

- Savings in foreign exchange for import of chemical fertilisers, pesticides is an additional benefit. Each mechanical tractor of 30 Hp consumes 4,500 litres of diesel fuel per year. Each BDT will therefore save 30,000 litres of diesel fuel in 20 years, which is only half its total life span.

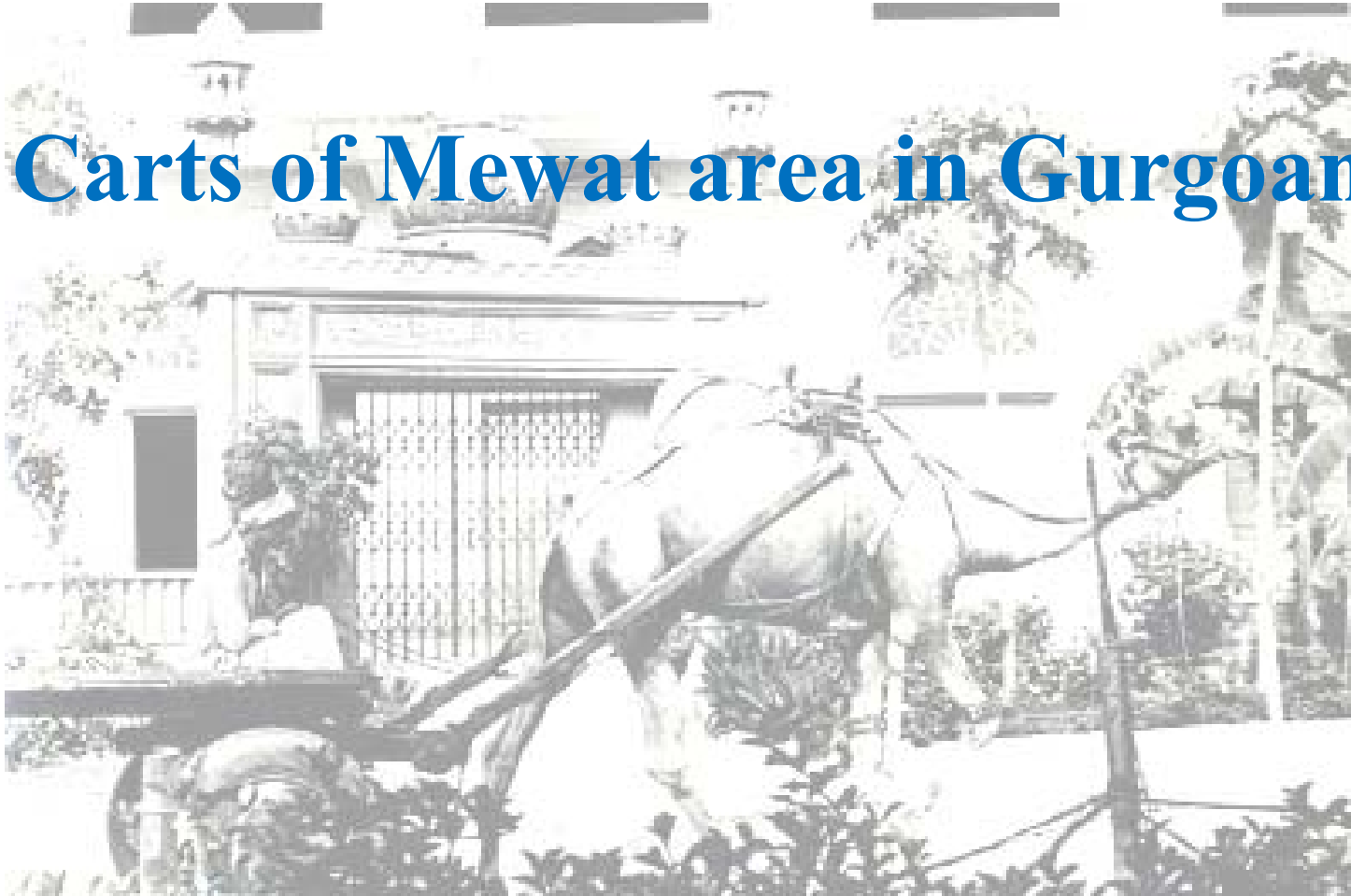
### 3. Profitable and economical

- The mechanical tractor is very expensive compared to BDT.
- Like the tractor, BDT can be used for custom hiring. This will provide a livelihood and also benefit small farmers, who can then hire BDT.
- Maintenance and repair are easy and economical, compared to a mechanical tractor.
- By using BDT and resorting to organic farming, farmers will derive not only monetary benefits, but also the satisfaction which comes from being in harmony with nature.
