

Livestock in the Republic of the Sudan: Policies, production, problems and possibilities

Abstract

The estimated total number of livestock in Sudan is 105.6 million, comprising 39.8 million sheep, 31.0 million goats, 30.1 million cattle, and 4.7 million camels (USAID 2022). The country has one of the largest livestock populations in Africa. Cattle, sheep, goats, and camels provide milk and meat for local consumption and meat and live animals for export. Ruminants also provide ancillary functions including draught and transport, produce manure and act as a store of wealth. In spite of their importance to the national economy livestock do not receive sufficient attention in government policies and financing. Almost all animals are owned by smallholder farmers or traditional pastoralists. Livestock feed is often in deficit in relation to needs and crop by-products and range vegetation are fibrous and of low nutritional value. Livestock are affected by a multitude of diseases but receive little health care. Access to finance by producers is difficult and credit is limited and expensive if obtainable. Services to the sector are not adequately funded and are generally poorly equipped. Livestock output is low in relation to numbers and to the sector's potential. Some suggestions are made for the improvement of performance that will add value to the sector and contribute to people's livelihoods.

Livestock in the Republic of the Sudan: Policies, production, problems and possibilities

R Trevor Wilson
Bartridge House, Umberleigh, UK
DOI: 10.15761/AHDVS.1000142

[Article](#)

[Article Info](#)

[Author Info](#)

[Figures & Data](#)

Abstract

This paper reviews some major aspects of the livestock sector in the Republic of the Sudan. The country has one of the largest livestock populations in Africa. Cattle, sheep, goats, and camels provide milk and meat for local consumption and meat and live animals for export. Ruminants also provide ancillary functions including draught and transport, produce manure and act as a store of wealth. In spite of their importance to the national economy livestock do not receive sufficient attention in government policies and financing. Almost all animals are owned by smallholder farmers or traditional pastoralists. Livestock feed is often in deficit in relation to needs and crop by-products and range vegetation are fibrous and of low nutritional value. Livestock are affected by a multitude of diseases but receive little health care. Access to finance by producers is difficult and credit is limited and expensive if obtainable. Services to the sector are not adequately funded and are generally poorly equipped. Livestock output is low in relation to numbers and to the sector's potential. Some suggestions are made for the improvement of performance that will add value to the sector and contribute to people's livelihoods.

Key words

animal health, equines, feed supplies, finances, ruminants, veterinary services

Livestock sector background

The livestock sector plays a critical role in the Sudanese economy and in the welfare of the whole population. It yields a flow of essential food, brings in a large amount of foreign exchange from export earnings, is a major means of transport, produces draught power in support of crop production and processing, provides dung for fertilizer and fuel and creates employment. For all these reasons and especially from the equity and livelihood perspective it is an important, indeed a major, component of poverty alleviation. The value of exports from the animal sector has consistently been just under 50 per cent of all agricultural exports and just under 30 per cent of non-oil exports. Despite this contribution to the national economy, resource allocations for livestock and animal health services are not commensurate with the revenues generated by the sector. It is also usual for less than one quarter of the development budget actually being delivered. The livestock sector employs directly or indirectly about 40 per cent of the population and contributes valuable animal protein to the diets of all of Sudan's people. To complement its already substantial comparative advantage the sector's own foreign exchange requirements are small when compared to those needed for crop production [1,2].

Livestock are a strategic element in livelihoods, income generation, food security and in agricultural development. They contribute to the national economy and to human welfare and livelihoods via four principal pillars: poverty alleviation, food security, environmental conservation and gender equality.

In poverty alleviation they are often the only assets of many of the landless poor; their products (milk, meat, eggs, wool) provide a direct or indirect source of income throughout the year; they are a means of capital accumulation (livestock always appreciate but rarely depreciate) and provide a cash buffer in times of need.

In food security they are a buffer against low crop yields and crop failure and are thus an important element in risk management; produce milk and eggs that are the only agricultural products that can be harvested every day of the year; can be productive year round where crop production is difficult or impossible; provide draught power without which crop production in many areas would be severely compromised; make use of crop and agro-industrial by-products and waste and convert them to high quality human food.

In environmental conservation they produce manure that contributes to sustainable nutrient cycling and maintenance of soil fertility and structure; contribute to bush and weed control in many areas.

In matters of gender equality livestock, especially small animals, are often owned by women who have no access to land; women (and children) may have priority access to animal products for consumption or sale; they reduce much of the drudgery of women's and children's work when used for transport.

Policies

The Ministry of Livestock, Fisheries and Rangelands (formerly the Ministry of Animal Resources and Fisheries and various other names, often as part of Ministry of Agriculture and Natural Resources, the Ministry of Agriculture and Forestry or other incarnations of the Ministry of Agriculture) is responsible for controlling livestock diseases, regulating domestic and export trade, and formulating national livestock policy. The National Assembly's Committee on Agriculture and Animal Resources is, however, the final link in the development of livestock policies which it bases on the input of the Ministry, the Pastoralists Union, individual members of the National Assembly and other federal and state ministries. The Committee arrives at decisions on a majority basis and forwards policy recommendations to the full Assembly where the outcome is again decided on a majority basis.

The "Livestock" Ministry is considered to be below optimal strength and is underfunded with respect to the value of livestock to the internal economy and to export earnings. Policy is therefore largely

determined by people and organizations outside the Ministry. Policy in general with regard to livestock and range has usually been subordinated to crop agriculture. In the late 1960s, for example, livestock concerns were subordinated to the then regime's "breadbasket" strategy that focussed on the horizontal expansion of crops. Despite the importance of livestock for Sudan's rural and urban populations decades of development policies and projects have continued to promote the horizontal expansion of crop production to the detriment of livestock and pastoralism. Successive governments have seized vast areas of rangelands and pasture lands to promote irrigated and mechanized rain-fed production and caused social, political, and economic disruption virtually throughout the country [3].

