

Harnessing guidelines for single donkey carts

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Summary

The harnessing guidelines for donkeys pulling a single donkey cart are based on practices from Europe which are adapted to the situation in many African countries. The basic principles remain the same, anatomy of the donkey and criteria for a donkey harness, but the concept is to make a comfortable harness from locally available materials. The most simple pulling device is opted for, the breast strap harness. Examples are given how to measure the size of the straps and how to make the breast strap harness, keeping in mind the necessary animal comfort. Cheap saddles and breaking devices are also described and a few examples of single donkey carts from Kenya and West Africa are included.

Introduction

There is a growing interest in how to use donkeys in rural transport and for agricultural operations. In some areas cattle died due to effects of droughts and cattle diseases, and farmers are looking for an alternative to ox-power. In areas where donkeys are already used, their assistance in carrying goods, rural transport and agricultural operations like plowing and weeding is very much appreciated. Although donkeys are very clever and easy to train, there are some limitations compared with oxen. They are lighter, their power is lower and the harnessing system is more complicated. Some farmers who start using donkeys for pulling carts and implements, use a yoke. However, yokes are not suitable for donkeys. They cause wounds and sores on the donkeys' necks, making donkeys stubborn and rendering them unusable for several days.

The widely used system of harnessing two (or more) donkeys to a two-wheel cart in South Africa can cause distress to the animals. The weight of the dissel-boom is taken on the necks of the donkeys and thin straps can cut into the flesh. This problem is generally avoided by using carts for single donkeys. On these the weight of the two shafts is taken by a broad saddle on the animal's back, which is more comfortable (Starkey, 1995).

These guidelines to harness donkeys are made for extension staff, harness makers, manufacturers of donkey carts and farmers in order to create more understanding about the harnessing principles for donkeys and to provide information about cheap and simple harnessing possibilities for pulling single donkey carts.

The key issue is efficiency and donkey comfort. Traditional harnesses are 'minimal-cost' designs, and any improvement is likely to involve extra cost. The benefits will depend upon the potential for exploiting the increase in efficiency.

Anatomy of a donkey

The structure of the body (anatomy) of a donkey is different from that of an ox. A donkey has no hump and there is little muscle tissue to form a cushion at the withers. Therefore a yoke does not fit on the neck of a donkey. Besides, a donkey has a thin skin and a yoke and the skeis (wooden sticks to separate the oxen) cause wounds and sores on the neck and shoulders.

Donkeys can be harnessed with a breast strap harness which is the most simple harness for a donkey. But looking at the breast of a donkey, it is narrower than that of a horse and it is slanting (Figure 1). When the donkey pulls, the breast strap tends to slip downwards, which has to be prevented by the neck strap. This is less of a problem when pulling carts (line of pull more or less horizontal) than when pulling implements. The breast strap should not be fitted too high, because

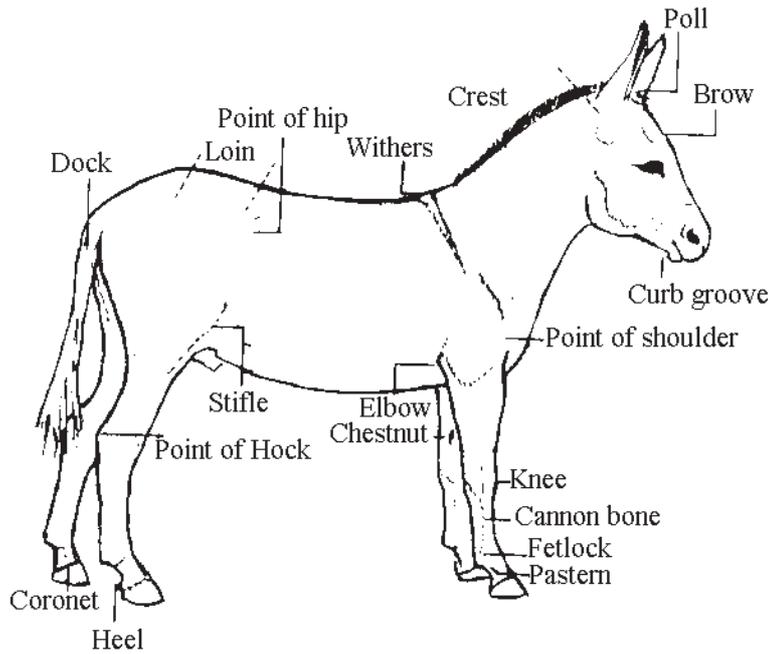


Figure 1: Names of the parts of a donkey
 Source: after Ellis, Ellis and Claxton, 1980

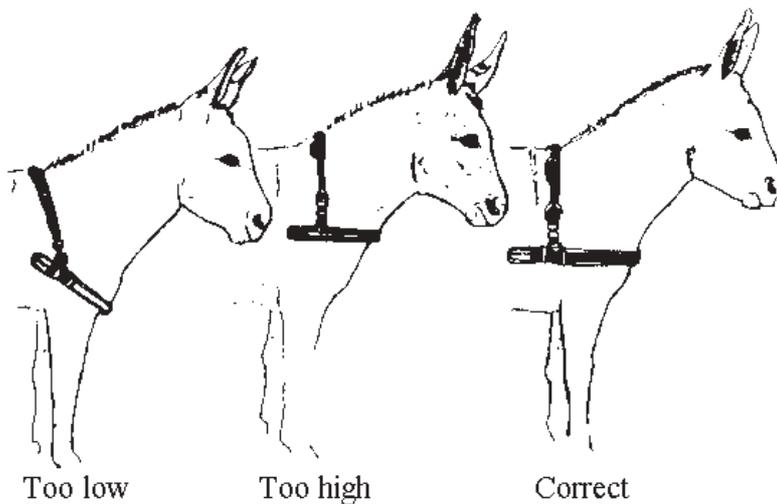


Figure 2: Breast strap positions. Source: Ellis et al, 1980

then it will press against the wind pipe and choke the donkey. However, also not too low. The breast strap should run across the chest just above the point of shoulder (Figure 2).

Another possibility to harness a donkey is a collar harness (Figure 3). This harness has pads laying against the neck, just in front of the shoulder blades. It has many advantages, eg a large contact surface (comfort) and no pressure on the wind pipe, but it is more complicated to make than a breast strap harness and it is far more expensive. The main advantage of the collar harness is its efficiency in transmitting high draft forces (plowing). In this paper, no attention is given to the construction and use of the collar harness. The reason therefore is that still much can be done at low cost to improve the cheap and widely used breast strap harnesses in Southern Africa.