- Use of BDT is therefore not just a question of a cheaper and more productive alternative - it is also a reaffirmation of the faith they had on their own wisdom.
- Suggestions from farmers and specialists have been incorporated to improve BDT for durability, ease of operation, safety and convenience of farmers. Constant efforts will be made to improve for greater durability and ease of operation, based on feedback from our farmer friends.

# 14 About Improved Carts and Cart Driven Gadgets

- What are the salient development to make animal carts more efficient and faster for rural transportation.
- Some innovations in developing cart driven gadgets such as battery charger, mobile milk chilling etc (e.g. Work done by Sudhakar, David and others).

# The Carts of Mewat area in Gurgooan





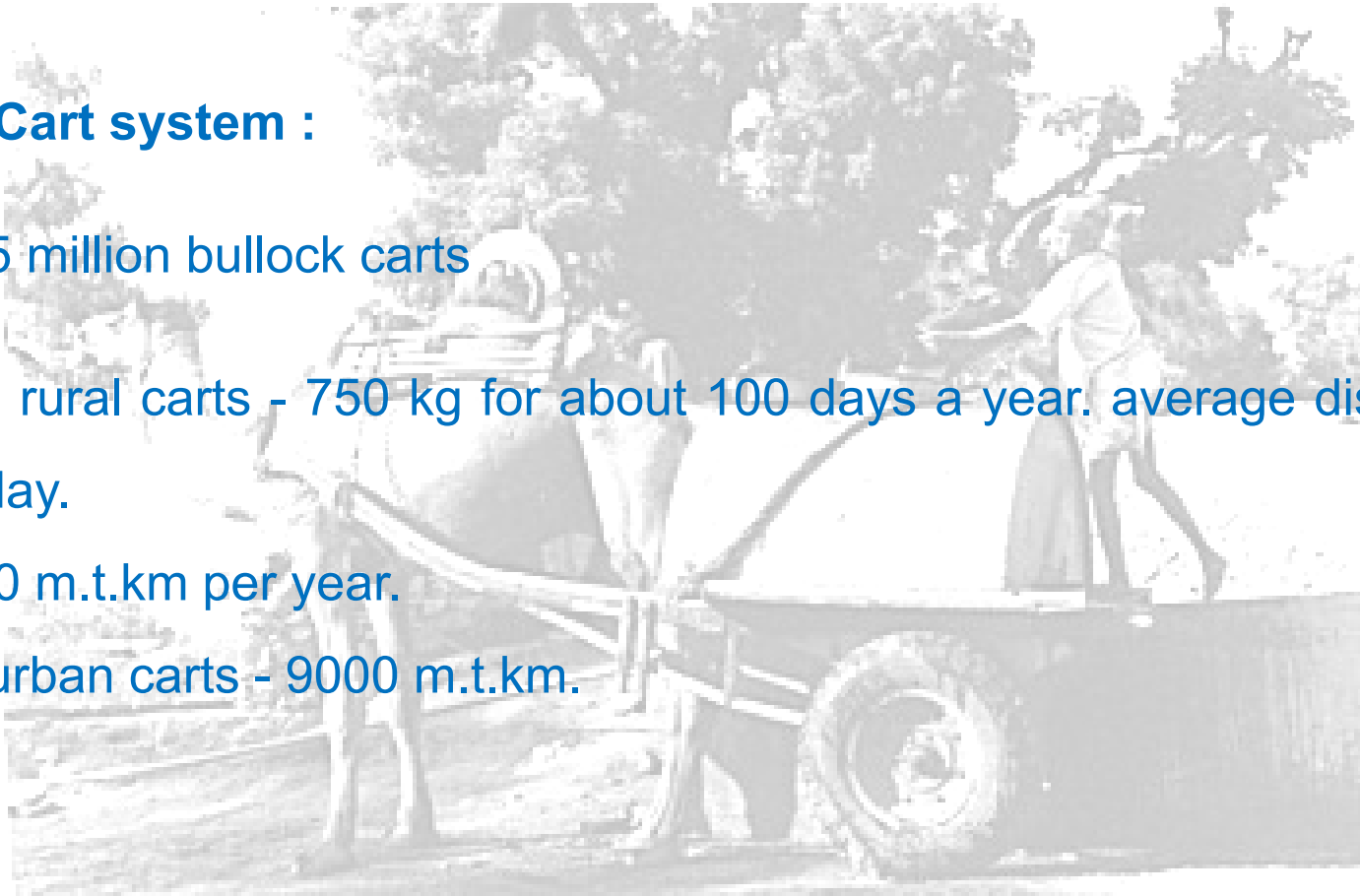
## Bullock Cart system :