Political and economic forces that affect the design and implementation of livestock policies include:

- the conflict in Darfur that results in diversion of funding and government attention away from development policies and programmes;
- an economic system that has historically favoured the horizontal expansion of crop production at the expense of livestock production and pastoral livelihoods;
- a political system that formulates development policy without sufficient consideration of the aspirations of livestock owners and especially of poor producers;
- the production of oil that disrupted pastoral livelihoods in producing areas and diminished the importance of livestock production for the Sudanese economy; and
- flows of international aid and assistance that have supported, and continue to support, policies that harm pastoral livelihoods (and possibly lead to conflict) [3].

Nomads have historically been blamed for an array of social, economic and environmental problems. There is a long history of programmes and projects to "**Settle the Nomads**". The aim to settle stems not only from a desire to control the lands they use but also from an "educated person" perception that the nomadic lifestyle is "backward and irrational" and has "several important disadvantages such as extensive and destructive use of natural resources, inefficient use of human resources, and a marked inability to use social services." This belief was reflected in the government's 2006-2010 Green Alert Programme which provided funds for "settlement of moving herders" to achieve "rational utilization of the animal wealth" and "provision of the essential services to the pastoralists". Current government policies promoting the settlement of migratory pastoralists could have negative outcomes for nomadic populations as it has been shown empirically that migratory livestock of the same breed type as settled stock have superior growth, reproductive and survival performance [4]. Livestock disease control has, and continues to be, focussed on diseases of significant international reach (i.e. that are likely to have an effect on exports) such as rinderpest and avian flu and especially, recently, the international veterinary community's morbid (pun intended) fascination with Highly Pathogenic Avian Influenza (HPAI). Greater consideration for animal health interventions to assist livestock keepers directly is warranted. Constructive changes in taxation and in policy and institutional support to the animal production, processing and marketing chain could have a strongly positive influence on the livestock industry.

Elements of policy that are needed to support livestock production include:

- better coordination of federal/state ministries and agencies;
- promotion of efficient, market-based production incentives and sustainable land use;
- rejuvenation of agricultural research and extension to achieve technical improvements in production, particularly in traditional rainfed areas;
- rehabilitation and modernization of rural infrastructure (roads, railways, communications) to reduce transaction costs and improve efficiency;

- improvement of rural services (domestic water supplies, sanitation, primary health care and basic education);
- enhanced marketing and export services; and
- improved access to rural credit.

Livestock numbers and distribution

Sources differ widely in estimates of livestock numbers. Actual figures can be disputed but there is no doubt that Sudan's vast multitude of domestic animals represent a large proportion of all African livestock. Based on FAO data, the country sits at the very top of the league table of African countries with respect to its animal populations. The country ranks first to third among all African countries in the number of cattle, sheep, goats and camels, third in the number of poultry and fifth in the number of donkeys [5]. In 2009 Sudan official sources estimated cattle numbers at 41.653 million, sheep 51.555 million, goats 43.270 million and camels 4.521 million. In addition to these there were also 7.515 million donkeys and 784 thousand horses [1] [6].

Pastoralists, agropastoralists and sedentary farmers own and manage approximately 90 per cent of Sudan's livestock. The social and economic significance of these assets for producers varies across and within tribal groups as well as spatially and temporally. Relatively few purely nomadic groups depending exclusively on livestock for their livelihoods remain, but nomads typically own the largest herds. Many livestock producers are now transhumant or sedentary farmers who maintain herds but also engage in crop production and/or wage labour. Urban dwellers also maintain livestock including donkeys for transport and small ruminants and chickens for personal consumption or sale. The 10 per cent of livestock producers who do not fall into the foregoing category are mainly industrial schemes located near Khartoum and include poultry and egg production facilities and dairy farms that serve – but do not satisfy – the local market with fresh eggs and milk and processed products (Figure 1).



Figure 1. Products and outputs from the Sudan’s vast array of domestic livestock (A. Rural milk supply – El Hawata, Gedaref State; B. Retail butchers – Kassala city, Kassala State; C.-F. Value added primary products – Khartoum Capital City; G. Draught power – South Darfur State; H. Urban transport, Omdurman, Khartoum State) (all photographs by the author).

Livestock products and productivity

National level

Animals are more than just producers of milk and meat. For the majority of the population who depend on animals for their livelihoods and for contributions to their diets, however, milk is the major output. All four species of domestic ruminant provide milk but because this goes mainly to feed their offspring with most of the surplus being consumed by the household it is often overlooked. In 2009 it has been estimated that the national animal herds and flocks produced 7.4 million tonnes of milk (Table 1). Probably less than one quarter of milk produced is marketed yet the country imports liquid and powdered milk and processed dairy products to supply the mainly urban demand. Annual imports of milk powder, for example, increased from 2678 tonnes in 1996 to 30 365 tonnes in 2006. The large seasonal surpluses produced during and after the wet season, mostly in distant breeding areas, are inefficiently used or even wasted due to the lack of processing, transport and storage facilities.

Table 1. Livestock numbers and livestock products in Sudan, 2009.

Item	Livestock species				Total
	Cattle	Sheep	Goat	Camel	
Numbers ('000)	41 563	51 555	43 270	4 521	140 909
Total meat production ('000 tonnes)	1 252	313	151	125	1 841
Total milk production ('000 tonnes)					7 406
Total hides and skins (number)					34 165
Total live animal exports (number)	19 265	1 510 996	104 630	154 477	1 789 368
Total meat exports (tonnes)	18.4	1 765.6	1	-	1 785

Source: [6]

Cattle, sheep, goats and camels produce red meat with the first being by far the most important source (Table 1). Cattle contributed more than two thirds (67.2 per cent) of the locally consumed red meat in 2009, followed by sheep (about 17.7 per cent), goats (10.3 per cent) and camels (4.8 per cent). According to Ministry data the total number of animals slaughtered for local consumption was 43 715 000 head in 2009 representing 31 per cent of the livestock population. In spite of the overwhelming market share of cattle it is sheep that provide the meat of choice as reflected by the higher market price.