Criteria for a donkey harness

(this section is drawn from Barwell and Ayre, 1982)

The power output of a donkey depends very much on the harnessing device. The harness transmits the power from the donkey to the cart or implement. With a well designed (comfortable) harness a donkey is able to develop more power

and becomes less fatigued. The importance of a good harness is not only the welfare of the donkey but it is also the interest of the owner. A good harness makes it possible to do the same amount of work with fewer donkeys.

Ergonomic criteria

To suit the donkey, the harness should:

- fit the physical characteristics of the donkey;
- be designed in such a way that the donkey's strong muscles are effectively utilized, and that it can put its full weight into work;
- not cause discomfort or injury to the donkey. This requires:
 - that the harness should fit well on the donkey and that it is smoothly-shaped or padded so that the loads imposed on the donkey's body are spread over a large area, with the avoidance

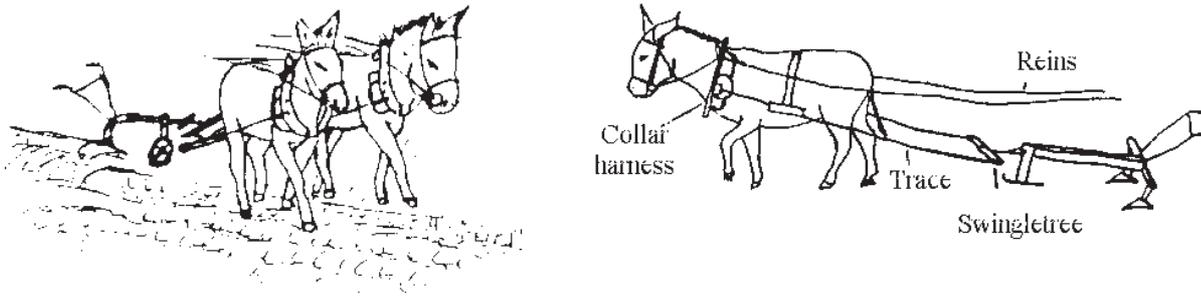


Figure 3: Plowing and weeding with donkeys using collar harnesses

of excessive friction in one place;

- that pressure on critical areas of the donkey's body is avoided;
- that the harness should be securely fitted to the donkey to prevent it from moving about and banging against the animal during normal work and manoeuvring;
- be easily adjustable to fit the donkey at all times. A standard harness should fit donkeys of various sizes and if it is made for a particular donkey, even that donkey can grow thicker or thinner depending on the amount of work it does and the amount of feed available. Adjustments are made with straps and buckles.

To suit the characteristics of the implements to be drawn by donkeys the harness should:

- have suitable attachment points for the range of implements to be used;
- have sufficient 'flexibility' to allow manoeuvring of implements, for example: turning of agricultural implements at the end of the field; reversing of wheeled implements, including carts. This requires that the donkey should be able to push backwards against the cart;
- be designed in such a way that the cart can not run forward into the back of the donkey and allows the donkey to apply a braking force in a comfortable and efficient way. Ideally carts should be fitted with brakes, but frequently this is not the case. Even when brakes are fitted, the harness should be designed such that the cart is prevented from running forward into the donkey(s) in the event of brake failure or driver error;
- be designed so that the downward loads imposed on the animal are supported in an efficient way. Donkeys, when drawing a two-wheeled cart, act as the third point of support for the cart and therefore carry a proportion of the load. Even when the cart is perfectly balanced about the wheels when stationary, loads will be imposed on the animals under dynamic conditions (eg traversing a bumpy track, accelerating and braking). Ideally these loads should be supported on the animals' back and not on the neck;
- be designed in such a way that tipping backwards of two-wheeled carts can be avoided, without causing injury to the donkeys.
- have some flexibility in relation to the implement/harness system so that, when travelling on uneven ground, there is allowance for vertical movement of the animal relative to the implement. If the system is rigid the animal will experience considerable discomfort.

Technical criteria

The harness should be manufactured by using locally available materials and skills. Wherever an improved harness is being introduced to replace a traditional design, it is desirable that local craftsmen are capable of manufacturing it.

The harness should be durable and easy to maintain.

Economic criteria

The cost of a harness should be appropriate to the circumstances of local users. Traditional harnesses are 'minimal-cost' designs, and any improvements are likely to involve extra cost. The willingness of users to invest in more efficient harnesses will depend on their ability to pay the cost for the benefits which they gain from increased working efficiency of their animals. These benefits will depend upon the potential for exploiting this increase in efficiency.