1994 - 15 million bullock carts

12 million rural carts - 750 kg for about 100 days a year. average distance - 20 kms per day.

i.e. 18,000 m.t.km per year.

3 million urban carts - 9000 m.t.km.



<b>S.n.</b>	<b>Issues</b>	<b>Traditional bullock cart</b>	<b>Improved bullock cart</b>
<b>1.</b>	<b>material</b>	<b>Wood and small parts-steel</b>	<b>Major parts steel, yoke of wood</b>
<b>2.</b>	<b>weight</b>	<b>550 Kg</b>	<b>350 Kg</b>
<b>3.</b>	<b>life</b>	<b>~10 years</b>	<b>20 years</b>
<b>4.</b>	<b>Refitting of iron rim</b>	<b>6 months</b>	<b>Nil</b>
<b>5.</b>	<b>tyre</b>	<b>Iron rim type, damages roads</b>	<b>Pneumatic tyres</b>
<b>6.</b>	<b>bearing</b>	<b>Rough plain</b>	<b>Roller brg.</b>
<b>7.</b>	<b>Drag on animal</b>	<b>high</b>	<b>Lesser</b>
<b>8.</b>	<b>Braking device</b>	<b>nil</b>	<b>yes</b>

## Mewat area of Gurgoan district of Haryana state.

s.n.		Mewat	Gurgoan	Haryana
1.	Irrigated area to net area	50.70 %	63.60	79.80
2.	Agricultural workers to total workers	71.99 %	51.25	54.49
3.	Hospitals/ dis per lac	9.0	19.0	18.0
4.	Literacy - total	46.46	63.65	68.59
	male	59.17	77.11	79.25
	female	25.83	48.29	56.31

