Draft animal issues, constraints and opportunities in Africa

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Abstract

Most African smallholders rely on manual labour or draft animals. Tractorization works for large-scale farms but is economically and logistically problematic for smallholders. Draft cattle and pack donkeys were employed in ancient Egypt 5000 years ago, and pack donkeys have long been used in the Horn of Africa and the circum-Saharan countries. In Ethiopia, the traditional maresha ox plough has been used for millennia, and still is. Elsewhere in sub-Saharan Africa, animal traction was introduced in colonial times, with ox ploughs and carts in many areas and donkeys and horses in drier and highland zones. Cattle are multipurpose providing work, milk, meat, hides, manure and lobola payments. From 1950-2000, the range of donkeys expanded, and they were increasingly used for transport and tillage, partly as their theft risk was low. This changed from 2000, when Chinese demand for ejiao (donkey gelatine) affected donkey values. Equid transport is increasingly replaced by motorcycles and three-wheelers. Through many influences (films, media, urbanization, modernization), animal traction has negative, backward connotations. Despite this, it is widely used and persistent although declining in some areas with diminishing support services, few political champions and minimal support from development agencies. Experience from Namibia suggests many university students see draft animals as relevant, available, affordable and sustainable. They improve smallholder farmers' timeliness and workloads through environmentally-friendly tillage and transport. Animal traction in Africa needs champions, policy support, relevant investment, good media coverage and appropriate networking to ensure its development and continuity, with a critical mass of users and support services.

Résumé

La plupart des petits exploitants africains ont recours au travail manuel ou aux animaux de trait. La tractorisation fonctionne pour les grandes exploitations, mais elle est économiquement et logistiquement problématique pour les petits exploitants. Les bovins de trait et les ânes de bât étaient employés dans l'Égypte ancienne il y a 5000 ans, et les ânes de bât sont utilisés depuis longtemps dans la corne de l'Afrique et les pays circum-sahariens. En Éthiopie, la charrue bovine traditionnelle, la „maresha" est utilisée depuis des millénaires et l'est toujours actuellement. Ailleurs en Afrique subsaharienne, la traction animale a été introduite à l'époque coloniale, avec des charrues et des charrettes à bœufs dans de nombreuses régions et des ânes et des chevaux dans les zones plus sèches et les hauts plateaux. Les bovins sont polyvalents et fournissent du travail, du lait, de la viande, des peaux, du fumier et des paiements de lobola (dot payée sous forme de bétail). De 1950 à 2000, la gamme des ânes s'est étendue et ils ont été de plus en plus utilisés pour le transport et le travail du sol, en partie parce que le risque de vol était faible. Cela a changé à partir de 2000, lorsque la demande chinoise d'ejiao (gélatine d'âne) a affecté la valeur des ânes. Le transport par les équidés est de plus en plus remplacé par des motos et des trois roues. Par de nombreuses influences (films, médias, urbanisation, modernisation), la traction animale a des connotations négatives et arriérées. Malgré cela, elle est largement utilisée et persistante, bien qu'en déclin dans certaines régions, avec des services d'appui en baisse, peu de champions politiques et un soutien minimal des agences de développement. L'expérience de la Namibie suggère que de nombreux étudiants universitaires considèrent les animaux de trait comme pertinents, disponibles, abordables et durables. Ils améliorent la rapidité et la charge de travail des petits exploitants agricoles grâce à un travail du sol et un transport respectueux de l'environnement. La traction animale en Afrique a besoin de champions, de soutien politique, d'investissements pertinents, d'une bonne couverture médiatique et d'un réseau approprié pour assurer son développement et sa continuité, avec une masse critique d'utilisateurs et de services de soutien.

Kurzfassung

Die meisten afrikanischen Kleinbäuer:innen sind auf Handarbeit oder Zugtiere angewiesen. Die Verwendung von Traktoren funktioniert in Großbetrieben, ist aber für Kleinbäuer:innen wirtschaftlich und logistisch problematisch. Zugrinder und Packesel wurden bereits vor 5000 Jahren im Alten Ägypten eingesetzt, und Packesel werden seit langem am Horn von Afrika und in den Ländern südlich der Sahara verwendet. In Äthiopien wird der traditionelle Maresha-Ochsenpflug seit Jahrtausenden verwendet, und das ist auch heute noch so. In anderen afrikanischen Ländern südlich der Sahara wurde die tierische Zugkraft in der Kolonialzeit eingeführt, mit Ochsenpflügen und -karren in vielen Gebieten und Eseln und Pferden in trockeneren und hochgelegenen Regionen. Rinder sind vielseitig einsetzbar und liefern Arbeitskraft, Milch, Fleisch, Häute, Dung und Lobola-Zahlungen. Von 1950 bis 2000 wurde das Angebot an Eseln vergrößert, und sie wurden zunehmend für den Transport und die Bodenbearbeitung eingesetzt, zum Teil auch, weil ihr Diebstahlrisiko gering war. Dies änderte sich ab 2000, als die Chinesische Nachfrage nach Ejiao (Eselgelatine) den Wert der Esel beeinflusste. Der Transport auf Pferden wird zunehmend durch Motorräder und Dreiräder abgelöst. Durch viele Einflüsse (Filme, Medien, Verstädterung, Modernisierung) hat die tierische Antriebskraft einen negativen, rückständigen Beigeschmack. Trotzdem ist sie weit verbreitet und hält sich beharrlich, auch wenn sie in einigen Gebieten mit abnehmenden Unterstützungsdienstleistungen, wenigen politischen Verfechter:innen und minimaler Unterstützung durch Entwicklungsorganisationen rückläufig ist. Erfahrungen aus Namibia zeigen, dass viele Studierende Zugtiere jedoch als relevant, verfügbar, erschwinglich und nachhaltig ansehen. Durch umweltfreundliche Bodenbearbeitung und Beförderung verbessern sie den Zeit- und Arbeitsaufwand der Kleinbäuer:innen. Die Zugtierhaltung in Afrika braucht Fürsprecher:innen, politische Unterstützung, entsprechende Investitionen, eine gute Medienberichterstattung und eine angemessene Vernetzung, um ihre Entwicklung und Kontinuität zu sichern sowie eine kritische Masse an Nutzer:innen und Unterstützungsangeboten.