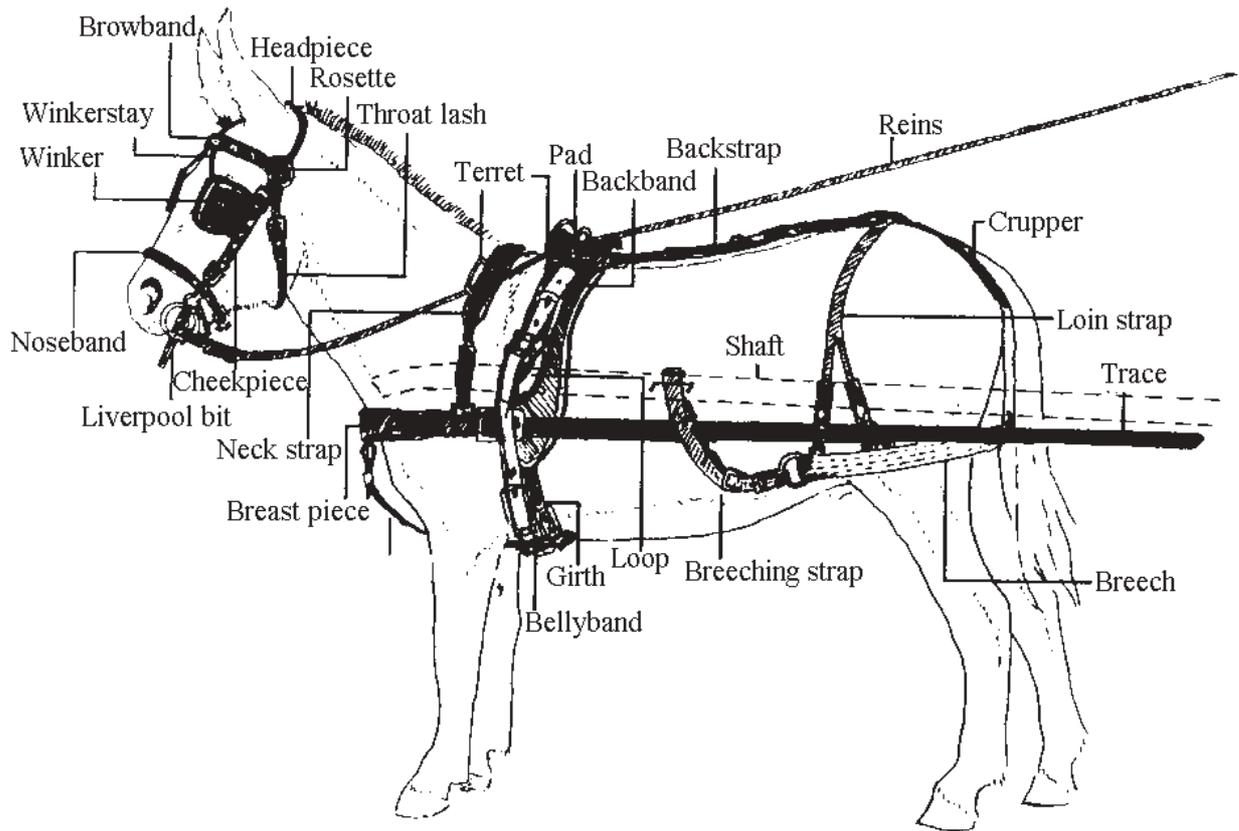


Figure 4: Example of a European type donkey harness for single carts. Source: Ellis et al, 1980

Parts of a donkey harness for pulling a single donkey cart

Functions

The functions of a harness for pulling a single donkey cart can be summarized as follows:

- controlling the donkey
- transmitting the power from the donkey to the implement or cart
- keeping a cart in balance
- braking device.

Bridle and bit

The bridle and bit are meant to control the donkey. They are of great help during the training of the donkey and by driving. Well trained donkeys can do without a bit and some even without a bridle. Experienced donkey owners guide and control the donkey(s) by oral commands. Instead of a bridle a halter can be used. However, when one works with donkeys for the first time, it is advisable to use a bridle and bit to ease control.

The bit must be buckled to the bridle by its rings. For each donkey the cheek straps of the bridle should be adjusted so that the bit fits in the corners of the mouth and the donkey can not move it with its tongue. The throat lash is done tight enough to prevent the bridle from slipping off but loose enough to allow the donkey to flex. The noseband keeps the bridle close against the head, without being uncomfortably tight. Allow enough room to insert at least one finger between the lower jaw and the noseband (Ellis et al, 1980).

Reins

The reins connect the donkey's mouth bridle to the driver's hands. The reins pass through the rein terrets on the neck strap (if available) and they are fixed to the rings of the bit (or to both sides of the halter if a bit is lacking). The reins can be made out of a (nylon) rope or narrow leather strap.

Breast strap harness

The breast strap harness is the most simple type of pulling device for a donkey. It can be made of leather, webbing, an old car tyre, etc. However, it must not be made from unprotected abrasive material. All sharp parts should be removed and edges rounded off. Although more expensive, leather is the most suitable material. A breast strap made of a folded piece of leather with a narrow strap on top is the best, as the wide strap distributes the pressure over a wider contact surface with the breast and the narrow strap takes the major part of the force (example B, Figure 7).

To determine the minimum length of the breast strap, measure from a point (A) 4 cm above the elbow on one side, go around the breast just below where the wind pipe enters the breast, to a corresponding point on the other side (Figure 5).

The neck strap keeps the breast strap in the right place. This is necessary, not only because of its own weight, but also because of the slanting breast; when the donkey is pulling the breast strap tends to slip downwards. Neck straps should be about 3 cm wide and have pads on the top to help to distribute the weight. Neck straps without pads should be wider.

To measure the length of the neck strap place a tape over the neck just in front of the highest point of the withers, carry the ends downwards where they cross the horizontal dotted line (point B). Move the ends 5 cm forward, along the horizontal dotted line, to point C. The proper length of the neck strap is the distance from point C over the neck to point C at the other side of the donkey. The points C are also the places where the neck strap should be fixed to the breast strap. The ends of the neck strap can also be split into two small straps, fixed behind and in front of point C (Figure 6); this improves the stability of the breast strap.

When a breast strap harness is made for one particular donkey, then a non-adjustable neck strap can be fixed straight to the breast strap. A breast strap harness to fit many donkeys should have an adjustable neck strap (with buckles).

A triangle of round steel (Figure 6) or strong buckle is attached at both ends of the breast strap. This triangle will be connected to the traces. One straight side of the triangle takes care that the pull by the traces is divided over the whole width of the strap. To make that happen, it is important that the stitches on the folded part of the breast strap are placed very close to the triangle. When pulling, the triangle (or buckle) will be situated just behind and little above the elbow where it is free to move back and forward, without touching the belly (see also swingletree).

Examples of simple breast strap harnesses

Leather breast strap (folded leather strap)

This breast strap is a folded piece of leather (figure 6). The outer part is about 5 cm wide and the inner part 6 cm. The strap has no sharp edges as the top edge is round (folded) and the lower side of

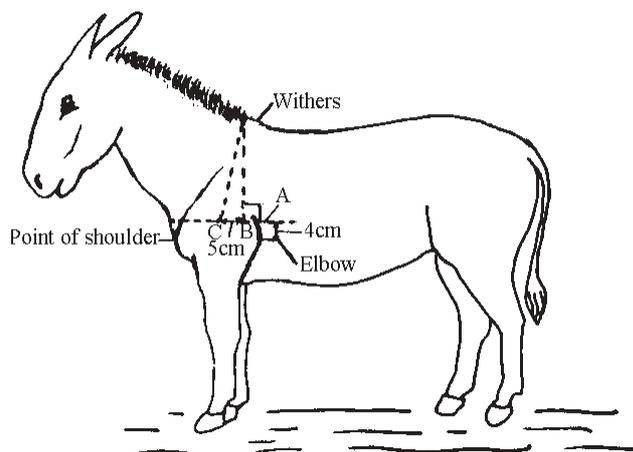


Figure 5: Measurements for a breast strap harness

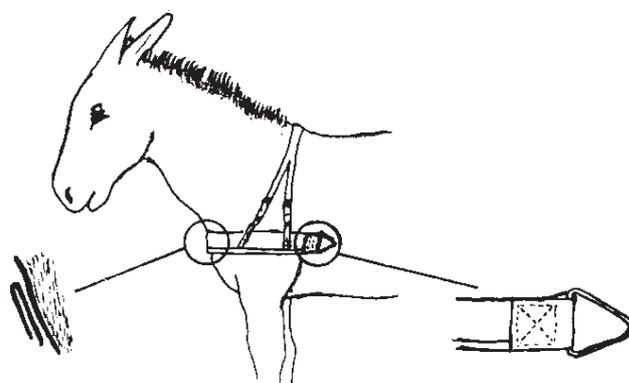


Figure 6: Leather breast strap harness (folded leather strap)

the inner part can quite easily move forward (from the skin). Besides that the bottom side of the inner part can be rounded with a sharp knife. This breast strap has no stitches touching the skin of the donkey.