The numbers of hide and skins produced varies considerably from year to year. More than 41 million pieces were exported in 2005 and brought in a revenue in excess of US\$ 40 million [7]. In 2009 the number of hide and skins exported was just over 34 million (Table 1). The economic waste in hides and skins is appreciable because of the poor practices and techniques used in their production, flaying, conservation and processing. This sector has to revolutionize in every respect, especially in value addition, to maximize its returns.

Sheep are by far the most important live animal export from Sudan with most going to Saudi Arabia. Only small numbers of cattle are exported to Yemen and the Gulf states. Live goat exports are also limited in number and restricted to only a few countries. The live camel trade is gradually increasing with most going on the hoof to Egypt and Libya. Sudan also exports a limited number of live animals and chilled meat to the United Arab Emirates, Qatar, Kuwait, Oman, Jordan and Abu Dhabi. Jordan is becoming a significant market for chilled beef while Saudi Arabia remains the major destination for chilled mutton and to some extent camel meat. Poultry meat and eggs have assumed increasing importance in the Sudanese economy and in Sudanese diets in recent years.

Animal level

The productivity of Sudanese livestock is widely reported as low. The parameter most often referred to, however, is production and not productivity as there is no reference to input: output ratios. Traditional systems in northern Sudan seem to be rather efficient in view of the constraints in which they operate (Table 2). Improved productivity would be achieved if a more favourable total environmental -- including input supply and availability of extension and veterinary services -- and economic conditions were to be made available. There has been considerable research on the potential of the very broad range of Sudanese animal genetic resources (Figure 2) which has shown the possibilities of improvement. Regrettably very little has been transferred to or taken up by the mass of traditional producers.



Figure 2. Animal genetic resources of the Sudan (A. Kenana bull – Um Banein Research Station, Blue Nile Province; B. Butana cow – Atbara Research Station, Nile State; C. Shugor subtype, Sudan Desert sheep – El Huda Research Station, Gezira State; D. Watish subtype, Sudan Desert sheep – El Huda

Research Station, Gezira State; E. Sudan Desert goat – near Kassala, Kassala State; F. Nubian goat – Tuti Island, Khartoum Capital City; G. Rufa’a camel – Wad Meskin, Gedaref State; H. Sudan Riding Donkey – Nyala, South Darfur State; I. Dongalawi type local horse – Riding School, Khartoum Capital City (all photographs by the author).

Table 2. Livestock vital statistics and production parameters in traditional systems.

Parameter		Species				
		Cattle	Goat	Sheep	Camel	Donkey
Herd/flock structure						
Males	total (per cent)	31.2	23.6	22.2	50.0	51.4
	breeding (per cent)	4.2	5.2	8.4	?	37.0
Females	total (per cent)	68.8	76.4	77.8	50.0	48.6
	breeding (per cent)	42.8	49.8	57.0	30.0	31.8
Vital statistics						
Birth rate (young/female/year)		0.49	2.08	1.45	0.70	0.65
Death rate (per cent/year)		19	19	23	15	?
Offtake (sales + consumption, per cent/year)		16	28	26	15	n.a.
Breeding female weight (kg)		300	30	40	414	120
Productivity						
Dressing percentage		45	49	41	49	n.a.
Index (g meat/kg female/year)		44	374	253	67	n.a.

Sources: [4,10]

Cattle

Cattle are used mainly as dairy animals in most Sudanese traditional production systems. On a comparative basis cattle produce less meat than the other species (Table 2).

Kenana cattle usually have their first calf at about 4.5 years but this can be reduced to 3.5 or even 3.0 years under improved management (Table 3). Calving intervals at the Um Banein Research Station averaged about 18 months in 1964-1980 where lifetime production total averaged 4.02 calves, but some cows produced as many as 12 calves. Birth weights averaged 22.7 kg. At six months the average weight was 56.7 kg. Adult cows showed seasonal weight changes being heaviest at 315 kg in October, lightest at 262 kg in February and 253 kg in June and then heavier again at 299 kg in late July in an overall range of 180-440 kg. Milk yields averaged 1415 kg per lactation of 251 days with the highest individual yield being 4530 kg in 1959-1983 [8]. Most milk parameters from Geziera and Khartoum University farms in earlier years were better than those at Um Banein. The performance of Butana cattle is similar to the Kenana [9].



Table 3. Performance traits of Sudanese indigenous cattle under research station management.

Parameter	Breed in Northern Sudan Group		
	Kenana	Butana	Baqqara
Reproductive traits			
Age at first calving (months)	42± 8	47 ±11	66±7
Calving interval (months)	1±3.0	13±2.5	14.9±0.3
Gestation (days)	286	290	287
Feedlot performance			
Daily gain (kg)	0.78±0.28	0.89±0.20	1.00±0.23
Age at slaughter (months)	17.8	11.5	21.8
Weight at slaughter (kg)	231.8	159.6	271.1
Feed conversion (kg feed/kg/gain)	8.15	6.20	6.44
First lactation milk yield (length in days/yield in kg)			
Um Banein ^{a)}	251/1423		
Nisheishiba ^{a)}	287/120	242/1095	
Atbara ^{a)}		220/1213	
Ghazala Gawazat^{b)}			244/671

Notes:a) green pasture; b) natural range

Sources: [8,9]

The calving rate in South Darfur in the 1970s was 59 per cent but was higher (60 per cent) in migratory than in sedentary (40 per cent) herds. In most traditional systems cows were culled after three calvings: average lifetime production was 2.90. Some 65 per cent of calves were born in April-June, related to conceptions in the previous year's rainy season. There were very few births in August-December. Weights in all age classes were lowest in the late hot dry and highest at the start of the cool dry season [4,10]. Seasonal changes in weight reflect not only the capacity for compensatory gain – of which advantage can be taken in fattening operations – but also the genetic potential for resilience to environmental stress.

The output of meat of weaned 6-month calf equivalent per kg live weight of breeding female per year was 57 g and 23 g in migratory and sedentary herds in 1973 in South Darfur. Most traditional owners take off 1.5 kg of milk per day per cow for periods that often exceed one year for drinking fresh and for making 'semn' (= ghee, clarified butter).