Resumen

La mayoría de los pequeños agricultores africanos dependen del trabajo manual o de los animales de tiro. Aunque la tractorización funciona en grandes explotaciones, continua siendo económica y logísticamente problemática para los pequeños agricultores. Ganado de tiro y burros de carga eran ya empleados en el antiguo Egipto hace 5.000 años, los burros de carga incluso son utilizados desde hace tiempo en los países del cuerno de África y los alrededores del Sahara. En Etiopía, el tradicional arado con bueyes maresha se ha utilizado durante milenios, y sigue utilizándose en la actualidad. En el resto del África subsahariana, la tracción animal se introdujo en la época colonial, en muchas zonas con arados de bueyes y carretas, en las zonas más secas y tierras altas con burros y caballos. El ganado es muy heterogéneo proporcionando trabajo, alimentos, pieles, estiércol y pagos de lobola. Entre 1950 y 2000, la cría de burros aumentó, utilizándose cada vez más para el transporte y la labranza, en parte porque el riesgo de su robo era escaso. Esto cambió a partir del año 2000, cuando la demanda china de ejiao (gelatina de burro) afectó al valor de los burros. El transporte de cargas con burros se sustituyó cada vez más por motocicletas y vehículos de tres ruedas. Debido a numerosas influencias (películas, medios de comunicación, urbanización, modernización), el transporte con animales tiene connotaciones peyorativas de atraso, de ser anticuado. Aunque su uso es extendido y persiste en muchas zonas, su utilización está disminuyendo, debido al escaso apoyo político y la mínima ayuda de las agencias de desarrollo. La experiencia de Namibia muestra que muchos universitarios consideran a los animales de tiro como relevantes, disponibles, asequibles y sostenibles, agilizan la producción de los pequeños agricultores gracias a una labranza y un transporte respetuosos con el medio ambiente. La tracción animal en África necesita defensores, apoyo político, inversiones relevantes, buena cobertura mediática y la creación de redes adecuadas para garantizar su desarrollo y continuidad, con un cuerpo extenso de usuarios y servicios de apoyo.

Introduction

This paper provides an overview of the past and present status of draft animals in Africa. It is based on observations, literature review, research studies and networking exchanges. There is a lack of recent data and statistics on draft animal ownership and trends within countries[1]. Two studies on animal traction in Africa have concentrated on francophone West Africa[2]. The most recent comprehensive overviews on draft animals in Africa have been provided by Starkey[3] with Blench[4] adding some additional information. Many reports published in recent years do not give a realistic perspective of the overall situation in Africa, as they have been based on small-scale projects relating to agricultural technologies or the promotion of animal welfare. These have tended to be optimistic to justify their funding and effort and do not generally portray the overall regional trends.

Historical perspective

Origins of draft animal power in Africa

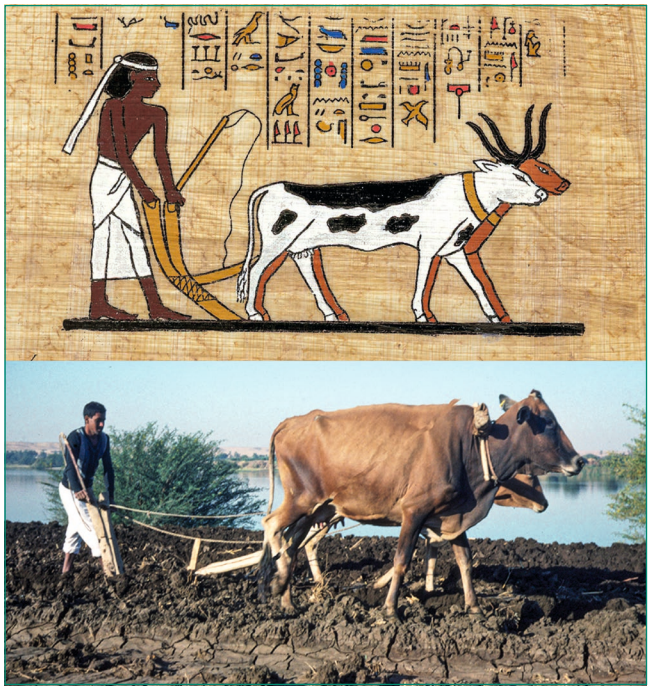

Figure 1 *– Replica papyrus illustration from an ancient Egyptian Book of the Dead showing cows ploughing (above) and modern use of very similar technologies, including use of cows (below)*

Animal power in Africa is recorded to have started about 6-5000 BP in Egypt with the first drawings of oxen and ard plows occurring in the III Dynasty[5]. These, together with the engravings of oxen and plows in early Mesopotamian civilisations, appear to constitute some of the earliest records of animal traction anywhere in the world. From Egypt and the Arabian Peninsula, draft animal technologies spread across North Africa and into Northeast Africa where they have been used for millennia[6]. In sub-Saharan Africa, pastoralists have also probably used cattle for pack transport for millennia. Transport animals such as horses, donkeys and camels spread through the Sahelian zone before the colonial era as did some milling technologies. Draft animals were systematically introduced into sub-Saharan Africa in colonial times, initially for transport around ports and subsequently for agriculture[7].

Draft animals in North Africa

The use of draft animal technologies spread from Egypt and the Middle East across North Africa, and animal power has been an integral part of farming and transportation systems for well over 2000 years[8]. A wide range of species and technologies are now used, with oxen, horses, mules, donkeys and camels used for transport, tillage, water-raising and milling[9]. Water buffaloes, of the dairy variety, were introduced to Egypt from Asia around 1300 years ago[10]. In addition to milk production some were (and still are) used to pull carts, turn irrigation equipment and sometimes pull a plough. Water buffaloes did not spread to sub-Saharan Africa and, despite efforts to promote them in the twentieth century[11], attempts to introduce them failed due to problems of heat tolerance (without standing water), susceptibility to trypanosomiasis and lack of relevant comparative advantages over cattle[12].

Figure 2 *– Imported water buffaloes ploughing in northern Senegal (top male, below female buffalo) – as with other water buffalo projects in sub-Saharan Africa, the trial was not a success*

Some of the technologies, particularly riding, pack transport and water-raising are likely to have been transmitted across the Sahara with the caravan trade. It is unclear whether the plough crossed the Sahara (although it

1 Starkey 2011; Blench 2015.
2 Le Thiec 1996; Lhoste et al. 2010.
3 Starkey 2000; Id. 2011.
4 Blench 2015.
5 Haudricourt/Delamarre 1955.
6 Starkey 2000; Blench 2015.
7 Starkey 2000.
8 Ibd.
9 Ibd; Id. 2011.
10 FAO 1977.
11 BOSTID 1981.
12 Starkey 1990.

Figure 3 *– Farmers in Ethiopia using pairs of oxen and the traditional maresha ard*

reached Sudan and Ethiopia millennia ago), but if it did, there appears to have been little or no uptake, which may be explained by the extensive nature of the predominant systems of shifting agricultural cultivation.

Draft animals in Ethiopia and the Horn of Africa

The *maresha* ard plough of Ethiopia is named after its blacksmith-made, spear-shape plough share[13]. It has been used in Ethiopia for several millennia, having been introduced either by Cushite-speaking peoples from Nubia (northeast Sudan) over 3000 years ago, or by Semitic-speaking peoples invading from South Arabia 2400-3000 years ago[14]. The use of the *maresha*, pulled by two oxen, is portrayed in illustrated manuscripts dating back many centuries. Similar implements are widely used today, despite many attempts over the years to introduce all-steel ploughs (which are heavier and more difficult to transport over the shoulder to the fields)[15].