In this example the neck strap, at both sides of the donkey, is split into two adjustable straps, which will assist in keeping the breast strap in place.

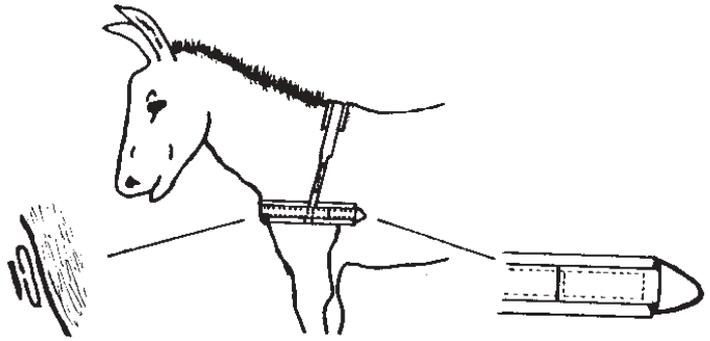


Figure 7: Leather breast strap harness
(leather strap, folded twice)

Leather breast strap (folded twice)

A 12 cm wide leather strap is folded twice and on top of the seam left, a narrow strap (3 cm) is fixed for taking the stress (Figure 7). The wide double leather strap (then about 5 cm wide) distributes the pressure on the breast and acts as a cushion at the same time. Fewer sores develop from this arrangement as the major stress is on the middle of the strap instead of on the edges. In this design the neck strap has a pad on the top in order to distribute the weight and it has adequate adjustments to fit many donkeys.

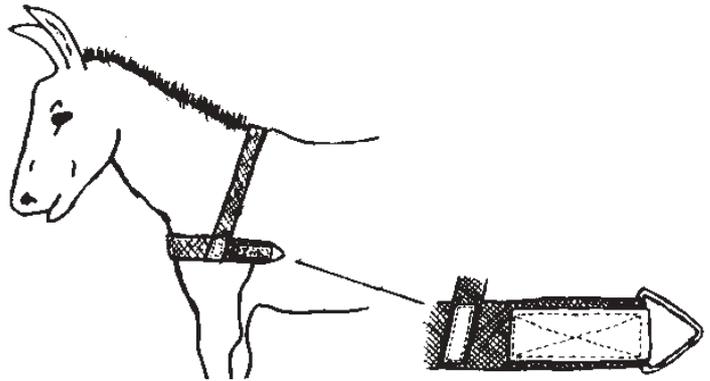


Figure 8: Webbing breast strap

Leather breast strap (wide and narrow strap)

This breast strap harness is similar to the one under B. The difference is that the wide strap is a single flat strap (5 cm). Again, on top a narrow leather strap (3 cm) is sewed taking the stress. The edges of the wide strap should be rounded to prevent sores.

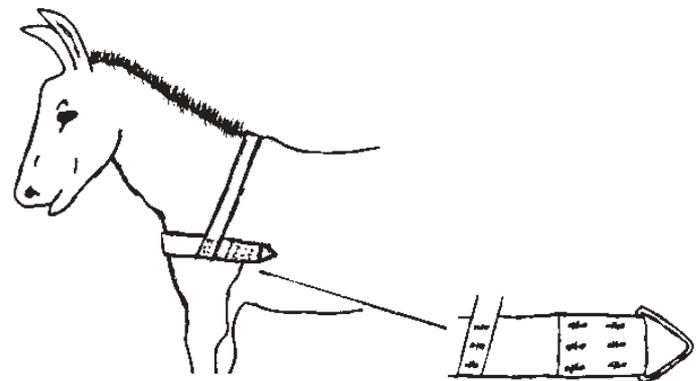


Figure 9: Rubber breast strap (car tyre)

Webbing breast strap

The idea behind this harness is to use leather substitutes to reduce costs. The width of the breast strap is about 6 cm. The edges of the straps should be rounded to prevent sores. A sheep skin or cloth, wrapped around the breast strap, will increase comfort. In this example the neck strap (3 cm wide) is not adjustable. Leather parts are used to reinforce the breast strap at the connections with the neck strap and the triangular ring.

Rubber breast strap

The breast strap is 6 cm wide and the neck strap 3 cm wide, both made from an old tyre (Figure 9). When the joints are stitched with thin wire, make sure that the wire is well tightened at the outside. At the donkey side of the breast strap the wire should be sunken into the tyre in order not to touch the skin. The edges should be rounded off to prevent sores. The breast strap should be wrapped with cloth or sheepskin to increase comfort and absorb sweat. This will also reduce the sores. In this example the neck strap is not adjustable.

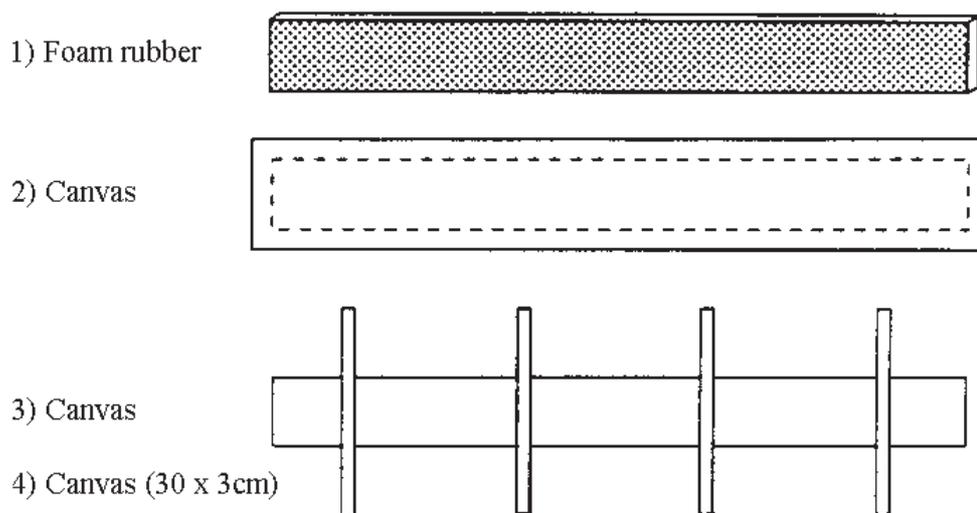


Figure 10: Parts of a breast protector

- 1) A 2 cm thick piece of foam rubber with the same length as the breast strap. It should be 4 cm wider than the breast strap.
- 2) One piece of canvas 6 cm longer and 6 cm wider than the foam rubber band.
- 3) One piece of canvas with the same length and width as the foam rubber band.
- 4) Four pieces of canvas 30 x 3 cm.