## **CARTMAN's Cart :**

1. Tare weight of traditional carts - carry 1 to 1.5 tonnes, weigh 350 to 500 Kg.

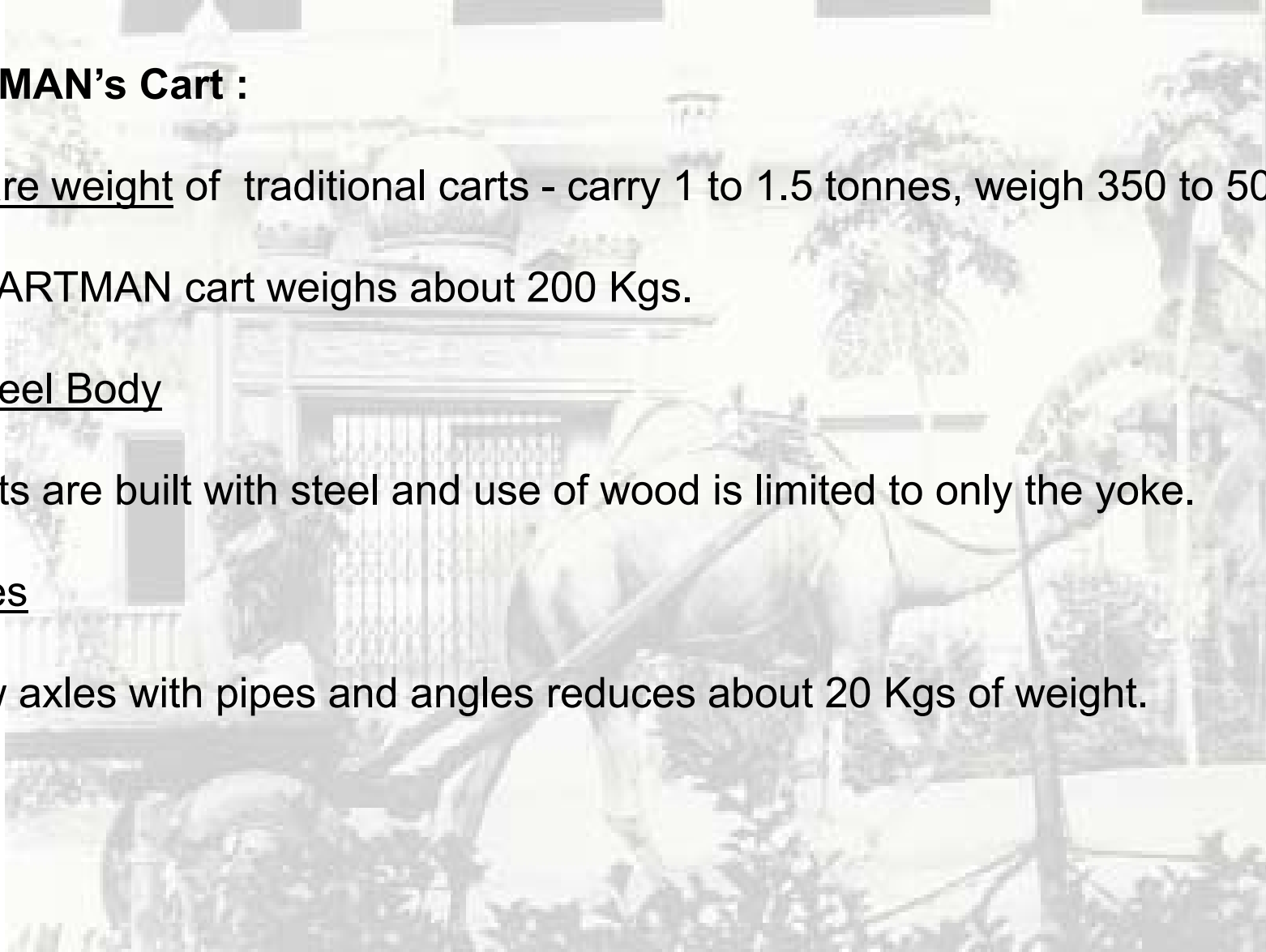
The CARTMAN cart weighs about 200 Kgs.

2. Steel Body

All carts are built with steel and use of wood is limited to only the yoke.

3. Axles

Hollow axles with pipes and angles reduces about 20 Kgs of weight.



## 1. Bearings

Taper roller bearings are used - reducing wobbling by tightening.