Stationary applications of animal power in North and Northeast Africa and the Sahel

There are iconographic images in tomb-paintings, papyrus and bas-relief from Ancient Egypt of the use of animals for threshing, milling and irrigation. For millennia, such technologies have also been employed in North Africa, the Horn of Africa and in the Sahel. Threshing can simply involve animals trampling the harvested crop (as in current-day Ethiopia) but threshing sledges can be used and date back over 2000 years. Water raising from wells (or from rivers) is important to provide water for communities, for livestock and for crop irrigation. The simplest method of using leather bags, long ropes and an animal pulling (camel, horse, donkey or ox) has been used in circum-Sahara countries for millennia and is still used to this day in many countries. In Egypt, the traditional *sakia* wheels turned by a single animal have internal spirals, allowing them to efficiently raise water that is within two metres of the surface[16]. There is iconographic evidence that these were in use in Pharaonic times[17]. Their use continued into the twenty-first century, but they are now increasingly replaced by motorized pumps. This *sakia* technology does not appear to have spread far and this may be because it only works for irrigation in fields where the water table is very high.

Figure 4 *– Camel raising water from a well in Mauritania (Top left inset illustrates the depth of the well, the distance the pulling camel walks; Bottom right inset shows the leather bags and pulleys)*

Animal powered mills that extract oil are used in North Africa (including for olives) and are also found in countries stretching from Somalia to Chad where they may have been used for centuries[18]. Oilseeds such as sesame or groundnuts are placed in a large wooden mortar,

Figure 5 *– Single ox in Chad turning a pestle-and-mortar mill to extract seed oil (see photo inset) – the ancient technology had spread into Chad in pre-colonial times*

13 Goe 1987.
14 Ibd.
15 Ibd.; Starkey 1989.
16 Löwe 1986.
17 Stead 1986.
18 Starkey 2000.

carved out of the trunk of a large tree. A single animal walks around pulling a counter-balanced frame attached to a large wooden pestle. This grinds the seeds, extracting the oil. Very similar technologies are found in some countries around the Indian Ocean, including Yemen and Sri Lanka.

Introduction of draft animals in sub-Saharan Africa

In most sub-Saharan African countries (excluding Sudan, Ethiopia and the horn of Africa), animal traction for tillage and wheeled transport was introduced during the colonial period. However, before this time, in certain countries, horses, donkeys, camels and cattle had been used for riding and pack transport for centuries, if not millennia. There are historical observations from fifteenth century European seafarers concerning the Khoi-Khoi of South Africa. The Khoi-Khoi were pastoralists owning large herds of cattle, some of which they rode and used for pack transport. Some cattle had sharpened horns for offensive or defensive use in battles[19]. Certain pastoralist groups in the Sahel and East Africa currently ride cattle and use them as pack animals.

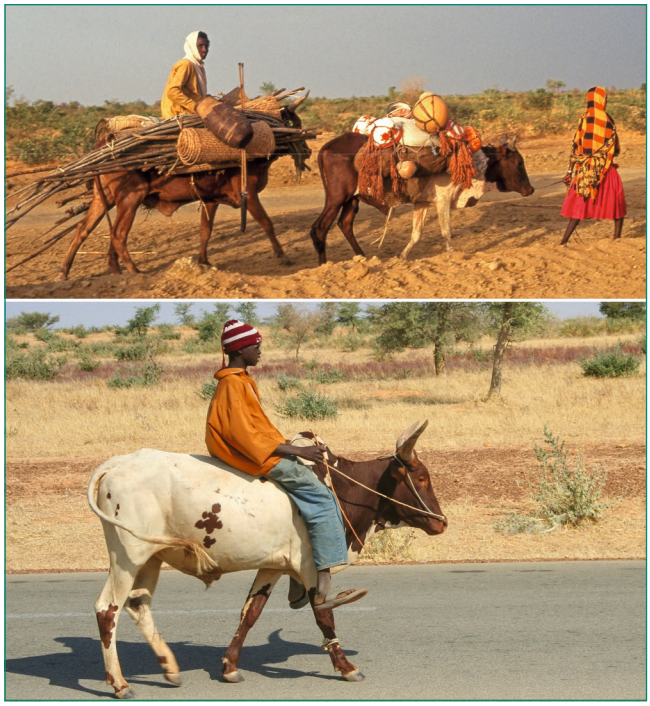

***Figure 6** – Top: Traditional pastoralists in Chad using cattle for riding and pack transport; Bottom: Modern continuation of the tradition of riding oxen in Niger*

In most sub-Saharan African countries, the use of draft animals started with animal-powered carts and wagons being used for transport operations around and beyond coastal and river ports in the seventeenth, eighteenth or nineteenth centuries[20]. In a few cases where social, economic and ecological conditions proved favourable, the use of animal-powered transport gradually spread from the coastal region, through the activities of traders, settlers, missionaries and the administering authorities. Animal-drawn cart technology spread inland in South Africa (and neighbouring territories), French West Africa (from Saint Louis) and in East Africa. In the South African Cape in 1657, white settlers were encouraged to use ploughs with teams of eight to twelve local oxen[21]. The settlers found that raising cattle and sheep and hunting were more profitable than crop production, and so the plough spread quite slowly through Southern Africa until the second half of the nineteenth century, by which time there were catalogues of available single and double mouldboard ploughs and other ox-drawn implements[22]. Also in the nineteenth century, some settlers and missionaries started to use ox-ploughs in several African countries, notably in East Africa and there was some transfer to the surrounding local farmers[23]. By the end of the nineteenth century, and in the early years of the twentieth century, draft animals played a crucial role in the agricultural, mining and transport sectors of the growing economy of South Africa and surrounding countries, and both large-scale and small-scale farmers used work animals for tillage and transport.

***Figure 7** – Team of eight Afrikander oxen pulling an example of a wagon that was used in the nineteenth century in South Africa*

Equids (horses, donkeys and mules) were used in Pharaonic Egypt and spread in the circum-Saharan coun-

***Figure 8** – Traders' wagons pulled by donkeys in Zimbabwe (then Rhodesia) in 1899*

19 Joubert 1995.
20 Law 1980.
21 Joubert 1995.
22 Ibd.
23 Starkey 2000.

tries for riding and pack transport. They were primarily used in arid, semi-arid or highland areas, due to health issues in the more humid areas. In East Africa, in pre-colonial days, donkeys were used by some pastoralists for pack transport. In South Africa, horses and donkeys were introduced to the Cape in the seventeenth century[24], and gradually spread to surrounding countries, with horses adopted for riding in Lesotho. By the end of the nineteenth century, donkeys were widely used for packing and cart transport on both large-scale and small-scale farms in Southern Africa, and large numbers of donkeys pulled wagons on trade routes, including in what is now Zimbabwe.