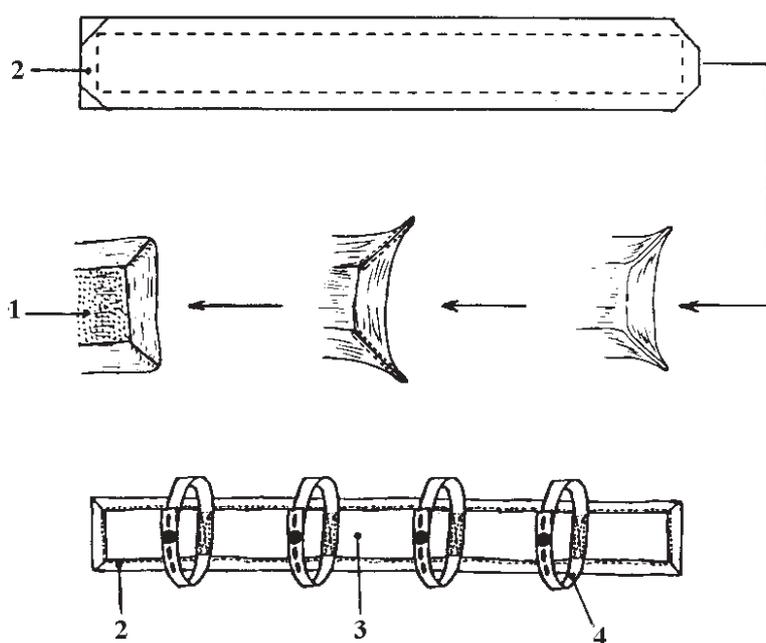
Breast protectors

Most of the sores and wounds that occur are the result of poor (fitting) breast straps in combination with traces which are fixed directly to a rigid part of the cart. In practice sheepskins, jute bags or old cloth are used to wrap the breast strap in order to protect the breast from getting sores, especially when the breast strap is made out of rough materials like rubber from car tyres. The protecting materials should be wrapped evenly over the whole length of the strap, otherwise wrapping materials will cause uneven pressure. Besides it should be cleaned regularly.

One can also make a simple removable and washable breast protector which can be fitted to the

breast strap. It is a kind of cushion between the strap and the donkey's breast. An example of a simple breast protector is given in Figure 11. The basic materials are foam rubber and canvas.

Figure 11: Construction of a breast protector (see text for details)



Construction of a breast protector

Cut off the corners of part 2, bend the flaps inside and stitch the sides of the flaps together (Figure 11). Turn the canvas inside out and put the rubber foam inside.

Stitch the 4 pieces of canvas (30 x 3 cm) to part 3 and fix at one side of these pieces a button and at the other sides some button holes (to fix the breast protector to the breast strap).

Put part 3 with the joined four narrow canvas strips on top of the rubber foam (the sides are put under the flaps). Stitch the parts 0.5 cm from the side of the flaps together.

Traces

The traces transmit the force from the breast strap harness to the cart or implement. Traces can be made of a chain, a leather strap or a rope. Traces made of sisal or nylon rope are most common. The traces are fixed to the triangular ring (or buckle) of the breast strap harness and pass the donkey on each side to a wooden bar located behind the donkey, called swingletree (or single tree). The traces should not touch the skin and therefore the swingletree should be about 60 cm long. If one can not prevent the traces from rubbing the skin (big belly), then the part of the trace touching the skin should be wrapped (preferable with leather). The traces must be even and long enough to make the donkey walk and trot without the hind legs touching the swingletree (Figure 3).

Swingletree

It is important that the donkey is free in its movements and that the harness does not rub the skin. When walking (pulling), the legs and shoulders of a donkey move forward and backwards and so do the ends of the breast strap. Therefore the traces should be able to move too. A swingletree makes this possible. The swingletree swings with the shoulder movements and prevents the breast strap from rubbing sores on the breast and shoulders. With a swingletree the draft on both sides of the (breast strap) harness remains equal and the breast strap stays in place. **Therefore the traces should never be fixed directly to a rigid part of the cart (shafts or cart body).**

The swingletree (Figure 12) is a piece of good wood. It has a ring in the centre to connect it to the cart or implement. The swingletree has grooves at the ends to attach the traces.

The best way to attach the ring to the swingletree is by means of a piece of (2") pipe, held in place by two short wood screws, since a sizeable hole in the centre of the swingletree makes it weak. The same applies to the evener, of course.

Saddle and belly band

The cart can be kept in balance by the donkey by means of a saddle and belly band (girth strap). The main function of the saddle is to take the vertical force of the shafts. Thus spreading the vertical load of the shafts over the back of the donkey. The load on the back should be spread over the rib cage. It should not rest on the spine. A bellyband prevents the cart from tipping backwards (see also Figure 4)

The minimum requirements for a saddle (pad) are a cushion with on top a rigid part (out of metal sheet or wood) that spreads the load and avoids pressure on the spine (like a riding saddle). A back band is placed on the rigid part. It has loops to hold the shafts.

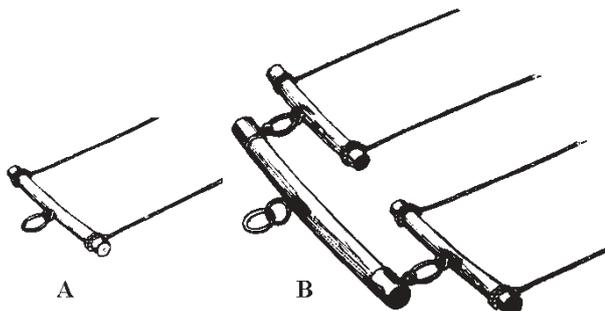
A belly band can be attached to the back band or the shafts.

Examples:

The cushion (about 40 x 40 x 8 cm) can be made of canvas or jute bags, filled with cow hair (from a slaughter house), cotton or any other soft material that does not rot quickly. Sometimes the 'cushion' is made out of a number of folded jute bags.

