Donkeys for Tillage

A Reference Manual for South Sudan

VSF VETERINAIRES SANS FRONTIERES SUISSE

BROOKE ACTION FOR WORKING HORSES AND DONKEYS

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First Edition

June 2018

VSF VÉTÉRINAIRES SANS FRONTIÈRES SUISSE

BROOKE ACTION FOR WORKING HORSES AND DONKEYS

A Publication of Vétérinaires sans Frontiéres Suisse (VSF Suisse)
South Sudan Program

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First Published in 2018

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Citation: Vétérinaires sans Frontières Suisse (VSF Suisse), 2018. Donkeys for Tillage. A reference manual for South Sudan.

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Acknowledgement

I greatly thank Dr. Martin Barasa for technical backup during the production of this manual. I convey my sincere gratitude to Dr. Kevin Miheso, Dr. Kwajok Tongun and Dr. Luke Wono for their additional contributions. Thanks also to Rose Juru and the other VSF Suisse Northern Bahr el Ghazal team and Juba staff for other logistical arrangements during context analysis at field and Juba. The Brooke East Africa is greatly appreciated for their financial support for the project through which this manual was developed. Lots of thanks go to the secretary, Relief and Rehabilitation Commission Aweil East, Director General of Agriculture and Animal Resources for Aweil Center and Aweil East for their assistance and cooperation in accessing farming communities in Northern Bahr el Ghazal during context analysis.

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Abbreviations and acronyms

BCS	Body condition scoring
CTA	Technical Centre for Agricultural and Rural Cooperation
FAO	Food and Agriculture Organization of the United Nations
OIE	World Organization for Animal Health
RRC	Relief and Rehabilitation Commission
VSF	Vétérinaires sans Frontières
Feddans	Area equivalent to about 0.42 hectares (1.038 acres) of land

Preface

Use of animal power generally enables farmers in sub-Saharan Africa to increase agricultural production and improve the quality of life. Although draught animal power has been superseded by tractors on many of the large commercial farms in Africa, it remains a relevant farm technology in small scale agriculture, mainly for economic and agro-ecological reasons. It has proved beneficial especially for medium to small holder farming in developing parts of the world. Other than human labor, donkey draught power is considered to be the 'cheapest' form of farm power, and within reach of the 'poorest of the poor'. It is 'available' to women in cultures where men usually manage the heavy labor and can alleviate the drudgery of women's household activities such as water and firewood carrying. Donkey draught power has particularly been significant where farm mechanization by tractors is still limited by maintenance needs and availability of capital.

Effective use of working animals depends on an understanding of the capabilities of the animals for work, their husbandry requirements and the factors which can influence their performance. Although feed requirements for work are generally low, the quality feed provided by handlers can be so poor that animals are unable to eat enough to meet energy needs for work, and so the animals lose weight during the work season. Food availability, diseases and heat stress are the major constraints to performance of draught animals in sub-Saharan Africa.

VSF Suisse implemented the equine welfare promotion project titled *"Integrated Equine Welfare Advocacy Campaign in the Greater Bahr el Ghazal, South Sudan*", funded by the Brooke East Africa. It commenced on 1st of September 2017 to 30th April 2018. Development of this manual was part of the project objectives to enhance the knowledge, attitudes and basic equine handling and harnessing practices and skills among owners and users through advocacy and awareness campaigns, to enhance access to quality

equine healthcare services through training of veterinarians and para-veterinary professionals and support to veterinary service inputs supply chain and to promote the integration of equine welfare campaigns in the food security and livelihood strategies through income generating animal draught power trainings and dialogue initiatives.

This manual has been developed for general improvement of food security and living standards and to enhance quality of handling of working donkeys in South Sudan. It is intended for use by agriculture, livestock and social workers as reference material for donkey plough training activities.

Chapter 1

Background and Historical Overview of Donkey Draught Power in South Sudan

Donkeys are believed to have first come to South Sudan (then part of other territories and Sudan) when the Ottoman Turks expanded their areas southwards. They used donkeys together with horses in covering the diverse terrains and carry various material that they needed. Natives got involved in taking care of the animals and with time also owned some for transport over long distances. The keeping of donkeys in South Sudan gained more prominence when more people realized that they were useful for carrying disabled persons. The donkeys could be trained to take instructions from disabled people and would transport them over long distances.

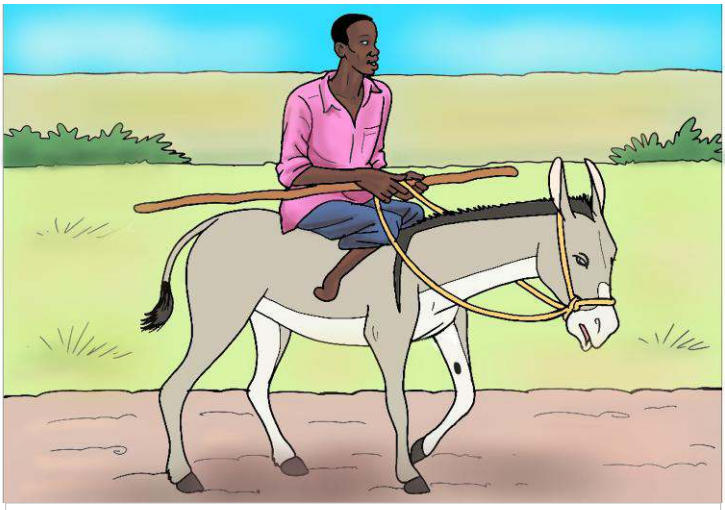


Figure 1: Donkeys were helpful in movement of disabled persons

Paintings found in pyramids in Egypt dating as far back as 5,000 years ago are the earliest evidence of use donkeys by man for transport. The evidences indicate that initially donkeys were reserve of the elite ruling royals. Donkeys were already an important means of transport even before the invention of

the wheel. In the ancient time, donkeys were used for travel “on-back” (pack animals) over long distances. Early drawings have shown the donkey pulling sledge, indicating that they were used before the transition of sledges to wheels, and also that sledges were among earliest implements pulled by donkeys. Donkeys were important as transport animals because they could be fed less often, could survive on various forms of feeds and could be accustomed to obey instructions. It is noted that Joseph, father of Jesus, travelled with Jesus mother Mary by donkey from Nazareth in their trip to attend population census in Bethlehem during which Jesus was born.

To date, donkeys make considerable contribution to socio-economic wellbeing of communities in South Sudan. They are important for carrying building materials, commodities at trading centers, farm harvests, water, human beings and ploughing other diverse draught power. Use of equines in South Sudan has been concentrated more in urban areas where they are used to move traded commodities and building materials but, over the years, there has been gradual spread to rural areas. With the spread to rural areas, the involvement of donkeys in agriculture in the country, other than for transport of traded agricultural produce, is steadily rising.

The Ministry of Agriculture, Animal Resources and Cooperatives Development of South Sudan in collaboration and partnerships with aid agencies have over the past few years made strides towards increasing crop productivity by the country. However, decades of conflicts and changing political circumstances have limited effective utilization of the country’s agricultural resources. In whereas, over 80% land area in South Sudan is arable only less than 20% of the agricultural potential of the country is utilized. The opportunity for utilization of the plain lands, water and other resources for increasing productions is great.

Over 60% of the people of South Sudan live in poverty. The majority of these are rural residents. Use of donkey draught power for agriculture offers an

opportunity for more agricultural productivity by majority of communities in South Sudan. This is despite their immense contribution in food security and livelihoods through provision of draught power among agro-pastoral and business communities. Equine use has been of particular contribution among women and youth in the country where motorized transportation is hindered by the poor terrain and infrastructure, particularly during the rainy season.

Like in many other countries, equines in South Sudan face enormous suffering from neglect and outright mistreatment by the owners and users, in addition to facing immense challenges such as poor access to water, poor pasture and inadequate healthcare services. Neglect of donkeys is commonly attributable to perceived low value associated with its other qualities that are not draught power. Keepers tend to assume that there is never any gain in care to produce quality meat, milk and hides and skins.

Protracted civil strife in the country exacerbated by dysfunctional animal healthcare services, lack of veterinary drugs/equipment, scanty information on knowledge, attitudes and awareness on equine welfare concerns; in addition to prevalent equine diseases and conditions have led to immense suffering of equines in South Sudan.

Chapter 2

Importance and uses of Donkey Draught Power

Donkeys are important working animals at home and in business. Historically, donkeys were domesticated from the wild by man, initially for the reason of providing transport and thereafter for other draught power. Initially transportation was on the back of the donkey without other implements but gradually as transportation of goods and other draught power became important in the life of man, needs for control ropes, harnesses and carts developed over time.

Donkey draught power contributes to the life of man in various ways: -

- Farm cultivation/tillage – ploughing, harrowing, sowing, weeding
- Transportation of farm harvests from the fields to the homestead
- Transportation of farm produce from the villages to trading centers
- Transportation of water from the borehole or river to the homestead

Figure 2: A donkey pulling a cart

- Transportation of construction materials
- Transportation of human.

Presently forms of donkey draught power in South Sudan are ploughing, transportation of water, transportation of business commodities, transportation of farm harvests, transportation of building materials (poles, grass, bricks, soil). Donkeys also carry people directly on the back. Donkeys have been important as transport for disabled persons in which they are instructed by the disabled alone throughout without need for additional assisting person. The donkey is trained to go low for the disabled to embark and disembark, walk, stop, turn, reverse and others. Disabled persons have been able to travel to distant locations and back, just alone, on donkey back. It is believed that use of donkeys to carry disabled is a main factor for spread of donkeys in South Sudan.