In several countries, attempts were made by settlers to domesticate wild indigenous animals for use as draft animals to avoid the health problems (such as African horse sickness) experienced by exotic animals. There were some short-term successes, for example, zebras pulled a stagecoach from Pietersburg into Botswana[25]. However, there was no sustained use of novel species.

Precisely when simple, wooden, triangular sledges started being used by smallholder farmers is not clear. Simple sledges (often made from V or Y shaped branches[26]) and some with basketwork superstructure are widely used for transport in Eastern and Southern Africa and Madagascar (but less so in West Africa)[27]. These were probably adopted after the start of the colonial period, as they are almost invariably pulled by one or two pairs of yoked oxen using a steel chain[28]. One example from north-eastern Zimbabwe appears to have been a farmer response to the banning of sledges by the colonial authorities (who feared that sledges accelerated erosion).

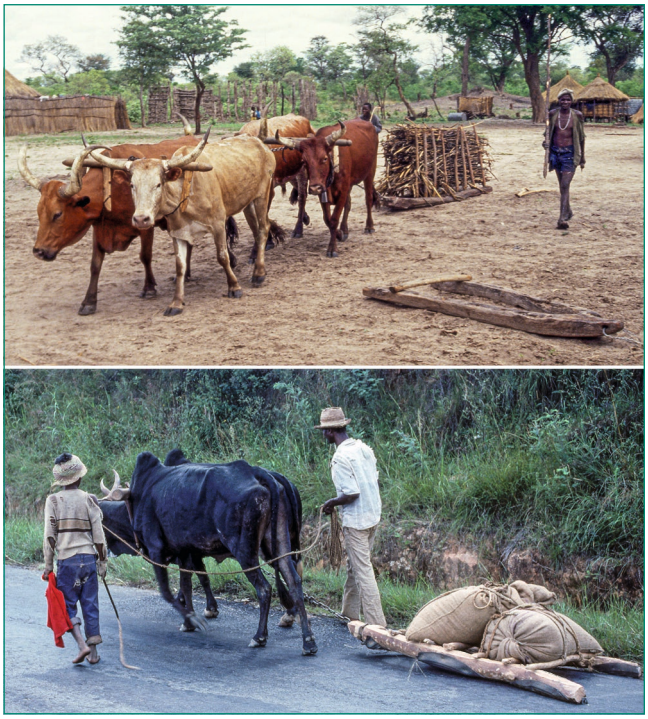

***Figure 9** – Ox-drawn sledges in Namibia (top) and Madagascar (bottom)*

24 Joubert 1995.
25 Ibd.
26 Müller 1986.
27 Starkey 2000.
28 Ibd.

Four-wheel, articulating carts were developed from Y-branch sledges using cross-sections of tree-trunks as wheels and simple wooden axles. Similar innovations have been seen in the Mbeya region of Tanzania.

By the start of the twentieth century, the use of animals for transport remained important for some pastoralists, and was becoming important for port cities, internal and international trade, and on the large-scale farms of settlers and some missionaries. However, the use of draft animals by smallholder farmers for soil tillage was minimal. This was partly due to the lack of promotion and that fact that most farming systems were based on shifting cultivation, meaning the soil remained full of woody roots, and so was difficult to plough. In Madagascar, cattle were used for rice cultivation by trampling and puddling the soil in paddy fields, a technique that is also seen in Indonesia which shares cultural and genetic traits with Malagasy people[29].

***Figure 10** – Cattle in Madagascar being used to puddle rice fields by trampling*

Promotion of draft animals in sub-Saharan Africa

Promotion of draft animals by colonial authorities

In the early twentieth century, some colonial authorities and companies growing export crops (cotton, groundnuts, rice) started to encourage local farmers to adopt the use of draft animals, notably oxen. In 1900, 1908 and 1913, farmers in three locations in German Togo were trained to use oxen to cultivate cotton, but uptake was not great[30]. Starting from 1914, small schemes were started in French Guinea and by 1929, 15,000 oxen had been trained[31]. The success of this reached neighbouring British Sierra Leone, and farmers were sent to Guinea to learn how to use oxen. The background and success of the Sierra Leone promotion was researched in the 1980s and it was found that farmers at that time not only remembered the training, but still used some French words to control their local N'Dama oxen[32]. Comparable schemes to promote the use of draft animals were carried out during the colonial period elsewhere in French West Africa (notably to increase the smallholder produc-

29 Ibd.
30 Westneat et al. 1988.
31 Bigot 1989.
32 Starkey 1981.

tion of the export crops of cotton and groundnuts in Senegal and Mali[33]), as well as in The Gambia, Kenya, Tanzania and Uganda[34]. By the 1950s, there had been modest take up of animal power by smallholder farmers in many countries in Africa, but still the majority of smallholder farmers used manual cultivation. The use of draft animals was mainly limited to transport and to ploughing (or ridging, notably in Nigeria), with some adoption of seeding and weeding technologies in Senegal and Mali. During the 50s, both the colonial authorities and the groundnut and cotton production companies were envisaging the increasing use of tractors, with tractor hire schemes to allow smallholders to benefit from tractorization.

***Figure 11** – Promotional exhibition and competition in Guinea demonstrating how to train N'Dama oxen to walk in rows to allow operational diversification to weeding with animal power*

Promotion of draft animals by authorities after independence

As most sub-Saharan African countries gained independence in the 60s, the national ministries and the export-orientated cotton and groundnut marketing authorities were hoping that there would be rapid modernization of smallholder farming through the use of mechanization. Smallholder tractor hire schemes were launched in most countries in sub-Saharan Africa, supported by donor agencies. However, none proved sustainable due to the highly seasonal nature of demand, the logistics of moving between different small farms and problems maintaining the tractors in remote rural areas. However, as one fleet of tractors died, another donor would support the drive to mechanization, so that in the yards of the agricultural mechanization authorities, graveyards of tractors developed, with identifiable strata with the particular colours and makes of the machines funded through the various donor agencies over the years. The sequential failures did not stop further tractorization initiatives, as these were popular with politicians and authorities, with photo opportunities with the new, modern tractors and, in some countries, possible benefits from the tractor contracts and the availability of subsidized tractors for the farms of the elites and their friends.

In the meantime, where implements and spares were available, animal traction was gradually spreading spontaneously, as farmers knew they could not rely on tractor mechanization at the time they would need it.