The rigid part can be made of sheet metal (35 x 20 cm) which is bent in the middle to avoid pressure on the spine. A simple back band can be made out of a car tyre whereby the tug loops are part

*Figure 12: Swingletrees: (a) for one animal; (b) for two animals with two swingletrees and evener.
Source: Hopfen, 1969*



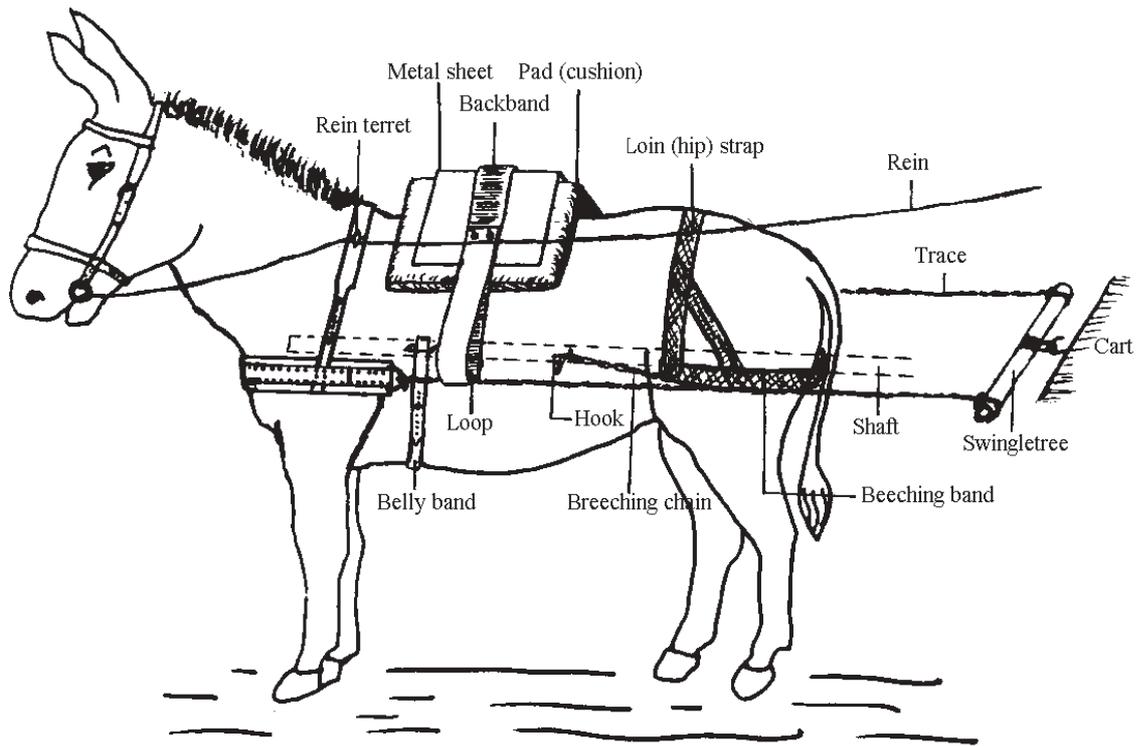


Figure 13: Basic elements of a donkey harness

of the back band (Figure 13). Instead of sheet metal, one can also use a wooden frame with the same purpose (Figure 14).

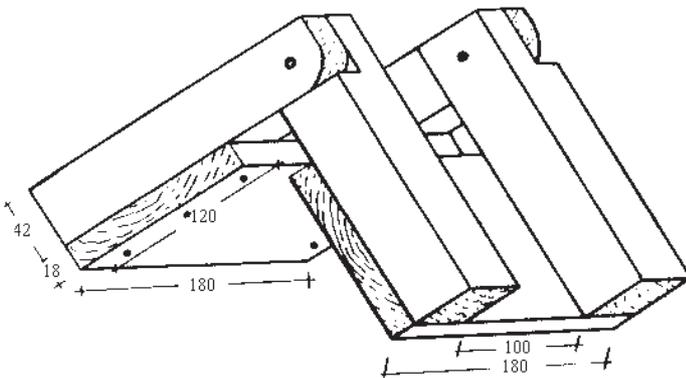
A belly band should be a wide, soft strap that is adjustable. It is fixed to both shafts and passes under the belly.

NB Make sure that the belly band attachment does not interfere with the free movement of the shafts through the loops (from the pulling to the braking position, or vice versa).

Breeching (braking device)

A breeching band (also called breeching or breeching strap) is only necessary when a cart or wheeled implement is being used. It acts as a braking device. In the first place a breeching band should prevent the cart from running forward into the back of the donkey, what can cause accidents. Secondly it is needed to enable the donkey to push the cart backwards.

Figure 14: Wooden frame for a saddle



The breeching band is a wide strap that passes under the tail, about 6 cm below the seat-bone knob (or lie half way from the tail head to the hocks). This prevents the breeching band from slipping under the tail. If the breeching band is too low, it interferes with the movement of the legs. A loin (hip) strap holds the breeching band in place. The loin strap can be adjustable and split into two connections with the

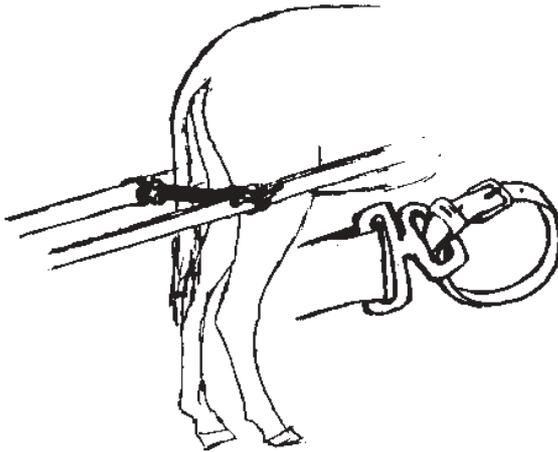


Figure 15: False Breeching and detail
Source: Ellis et al, 1980

breeching band (Figure 4), or not adjustable and made according to the size of the donkey. The latter should have an extra strap to keep the breeching band in place (Figure 13). The loin strap is laying just behind the point of hip. The breeching straps (or breeching chains) should be attached to the shafts of the cart (either through a cramp-iron or to a hook). After attaching the breeching straps or chains to the shafts, they should be in line with the breeching band (Figure 13).

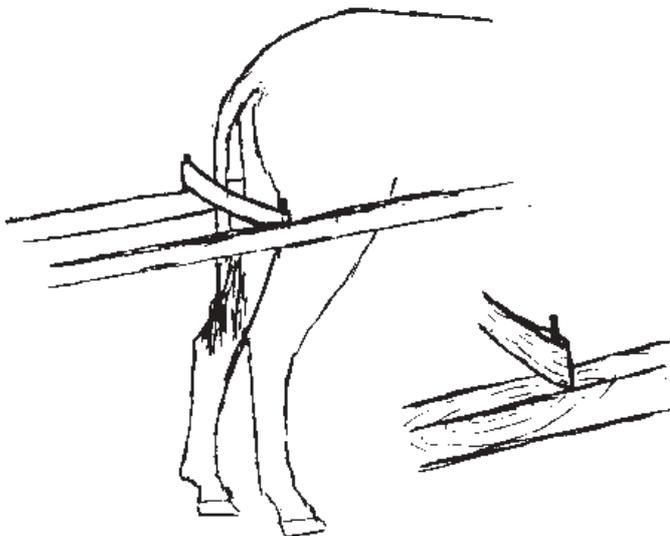
The breeching band can be made out of leather, canvas or webbing.

When the traces are tight (ie when the donkey is pulling), there should be about 9 cm (a hand's width) distance between the breeching band and the rump of the donkey. If necessary, adjust the length of the traces.

