Deutsche Gesellschaft für
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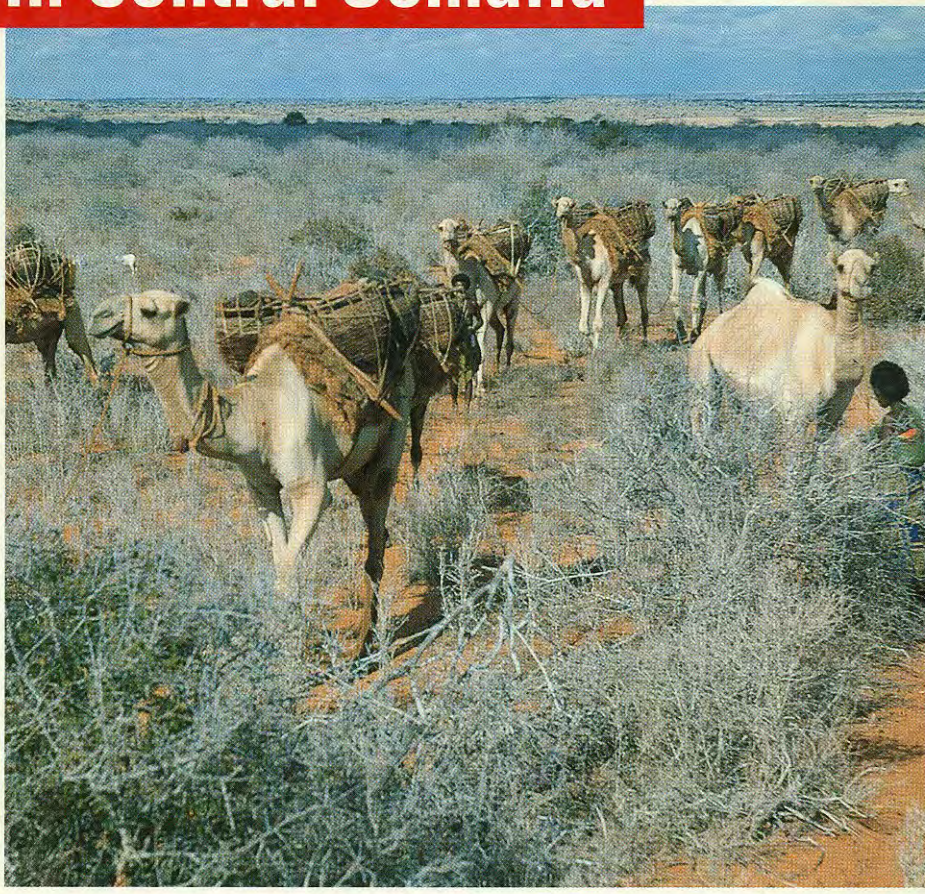
Pastoral Production in Central Somalia



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FOREWORD

For a long time it seemed as though Somalia was in an incomparably favorable situation, because, unlike other states in Africa, the people of Somalia are linked by the common bonds of language, culture and religion. But what was presumed to be the ideal basis on which to accelerate the achievement of development goals, without subordinating those goals to particular ethnic interests, proved to be a fiction. This has been clearly demonstrated not least by the dreadful events of the last three years.

After its independence in 1960, Somalia received generous assistance from the Federal Republic of Germany. Following the freeing in 1977 of the Lufthansa aircraft Landshut in Mogadishu, the assistance was extended even further. One of the key areas of the development cooperation activities was the support of nomadic pastoralism, which constituted the backbone of the national economy. During the mid-eighties, the livestock sector accounted for 47% of the gross domestic product, and 65% of the export earnings of Somalia. Even if the constantly growing herds of camels, cattle, goats and sheep did represent an increasing environmental burden, and in some parts of the country overgrazing and erosion were the result, this form of economic activity based on migration was nevertheless the only possible form of land use for large sections of the country, which is equivalent in area to France and Benelux.

In its capacity as implementing agency of the Government of the Federal Republic of Germany, the Deutsche Gesellschaft fnr Technische Zusammenarbeit (GTZ) GmbH became involved from 1982 to 1989 in the multidisciplinary Central Rangelands Development Project (CRDP), designed by the World Bank. The GTZ was responsible for the veterinary component, the forestry component, the central workshop and a part of the formal training activities. This involvement strongly underlined the importance which the German side attached to pastoral livestock in Somalia.

Yet it is precisely those traditions and way of life associated with nomadism which have led to the state of Somalia no longer existing. To a nomad (and even the majority of the urban population still has a certain affinity for their nomadic roots), allegiance to a clan or subunit thereof defines an individual's frame of

social reference. In this context, it proved impossible to create a centralistic state, particularly one which never grasped that to break traditional bonds it is necessary to put something in their place.

The impacts of the three-year-old civil war are devastating. Whereas at the outset it was the North of the country which had ruin brought down on it by the central government in Mogadishu, today it is a fact that the entire country has been thrown back in time to an age long before the state was created. It has disintegrated into a number of more or less autonomous regions. The Northwest of the country has unilaterally declared its independence.