Figure 3: 400 liter water drums carried through donkey carts

Advantages of using donkeys for draught power

- Donkeys are friendly towards human
- Donkeys are easy to train

- They are willing to work
- Need little supervision
- Affordable to most households
- Need little water
- Strong power relative to their size
- Can turn within small areas
- Can perform diverse work – carrying, pulling, ridding
- Longer working years compared to other animals
- Can utilize locally available feeds
- Women and children can handle donkey draught power implements.

Disadvantages of using donkeys for draught power

- Meat not commonly eaten
- Sensitive to being alone
- Mature very slowly
- Breed slowly
- Manure more fibrous than ready soil nutrients
- Have small body size compared to other animals
- Once they establish friends, not easy to separate.

Other uses of donkey draught power in the other parts of the world are pumping of water, threshing cereals and crushing of sugarcane.

Chapter 3

Selection of Donkeys for Drought Power

Work requires adequate health and fitness. During selection of donkey for draught power, the characteristics considered are health, physical/body structure, temperament, eye sight and work years.

The animal should be free from sickness (healthy and fit)

Selected donkey should be physically and mentally sound as well as fit. If the animal has any infections such as chest infections, lameness, sores, cuts, hernia and others, it cannot work. It may also introduce zoonotic infections such as tetanus to the handler or owner. An animal in pain due to sickness cannot work.

During selection, the animal should be checked for indicative signs such as coughing, difficult breathing, limping, poor eyesight, dullness, lack of appetite, skin diseases and abnormal movement patterns (abnormal gait).

Animals with treatable conditions should be treated and allowed time to heal and recover before being selected for draught power.

Well formed body structure

The draught animal derives much of working strength from its muscles and related functions including skeleton. During selection, muscle development and general body frame should be carefully observed. The following are desirable: -

- Large body frame with wide shoulders and deep chest
- A straight back
- Symmetrical body frame
- Well muscled straight legs that are perpendicular to the ground
- The base of the hooves should be slightly concave.

Undesirable characteristics in body structure include: -

- Sagging of the back (very slight sag is acceptable)
- Feet abnormalities. The feet should be checked for any signs of lameness.

Figure 4 gives desirable and undesirable body conformations.

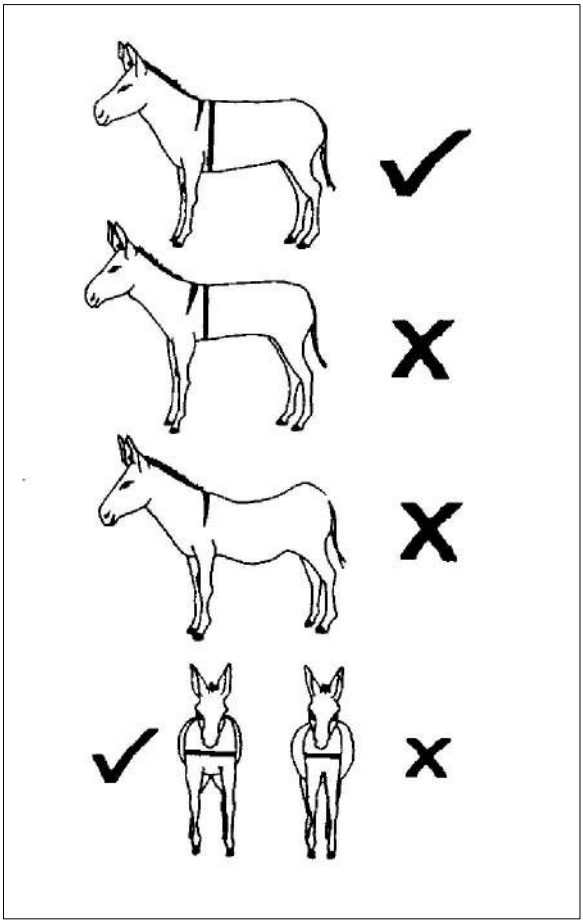


Figure 4: Desirable and undesirable body conformations

The weight of the animal is determined using a weighing band (Figure 5).

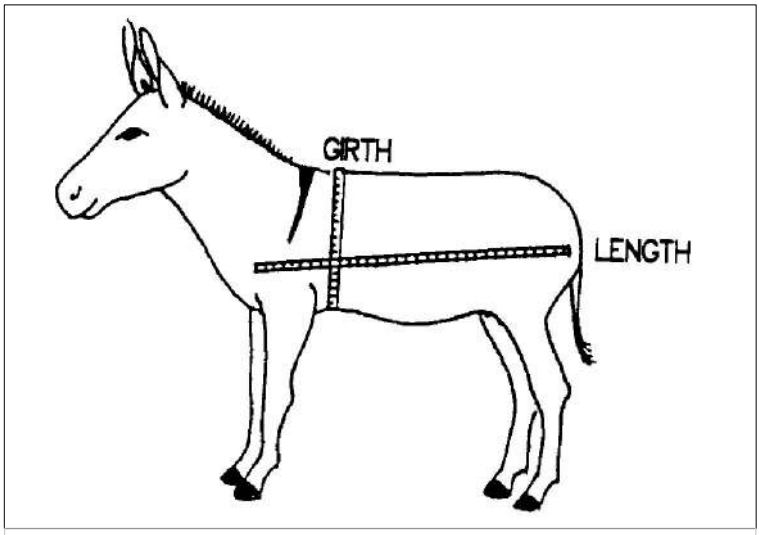


Figure 5: Estimation of weight of donkeys using weighing band

Temperament

The animal should be responsible, calm and not aggressive or easily excitable.

Working years

The working donkey should give the owner maximum number of working years (or working lifetime). The interest of the owner is to use the donkey for as many years as possible. However, the draught animal should not be used while too young or too old. Age is commonly estimated by examining stage of development of the incisor teeth. Permanent central incisors erupt at about 2.5 years, followed by the permanent lateral incisors after 3 years and then the permanent corner incisors after 4 years (Figure 6).

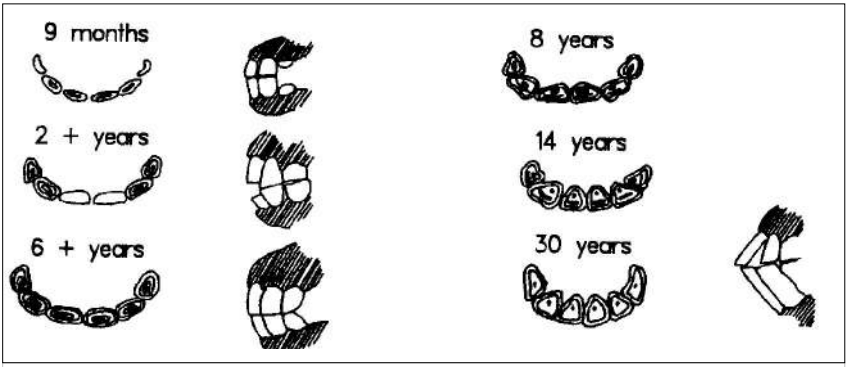


Figure 6: Estimation of age of donkeys by examining dental development

Body condition score

In some circumstances, body condition score (BCS) is used to evaluate the animal. BCS indicates nutrition, growth rate, physical fitness, muscle development, skeletal development, health and other characteristics for suitability for draught power. Emaciated animals and those with poor body condition have low BCS.

Chapter 4

Types of Harnesses for Donkey Draught Power

4.1 Qualities of a good harness

Various types of harnesses have been developed over time for various forms of donkey draught power. The types of harnesses also vary in different countries. Whichever type of harness is used, it should be able to attach properly to implements while not causing harm to the donkey. Harnesses should be simple to constitute and not expensive. It is most convenient for harnesses to be constituted using local materials as much as possible.

Figure 7: Local collar harness

The harness should attach firmly to the body of the donkey while providing adequate padding to protect the body form injuries. Paddings are commonly ensured by use of sacks, clothes and animal fur. The simple donkey plough harnesses comprise of ropes and clothe paddings. However, since the donkey cart carries heavier weights than the power used by the plough, harnesses for the cart include metal parts.

The harness links the animal to the cart or implement. So, to be effective, it has to tap the power of the animal in the right places. One can use donkeys with withers yokes (also called neck yokes), similar to those used for cattle. The weight of implement is best borne on the back, while the shoulders are the best place to generate pulling force. Donkey shoulders are too low to be reached by a yoke. By pushing on the neck, the yoke can force a donkeys' head to be kept low, whereas a donkey works best with its head up and looking straight ahead.

4.2 The breast band harnesses

The breast band harnesses is the webbing breast band and may be made from strips of webbing, which are sewn, together to fit the donkey (Figure 8). The arrangement shown in figure 8 provides a wide range of adjustments, allowing it to be fine-tuned for the conformation and comfort of the individual animal. The design maintains the simplicity and low cost of a widely used traditional design. With the breast band, the work force is primarily taken from a broad band of leather, rubber or strong canvas material across the animals' chest.

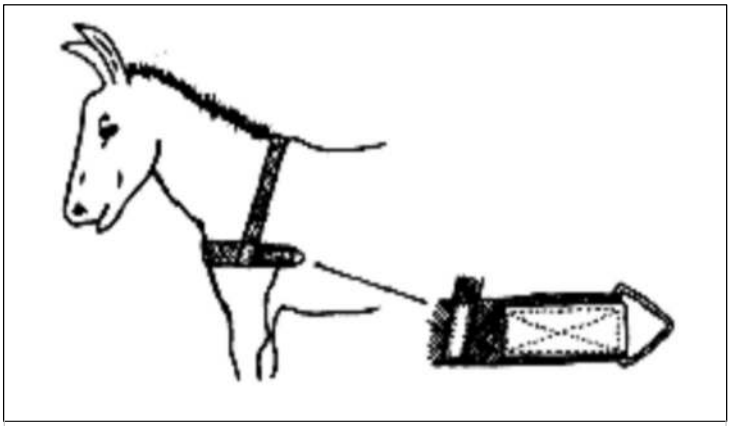


Figure 8: The breast band harness

Traces (ropes or chains) or shafts attached to either end of the breast band pass back to the implement. One or more straps hold the breast band in position. Usually there is a neck strap crossing the withers and a back strap across the middle of the back. They are often padded on the back and referred to as saddles. The back straps may be adjustable or made to size. For heavy work a well-fitting collar around the neck is preferred over a breast band harness. It is positioned between the strongest points of the donkey (its breast and its withers) and is therefore most efficient for pulling at an angle as is required for cultivation implements. The collar is made in two parts so that it is easy to put on.