Sheep

Sudanese sheep have the capability to be highly productive. Most types are potentially prolific, can (and often do) have more than one parturition per year, have rapid growth rates, good dressing percentages and produce an acceptable and indeed a sought-after carcass for local markets.

Age at first lambing was 13-15 months in the Southern Darfur traditional system [11]. At El Huda station it was about 14 months for all of Shugor, Dubasi and Watish types when ewes ran continuously with rams but was delayed to almost two years when a conception weight of 35 kg was imposed before access to rams was allowed [12]. Lambing intervals in Southern Darfur were spaced at about nine-month intervals but were longer than 14 months at El



Huda. Litter sizes in the traditional system were 1.14 but improved to 1.22 on average for the three subtypes studied at El Huda where there were differences between the three types. In spite of more lambs being born per parturition on station the important parameter of number of lambs born per ewe per year or annual reproductive rate was much higher in the traditional system at 1.52 than the 1.05 at El Huda due to the much shorter lambing interval. Weights at birth average about 4.0 kg and animals reach 18-20 kg at five months. By one-year female Sudan Desert sheep weigh more than 30 kg but growth then slows so that at two years they are 36 kg and at three years 40 kg; males weigh some 50 per cent more than females of the same age. Dressing percentages approach 50 per cent in well finished sheep but vary with nutrition and especially the amount of dietary fibre [13].

Useful comparisons can be made on the basis of analyses in overall productivity between the supposedly "better" station system and the often presumed "poor" traditional system. This is not only in respect of actual performance but also in relation to management. For all three subtypes at El Huda performance is similar but grossly inferior to comparable types of sheep under traditional management in the South Darfur traditional system. Differences between the two systems are mainly related to control of the breeding process (leading to poor reproductive performance because of long parturition intervals as well as to advanced ages at first lambing) and very high mortality rates. Long term improvements would be achieved by selecting for superior stock within the local populations.

Goats

Nubian goats have average kidding intervals of about seven months. These are prolific goats with a rather high proportion of 30.4 per cent of parturitions resulting in twins and 3.5 per cent in triplets to give an average litter size of 1.4 overall. Births occur throughout the year [14]. Birth weights are in the range of 2.5-3.0 kg. Males weigh 22.2 kg at 12 months and females 18.0 kg. Nubian goats are reputed as milk producers and yield 150-200 kg per lactation in addition to that taken by the kids [15]. Dressing percentages were 43.2 at 14.1 kg live weight with cotton seed cake as the nitrogen source and 38.4 at 12.1 kg live weight with blood as the nitrogen source.



Many Sudan Desert goats have their first kid when they are less than 10 months of age and most have already given birth by 15 months. Kidding intervals in South Darfur and South Kordofan traditional systems are usually 7-9 months. Multiple births are common with 30.2 per cent of parturitions resulting in twins in first kidders and 54.5 per cent in twins and 6.5 per cent in triplets in multiparous females in South Darfur. The overall litter size is 1.57 with primiparous does achieving 1.30 young and multiparous does 1.68 young per litter. Annual reproductive rate averages 2.41 kids per doe and a lifetime production of 9-10 kids is achieved. Birth weights average 2.13 kg and are 2.27 kg for single births, 2.05 kg for twin births and 1.82 kg for triplet births. Kids weigh an average of 12.6 kg at five months and 14.7 kg at six months [16]. On a diet comprising high roughage/sorghum bran with an addition of 30 mg Monensin per day average daily gain was 89 g from 26.5 kg to 33.2 kg with a conversion rate of

10.7 feed/gain and on a high concentrate/sorghum grain diet with 30 mg Monensin added was 93 g at a conversion rate of 9.0 from 29.9 to 34.0 kg. Entire males have a dressing percentage of 48.2 at a live weight of 34.7 kg with castrates yielding 51.2 per cent at a live weight of 35.8 kg in South Darfur: dressing percentages are slightly lower at 46.0 per cent in central Sudan [17].

Camels

In the Butana area only two per cent of females first had a calf at 3-4 years old, 10 per cent calve at 4-5 years, 37 per cent at 5-6 years and 51 per cent at more than six years. Advanced ages at first parturition and subsequent long intervals averaging two years or more mean that more than half of female camels do not have their second calf until 9-10 years and only about a quarter have had their third calf by this age. Almost 50 per cent of fourth calves are born to dams over 15 years old. Calving is very seasonal and depends to a great extent on nutritional status which is why calving intervals are so long. Birth weights range from 26-45 kg and are affected by several factors including season of birth and age of dam. Daily weight gains of young camels range from 300 g to more than 1000 g for animals from birth to one year old. Mature camels weigh from 450 kg for the lighter and leaner riding types to 650 kg for the heavy pack or baggager types [18,19].



Many traditional owners keep camels solely or mainly for milk. Their value in this role is their ability to give milk over long periods. They also provide milk through long dry seasons when perhaps the only other domestic animal providing very small amounts of milk is the goat. Meat, with few exceptions, is usually a by-product of a camel system and comes mainly from old males and females that have served usefully in other functions in earlier life. Camel meat contains 36.8 kJ/g of energy in the fat and 17.9 kJ/g in meat protein, the protein content being 270 g/kg of meat. Camel meat is a good source of protein but a lesser source of energy. Dressing percentages of camels are in the range of 45-55 per cent, exceptionally up to 60 per cent [20]. Total carcass composition is about 66 per cent muscle, 19 per cent bone and 14 per cent fat, the last being mainly in the hump. Lean meat has more moisture and less fat than beef, with the pH being about 5.75. Muscle is formed of 75.5 per cent water, 21.4 per cent protein and 1.4 per cent fat [21].