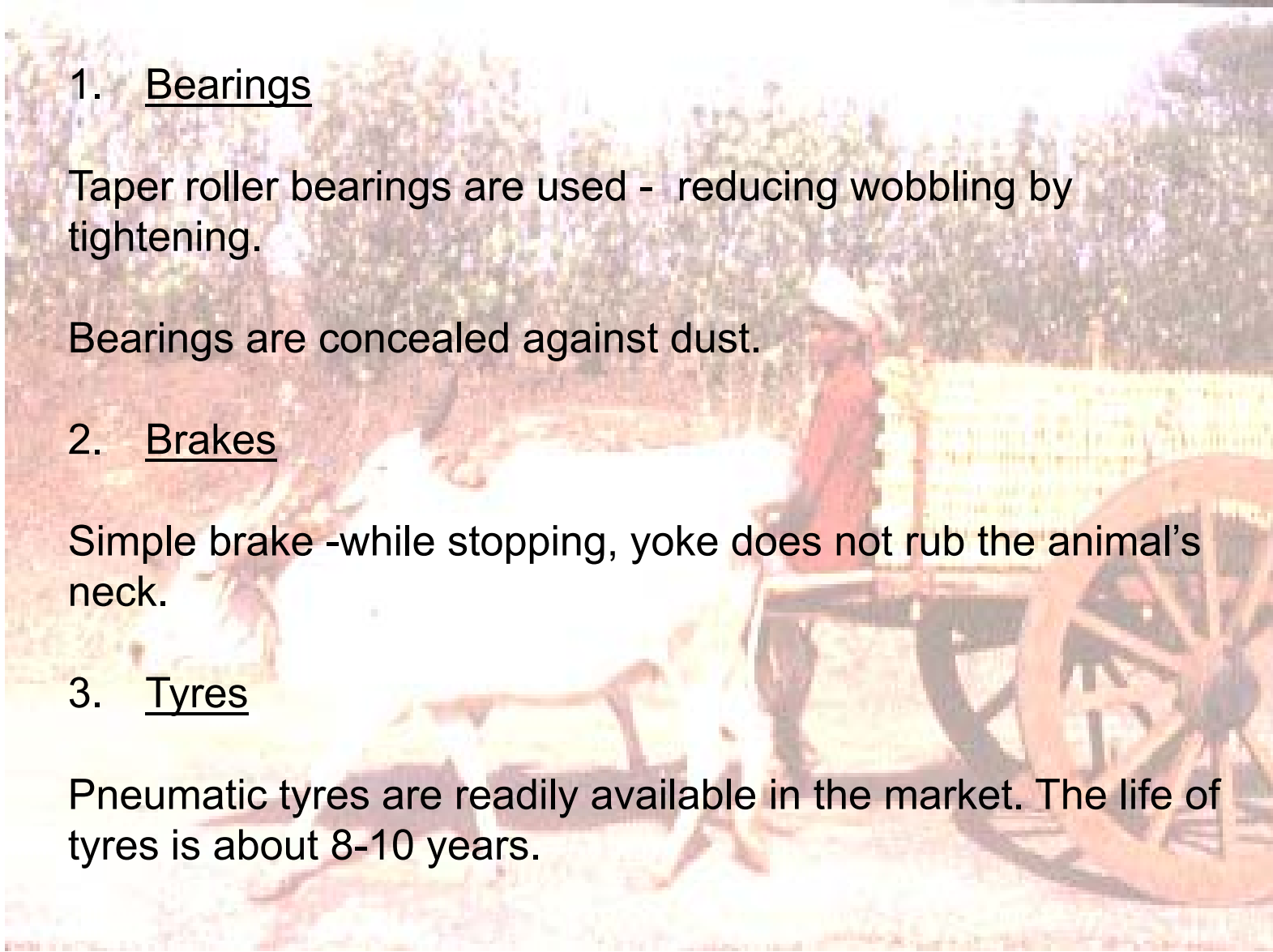
Bearings are concealed against dust.