4.3 Materials for harnesses and maintenance

The best material for harnesses is leather, although this is often unobtainable or expensive in some regions. Leather needs to be well cared for, as it is prone to drying out and hardening. To prevent hardening, a leather harness should be waxed or oiled with vegetable oil or animal fat. However, leather harness may become moldy if allowed to be constantly damp. All harness equipment should be kept free of dirt and dampness to avoid sores and infection in the donkey. Therefore, harnesses should never be left lying on the ground, but should always be hung up somewhere out of the reach of children and animals.

4.4 Connecting to implements

There are various pulling harnesses. The width of the breast band is about 6 centimeters (cm). The neck strap is 4 cm wide and not adjustable. Leather parts are used to reinforce the breast strap at the connections with the neck strap and the triangular ring. Short breast bands with one neck strap have the advantage of connecting the traces near the power point. Long breast bands with two back straps are required where the implement needs a certain amount of lifting, like single moldboard ploughs without a support wheel.

A similar design can be made with rubber from an old car tire. The breast band is cut from the tread of the tire (6 cm wide) and the neck strap from the tire casing (5 cm wide). The joints are stitched together with thin wire. To avoid hurting the donkeys' skin, the wire is pulled tightly toward the outer side while stitching, so that the wire is well sunken into the rubber on the inner side of the breast band, which touches the donkey. Edges should be rounded.

The harness should be properly adjusted for the donkey. The breast band strap should run across the chest just above the point of the shoulder (Figure 9). When fixed too high, there is a danger of choking the donkey; when fixed too low, the two ends may run over the shoulder points where the front leg bones attach to the main skeleton, making walking very uncomfortable for the donkey. The space for a breast band is actually very limited on the chest of a donkey, which is a major drawback for this type of harness.

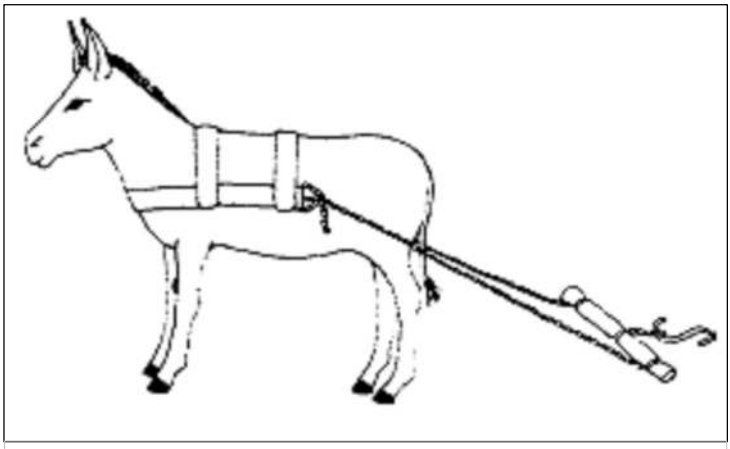


Figure 9: Harness for connecting traces to implement

Longer breast band harness is used for field implements. The further away the implement, the smaller the pulling angle, which puts less strain on a harness, depending on the resistance of the soil and the required ploughing depth. Greatest force is exerted where breast-strap and front-back strap meet. For a steeper pulling angle, second back-strap should be further back, over the donkeys' hipbone.

Figure 9 shows the extended breast band harness applied on two donkeys pulling a cart (Figure 10). Since these breast bands are not adjustable, they should be made to size to be comfortable. The sharp edges of the belts should be filed round or padded to prevent cutting into the donkeys' skin. To prevent the heads of the bolts that connects the different straps from catching into the donkeys' hair and bruising the skin, it is necessary that some padding is provided, preferably enclosed in material that absorbs the donkeys' sweat.

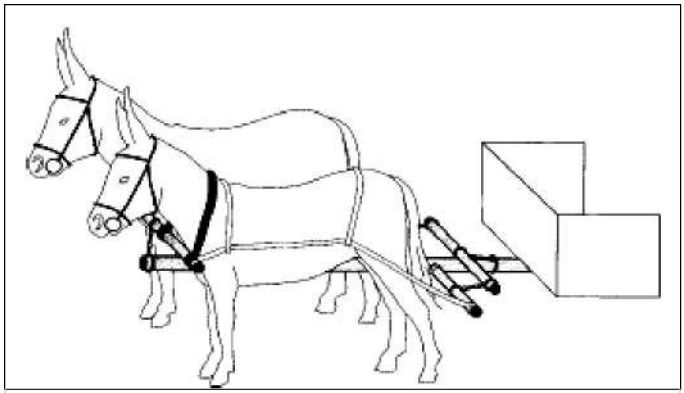


Figure 10: Breast-band harness for pulling cart

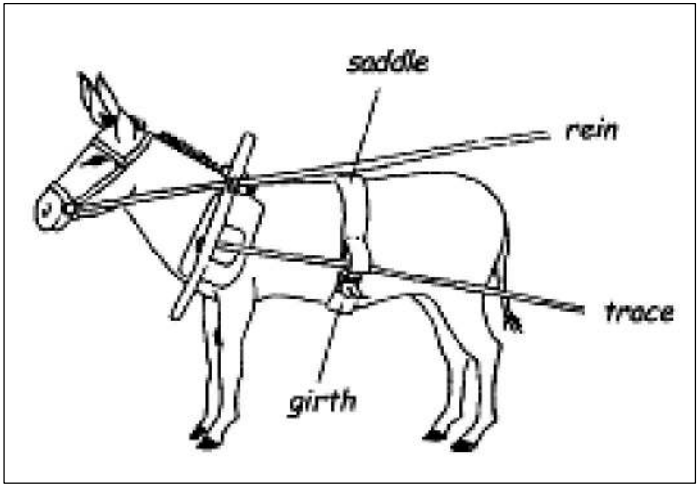


Figure 11: Adjustable harness for connecting

The best solution is to make these types of harnesses with leather, such as braided goatskin. Breast protectors are recommended to be used to minimize sores

and wounds caused by poor quality or ill-fitting breast bands in combination with traces that are fixed directly to a rigid part of the cart and not to a swinge tree. Instead of heavy cloth or sheep-skin as padding for the above-mentioned breast bands, one may also make a simple removable and therefore easily washable breast protector. It is a cushion made of foam rubber and canvas placed between the strap and the donkeys' breast, which can be buttoned to the breast strap.

A new innovative design is the collar harness with straight hames, using straight wooden bars padded with sheepskin. The hame straps are made of

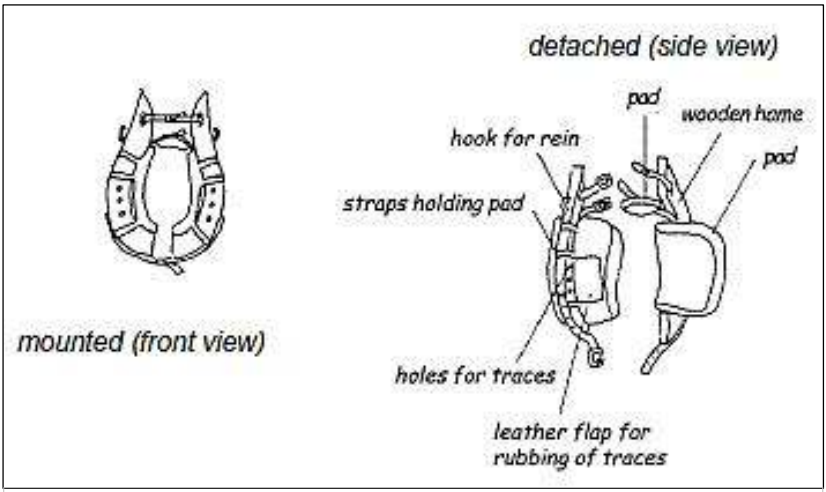


Figure 12: Three - pad collar harness

home-tanned leather, and are simply tied together in a way that will easily allow adjustment (Figure 12). The saddle shown is part of the full harness, including a breeching made from old fire hose, needed for pulling a cart.

In Kenya, three-pad collar harness has been developed, and comprises two wooden hames, hinged by leather straps at the top and joined by a leather strap at the bottom. The hames are shaped to match the contours of the animal. The shoulders are protected from direct contact with the hames by

two pads, made of canvas and stuffed with cattle tail hair, recovered from butcheries. The third pad is made of leather and is attached to the lower of the two top straps, which rests on the withers. The load is passed by nylon traces from the hames to a swingle tree.

For pulling operations, a back and girth strap with trace holders are used to prevent entanglement of the traces and the donkeys' hind legs. Three-pad collar harnesses are expensive compared to harnesses discussed previously, because they are produced by artisans using good quality materials like hardwood, leather, and canvas.

4.5 Attaching many donkeys simultaneously to an implement

In order to use many donkeys simultaneously for an implement, *hitching* is done**.** As the donkey walks, its shoulders move backwards and forwards. To prevent rubbing the skin, the harness must be able to move in line with the shoulders.