Equines

The Sudanese Pack donkey is by far the most numerous of the equines. The Sudanese Riding donkey has possibly evolved by hundreds of years of selective breeding from the Sudanese Pack. A large white donkey restricted mainly to urban areas is akin to the Syrian or Egyptian type. Native horses are small, and light boned but except for a very few sport horses all Sudanese equines are true work animals. The Pack donkey is mainly a beast of burden in the classic sense in that most of its output results from loads carried on its back. In urban areas and some larger villages Pack donkeys are harnessed in carts. Common burdens for rural donkeys are water and fuel wood for household use and cereal grains and straws transported from field to homestead and from farm to market. As for the Pack donkey the name of the Sudanese Riding donkey largely derives from its principal function although it is often used as a pack animal. The white Syrian or Egyptian type is a specialist riding animal that is rarely used for other purposes. Horses are ridden in rural areas but in urban areas are mainly used for local transport attached to waggons or carts. Equines are a self generating (and therefore renewable and sustainable, at least until the grass is all eaten) source of energy that do not have the negative side effects or at least have only minimal side effects in the emission of global warming gases [22].



Improved livestock

It is almost invariably assumed that the domestic livestock of Sudan produce very little and that they are of low genetic potential. It is also considered that improvement is only possible by introduction of exotic stock with increased genetic worth. Neither assumption takes account of the resources available. There are certainly, if somewhat limited, opportunities for the use of exotic animals but improvement of the locally adapted types by selection within existing populations will provide the most appropriate and sustainable genotypes [15,23,24].

Problems

Problems facing the Sudanese livestock sector can conveniently be classed under the headings of political, technical and financial.

Political

Animal production has been consistently inhibited by the political emphasis on crop production. Much of the formerly productive rangeland of the central belt of Sudan from Darfur in the west to Kassala and Gedaref in the east has been thoughtlessly and relentlessly converted to crop production. Both rainfed (“mechanized farming”) and irrigated crop production have proliferated and now occupy vast areas. Many of these schemes cut across traditional migration routes. The consequent decreased or hindered mobility of the pastoral herds and semisedentarization of the herders in addition to the increased stocking rate lead to a severe degradation of the pasture land.

Two government actions that resulted in far reaching negative impacts on pastoralism and pastoral resources; were the abolition of traditional institutions (tribal administration) and the “nationalization” of all unregistered land. As a consequence, there was:

- a large influx of herders and farmers with no traditional access rights to tribal land for grazing or cultivation giving rise to serious consequences in terms of destruction of vegetation cover destruction and land degradation;
- expansion of both traditional and mechanized rainfed farming onto the rangelands;
- intensified competition for grazing; and
- pressure on pastoralists to move to marginal areas that were subject to more frequent drought.

These actions, in addition to the political, socio-economic and environmental changes that took place and the complexity of the traditional tenure system, necessitates a review of the land tenure and grazing rights with a view to formulating acceptable systems that take into account present day realities and meet the needs of pastoral groups.

More recently civil war in western Sudan and general unrest in other areas has resulted in a strongly negative impact on animal production.

Technical

Two major technical constraints to animal production might be considered to be:

- seasonal variability in feed and water which may reduce reproduction rates, increase mortality and lower growth rates; and
- inadequate access to a full and comprehensive health services in most places and at most times (and especially with regard to the presence of “first aid” activities at village and pastoral camp level) that further aggravates the productivity problems associated with the feed supply.

A third perceived problem, that of animal genetic resources being of inferior quality is probably not of the same order of magnitude. Existing genetic resources adapted to the environment and well understood by their owners are not a real primary or short term constraint to livestock output. More important in this context is that producer management skills for improved systems of production and

their very limited access to information and new and appropriate technology because of poor extension services are factors that will potentially limit production in the future.

Feed and water

The main constraints to providing adequate nutrition to livestock include:

- degraded range grazing supplemented only by high fibre crop residues (Figure 3)



Figure 3. Livestock feed resources: degraded desert range near Meroe Pyramids, Nile State and high fibre low quality sorghum stover near Zalingei West Darfur State (photographs by the author).

- lack of forage reserves for feed shortage and drought periods;
- inadequate technical support to livestock holders;
- inadequate research and extension activities related to range improvement;
- low level of involvement of populations in range improvement and seeding activities;
- insufficiency of public funds allocated to range rehabilitation programmes;
- absence of private investment in range infrastructure and management;
- little producer knowledge of feed nutritional value and use of balanced rations; and
- recurrent droughts.

Animal health and welfare

The major epidemic diseases of livestock have been contained or eradicated or at least their containment and eradication is possible in the foreseeable future. The Pan African Rinderpest Campaign and the Pan African Campaign against Enzootic Diseases, both funded by the European Union through the African Union/Interafrican Bureau of Animal Resources (Figure 4), are laudable examples of what determination and good organization can achieve. Unfortunately, these and later campaigns have been funded largely by international donors which continues to encourage the mentality of dependency by the technical services and fails to provide government with an incentive to ensure long term budgeting.



Figure 4. The main building of the Veterinary Epidemiology Department in Khartoum funded for more than 25 years by international donors (photograph by the author).

Animal health services have concentrated in the past on diseases affecting exports, mainly rinderpest and contagious bovine pleuro pneumonia. Production diseases such as trypanosomosis, mastitis and contagious abortion and the control of internal and external parasites have received much less official attention. New diseases, including zoonoses, will undoubtedly appear and existing ones will assume more importance. All disease has a negative impact on animal welfare, reducing output and affecting food security and human livelihoods. Provision of more clinical and consulting services to complement the mass campaigns is needed.

Financial

Pecuniae obediunt omnia: all things yield to money. In other words, money makes the world go around. It is probably lack of finance for livestock that is the principal reason for it not going around fast enough.

Formal system

The Agricultural Bank of Sudan (ABS) is one of the most important pillars of the Sudanese banking sector and “contributes to the advancement of agricultural development and growth of the GDP of the country” [25]. It is wholly owned by the Government whose capital is mutually contributed by the Central Bank of Sudan and the Federal Ministry of Finance and Economic Planning. ABS’ strategic objective is to effectively mobilize the national economy dependent on agricultural production, both plant and animal, in addition to agricultural processing. In order to achieve this objective, it is to:

- facilitate mobilization and development of the agricultural sector and all other related activities, whether of emergency, supplementary, secondary or subsidiary nature in Sudan by provision of financial funding (in kind or cash), services, extension, training, marketing and storage to accredited persons funded by the bank who work in the agricultural sector and related agro-industries;
- provide comprehensive banking services to assist in the development of the agricultural sector and other activities in the country and raise the rates of production and realize rural development; and

- provide strategic stocks of commodities to achieve food security through collecting information, preparing studies, conducting research, providing financing and increasing storage capacity in the country, and assisting in the establishment of pilot projects to increase production in the agricultural and industrial sector according to modern technologies in coordination with the concerned parties.