An alternative breeching device is a False Breeching (Figure 15). Hereby the breeching band is not attached to the donkey, but it is buckled through the 'D' fittings on the shafts, fixed on their exterior face situated slightly behind the donkey. The False Breeching when fitted, must not touch the donkey when moving forward (again about 9 cm distance) but it must be just close enough to come into contact with the quarters when going downhill or stopping (Ellis et al, 1980). This alternative breeching device is only possible if the shafts, near the tail of the donkey, lie high enough, ie half way between the tail head and the hocks.

There are more possibilities for a False Breeching, eg ropes, webbing, canvas or leather straps tight between the shafts just after the donkey (Figure 16). However, one should keep in mind the basic principles of a breeching device: the required distance between the breeching band and the rump of the donkey as well as the comfort of the donkey.

Figure 16: False Breeching using a band coupled to two iron pins on top of the shafts



Single donkey carts

The following donkey carts (Figures 17, 19, 20 and 21) are examples of carts which can be pulled by one donkey harnessed in such a way as described before. The basic criteria for a single donkey cart are:

- light, well balanced
- low rolling resistance (axle with anti-friction bearings and tyres)
- carrying capacity about 500 kg.
- two shafts.

Shafts

The shafts of a two-wheeled donkey cart are fixed to the cart body. The length of the shafts and their distance depends on the size of the donkey. Some guidelines are stated in Table 1 and figure 18.

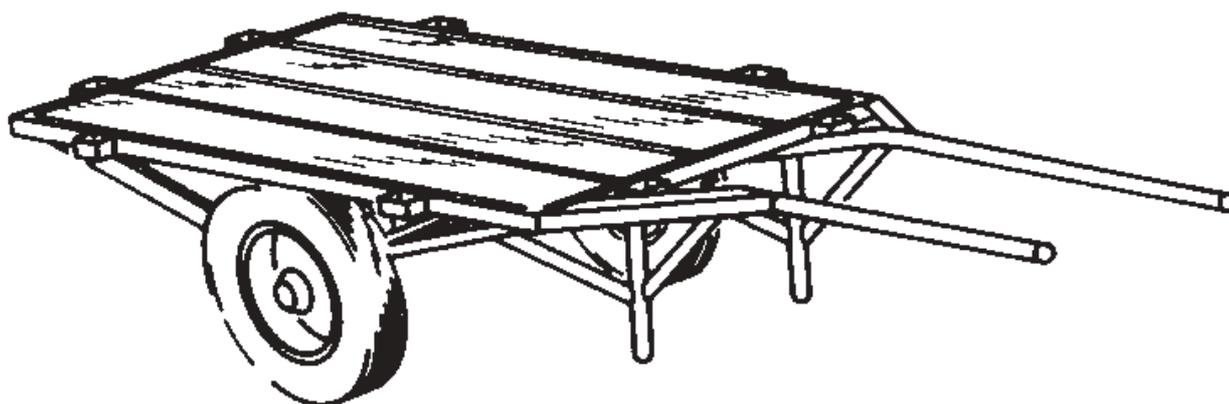


Figure 17: Donkey cart from West Africa; metal frame and raised platform

Table 1: Length of the shafts and their distance in relation to the size of the donkey or mule (see figure 18)

Shafts	A	B	C	D
Withers height	Length (m)	Minimum width (cm)	Maximum width (cm)	Cramp-iron for breeching strap
1.40	1.80	57	65	70
1.3	1.80	55	65	65
01.20	1.65	45	60	65
1.10	1.60	45	60	60
1.00	1.60	40	60	60