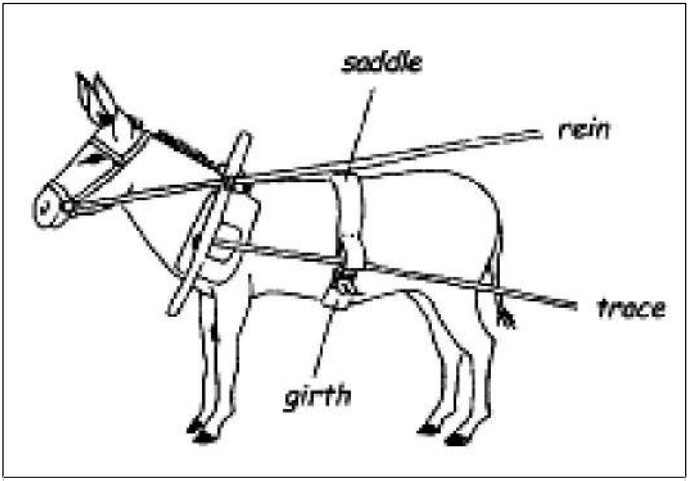


Figure 13: Harness for hitching

Ideally, the traces should be attached to a *swingle* or *swingle* tree and not directly to the implement. Linking two donkeys to a cart or implement requires the use of an *evener*. The implement is normally pulled from the center of the evener, but if one animal is stronger than the other, the trek chain should be attached closer to the side of the

stronger animal to compensate for the inequality in pulling force. If the traces are made from rope, notches should be filed in the wooden swingle tree so they cannot slip off (Figure 13).

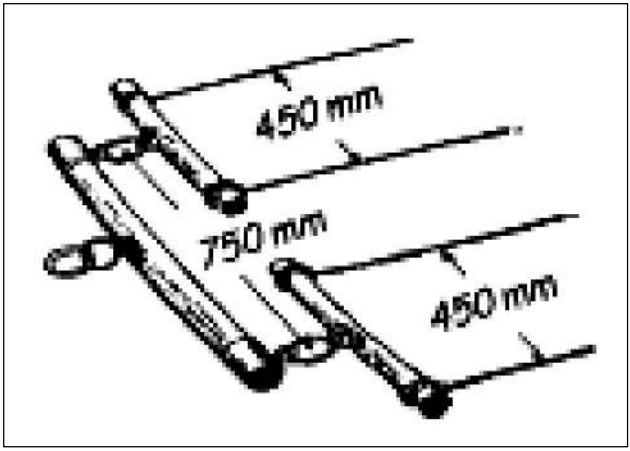


Figure 14: Three shafts to hitch two donkeys

The belly strap keeps the saddle in place, while connections between the saddle parts keep them together.

To hitch two donkeys to an implement, three shafts are used in the figure arrangement shown in figure 14. In a similar arrangement with four steel shafts, the vertical load comes on the back saddles and traction is taken through the collars or breast band harnesses. Commercial transporters, who use their cart and donkeys daily, should consider this option.

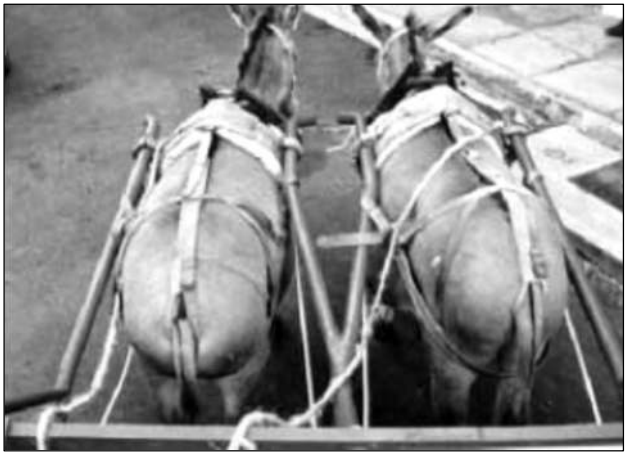


Figure 15: Parallel metal shafts to hitch two donkeys

Other hitching arrangements for teams of two or more donkeys involve

alternative hitching for teams of two, three and four donkeys with collar harness pulling implements (Figure 15, 16, 17 & 18).

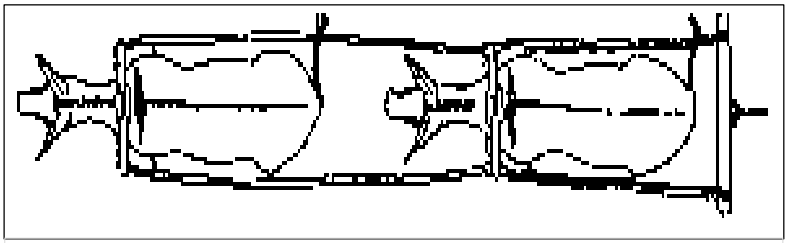


Figure 16: Hitching in tandem

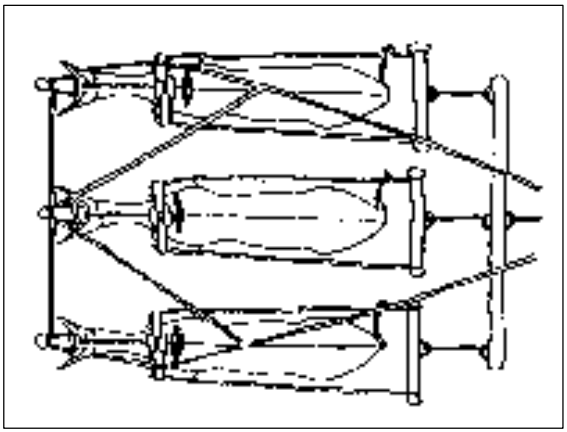


Figure 17: Hitching side by side

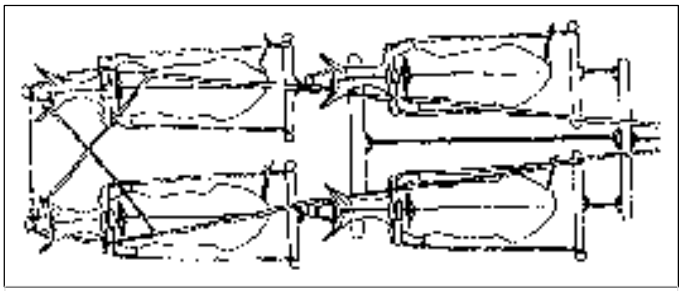


Figure 18: Hitching tandem pairs

Chapter 5

Training of Donkeys to Work with Implements

Training of donkeys to work with implements involves training them to understand instructions, to obey instructions and training of the driver to be able to use the donkey.

5.1 Training of the Donkey

Donkeys are trained to understand simple commands and to be able to act as commanded. Training is usually done in stages.

Stages in training: -

1. Catching the animal, placing a rope loop and leading it to walk; this is done for about 2 – 3 days.
2. Fitting the halter, and thereafter, the rest of the harness, and then directing it to walk; this is done for about 7 – 14 days.
3. Directing the donkey from behind to walk, stop, turn and reverse and to pull a log (about 20 kg); this is done for about 7 – 10 days.
4. Training the animal to work (to work alone or in a team); this is done for about 21 – 30 days.

Basic principles to be observed during training: -

- The trainer should be calm, patient and consistent.
- Follow training steps until full control of the animal is attained.
- Reward correct behavior of the animal with short rests, some food and nice kind voice.
- Durations of learning may vary with specific animals and experience of trainer.
- Water and feeds for the donkeys should be readily available at the training site.

- Each training session should be about 1 to 1½ hours and two sessions in a day.
- Watch out for any abnormal behaviors by the animals and act promptly.
- Each training stage should be successfully completed before moving to the next.

i). Training the donkey to walk

To catch the donkey, the trainer should approach the animal slowly, quietly and probably with some food, then introduce rope loop. The animal is then lead to walk forwards while the trainer holds the rope from behind. It can be whipped lightly with the free end of the rope when necessary.

Introduce voice commands of "stop" and "go" at this stage. If the animal does not stop on this command, the trainer should avoid being drugged along and holding the rope too hard to stop movement. The rope can be pulled lightly while commanding the animal to stop. Reward the animal on each successfully completed exercise.

ii). Training the donkey to obey instructions

This stage starts with further emphasis of first two voice commands "stop" and "go" that started in step i). Other voice commands are then introduced - "turn", "left", "right", "reverse". Commands should not be too many, up to about 7 are suitable. Other commands such as "lift leg", "go home", are introduced thereafter.

iii). Training the donkey to pull weight – log

This stage follows after the donkey has learnt to understand commands and is able to respond to commands. Training in this stage starts with getting the donkey to learn to be driven. A head halter is fitted, then the animal is given instructions while pulling the halter left, right, both backwards as well as full relaxation of the halter. Once it learns the halter control, it is fitted with

harness and a weight, usually log of wood is attached. The animal should learn to pull harness with the traces before the log is introduced. A log of about 10 kg is initially attached but as the animal gets accustomed, 20 kg log is introduced. It is important that the animal also gets used to sounds of log pulling on the ground. Figure 19 shows a donkey being trained to pull a log.

Figure 19: Using a log to train a donkey to pull weights

iv). Training the donkey to plough on straight line and to harrow

The animal is led to the furrow (furrow is prepared in advance using a trained animal) at the field. The plough is the fitted and the animals lead to pull it alongside the furrow (Figure 20). Initially the plough is held at a shallow depth as the animal pulls until it gets

Figure 20: Training a donkey to plough on straight line

accustomed to sounds of plough dragging on ground. Thereafter, the soil depth is increased gradually. Towards the end of this stage, the donkey is no longer lead by an assistant so that it only follows commands of the person walking from behind. The donkey should learn to use the previous furrow as reference for where to follow and to move in straight line.

To harrow, the donkey is lead on a ploughed field and the command go straight ahead is introduced. The donkey should move in a straight line without having to follow a furrow.

v). Training the donkey to work in pairs, as a team

In cases in which the donkey will be required to work in pairs, it is necessary to train them to work together, to be able to accept each other, to be able to walk together and to be able to walk at similar speed without being slower or faster than the other. This is achieved by holding the donkeys together in a crush for about 4 days. Figure 21 is a crush made from locally available poles.