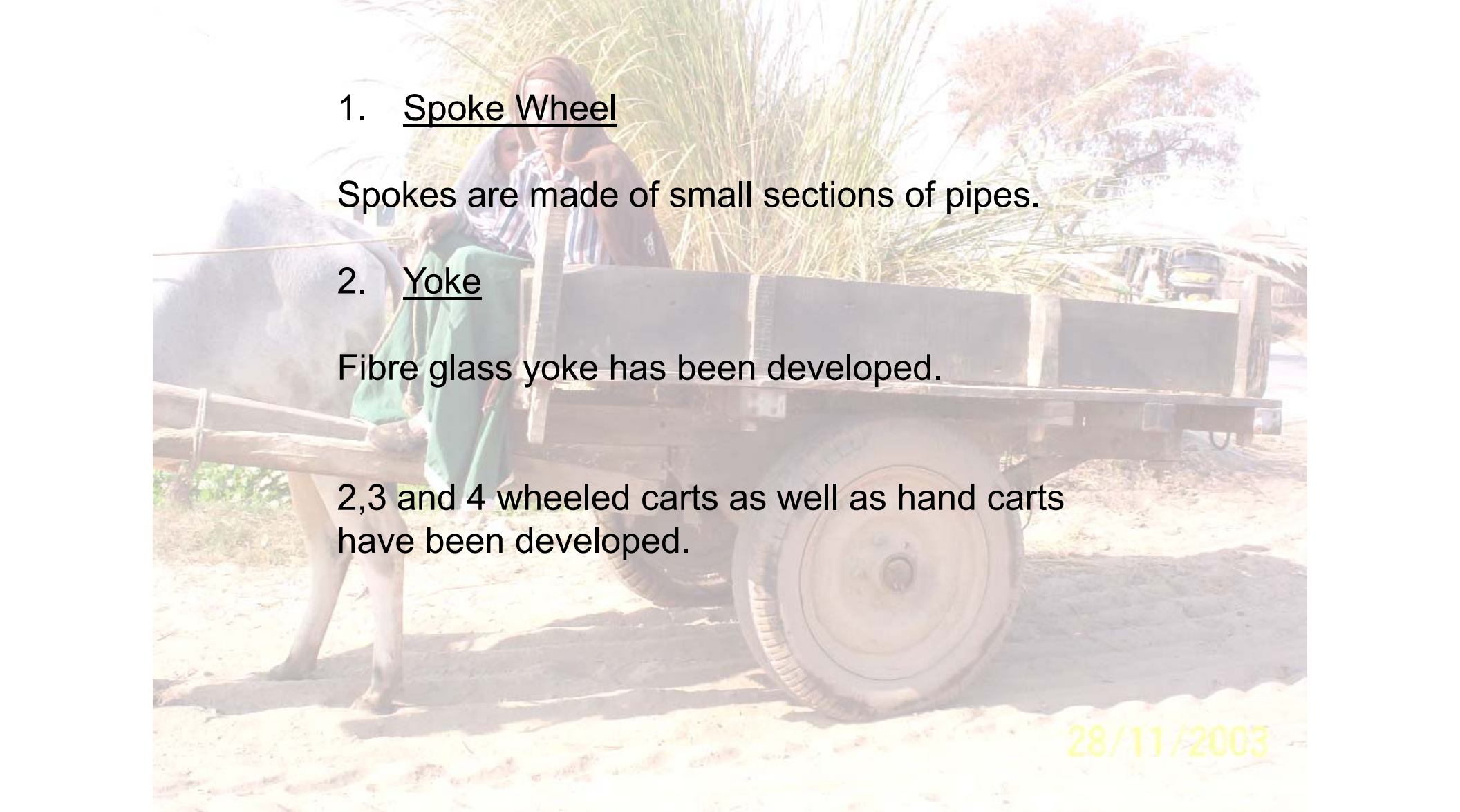
## 2. Brakes

Simple brake -while stopping, yoke does not rub the animal's neck.