By the 70s and 80s, the problems of smallholder tractorization became more apparent, and so this became the heyday of donor-supported projects to promote and diversify the use of animal traction in sub-Saharan Africa. The idea of promoting draft animals was controversial, as politicians and urban elites often considered animal traction as backward and unworthy of promotion in independent countries striving for modernization. Nevertheless, it was national authorities that were responsible for the decisions to promote animal traction (although the offers of some donors at this time may have been explicitly to support smallholder farmer animal traction projects, rather than offers of funding with no conditions attached). In many countries, including Senegal, Mali, Burkina Faso, Niger, Togo, Guinea, Sierra Leone, Tanzania and Zambia, donor-support was provided to develop factories or workshops for the local production of animal-drawn implements and spare parts. In Francophone West Africa, the large increase in the use of draft animals was facilitated by parastatal crop export companies that provided credit and ensured implements (including seeders, weeders and carts) and spare parts were readily available[35]. In South Africa and Zimbabwe, the private sector had been producing ploughs for decades, and this continued, with some export orders to other African countries.

***Figure 12** – Stocks of Siscoma Houe Sine implements in Senegal*

The development of animal traction networks

In very many countries, projects were promoting the training of oxen (and in a few cases donkeys) and producing training manuals[36]. The West Africa Animal Traction Network was established to link the various francophone and anglophone initiatives. The network held four major international workshops (conducted in French and English), with published proceedings[37], and also promoted and facilitated study tour exchanges between different countries. The network did not itself receive funding, but its activities were funded by a range of donors and also supported by international research organisations and dissemination centres in Europe and USA. These included the International Livestock Centre for Africa (ILCA), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Centre d'Etudes et d'Expérimentation du Machinisme Agricole Tropical (CEEMAT), Centre for Tropical Veterinary Medicine (CTVM), Institut d'Elevage

33 Havard et al. 2009.
34 Starkey 2000.
35 Havard et al. 2009.
36 CEEMAT 1971; Watson 1982; AETC 1986; Jones 1991; FAO 1994.
37 Poats et al. 1986; Starkey/Ndiamé 1988; Starkey/Faye 1990; Lawrence et al. 1993.

et de Médecine Vétérinaire des Pays Tropicaux (IEVMT), Instituut voor Mechanisatie, Arbeid en Gebouwen (IMAG), Silsoe Research Institute, Technical Centre for Agricultural and Rural Cooperation (CTA), Tillers International and Howell Farm.

The success of the West Africa Animal Traction Network, led to the formation of the Animal Traction Network for Eastern and Southern Africa (ATNESA). This also held three large international workshops with published proceedings[38], and several thematic workshops relating to donkeys[39], weeding technologies[40], gender issues[41] and conservation tillage[42]. National networks were also established, notably in Kenya, Tanzania, Zimbabwe, Namibia and South Africa. The South African Network for Animal Traction (SANAT) hosted some international and national workshops and produced a newsletter and a variety of publications[43].

The availably of donor funding not only allowed national animal traction research and development projects to be funded, but also enabled researchers in international centres (notably ILCA and ICRISAT) and European centres (Silsoe, CEEMAT, IEVMT, IMAG, CTVM, University of East Anglia, etc.) to carry out research relating to animal traction in Africa, including agricultural implements, animal nutrition, animal health and socio-economic issues. Most, but not all, of this research was carried out in collaboration with local projects, universities and/or ministries. The international and national networks assisted the rapid diffusion of ideas and technologies, and enabled national researchers to publish their findings, so rewarding their work in what was considered by some of their colleagues to be a 'backward technology'. The CTVM's 'Draught Animal News' (also donor funded) also assisted networking and the rapid publication of local research findings[44].

Some of the research on implements at this time was decidedly 'top-down' in its approach, with engineers developing implements on research stations without sufficient regard to the realities of smallholder farming needs and constraints. The classic example was the development of animal-drawn wheeled toolcarriers that were 'perfected' on research stations in Senegal, The Gambia and Mali and strongly promoted with stories of great success as to how one versatile implement could replace a plough, harrow, seeder, weeder and cart. However, from early on they were rejected by farmers as too expensive, too heavy for their cattle, insufficiently manoeuvrable for their small farms and of high risk, as one problem could make all operations impossible. Farmers preferred a range of lighter implements and a separate cart. It is estimated that over 40 million US dollars were spent by various development agencies on promoting this technology to smallholder farmers, before it was quietly forgotten[45].

Despite a few failures, the overall result of the research-development and extension projects was a gradual uptake and diversification of draft animal power, which continued into the twenty-first century[46].

***Figure 13** – Wheeled toolcarrier fitted with a motorised grass cutter on a research station in Zambia*

The increasing range and importance of donkeys

One of lessons shared through networking was the increasing importance of donkeys. Most of the draft animal promotion in the 70s and 80s was focussed on the importance of oxen for tillage and transport, with little attention given to the use of donkeys. However, while oxen remained the main draft animals, farmers in semi-arid areas were increasingly choosing to use donkeys for cart transport and light tillage. Donkey populations were generally increasing in the semi-arid and highland zones of Africa[47]. This was partly due to deforestation, as farmers cleared more and more land, and a drier environment that reduced the health threats of tsetse flies and parasites. In West Africa, the rainfall isohyets run more or less east-west, and so does a 'donkey line' that during the past fifty years has been steadily moving southwards[48]. North of the line donkeys are common, while south of the line they are seldom seen, and around the line there are villages where farmers have just started to use donkeys. For example, in the 60s the 'donkey line' ran north of The Gambia and donkeys were rarely used and in the 70s a development project promoted oxen. However, by the 80s many farmers had switched to donkeys.

***Figure 14** – Woman in Burkina Faso using a donkey cart to transport firewood*

38 Starkey et al. 1994; Starkey/Kaumbutho 1999; Kaumbutho et al. 1999.
39 Pearson et al. 2003; Fielding/Pearson 1991; Fielding/Starkey 2004.
40 Starkey/Simalenga 1998.
41 Sylwander/Mpande 1992.
42 Kaumbutho/Simalenga 1999.
43 Joubert 2002; Simalenga/Joubert 2004; Simalenga et al. 2007.
44 CTVM 1983-2009.
45 Starkey 1988.
46 Lhoste et al. 2010.
47 Starkey/Starkey 2000.
48 Starkey 1994.

Figure 15 – Women weeding with donkeys in Tanga Region, Tanzania

Similar situations were occurring in Guinea Bissau, Guinea, Mali, Burkina Faso and elsewhere in West Africa[49]. Donkeys were also increasing their range in Eastern and Southern Africa, although the donkey lines were not so obvious. The adoption of donkeys for tillage as well as transport was related to their low price (at that time): they were cheap and so the risk of theft was low. They could be left to forage by themselves without fear that they would be stolen. In most countries, there was little demand for donkey meat, whereas a stolen oxen could be rapidly converted into anonymous and expensive meat. Historically, donkeys were considered low status animals, and were often the responsibility of women. As donkeys became increasingly common, women had greater access to draft animal power. While the increasing adoption of donkeys was initially farmer-led, the draft animal projects and networks in the 80s and 90s paid increasing attention to donkey welfare, harnessing and low-draft tillage implements[50].