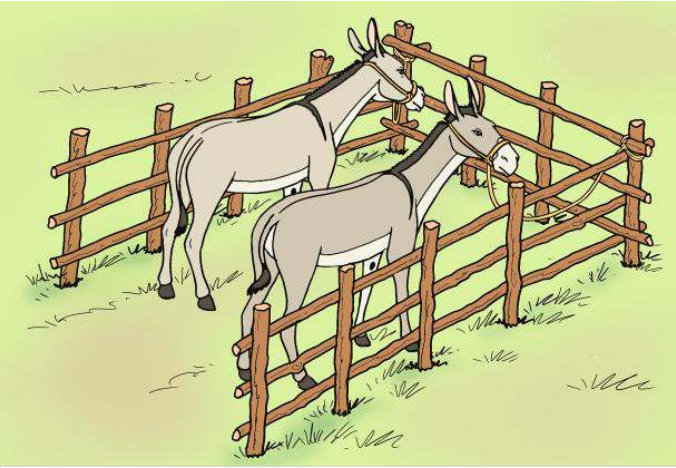


Figure 21: Simple crush for two donkeys

They are fitted with breast band or collar harness and tied to a fence for a few hours at a time for several days, on the same side, and this position that is later maintained when working in the field. Once the pair is familiar with each other, they are led together from the stock with the harness fitted for training. Training involves a select area with

enough space and the animals are hitched to a 20 - 40 kg log, and a helper leads the animals, the trainer uses voice commands to direct them from behind. After a couple of days pulling the log along the ground, the pair should be introduced to working in a furrow.

5.2 Training of the Driver

Drivers for draught power donkey are usually trained together with the donkeys (Figure 22). Learning points for the driver are: -

i). Selection of donkey for draught power
ii). Instruction commands used for draught donkey power
iii). Techniques for ploughing
iv). How to prepare a halter
v). How to fix harness and implements
vi). Care of the donkey – Feeding, Health care, shelter, working ethics.

Other learning objectives that may be included are: -

i). Types of donkey drought power
ii). Donkey breeding
iii). Business skills in donkey draught power.

Figure 22: Training of drivers of draught donkeys

Chapter 6

Use of Donkeys for Tillage - Ploughing, Harrowing, Planting and Weeding

6.1 Farming Systems, and Seasonality in South Sudan

South Sudan has over 80% of the country's territory under climatic conditions that are considered suitable for agriculture. However, most of the land that is suitable for agriculture is still under natural vegetation. Land that is currently under crop cultivation, most of which are rain-fed, accounts for less than 4 percent of total land. The largest part of the country is still under trees and shrubs (62.6%).

Before South Sudan became an independent country, crop areas in Sudan as a whole accounted for 7% of total land. Given that the agro-climate conditions are less favorable in the northern Sudan than that in South Sudan, it is obvious that South Sudan is significantly underdeveloped in agricultural production. While the large land areas under natural vegetation definitely indicate huge agricultural potential in the country, the challenges to develop them into agricultural land, including required large physical investments and difficulty in identifying suitable farming systems and crop patterns are huge.

The extent and distribution of land use types at both state and livelihood zone levels show that Western Flood Plains, which covers parts of Northern Bahr el Ghazal, Warrap, Unity and Lakes, is the most important livelihood zone, providing 34.2% of national cropland and 24.2% of national cropland mixed with grass and trees. Moreover, this zone has the highest ratio of cropland over total land, as cropland and cropland mixed with grasses/trees account for 8.5 and 5.4% of zonal territorial area, respectively. Greenbelt (spanning parts of Western Equatoria and Central Equatoria) and Eastern Flood Plains (encompassing Upper Nile and parts of Jonglei) are the two other major crop producing regions, accounting for respectively, 17.6% and 26.2% of national cropland, and 25.7% and 14.6% of the country's land mixed crops with grasses/trees. Both zones also have high ratio of cropland to total

land as lands with crops and crops mixed with grasses/trees account for 11.4% of total land in Greenbelt and 6.8% of total land in Eastern Flood Plains. In total, these three agricultural zones provide 78% of national cropland and 64.6% of national cropland mixed with grass/tree, but only covers about 47% of national territorial area.

A variety of livestock are reared in South Sudan including cattle, donkeys, goats, sheep and poultry. Livestock is the main source of livelihood in many households in the country particularly in Jonglei, Greater Upper Nile, Eastern Equatoria and Bahr El Ghazal State where cattle are mainly reared. 80% of South Sudan population is engaged in agriculture, farming, livestock and fishing. The pastoral systems are economically viable but fragile as they manage a fragile environment. It is based on risk management; spatial management which needs to maintain mobility as best way to utilize resources; accumulation of capital only in livestock assets (increase the risk and diminish at the same time); and need to maintain a minimum herd size to face future risk and face social obligations.

Although draught animal power has been superseded by tractors on many of large commercial farms in Africa, it remains a relevant farm technology in small scale agriculture, mainly for economic and agro-ecological reasons. Use of animal power generally enables farmers to increase cultivated land area, hence, agricultural production and ultimately improve the quality of life.

6.2 Types of Donkey Ploughs

Two types of donkey plough are used in South Sudan (Figures 23 and 24). The South Sudan model is a modification of the Sudan type. Both of them function similarly. However, experience shows that the Sudan type is slightly more durable. Originally the Sudan type was only bought from traders who brought them from Sudan, but later on some are fabricated by artisan blacksmiths at local trading centers in South Sudan.

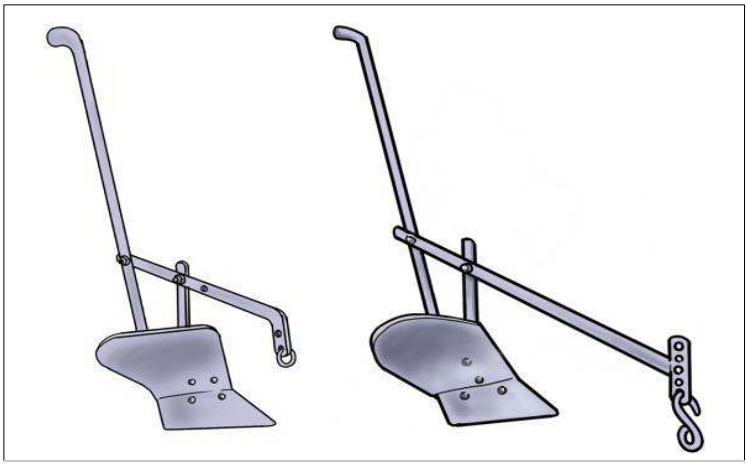


Figure 23: Donkey ploughs commonly used in South Sudan, left, and in Sudan, right

Figure 24: A man holding donkey plough commonly used in South Sudan

6.3 Structure and Parts (Accessories) of the Common Donkey Plough

The donkey plough is an assembly of different metal parts. There are about 10 parts (considering the chair as one part) in the donkey plough. Figure 25 shows various parts of the donkey plough.

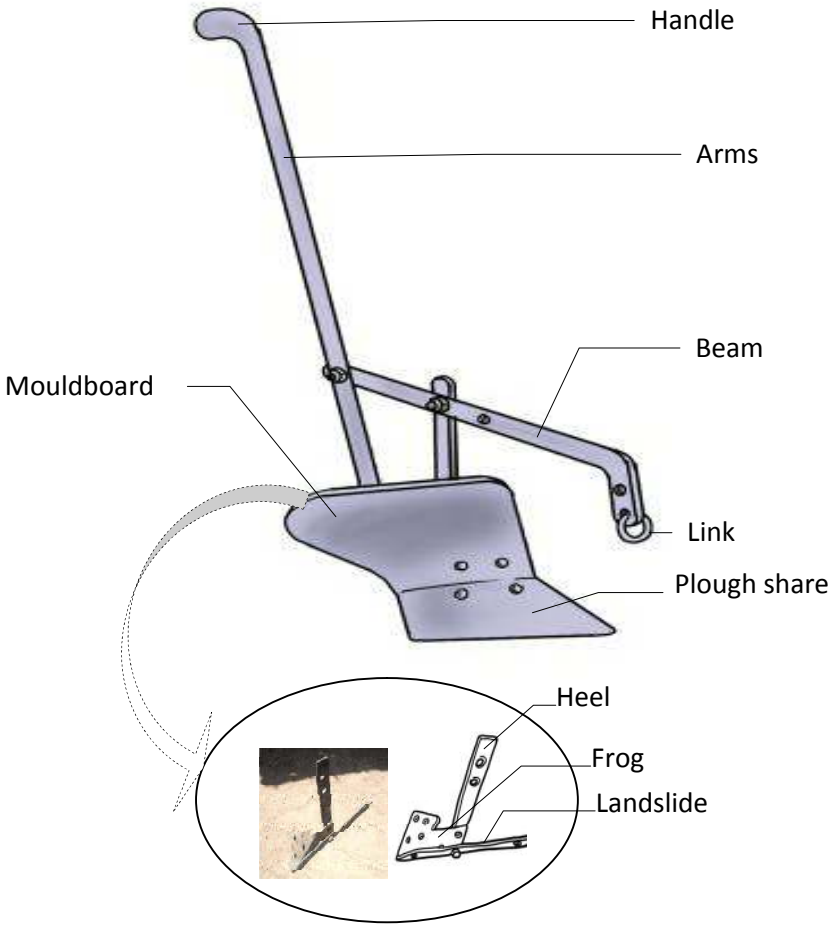


Figure 25: Parts of the donkey plough commonly used in South Sudan

6.4 Fabrication, Assembly, Maintenance and Repairs of Donkey Ploughs

The donkey plough can be assembled by blacksmiths operating in local trading centers. Although the parts can be fabricated from metal material purchased from hardware shops, materials of the required specifications are not readily available in such shops in local trading centers. Blacksmith artisans mainly use scrap metals that they buy from dealers of scrap metal, from motor vehicle workshops and from other individuals who may have waste scrap from their businesses. Local blacksmith artisans use simple tools and equipment to fabricate donkey plough. These include foundry forge, charcoal fire, anvil, hammers and tongs. Figure 26 is a picture of a black smith operating at Marial Baai in Lol state.