## 3. Tyres

Pneumatic tyres are readily available in the market. The life of tyres is about 8-10 years.





1. Spoke Wheel

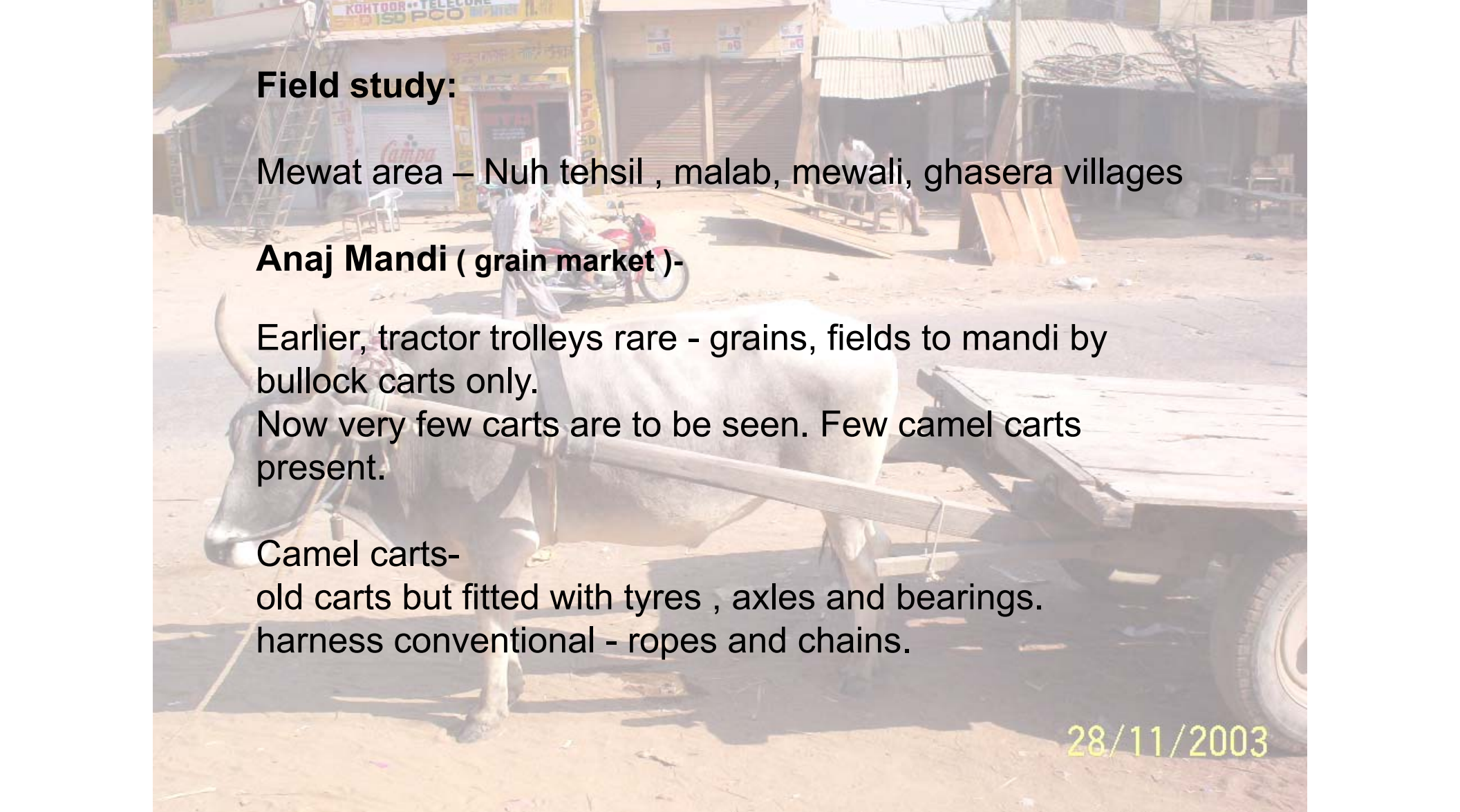
Spokes are made of small sections of pipes.