Current status and trends in sub-Saharan Africa

The great majority of all farmers in Africa still rely on manual labour or draft animals. Estimates that this could be 80-90 % of farmers continue to be cited[51], but such figures may be outdated. The use of tractors is steadily increasing, but in most sub-Saharan African countries only a minority of farmers have timely access to tractors. In Ethiopia, the *maresha* plough is still widely used with oxen, as are pack donkeys. In the semi-arid regions of West Africa, Central Africa, East and Southern Africa use of cattle and donkeys has become part of smallholder farming systems.

Cattle remain multipurpose animals, kept for milk, meat, hide, manure, the paying of lobola and for tillage and transport. Draft animals can also relieve the burden of women by contributing to the transport of water, wood, fertilizer, manure, seeds, tillage implements and produce, which would otherwise be head-loaded by women, reducing their availability for other tasks. During the twentieth century, draft cattle were used mainly for mouldboard ploughing and cart transport. However, the impact of the development projects in the final decades of that century led to a diversification, with more farmers using draft animals for tine tillage and seeding (particularly in Sahelian countries[52]), weeding and conservation tillage[53]. This was made possible by the availability of appropriate implements, spares and, in some cases, credit. The labour-saving and environmental benefits of animal power are likely to see continued diversification, provided the implements and spares remain available. In Tanzania, small-scale cotton farmers rely on rainfed production, use limited inputs, and plant the cotton crop by hand hoes and animal traction[54]. In South Africa, animal traction continues to be a major part of smallholder farming[55]. While there is likely to be a gradual increase in the use of tractor power for primary cultivation, there is little sign that tractor use is diversifying much. Therefore, operations such as seeding and weeding will continue to be carried out using hand or animal power. Whether or not farmers will continue to train and maintain draft animals only for secondary operations and transport will depend on many factors, including supply chains, support services and the prevailing environment of policies and attitudes.

Cattle are largely absent from the humid forest zones and equids do not thrive in such conditions, so that draft animals are rare. However, animal power for transport and tillage is gradually increasing at the margins, where

49 Ibd.
50 Fielding/Pearson, 1991; Le Thiec 1996; Hagmann 1998; Pearson et al. 2003; Fielding/Starkey 2004.
51 Daum 2020.
52 Lhoste et al. 2010.
53 Starkey 2011.
54 USDA 2020.
55 Manzana 2014; Zantsi/Bester 2019.

deforestation is creating savannah ecosystems, for example in parts of the Democratic Republic of Congo.

Light horses are mainly used for transport in highland plateau areas such as Ethiopia and Lesotho, temperate/sub-tropical areas (North Africa and South Africa) and the Sahelian region. Their continued use is being affected by the availability of motorcycles and three-wheelers and is declining in Ethiopia. The use of horses for peri-urban cart transport in Ethiopia and South Africa is also declining, partly due to regulatory requirements and enforcement.

In Kenya, it is estimated that 1.3 million donkeys are still widely used for transport and some tillage, while in Burkina Faso, the use of donkeys for transport and tillage also continues to have major socio-economic benefits for society[56]. KENDAT (a Kenyan NGO: the Kenya Network for Dissemination of Agricultural Technologies, formerly the Kenya Network for Draught Animal Technology) highlighted that the donkeys were critical to Kenyan households as a transport mode. One lady empowered by KENDAT reported that the donkey income had enabled her family to educate their children with ease. Because of the success of her donkey enterprise, she had also bought a parcel of land on which she planned to construct semi-permanent rental houses[57].

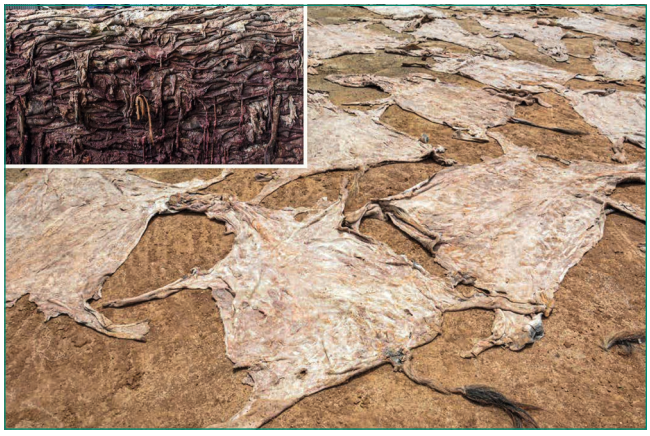

Figure 16 *– Drying donkey skins in Kenya destined for the ejiao market. Inset: warehouse with large stocks of donkey skins for export to China*

It has already been noted that the donkey population in Africa increased between 1950 and 2000, but since then their numbers have crashed due to their sale and slaughter for their skins. *Ejiao* is a traditional Chinese medicine made from donkey gelatine obtained by boiling donkey hides and has been used by Chinese people for more than 2,500 years. From 2000, Chinese demand for *ejiao* led to Chinese traders buying donkey hides in many African countries, and in some cases working with partners to establish slaughterhouses specifically for donkeys[58]. This led to greatly increased donkey values and led to a decimation of some donkey populations[59]. The high value of donkeys led to a rapid increase in donkey thefts. In some cases, men who learned of their high value, sold donkeys to traders, even though the donkeys were in regular use for transport by female family members. By 2019, fourteen African governments, including most Sahelian countries, had closed donkey slaughterhouses and/or banned the export of donkey skins, according to the UK-based animal welfare group the Donkey Sanctuary[60].

Challenges

Motorized transport

Cars and lorries have largely replaced long-distance transport of goods and humans using animals, although there are still some traders using camel trains in Ethiopia. Equid transport is increasingly replaced by motorcycles and three-wheelers in countries such as Ethiopia, Kenya, Nigeria and Uganda. Nevertheless, while motorized transport has increased greatly in the past 30 years, the use of animal power for local transport has not experienced a proportionate decline. Ox carts and donkey carts are still widely used for local transport, as are pack donkeys.

Figure 17 *– Motorised three-wheeler and donkeys travelling to market in Tanzania: there is a tendency to use motorcycles and three-wheelers instead of donkeys*

Tractors

Governments, donor agencies and people aspire to modern, tractor farming. Tractorization is economically viable for large-scale farms but is economically and logistically problematic for smallholder, rain-fed systems[61]. Two-wheel tractors or power tillers are widely used in Asian countries, primarily for irrigated rice cultivation, but also for tillage of rain-fed crops, farm transport and post-harvest operations[62]. Since the 1960s, there have been numerous attempts to promote two-wheel and other small-scale tractors, with many innovative designs as well as the importation of proven Asian technologies[63]. However, while there has been some adoption (primarily for transport and swamp rice production), small-scale tractors have yet to become a major part of smallholder farming in sub-Saharan Africa. Despite huge investment and subsidies for smallholder mechanization in the past 50 years, there are few examples of sustainable, unsubsidized smallholder tractor expansion in sub-Saharan

56 Mwita 2020; Brooke 2019; Id. 2020.
57 Mwita 2020.
58 Cheng 2018; Donkey Sanctuary 2019.
59 Star 2018.
60 Donkey Sanctuary 2019.
61 Starkey 2011.
62 Justice et al. 2016.
63 Holtkamp 1990; Grain de sel 2009; Daum/Birner 2020.