Figure 26: Blacksmiths at Marial Baai fabricating donkey plough

The plough share, bolts and nuts are the parts that require replacement most frequently. The bolts tend to unwind and disappear into ground during use. The bolts and nuts should regularly be checked for loosening and tightened. The donkey plough user should own appropriate tools for home maintenance and repairs of the plough. These include spanners and pliers of the correct sizes. It is advisable that the donkey plough user keeps necessary spare bolts,

nuts and washers at home or alone with him during long journeys for quick replacements when these get lost or worn out.

Figure 27: Donkey ploughs on display for sale at Marial Baai

6.5 Techniques in Tillage by Donkeys - Ploughing, Harrowing, Planting and Weeding

Techniques in tillage relate to the pattern used on the field, specific implement used and number of draught animals used.

6.5.1 Pattern of tillage

i). 'Inside-out' ploughing technique

Ploughing begins from the central point and expands gradually outward until either the area is complete or work can be stopped before resuming it another time.

ii). 'Outside-in' ploughing technique

With this technique, ploughing starts from outside (in a rectangle or circle) and moves toward the center until the marked area is completed.

iii). 'One-point incremental' ploughing technique

Ploughing starts from one point and then moves incrementally in a single direction until the area is completely ploughed.

iv). Ploughing across a slope - Contour ploughing

This pattern involves following the contours of the terrain. It is applicable in hilly areas with gentle slope. Contour ploughing is important to avoid soil erosion.

6.5.2 Type of cultivation and number of animals

i). Using a single donkey to plough

The pull capability of a single donkey is between 175 kg and 200 kg and a pull/weight ratio of 12 % to 14 %. To meet the draught target, the plough is made as light as possible and designed to work with an angle of pull up to

Figure 28: Using a single donkey to plough

about 35^{o}. A working width of 115 mm is chosen for the plough body to ensure a reasonable depth of work at the target draught. Design of the plough is such that it can be adjusted to run in a balanced condition with pull angles from 20^{o} to 35^{o}, thus ensuring that only the minimum of corrective action is needed by the operator to produce high quality work.

ii). Using a single donkey to plough and sow

Using the same principles as for i) above, the single donkey ploughing can be combined with sowing operation. Usually the second ploughing is done as harrowing, to get fine seedbed tilth. As plough furrow is created, the follower team member, usually one person, sows crop seeds at estimated within-row distance, behind the plough driver. During the return plough trip, the seed is covered by the new plough furrow wave, and the process is repeated until the designated plot of land is completely harrowed and sown.

iii). Using two donkeys to plough and sow

Two donkeys may be used consecutively in which one ploughs and prepares a furrow while the second, covers sowed furrow in a much similar process to ii) above. A second pair can follow the first pair in an inner lane.

The second method of using two donkeys to plough and sow is to attach both to single. Initially they should be made familiar with each other first through training.

i). Using two donkeys harnessed together

Using the techniques of harnessing and hitching, two donkeys can be paired for any tillage operation, be it ploughing, harrowing and/or weeding.

ii). Using many donkeys to plough

To use many donkeys to plough, two options may be applied. The first option involves harnessing and hitching processes, while the second option is to harness each separately and they follow each other.

Chapter 7

Welfare of Working Donkeys

7.1 Animal Freedoms

The welfare of any animal is determined according to its individual physical and emotional state. This applies to all animals including food animals as well as pets. Animal welfare involves everything that may affect the physical and emotional state of the animal, its ability to cope and its quality of life. The welfare of a sentient animal is grounded on rules summarized in **Five Domains (FD)** derived from the **Five Freedoms (FF)** and the framework the assessment of quality of life of the animals. The Five Domains are based on **nutrition**, **environment and health** and are categorized into *survival-related factors*, and behavior. Behavior is a situation-related factor, also described as *opportunity to express rewarding behavior*. The fifth domain is **mental state**, the outcome for the animal expressed in terms of negative and positive experiences and it is this domain that determines its welfare status.

The Five Freedoms

These state that farm animals in confinement should be allowed sufficient space to permit the following five minimal behaviors or activities, namely **to stand up, lie down, turn round, stretch their limbs and groom all parts of the body**. They are: -

- ***Freedom from thirst, hunger, and malnutrition* -** by ready access to a diet that maintains full health and vigor.
- ***Freedom from thermal and physical discomfort*** - by providing a suitable environment including shelter and a comfortable resting area.
- ***Freedom from pain, injury, and disease*** - by prevention or rapid diagnosis and treatment.
- ***Freedom from fear and distress*** - by providing sufficient space, proper facilities and the company of the animal's own kind.
- ***Freedom to express normal behavior*** - by ensuring conditions, which avoid mental suffering.

The Five Freedoms are a checklist by which to assess the strengths and weaknesses of animal husbandry systems.

7.2 Work Ethics on Donkeys

Work ethics embraces "promoting the welfare and status of donkeys through a culture of caring". Accordingly, the following ethical standards should be observed and enforced: All decisions and actions undertaken by the owner and/or user of a donkey shall: -

- Promote the welfare of all donkeys through good practice in the care and handling of donkeys, whether resident at their homes, in foster care, under rehabilitation guidance or where asked to advice.
- The owner and/or user shall at all times endeavor to be a center of excellence in terms of donkey care - caring for donkeys with passion and commitment. All actions carried out by our must aim to be impeccable and to the highest professional standards.
- Donkeys deserve respect and are worthy of the best quality attention, care and treatment. Donkeys carry a heavy burden of negative perceptions attributed to them by humans. The owner/ and or user of donkey shall at all times promote a positive perspective of donkeys, raising the status of donkeys so that they can be seen as worthy creatures with special qualities.
- The owner and or user of donkey shall not promote the exploitation of donkeys for human entertainment (such as rides or cart rides for entertainment).
- The owner and/or user shall use the donkey judiciously for work where it is essential for the survival of the owners and/or user, but at all times the well-being of the donkey is paramount.
- The better cared for, the better the donkey can work. This implies sufficient food, water, care, shelter, rest and correct harnessing.

Every donkey owner and/or user shall promote a culture of caring that extends from donkeys to all other animals as well as human beings.

7.3 Feeding of Donkeys

Working donkeys should be well fed. Balanced feeding should be ensured. Feed for donkeys should be balanced in energy, proteins, vitamins and mineral elements. Water should be provided regularly. Donkeys have evolved to live in a wide range of environment, including arid, mountainous, desert areas where feed is sparse and of poor quality. As a consequence, they are excellent at digesting very fibrous plants and can feed off woody shrubs and trees as well as grass. Every donkey should be adequately fed according to their body condition, age, underlying health issues, time of year and grazing availability.

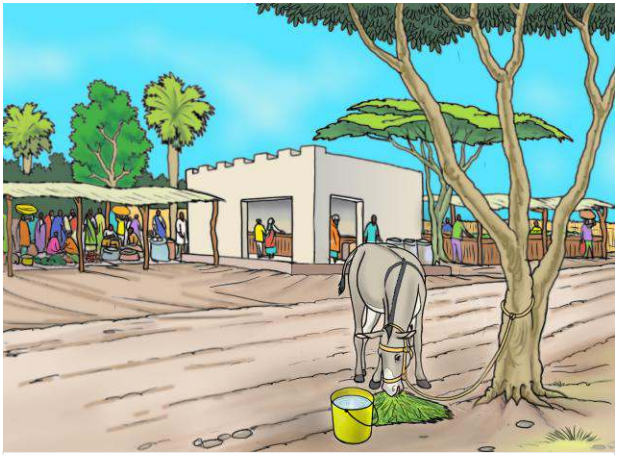


Figure 29: Balanced nutrition should be provided to the donkey

Inappropriate feeding can lead to emaciation and other health issues. Although feed requirements for work are generally low, the quality feed provided by handlers can be so poor that animals are unable to eat enough to meet energy needs for work, and so the animals lose weight during the work season. During work, periods of rests should be included for feeding and watering.

Basic rules on feeding donkeys

- Feed little and often, and keep feeding times regular.
- Any change in the feeding regime must always be carried out gradually, over two or three weeks.
- Always feed according to the donkeys' age, weight, and temperament.

- Avoid dusty or moldy feeds.
- Always have clean water available.
- Access to an equine salt or mineral lick is advisable.
- Always allow recently arrived donkeys time to settle down and fed as they were in their previous home. Only start the diet when donkeys have adapted to the new environment.

A healthy, fully-grown donkey requires 1.3% to 1.8% dry matter of their bodyweight per day. The 1.3% being for dry period maintenance while the 1.8% during wet season). Based on this, a healthy, 180 kg donkey would require between 2.3 kg and 3.2 kg of dry matter per day. Consider the specific needs of animals under five years or with poor teeth. During the wet season, donkeys require more than 25% to 50% of their forage by weight to be composed of hay/fibrous feeds. Pregnant or lactating donkeys should be provided with ad-lib hay or hay during the last third of pregnancy and the first three months of lactation.