2. Yoke

Fibre glass yoke has been developed.

2,3 and 4 wheeled carts as well as hand carts have been developed.

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**Field study:**

Mewat area – Nuh tehsil , malab, mewali, ghasera villages

**Anaj Mandi ( grain market )-**

Earlier, tractor trolleys rare - grains, fields to mandi by bullock carts only.

Now very few carts are to be seen. Few camel carts present.

Camel carts-  
old carts but fitted with tyres , axles and bearings.  
harness conventional - ropes and chains.

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## Local transport in villages –

Earlier horse carts (Tanga- ghora) - main means of commuting. Now horse carts only in far flung, remote villages.

On state high-way Gurgoan to Alwar, buses, jeeps and sumos are plying.

People have two wheelers in large numbers.

The **horse carts** few but in relatively good condition.

Tyred wheels, roller bearings with cover plates and harness of proper size and fitment for horses used. But body is all wooden, except axle and fasteners. The frame is made of sagwan wood.





A photograph of a camel carrying a large, rectangular load of hay on its back. The camel is walking on a dirt road, and the background shows a rural landscape with green fields and trees under a bright sky. The image is slightly blurred, suggesting motion.

## **Bullock carts -**

Plough replaced by tractors, even in Mewat area. No bullocks.

Bullocks replaced by buffaloes.

carrying capacity and speed of buffaloes is less

manufacturing sources at Taudu, Hapud, Sonapat, Merut etc. But additions are few.

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carts tyre size – 500 or 600 mm dia and 19 inches thickness. These tyres are easily available in local market.

Ball bearings are used. No taper bearing used.  
In older types, bearing is secured by a cotter fitted in axle.  
In newer type, bearing cap screwed on axle keeps bearings safe from dust.

The weight - 200 to 300 Kgs , small in size – 5x4 feet.

Except axle and fasteners, no other metallic parts are used.

few carts- tie bars across side frame members.

No improved cart with metal frame or structure found.

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## Camel cart –

Few Camel carts are still plying.

Useful in some hilly villages nearby in adjoining state of Rajasthan as well as in some areas of Sohna and Tauru.

Camel carts are used to carry light but voluminous materials like crop waste, sugar cane, cotton etc.

Camel cart - raised , normally four wheeled. The yokes are slanted to fit camel back. Tyred, made of wood.

However wheels of same size as buffalo cart are used, which are small for camel cart. The size of camel cart also appears to be inappropriate.

Cart can be designed ergonomically.

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Compared to improved Carts developed by CARTMAN, Bangalore and others the areas of improvement in Mewat carts as follows -

- 1. Steel frame and structure** – As wood becomes increasingly scarce, this is only alternative. Then double life compensates for higher cost. Regular maintenance will be less. Earlier carpenters were easily available for wood repair works. Now welders are available for structure welding works.

- 1. Hollow axle in place of solid axle.-** CARTMAN has reported that hollow axles are successful.
- 2. Yoke** is one week area of these carts. They are just two straight wooden planks fitted to cart frame. Some angle is given by fitting a wedge wood piece. This angle has been historically followed. Now buffaloes replacing bullocks all over, the right angles and ergonomic design of yoke can be designed.

1. **No brake** in any cart was found. Since the region is normally plain with pucca or katcha road every where and speeds are very low, it may not be required. However in Camel carts, which have loads, speeds and which ply on undulating terrain also, provision of brake will help in avoiding unnecessary loads on poor animal.
2. These carts were initially ment for Bullocks . But now mostly **buffaloes** are pulling them. The two animals have different capacities and built-up. More efficient carts may be designed in terms of wheel size, yoke angle, harness, height of load etc.























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**THANK YOU**