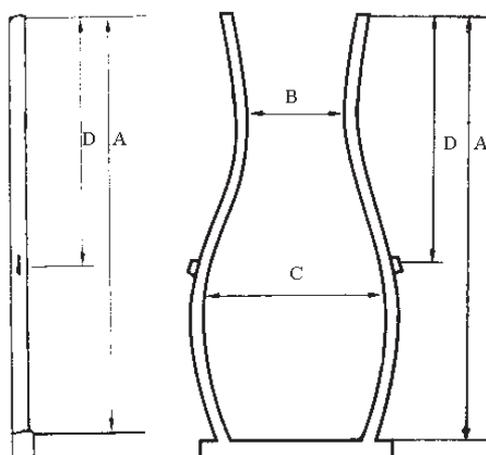


Figure 18: Diagram of shafts showing measurements in table 1

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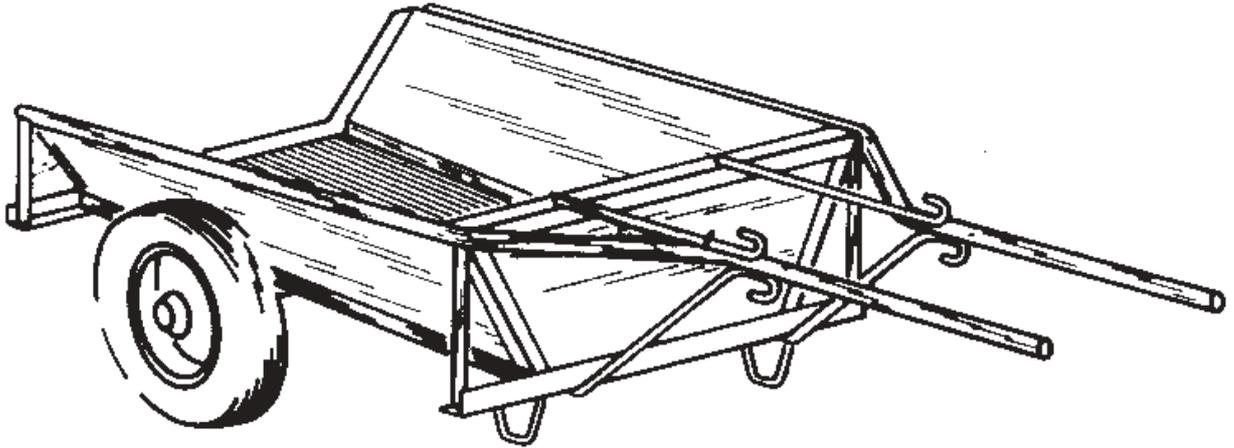
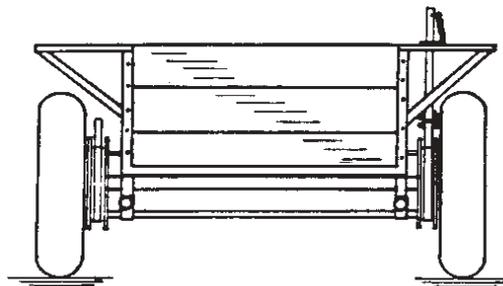
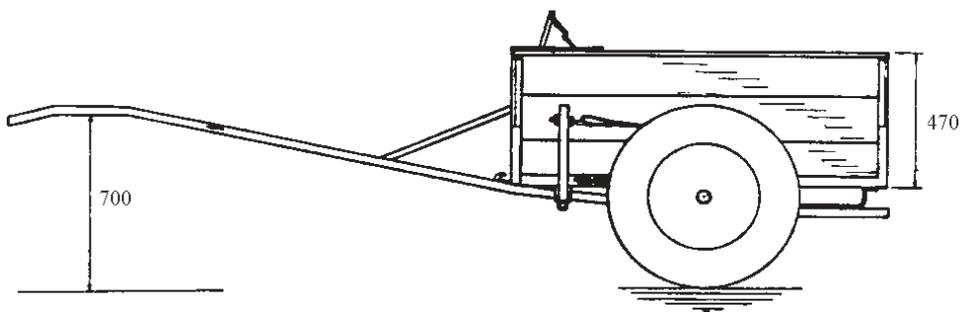
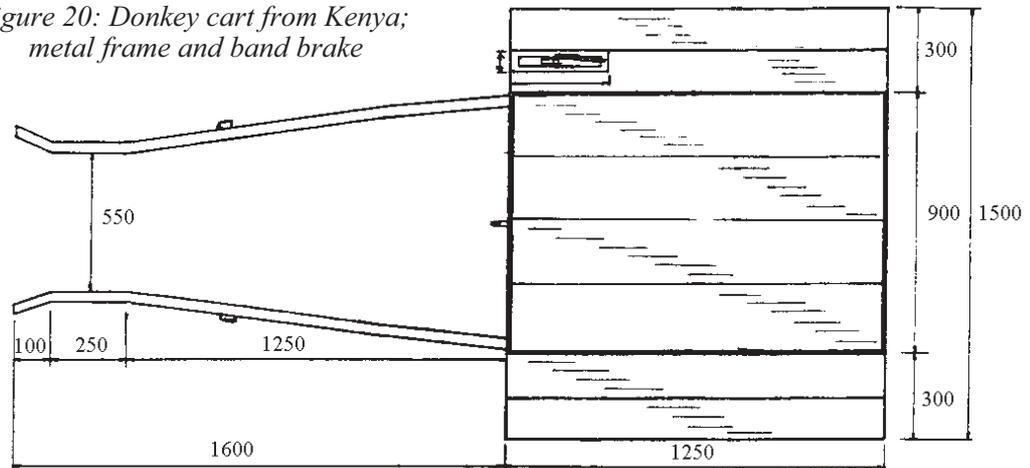


Figure 19: Donkey cart from West Africa; metal frame and box of sheet iron

Figure 20: Donkey cart from Kenya; metal frame and band brake



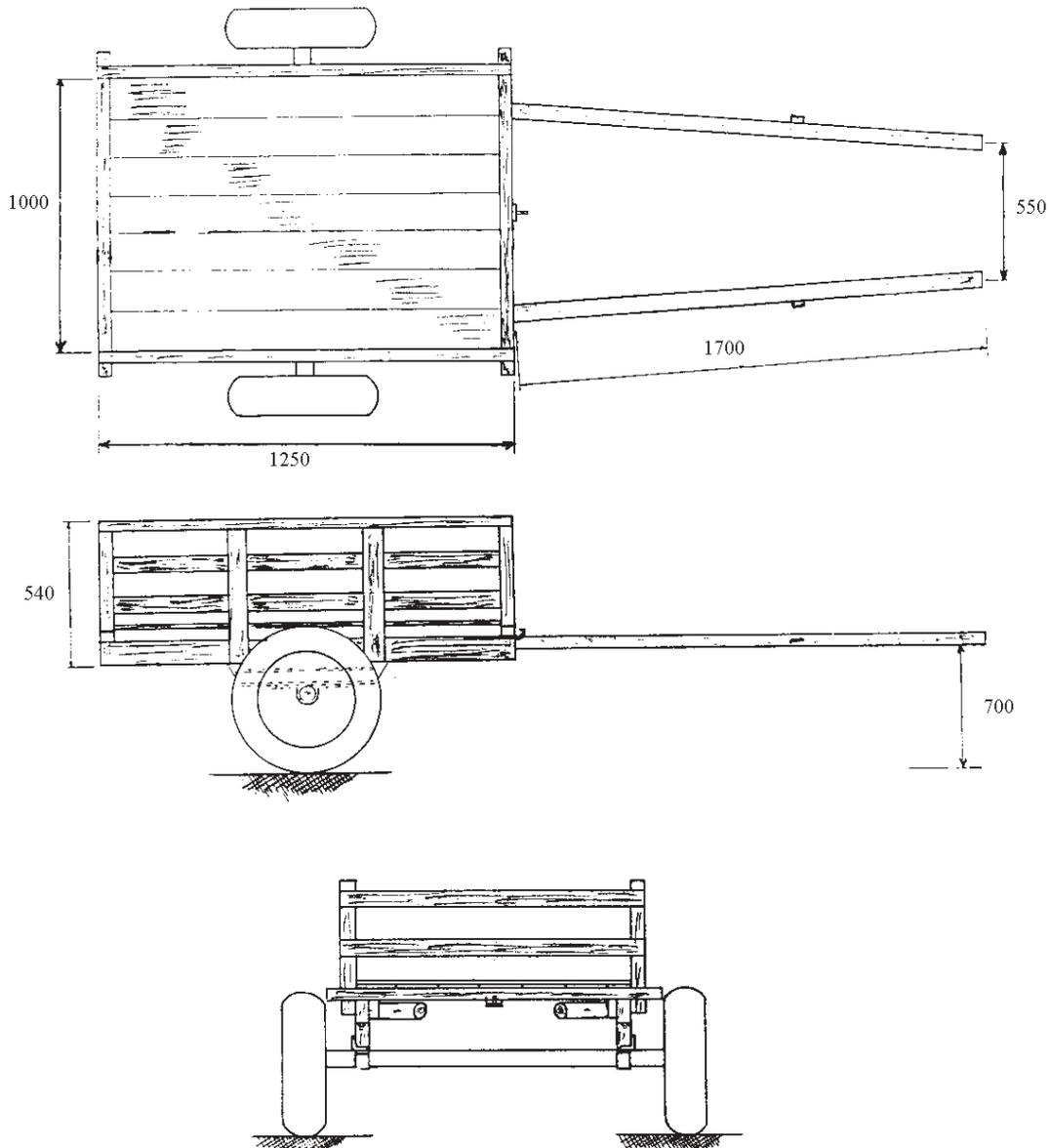


Figure 21: Donkey cart from Kenya; wooden frame, platform and shafts

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