Types of donkey feeds

a) Forage

Donkeys have a natural appetite for eating large quantities (1.3% - 1.8% bodyweight daily) of highly fibrous forages. During times of increased energy needs, such as working season, pregnancy, lactation or growth, hay or hay can replace up to 50% of their forage by weight. Always ensure that hay is of good quality and is not dusty or moldy. Forages include sorghum stover, maize stover and several types of grasses.

b) Grazing

Strict control must be kept of access to actively growing grass. Grazing with other species of livestock can be very effective. When grazing is not available, fibrous grass should always be provided.

c) Supplementation

A diet consisting of grass, straw and hay may be lacking in vital vitamins, minerals and proteins that a donkey needs. Addition of a multi-supplement donkey forage balancer ensures a balanced diet. Grains such as maize, sorghum, sesame and rice may be used as necessary. Balancers can be fed to donkeys from the age of three weeks.

d) Browsing

Donkeys enjoy access to shrubs and trees and will eat those plants that are safe. Enrichment of the environment with branches, twigs and logs from safe plants is recommended for all donkeys who have limited access to grazing.

Key Points

- Donkeys have different physical and psychological needs compared to other equines.
- Most donkeys should receive a diet of 75% (by weight) grass straw and 25% hay or hay, plus a vitamin and mineral balancer.
- Dieting should always be undertaken in a slow and controlled manner. Sudden and rapid weight loss can make a donkey seriously ill.

7.4 Health Care for Donkeys

7.4.1 Checking Health of Donkey

Donkeys generally do not show obvious or dramatic signs of illness or lameness until the problem is well advanced. Familiarity with routine health checks and the behavior of donkeys is the key to recognizing problems early. Changes in behavior and other should be monitored at least daily. Owners and handlers should monitor: -

- Behavior
- Appetite and thirst
- Faces and urine

- Eyes, nose, and resting respiration (breathing)
- Coat and skin
- Movement.

In case unusual behaviors are noticed, an animal health worker should be informed. In addition to the above, the animal health worker will check for other clinical signs and parameters such as temperature, gait and mucus membranes.

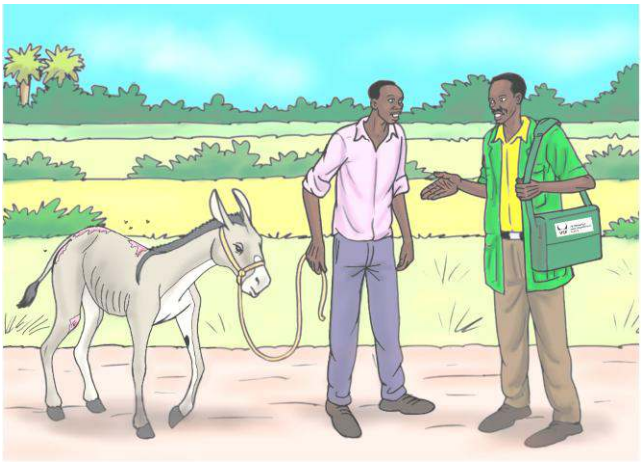


Figure 30: The animal health worker provide advice on the health of donkeys

7.4.2 Common Health Concerns for The Donkey

a) Colic

Colic is a symptom rather than a disease, and is defined as abdominal pain or constipation.

Signs of colic:

- Dullness
- Lack of appetite or refusing to eat
- Unusual repeated patterns of lying down and getting up
- Fast breathing and raised heart rate
- Excessive sweating

- Changed color of gums or inside eyelid (brick red color is a bad sign)
- Lack of or fewer than normal droppings
- Rolling and pawing at the ground (rare in donkeys but should be taken to indicate serious problem).

Treatment of colic:

- Treatment depends on cause.

Causes and prevention of colic:

There are many causes of colic, such as,

- Sudden changes to diet, poor quality feed, too much grass, feeding cereals
- Inadequate or dirty water supply and intake
- Eating non-food items such as plastic bags, rope and bedding
- Ingestion of poisonous plants, sandy soil
- Dental disease
- Worms
- Stomach ulcers.

Colic is potentially dangerous because, by the time it is noticed by signs, it might be too late to save the animal, thus, prevention is more important.

b) Respiratory diseases

Donkeys are very stoic (without emotions). It is easy to miss the signs of respiratory disease.

Causes:

- Infections
- Allergies

- Fibrosis
- Tumors
- Tracheal narrowing or tracheal collapse.

Signs:

- Nostrils flaring with each inspiration
- Excessive abdominal movements
- Outstretched neck or very noisy respiration
- Persistent coughing
- Nasal discharges - thick or thin
- Abnormal swellings, especially between the bones of the lower jaw and throat area. These could indicate swollen lymph glands as a result of infection
- Reduced appetite
- High temperature.

Treatment:

Treatment depends on the specific cause and condition of the animal. Advice of the animal health worker should be sought. Although most respiratory diseases are highly infectious, avoid separating the sick donkey from its companion as this may only worsen feelings of the donkey.

Reducing risk:

- Ensure good hygiene at donkey shelter and of handlers.
- Even if the donkeys never leave the paddock, they are still at risk because other equines might be in the vicinity and could spread infection.

- Influenza is zoonotic and handlers themselves may bring in infection.

c) Dental care

Donkeys evolved to roam over long distances in very arid climates across rugged terrain, in search of sparse and coarse grasses as well as other fibrous plant materials. Thus, in order to cope with long-duration feeding on highly abrasive matter, donkeys have developed teeth that are designed to wear constantly. As the chewing surface wears, the long crown hold in reserve, below the gum, erupts slowly towards the point at which the upper and lower teeth meet. Donkeys have a finite amount of tooth available, so as they age their teeth begin to literally wear out. It is important that the milk teeth or 'caps' are shed at the correct time. If they are retained they are likely to cause infection, pain and trauma. If they shed too soon, the underlying permanent tooth might not have had sufficient time to develop fully - even if the tooth looks normal, it will be at much greater risk of increased wear and dental cavities.

All donkeys should have their teeth regularly checked by an appropriate professional. It is important that they are checked soon after birth to identify any serious problems. From then on it is recommended that all donkeys are checked twice annually, as their teeth shed, erupt and wear at a rapid rate whilst young.

There is no need to wait until the donkeys' teeth are razor sharp or have the typical warning signs before being checked. Dental treatments are much more effective when carried out at regular intervals.

Signs of dental problems:

- Difficulty nipping at grass
- Difficulty chewing
- Dropping food out of mouth
- Excessive salivation
- Inability to eat or no desire to eat
- Strong-smelling mouth
- Food packing — retention of partly chewed food in cheeks pouches
- Whole grains or long fibre in the faces
- Nasal discharge; colic episodes
- Weight loss.

d) Common skin conditions

Skin conditions in donkeys include external parasites (flies, mange other midges), infections (fungal and bacterial infections), blisters, sun burn and other wounds.

Signs of skin conditions:

Include observable parasites, loss of hair, irritation leading to rubbing, sore areas, bleeding, attracting more insects and pus discharges.

Treatment and prevention:

- Depends on cause and level of involvement; Insect repellents, creams, sprays, healing oil, ointments, skin anti-inflammatory medicines.
- Regular use of insecticides such as acaricides and pour on.

- Antibiotics (Pencillin, Betamox, Pen-Strep); Injection can be applicable to prevent secondary bacterial infections, in cases of wounds. Antibiotic wound sprays can be applied on fresh and clean wounds.

e) Foot care

Donkeys are adapted to a dry environment and to thrive in semi-arid parts of the world, where the ground is dry and stony and where, for most of the year, the vegetation is of poor nutritional value and very fibrous. The feet of donkeys are more efficient at absorbing water: this is probably an adaptation to the dry environment in which they evolved. When donkeys are kept, on lush, wet pasture, their feet easily become soft and more crumbly. They quite frequently get foot diseases such as infection of the sole and frog (thrush); infected, penetrating wounds (abscesses); and seedy toe/white-line disease.

i) Laminitis

This is a cripplingly painful disease, often with irreversible consequences. There are several causes, including infection and pregnancy. Usually the end result is a destruction of the support structures of the toe bone within the hoof such that the toe bone can rotate or move downwards. It is a veterinary emergency. Feeding cereal based 'feed mixes' is a common cause of laminitis in donkeys.

Signs:

- Donkey is unwilling to walk
- Lying down more than usual
- Easily-felt pulses in the blood vessels around the fetlock.

Treatment and prevention:

- Provide enough rest to the animal.
- Provide easy access to food and water until animal health worker arrives.
- To avoid laminitis, restrict access to new or fast-growing grass pasture.
- Feeding with hay or straw prior to turning out might help reduce consumption of too much rich grass initially.

ii) Seedy Toe

All or part of the white-line area becomes weak and crumbly. Often little stones and dirt are stuck in the white line. Eventually it can extend quite far up the hoof, towards the coronary band. It is treated by cutting out the affected part of the hoof wall and allowing new, healthy horn to grow. The donkey must also be kept on clean and dry ground.

iii) Thrush

Thrush is an infection of the ground surface of the foot, particularly affecting the frog. It has a distinctive, unpleasant smell. It is often associated with keeping the donkey in wet conditions. Thrush is prevented by keeping the feet clean and dry as much as possible.

iv) Foot abscess (pus in the foot)

An abscess is usually the result of a wound that penetrates the sole or white line and becomes infected, with a build-up of pus. The wounds can be a cause of tetanus. Ensure that the donkeys are protected by vaccination.

f) Control of worms

It is necessary to de-worm donkeys regularly. However the use of chemical worming products forms only a part of effective worm control. Always consult the animal health worker about de-worming program according to season and other management factors.

Other disease conditions of concern among donkeys in South Sudan are rabies and anthrax. Rabies is usually associated with dog bites. Prevention should be through control in dogs and vaccination of donkeys when higher risks are anticipated.

Anthrax is likely to involve donkeys when there is outbreak among cattle. During vaccination of cattle, donkeys should also be vaccinated when risks are eminent.

7.5 Care of Older Donkeys

The natural lifespan of a donkey is slightly over 40 years of age. Some donkeys show signs of old age in early twenties. The average life expectancy of a donkey is just over 30 years. Any donkey over the age of 20 years should be cared for as an older donkey.