Africa entirely managed by the private sector[64]. This is in total contrast to animal traction, and to transport technologies such as motorcycles, three-wheelers, cars and minibuses.

Some researchers in Namibia cited two important lessons for smallholder farmers, based on a comparison of different draft power sources[65].

- For a large field (e.g. 10 ha and above), it is convenient and economical to use a tractor because of the amount of effort and time required if other power sources are used.
- For a typical, average-sized field (e.g. around 2 ha) it is economic and convenient to use draft animals, since they are affordable and fast enough to carry out the operations in good time.

Figure 18 shows one disadvantage of using a tractor-drawn disc harrow. The operation shows a cloud of dust from using the tractor disc harrow and this is detrimental to the environment and the operators.

Figure 18 *– Tractor harrowing in Namibia, showing dust cloud*

Draft animal use is almost entirely private sector, sustainable and unsubsidized. Yet governments, donor agencies and people want to see smallholder tractorization, and the authorities are often willing to subsidise this. There is likely to be a continued expansion of the use of tractor power for primary land preparation, but in the coming decade much of semi-arid West Africa, Ethiopia and the Eastern and Southern African regions will continue to be cultivated using hand and animal power[66].

In semi-arid areas, a delay of even one day in cultivation, weeding or planting after rain has fallen can reduce yields. Research conducted in Zimbabwe found that 5-10 % of cereal potential grain yield is lost for every week of delay in planting[67]. This is very important in semi-arid areas like Namibia and the Sahel, where the time of planting after the first rains is critical. In theory, greater timeliness can come from tractors, but in practice when it comes to tractor-hire tillage services this is only true for the first in the tractor queue. In contrast, when many smallholder farmers own animals, they can all plough their fields at the same optimum time, and this is still widely seen in Africa[68]. Assuming that everything else goes well, then farmers can expect good yields.

64 Starkey 2011; Mrema 2011.
65 Chigariro et al. 2008.
66 Starkey 2011.
67 Nyagumbo 2008.
68 Starkey 2011.

Draft animals and tractors are not necessarily alternatives: there can be systems where the different power sources complement each other, so benefiting from the comparative advantages of both power sources. Studies conducted in Namibia suggested that where possible and needed for land preparation, farmers should use tractor-drawn ripper furrowers to achieve maximum depths and widths, and then use animal-drawn ripper furrowers in subsequent years. This study also showed that in order to break the plough pan, for the first year a tractor ripper can be used and then in subsequent years animals can be used[69].

Image

A major constraint for animal traction is the negative connotation as people, particularly politicians and urban elites, view draft animals as backward. Through many influences such as films, media, urbanization and modernization, animal traction has negative, backward associations and the idea that the promotion of draft animals is a 'U-turn back to the stone age'. In South Africa for example the spread of modern mechanical power led to many perceiving animal power as backwards, irrelevant and less important. Despite the negative perceptions and neglect of animal traction, draft animals persist in smallholder farming systems and remain important to some farmers[70].

Animal welfare and care

Most working animals are well looked after and treated with respect by their owners. Nevertheless, there are examples of poor animal welfare and this can be a problem for the animals themselves, and for the image of draft animal power. Draft animals may work long hours in some situations. The welfare of transport equids can be particularly problematic, with heavy loads and poor harnessing systems. The problem can be particularly difficult for horses pulling carts and wagons if inappropriate harnessing systems are used, due to lack of understanding by operators and/or the lack of good quality harnesses that are affordable to the transporters who are probably struggling to make a livelihood. ***Figure 19*** shows an example of such problems.

Figure 19 *– Examples of harness sores from horse pulling a passenger 'gary' in Ethiopia (left) and a donkey pulling a freight cart in Senegal (right)*

69 Mudamburi 2016.
70 Zantsi/Bester 2019.

In most of the world, farmers use yokes for cattle and harnesses for equids. In Namibia and Zimbabwe, it is not uncommon for farmers to use yokes with donkeys, and yokes are more likely to cause problems than well-fitted harnesses[71]. ***Figure 20*** shows yokes on donkeys in Namibia.

Figure 20 *– Four donkeys, harnessed in pairs with yokes, pulling a donkey cart in Namibia*

Animal welfare organisations can be influential. The international ones tend to concentrate on the protection of equids, and tend to ignore working cattle. Some organisations have been promoting the appropriate use of working equids, including promoting the availability of good, low-cost harnesses[72]. Several national and international organisations have been campaigning against the trade in donkey skins[73]. However, some animal rights campaigners believe no animals should be used for work. Some animal welfare organisations encourage crackdowns against draft animal usage (such as tourist carriages), despite the socio-economic importance for their owners[74].

Institutional neglect

As has been noted, during the last three decades of the twentieth century, there were projects researching and promoting animal power in most sub-Saharan African countries. These were often funding by multilateral or bilateral aid agencies and technically supported, or influenced, by technical teams working in international research centres, United Nations agencies and several research centres and universities in Europe. In 2022, there is a totally different situation. There are very few projects or ministries promoting draft animals, and very few researchers in the world actively engaged with animal traction issues. In most countries, there is minimal support for draft animals from governments, political leaders and development agencies.

Problem of costs, theft and supplies

As the value of animals has increased, draft animals have become less affordable and more prone to theft. Stolen cattle can be quickly converted to meat and stolen donkeys can be stripped of their valuable hides, and better roads and easier access to transport, including motorcycles, make it easier to quickly remove and sell stolen animals, meat and hides. The high cost of animals and the risk of theft are now major constraints to farmers.

In the first half of the twentieth century, animal power was widely used by large and small farmers in South Africa, Zimbabwe and some neighbouring countries, and there were good commercial sector supply chains for implements and spares and the services needed to support the use of draft animals (blacksmiths, cart makers, farriers). In many other sub-Saharan African countries, during the later decades of the century projects supported the establishment of implement and cart workshops and the development of appropriate support services, including credit facilities. This created a critical mass of demand, and allowed the suppliers and support services to thrive, so facilitating a virtuous spiral of increasing adoption and the availability of services. However, as animal traction declines (due to tractorization, image, theft or other factors) fewer traders continue to stock draft animal implements and spares and fewer local artisans specialize in supporting the use of draft animals. A vicious circle or downwards spiral develops, where it becomes increasingly difficult for farmers to continue using draft animals, and for artisans or workshops to survive through animal traction. Many implement workshops started in the twentieth century have closed down or switched to more profitable products such as security bars, for which the market is growing.