Established to serve the needs of medium- and small-scale producers the bank concentrated in its early years (1950s/1960s) on providing finance to the large private cotton schemes of the White Nile and Blue Nile Provinces. More recently it has transferred its business to financing imports of machinery and other inputs and to providing short- and medium-term loans to rainfed mechanized farming schemes that produce sorghum and sesame. Only about 6-7 per cent of finance goes to traditional agriculture and the Bank assumes that it provides only 3 per cent of the needs of traditional farmers compared to 20 per cent of irrigated and 50 per cent of mechanized farming needs. Lack of collateral is the major reason for not providing credit or finance to the traditional sector and as livestock have not normally been considered to be adequate collateral the pastoral sector has benefited from very little of the already minuscule amount of finance afforded to the traditional sector [26].

Farmers have been disadvantaged since the introduction of 'shari'a' law which does not allow interest to be charged on loans. The loan is thus recovered in kind which often diminishes the producer share of any output by as much as 50 per cent. Some formal credit is provided by various development or investment projects mounted by international and bilateral agencies. Only one (for stock route development) of some 20 projects financed by one international bank was for livestock with the major concentration being on irrigation and irrigation rehabilitation [27].

Informal system

Virtually no external sources of finance are available to small scale producers. Where it is obtainable the cost is exorbitant in terms of interest rates and repayment periods. A common means of credit in Sudan is the 'shiel' system wherein a trader or shopkeeper advances a loan, often in kind, to be repaid at harvest (or at sale of livestock) by a proportion of the output or offtake. Profit to traders in this system can be as high as 700 per cent [28]. Finance is essential for trading but here also external finance or credit is difficult to obtain. In one market study 70 per cent of traders used their own resources to start a business whereas the remainder received gifts or loans from their parents [29].

Pecunia non olet: money doesn't smell. Or, don't look a gift horse in the mouth. Sudanese livestock producers would welcome the chance to see a gift horse.

Possibilities

Future development of the livestock sector should target both sedentary ("farmers") and non-sedentary ("pastoralists") livestock producers. Smallholder farmers can produce valuable livestock feeds (sorghum grain, leguminous forages and crop residues and by-products) that could be used for fattening both their own and pastoral livestock. Mixed farming areas attract large numbers of camels and sheep in the rainy season and supplies of unfinished livestock to feedlots owned by farmers could easily be secured. In addition farmers and pastoralists could embark on joint ventures for finishing livestock.

There are good prospects for the development of commercial projects for fattening of meat animals for which there is strong demand in nearby export markets. Fattening of young camels (known in Saudi Arabia as 'gaoud' or 'hashi') for export to the states of the Gulf Cooperation Council (GCC) and of mature camels for the Egyptian market are two examples. Sudanese lamb and mutton are popular and strongly sought after in the GCC countries and in Jordan. Commercial finishing of sheep may be initiated in response to demands in these markets. Support services (including export quarantine, paved roads to the seaport, the seaport itself, a modern slaughterhouse and an airport) are currently available in Sudan but many need improvements.

Selected parts of traditional grazing grounds could be provided with water for livestock (although some past experiences have led to overstocking and range degradation) and humans. Areas of communal land should be zoned and rehabilitated for more formal access and possible rental charges to various groups of users. Existing forests should be rehabilitated, and new forests established.

Support services for livestock production (such as animal health, extension and training, marketing) are an extremely important and indeed essential adjunct to efficient livestock production. Owners should be encouraged to improve animal welfare (prophylactic and curative health activities, nutrition, culling of old and unproductive stock, early offtake of males not required for breeding). In addition, capacities in rangeland management, conservation and treatment of natural fodders and feeds to improve their nutritional value should be enhanced. The age-old tradition of extensive livestock production and the potential for improved pasture land management and introduction of new techniques and systems such as grazing reserves and cooperatives or producer organizations for pasture management provide considerable opportunity for the livestock sector.

Sudan's livestock breeds have adapted over thousands of years to local production systems and to the harsh physical environment in which they operate. There is thus considerable potential for breed development based on the adaptive genetic characteristics of Sudan's native livestock breeds and certainly in cattle and sheep production. As a corollary, it should be understood that genetic quality is not the primary constraint to greater animal productivity in the Sudan of the early 21st century and that replacement of existing breeds by "improved" ones is not some kind of magic formula.

Further attention to mitigation of some production constraints would greatly help the livestock sector. Aspects such as whole herd health and not just vaccination would reduce the effects of disease. Amelioration of disease impacts would also enable stock to make better use of the limited feed resources which would assist in increasing livestock output.

Possibilities for increasing the feed supply include:

- establishment of pasture legumes on fallow areas using various species adapted to the local environment;
- sowing immediately after the cropping phase or undersowing forage legumes in the last season of the cropping phase (dedicated fodder crop types include Dolichos bean or lablab (*Lablab purpureum*), cow pea (*Vigna unguiculata*), desmanthus (*Desmanthus virgatus*), Burgundy bean (*Macroptilium bracteatum*) and leucaena (*Leucaena leucocephala* on some favourable sites;
- better use of 'gerouf' (seasonally flooded and falling flood localities) areas, the approach being based primarily on quick maturing legumes with good tolerance of waterlogging which would regenerate after subsequent flooding (Figure 5).

Figure 5. A typical and suitable site for 'gerouf' cultivation of livestock feed at Wad Meskin, Gedaref State (photograph by the author).

The use of leguminous shrubs in rainfed cereal cultivation has many advantages. They provide stabilization of the soil, shade, for plants in the course of establishment, food for people, fodder for livestock, fuel for the cooking stove and fix nitrogen to enrich the soil. Two possible species for this "alley cropping" are *Leucaena leucocephala* and *Gliricidia sepium* [30].