As donkeys ages their behavior change. The changes include loss of eyesight. Discoloration or changes to the eye or changes in vision behavior are early signs of failing eyesight. Donkeys generally cope well with blindness so, if they start to lose their sight, they need to be in familiar environments to live in and to go through consistent routines that they can predict. The use of padding on head collar, to prevent bumps and knocks as eyesight fades helps to cope with blindness.

It is important that the older donkey maintain a good quality of life. If suffering in unavoidable, the tough alternative of putting an older donkey to sleep or death have to be taken. Other recommended management practices are: -

- **Regular professional care:** Such care might include more regular visits to/by animal health worker; specialized feeding that takes into account medical conditions, to help them maintain condition and preventing undue weight loss.
- **The environment:** Provide suitable shelter away from rain or heat, as well as to avoid flies. Leave doors open to give them the choice of where they feel most comfortable. Access to a sunny spot will allow donkeys to sunbathe and warm any stiff joints or aching muscles when they wish. A flat or gently sloping field is best for older donkeys as it will help keep them mobile. Access to hard-standing is good for all donkeys' feet. Arthritis of the neck and spine, as well as arthritis of the limb joints, is not uncommon. Water and feed offered at the most appropriate height helps donkeys affected with arthritis. Raising or lowering feed and water buckets as required may be necessary.
- **Quality of life:** Donkeys are very stoical (without emotions) in nature and, as old age encroaches, painful conditions become common. Such conditions include arthritis, dental disease, foot problems, and compromised breathing. Serious illness can affect a donkey of any age and might seriously compromise quality of life such that **euthanasia** is the best and kindest option.

  The following points should be considered in assessing quality of life: -

  i) Is the donkey able to move around freely and comfortably, particularly when turned out?

  ii) Is the donkey being bullied by other animals in the herd?

iii) Is the donkey able to lie down and get up again unaided and without any difficulty?

iv) Is the donkey able to roll without any difficulty?

v) Is the donkey able to eat and chew comfortably and maintain a healthy body condition?

vi) Is the donkey displaying its normal behavior?

vii) Is the donkey generally healthy, or is it suffering from any conditions that are affecting its physical or mental wellbeing?

viii) Has the donkey's breathing deteriorated to the point where it is persistently uncomfortable?

ix) Does the donkey seem 'happy'?

Donkeys form strong bonds with their companions and it is essential that surviving donkeys are allowed to remain with the body of their friend until they have lost interest. Ignoring this advice can lead to significant distress and anxiety amongst surviving donkeys. They might show persistent wandering, pacing, and braying as they look for the missing donkey. Allow at least an hour before the body of the donkey is removed. Closely monitor the bereaved companion(s) for several weeks afterwards as bereavement stress can manifest itself up to three weeks after the death of a friend.

Bibliography

1. Abdelgadir A., 1996. Beyond the tarmac: donkey drawn carts in Omdurman. Intermediate Technology Sudan, PO Box 4172 Khartoum.
2. Abdul Rahman and Sarah Kahn, 2013. Discussion paper on the future role of the OIE with respect to the welfare of working animals. OIE.
3. Aganga A. A., Tsopito C. M. and Seabo D., 1994. Donkey power in rural transportation: a Botswana case study. Appropriate Technology Journal 21 (3): 32-33. Intermediate Technology Publications, London, UK.
4. Bill Forse, 1999. Where There is No Vet. Macmillan Education Ltd. London and Oxford.
5. Blench R. M., 1997. A history of donkeys, wild asses and mules in Africa. In Blench R. M. and MacDonald K. (eds): The origins and development of African livestock: archaeology, genetics, linguistics and ethnography. UCL Press, London, UK.
6. Croxton S., 1993. Animal traction in Action Aid RDA's: Kibwezi and Ikanga [Kenya]. Intermediate Technology Development Group, Myson House, Railway Terrace, Rugby CV21 3HT, UK.
7. Dijkman, J. T., 1992. A note on the influence of negative gradients on the energy expenditure of donkeys walking, carrying and pulling loads. *Animal Production*.
8. http://www.fao.org/livestock/agap/frg/Draught/contents.htm
9. Löffler C., 1994. Transfer of animal traction technology to farmers in the North Western Province of Zambia. pp 354- 359 in: Starkey P., Mwenya E. and Stares J. (eds), Improving animal traction technology. Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. 92-9081-127-7.
10. Löwe P., 1986. Animal powered systems: an alternative approach to agricultural mechanization. Vieweg, for German Appropriate Technology Exchange (GATE), GTZ, Eschborn, Germany. ISBN 3-528-02023-7.

11. Martha Geiger & Alice Hovorka, 2015. Donkeys in development: welfare assessments and knowledge mobilisation, Development in Practice, 25:8, 1091-1104, DOI: 10.1080/09614524.2015.1078776.

12. Paul Starkey, 1994. Donkey utilisation in sub-Saharan Africa: recent changes and apparent needs. Second International Colloquium on Working Equines Rabat, Morocco, April 20-22 1994.

13. Pearson, R. A. and Vall, E., 1998. Performance and management of draught animals in agriculture in sub-Saharan Africa: A review. Tropical Animal Health and Production, 30(5), 309-324.

14. Starkey P., 1992. Changes in animal traction in Africa and Asia: implications for development. In: den Hartog G. and van Huis J. A. (eds), The role of draught animals in rural development. Proceedings of an international seminar held 2-12 April 1990, Edinburgh, Scotland. Pudoc Scientific, Wageningen, The Netherlands.

15. Starkey P., 1994a. The transfer of animal traction technology: some lessons from Sierra Leone. In: Starkey P., Mwenya E. and Stares J. (eds), Improving animal traction technology. Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands.

16. Starkey P., 1994c. Donkey utilisation in sub-Saharan Africa: recent changes and apparent needs. In Bakkoury M. and Prentis R. A. (eds) Working quines. Proceedings of second international colloquium held 20-22 April 1994, Rabat, Morocco. Actes Editions, Institut Agronomique et Veterinaire Hassan ll, Rabat, Morocco. ISBN 9981-801-11-9.

17. Svendsen, Elisabeth D., (2008). The Professional Handbook of Donkeys (4th Edition). Yatesbury: Whittet Books.

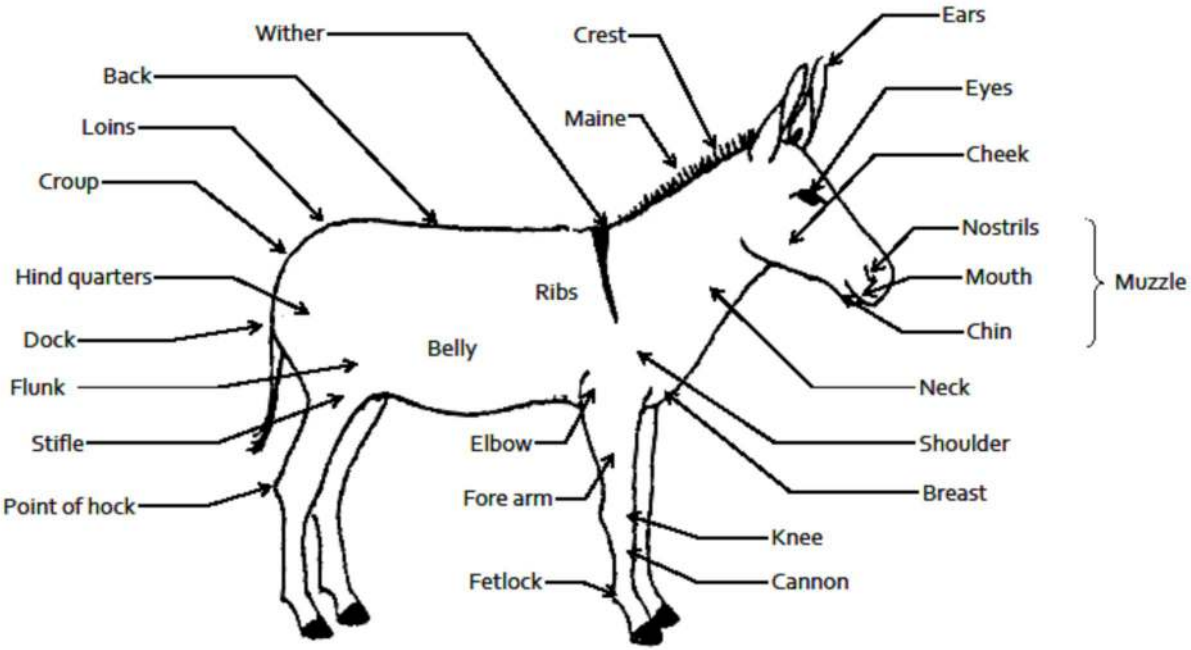
18. Veterinaires sans Frontieres Belgium, 2003. A training Manual for Animal Health Auxiliaries, Volume I and II. Veterinaires sans Frontieres Belgium, Nairobi, Kenya.

19. Veterinaires sans Frontieres Germany, 2004. An Illustrated Guide for Community Animal Health Workers (CAHWS). Veterinaires sans Frontieres Germany.

20. Vétérinaires sans Frontières Suisse, 2017. Baseline Survey Report: Equine Welfare and Health Conditions in Northern Bahr el Ghazal State, South Sudan.

21. World organization for animal health (OIE), 2016. Terrestial animal code. Welfare of working equids.

Annexes
Annex I: Parts of the Donkey



Annex II: Biological Figures about the Donkey

Age at puberty – 4 years

Age at maximum weight – 6 years

Average weight (mature) – 120 to 160 kgs (Africa)

Height at withers (mature) – 79 to 160 cm

Gestation period – 12 months (range is 11 to 14 months)

Work years – 12 to 15 years (In developed countries donkeys can live for 30 to 50 years)