Opportunities

Environmental issues and climate change

Draft animals are a renewable, ecologically sustainable resource that can improve resilience to climate change. With governments and donor agencies increasingly investing in ways to mitigate the effects of climate change, draft animals can contribute to rural resilience, the sustainable management of agricultural land, forests and environmentally sensitive zones and help to preserve biodiversity areas. With climate change increasing droughts and making feed resources less predictable, donkeys that require less grazing and water offer an alternative to oxen, provided the market distortion provided by the donkey skin trade is contained.

Conservation tillage and sustainable agriculture

Conservation tillage is environmentally friendly, with minimal soil disturbance, reduction in soil erosion, increased soil fertility, increased soil moisture and reduction in soil compaction. Conservation tillage helps reduce costs of production, saves time, increases yield through timelier planting, reduces diseases and pests through stimulation of biological diversity and reduces greenhouse gas emissions[75].

Conservation tillage can be beneficial using both tractor power, animal power or a combination of both. For smallholder farmers, it can be advantageous to move from hand labour to draft animals as this allows larger cultivation areas thereby increasing overall yields and incomes. Compared to hand labour, conservation tillage with draft animals can be economical and labour-sav-

71 Mudamburi/Keib 2007.
72 Pearson et al. 2003; Garrett undated.
73 Donkey Sanctuary 2018; Brooke 2019; Network for animals 2020.
74 World Animal Foundation 2021.
75 Hobbs 2006.

ing, which is important in view of the labour constrains caused by the HIV/AIDS prevalence.

Whilst using draft animals for conventional tillage can be slow, conservation tillage allows faster land preparation for smallholder farmers. Conservation tillage can use light implements making it easier for the animals and operators. A study conducted in northern Namibia showed conservation tillage using draft animals holds promise, is beneficial and has the potential to transform Namibian smallholder agriculture into a sustainable and productive crop production strategy[76].

Some farmers in Zimbabwe are using draft animals for conservation tillage. In Shamva District, farmers were introduced to an animal traction direct seeder which allows seeding and fertilizing directly into crop residues with minimum soil disturbance[77]. In the Sahel, much animal-drawn cultivation involves tine tillage and/or direct seeding.

Figure 21 *– Direct seeding with a horse in Senegal (top) and demonstrations of conservation tillage direct seeding in Zimbabwe (middle) and Uganda (bottom)*

Champions

With the problem of an old-fashioned image, animal traction needs champions to promote and identify with draft animals. A good example of this occurred in Namibia in 2020, when the Mayor of the City of Windhoek was seen and filmed ploughing in Zambezi Region. This was widely reported in the Namibian media and shared and discussed on Facebook[78]. This was an inspiration especially to young farmers who often see draft animals as backward. Of the more than 300 comments posted on the Facebook page, about 70 % were positive and in support of draft animals, but 30 % implied that this technology was taking Namibians 'back to the stone age'. Among the positive comments were:

- It saves costs and is effective.
- It is called the old way of ploughing but to me, it is the best way of doing it.
- It is not old, as we are still using it.

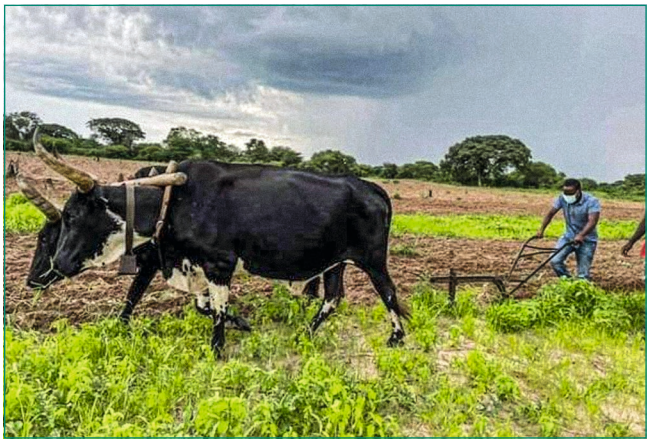

Figure 22 *– The Mayor of Windhoek ploughing with oxen in Zambezi Region of Namibia*

Networking and promotion

As noted, the international and national networks, including ATNESA, did much to improve information exchange and an understanding of the continuing importance of animal traction. They produced many resource publications that are still available online and widely used in Africa and elsewhere. Without funding, and with few researchers and projects working on draft animal issues, most networking activities have ceased.

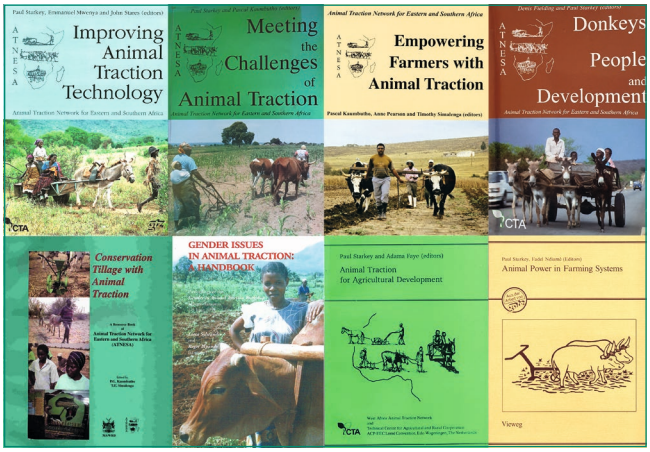

Figure 23 *– Examples of the many publications about draft animals available to download from the ATNESA website*

However, KENDAT, which established itself as an NGO able to receive funding for project implementation, continues to work on animal traction issues, and empow-

76 Mudamburi 2016.
77 CIMMYT 2016.
78 Entondo 2020.

ers communities in relation to the importance of donkeys in Kenya. The use of donkeys for transport has made a huge difference in some farmers' household incomes[79].

Apart from the continuing legacy of numerous resource publications, there are many lessons that can be drawn from the successful activities of the networks, and their importance in bringing stakeholders together to share lessons and to create a critical mass for influencing funding agencies, government authorities, public opinion and even smallholder farmers[80].

Students and young people

Experience from Namibia suggests that draft animals can improve smallholder farmers' timeliness and workload through environmentally friendly tillage and transport. Many students from the University of Namibia still view draft animals as available resources that are relevant to smallholder farmers. The students have argued:

- Draft animals are affordable, environmentally friendly and reduce the drudgery of farm tillage operations
- They enhance timeliness of operations and can be used with less soil disturbance than tractors
- Draft animals can also be used for rural transport (carting or packing) to carry water, produce and food
- For resource-poor farmers draft animals are better than manual tillage.

Recommendations

Africa needs leaders, political support and relevant investment to ensure the continuity and development of draft animal power with a critical mass of users and support services. National and international organisations could have a major impact by providing more information, educational materials and media resources explaining the benefits of animal traction in a modern world. Networks are highly effective for sharing information and providing the critical mass needed for influence, recognition and professional support.

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79 Mwita 2020.

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Figure 22 – J. Sh. Amupanda.

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