The nutritional quality of crop residues and fibrous feeds can be improved by a range of techniques including treatment with urea and with sodium hydroxide. These techniques are technically sound and simple to apply and can provide better nutrition. The alternative of supplementation with readily available high protein feeds is widely understood (but currently less practised) in Sudan and also offers good prospects for intervention. Animal conversion of the fibrous content of both coarse range feed and crop residues can also be improved by providing readily available sources of energy (e.g. molasses) and protein (e.g. nitrogen in the form of urea). Most animals also have a deficit or imbalance of minerals and vitamins. Livestock producers should be provided with demonstrations and with the necessary information, training and equipment to treat fibrous feeds as described and also to manufacture molasses-urea/multi nutrient blocks to feed to their stock.

Pastoralists have long had free access to surface water since time immemorial. In the last 80 years or so they have also had similarly free access to water from deep bores and publicly funded 'hafir'. These practices have led to proliferation of livestock numbers and environmental degradation. The new principal should be to control stocking rates both temporally and spatially. Water should not be freely available to all at all times. Water in range areas is, and should be used as, a very powerful management tool. Its availability therefore needs to be restricted in time and space and producers should be required to pay for it – water could be charged so that a pastoralist with a herd of 50 cattle would need to sell only one beast (2 per cent of the herd) to provide sufficient water for the whole herd for one year [31].

The level of livestock husbandry by many owners within the pastoral system is high. Pastoralists have exceptional skills in managing stock within a very demanding production environment. Interventions to adjust use of rangelands on a community basis can be successful but require extensive participatory planning. They are also long term and are unlikely to have a marked impact on the system in the immediate future. The improvement strategy should be based on:

- construction of low bunds and crescent terraces;
- careful site selection but initially over a wide variety of sites to enable both a rapid accumulation of local knowledge and high rates of spontaneous lateral spread;
- use of "shotgun" mixtures to provide a better chance of finding the most useful species; and
- low seeding rates (0.5-1.0 kg/ha) such that on suitable sites optimal densities will be reached within 3 years (and low seeding rates avoid excessive wastage of seed on less suited sites).

The likely results are:

- higher rainfall will produce more successes, but seasonally heavy cover of native grasses will limit success in some areas and some success may be achieved even in sites of 250 mm rainfall if grazing pressure is not extreme;
- on suitable sites there will be good persistence and spread and in heavily grazed areas with little grass cover livestock gains will be directly related to legume productivity;
- where legumes are successfully established in areas with better grass cover there can be a synergistic effect through having a high protein legume available to complement the low-nutritive value of dry season grasses;
- livestock productivity gains may be in the region of 30-50 per cent even in the absence of other interventions; and
- in suitable areas lateral spread through grazing livestock can be rapid.

Traditional routes for the movement of stock from the wetter and insect-infested areas of the country have existed for centuries. The advent of irrigated cultivation and the expansion of dryland cereal cultivation have further exacerbated the age-old conflict between the desert and the sown although

in theory (and to an extent in practice) stock routes and access to water still exist. The time has come for reintroducing the old and designing and implementing new binding agreements to be made among all users with respect to rites of passage and access to water. Routes and access ways should be marked in a permanent manner to prevent encroachment on to and out of the legal passageways. Additional water points should be made available on the stock routes in the form of 'hafir' or of pumped wells and boreholes. Stocks of feed should be laid up on the stock routes and animal health services should be readily available. Access to these water points could be closed at certain times to prevent random animal movements.

Little to no formal market information is accessible to livestock producers. Traders are better informed about market conditions and prices than producers via their informal or formal networks. Producers therefore largely rely on actual market day information or on information obtained from relatives, neighbours and friends to aid them in making selling and price decisions. Lack of market information therefore is a hindrance to improved livelihoods for livestock producers. The rapid growth of satellite communications networks and the more widespread use of mobile telephones and the increasing availability of satellite television provide an excellent opportunity for the establishment of a more formal market information system (MIS) which producers could download and therefore be better informed as an aid to decision making.

The national animal health services are well equipped intellectually but ill equipped with material support. Visits to producers and opportunities to treat stock on a herd basis or as individual cases are limited. Many former government veterinarians – encouraged by “structural adjustment” and some internationally funded development projects – have been “privatized” but a living cannot be made in the remoter areas so most private vets work in urban areas and deal mainly with companion animals or transport equines. The Sudan Veterinary Council [32] has made these points:

- Sudan is a vast country with a large widely distributed livestock population;
- provision of quality veterinary services to livestock owners in remote places is difficult in the foreseeable future; and
- employment of veterinary paraprofessionals as part of the veterinary care system helps alleviate the acute shortage and provide affordable services.

In Sudan “paraprofessionals” are of two types: Veterinary Technicians with three years of training and Community Animal Health Workers (CAHW) who receive 2-3 weeks training (often provided by international Non-Governmental Organizations). CAHWs are usually from within the local community trained in “first aid” measures for the prevention and control of animal diseases and for dealing with minor accidents and surgical procedures. Although officially sanctioned there is little government support for them the reasons given being that they assume the duties of veterinarians, are poorly qualified, trade in veterinary drugs of doubtful and illegal provenance, misuse drugs thus stimulating drug resistance and are difficult to regulate and control. In 2002 there were less than four paraprofessionals per 100 000 veterinary livestock units compared to more than 200 in Zimbabwe [33]. Willing and practical support for CAHWs could contribute to improved production and better welfare for livestock. Producers would be expected to pay for any veterinary pharmaceuticals they receive and would also pay a “consultation” fee to the paravet. In practice the number of paravets actually providing services to their communities after they have been trained appears disappointingly low and many fails to provide the services for which they have been trained.

Funding details

No external funding was sought nor provided for this paper.

Competing interest

The author declares no conflict of interest.

References

1. Behnke R (2012) The economics of pastoral livestock production in Sudan. Somerville MA: Feinstein International Center, Tufts University.
2. IGAD (2013) The contribution of livestock to the Sudan economy (ICPALD 6/CLE/8/2013). Djibouti: IGAD Centre for Pastoral Areas and Livestock Development.
3. Fahey D (2007) The political economy of livestock and pastoralism in Sudan (IGAD LPI Working Paper No. 06 - 08). Djibouti: Inter-Governmental Authority on Development
4. Wilson RT, Clarke SE (1975) Studies on the livestock of Southern Darfur, Sudan. II. Production traits in cattle. *Tropical Animal Health and Production* 8: 47-57.
5. FAO (2018) FAO Stat Data. Rome: Food and Agriculture Organization.
6. MARF (2009) Statistical Bulletin for Animal Resources No 19, 2009. Khartoum: Ministry of Animal Resources and Fisheries.
7. MARF (2006) Annual Report 2006. Khartoum: Department of Statistics, Ministry of Animal Resources and Fisheries.
8. Saeed AM, Ward PN, Light D, Durkin JW, Wilson RT (1987) Characterization of Kenana cattle at Um Banein, Sudan (Research Report No. 16). Addis Ababa: International Livestock Centre for Africa.
9. Lutfi M-AM, Mohamed-Khair AA, Peters KJ, Zumbach B, Kamal EAG (2005) The reproductive and milk performance merit of Butana cattle in Sudan. *Archiv fur Tierzucht* 48: 445-459.
10. Wilson RT, Bailey L, Hales J, Moles D, Watkins AE (1980) The cultivation-cattle complex in Western Darfur, Sudan. *Agricultural Systems* 5: 119-135.
11. Wilson RT (1976) Studies on the livestock of southern Darfur, Sudan. III. Production traits in sheep. *Trop Anim Health Prod* 8: 103-114. [\[Crossref\]](#)
12. Sulieman AH, Wilson RT (1990) A note on production characteristics of three subtypes of Sudan Desert sheep under station management. *Animal Production* 51: 209-212.
13. el-Hag FM, Fadlalla B, Mukhtar HK (2001) Some production characteristics of Sudan Desert sheep under range conditions in north Kordofan, Sudan. *Trop Anim Health Prod* 33: 229-239. [\[Crossref\]](#)
14. Yagoub MS, Alqurashi AM, Elsheikh AS (2013) Some reproductive traits of female Nubian goats. *Journal of American Science* 9: 285-389.
15. Abd El Gadir ME, El-Zubeir IEM (2005) Production performance of crossbred (Saanen and Nubian) goats in the second kidding under Sudan conditions. *Pakistan Journal of Biological Sciences* 8: 734-739.
16. Wilson RT (1976) Studies on the livestock of Southern Darfur, Sudan. IV. Production traits in goats. *Trop Anim Health Prod* 8: 221-232. [\[Crossref\]](#)
17. Ismail AM, Yousif IA, Fadlilmoula AA (2011) Phenotypic variations in birth and body weights of the Sudanese Desert goats. *Livestock Research for Rural Development* 23: 34.
18. Abbas B, Musa BE (1986) A rapid field survey of camel husbandry in the northern Butana (Group Document No. SRC 12). Addis Ababa: International Livestock Centre for Africa.

19. Abbas B, Saint-Martin G, Planchenault D (1993) Constraints to camel production in Eastern Sudan: A survey of pastoralists conceptions. *Sudan Journal of Veterinary Science and Animal Husbandry* 32: 31-42.
20. Wilson RT (1978) Studies on the livestock of Southern Darfur, Sudan. V. Notes on camels. *Trop Anim Health Prod* 10: 19-25. [\[Crossref\]](#)
21. Abrehaley A, Leta S (2018) Medicinal value of camel milk and meat. *Journal of Applied Animal Research* 46: 552-558.
22. Wilson RT (2007) The future for working equines: In: RA Pearson CJ Muir, M Farrow (eds) (2007) The Fifth International Colloquium on Working Equines - Proceedings of an International Colloquium held at Addis Ababa University 30 October-2 November 2006. Sidmouth (United Kingdom): The Donkey Sanctuary.
23. Musa LMA, Bett RC, Mohamed-Khair AA, Peters KJ (2008) Breeding options for dairy cattle improvement in the Sudan. *Outlook on Agriculture* 37: 289-295.
24. Mohamed-Khair AA, Teirab AB, Musa LMA, Peters KJ (2007) Milk production and reproduction traits of different grades of zebu x Friesian crossbreds under semi-arid conditions. *Archiv fur Tierzucht* 50: 240-249.
25. Agricultural Bank of Sudan (2018) About us. Khartoum: Agricultural Bank of Sudan.
26. Hansohm D (1991) Agricultural Credit In: GM Craig (ed) The agriculture of the Sudan. Oxford: Oxford University Press 116-124.
27. IFAD (2009) Country Programme Evaluation: Republic of the Sudan (Report No. 2060-SD). Rome: International Fund for Agricultural Development.
28. Saad el Medani Ahmed (1983) Interest rates in the informal credit markets of underdeveloped rural areas. The case of the 'shiel' credit in the Sudan Gezira Scheme (Rural Development Series Paper No 1). Khartoum: Department of Rural Economy, University of Khartoum. (Quoted in [26]).
29. el-Dirani OH, Jabbar MA, Babiker IB (2009) Constraints in the market chains for export of Sudanese sheep and sheep meat to the Middle East (Research Report 16). Nairobi: International Livestock Research Institute.
30. Wolz KJ, DeLucia EH (2018) Alley cropping: Global patterns of species composition and function. *Agriculture, Ecosystems & Environment*, 252: 61-68.
31. Wilson RT (2007) Perceptions, practices, principles and policies in provision of livestock water in Africa. *Agricultural Water Management*, 90: 1-12.
32. Shigidi TA (2018) Role of the Sudan Veterinary Council in the regulation of the practices of Veterinary Paraprofessionals. Khartoum: Sudan Veterinary Council.
33. de Haan C, Holden S, Peeling D (2001) The role of para-veterinarians in the delivery of veterinary services in Africa: Results of a survey of Chief Veterinary Officer's opinions. Proceedings In: 4th OIE Global Conference on Veterinary Education: Learning today, preserving our future 2001: 115-122.