There is no longer electricity, water, or medical supplies and treatment. Somalia has demonstrated in an alarmingly graphic way that the end of a reign of terror is not synonymous with peace, reconstruction and development.

Yet peace will return to Somalia. Reconstruction and development will then depend on the initiative of the population and on support from outside. Without doubt, nomadic pastoralism will play a key role in this process. And an analysis of the experience gained through the CRDP will be of great value and practical use in the planning and design of appropriate programs. This study is therefore a good investment in the future of Somalia.

Dr. H. Grell Dr. T. Labahn

SHIFO KU AF SAAR CAMEL-WATERING CHANT

Waa tan oo timid	They are all here, ready,
Waa na teennii	They belong to us
Waa na tolmoon	How splendid and useful they are
Waa na tubantahay	And they are standing ready.
Cagta saaray e	I set my foot (on the well),
Caalamiinkiyo	Oh Master of the world,
Caadilkow sahal	Oh God the Just, make our task easy.
Waad qaboobi ye	You will be cooled,
Qun yar soo soco	Come forward slowly.
Shifo ku af saar	Put your mouth to it with blessing,
Oo shar Kuu ma leh	It is devoid of evil,
Farihii kogay	Your shrivelled bones,
Waa kuwa fiday	Are now moist and full again.
Hadday tubantahay	When they are standing ready,
Ay tol leedahay	And the clansmen are all present,
Loo ma kala tago	None must leave till all are watered.

Author: Anonymous.
Source: Andrzejewski, B.W. & I.M. Lewis, 1964
Somali Poetry. An Introduction. Oxford.

NOTE ON TRANSLITERATION OF SOMALI WORDS

In transliterating Somali words we follow the official Somali orthography in use in Somalia since 1972 which uses Latin characters.

Three consonants, typical for the Arabic and Somali language as well, the aspirate h, the palatal d, and the ayn (´), are transliterated respectively by an ***x*** (e.g. *Maxamed*), ***dh*** (e.g. ***dh***eere), and ***c*** (e.g. ***c***eel). The glottal stop, or Arabic hamza, is rendered by an apostrophe. Accentuated vocals are doubled (e.g. ji***i***la***a***l).

The spelling of Somali words is based on Robles "Wörterbuch der deutschen und somalischen Sprache. Somalisch - Deutsch" Bonn, 1989. The geographical terms are used according to the official Somali topographical maps 1 : 100 000/ 1 : 200 000 (*Hoggaanka Kartografiyada Wasaaradda Gaashaandhigga J.D.S., 1976*)

EDITORIAL NOTE

The views expressed by the individual authors do not necessarily reflect the views of the editors nor of the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH.

PASTORAL PRODUCTION SYSTEMS IN THE DRY LOWLANDS OF EASTERN AFRICA

Horst Jürgen Schwartz

INTRODUCTION

Pasture based livestock production with domestic ruminants, dromedaries and donkeys is the dominant economic activity in the dry lowlands of Eastern Africa, which include almost all of Somalia and Djibouti as well as large parts of Ethiopia and Kenya. Common to these areas, which can be seen as the Eastern extension of the Sahel zone, are, the low and erratic rainfall divided into two distinct rainy sesons, the high risk of recurring droughts, the high rate of actual and potential evapotranspiration and the general scarcity of permanent surface water. These result in low and seasonal biomass production in the herbaceous and the woody vegetation, which in turn cause large seasonal changes of forage availability and of forage quality.

Despite significant differences in the political and economic conditions in these countries it is largely the similar ecological potential which determines the status, development and performance of livestock production in the dry lowlands.

ECOLOGICAL POTENTIAL AND CONSTRAINTS

Pratt and Gwynne (1974) have classified six ecological or eco-climatic zones for Eastern Africa. Table 1 summarizes some of the salient points of this classification. Mean annual precipitation and the number of months per year without effective rainfall are the two most significant parameters. Others, such as potential evapotranspiration, mean temperatures, the sum of sunshine hours per year, the annual and seasonal variation of rainfall and the risk of drought are closely correlated to the two key figures. With increasing aridity, i.e. with decreasing mean annual precipitation, seasonality becomes more pronounced as the periods without effective rainfall grow longer; the growing period for the vegetation becomes increasingly limited (Table 2) and the seasonal and annual variation of rainfall increases sharply. The reliability of rainfall events declines with a simultaneous increase of the risk of drought.

Table 1: Eco-climatic zones in Eastern Africa

Zone	Climate type	Rainfall [mm/year]	Months without rainfall	Characteristic natural vegetation
I	humid	> 1500	0	rain forest
II	subhumid	1000-1500	2	dry forest or evergreen bush
III	dry subhumid	800-1200	3-5	deciduous bush or thin woodlands
IV	semi-arid	500-800	4-7	deciduous thin woodlands (Acacia)
V	arid	200-500	6-9	deciduous thornbush
VI	very arid desert climate	< 200	8-11	dwarf shrubs or halophytic species

Special climate types are altitude modified variations (montane or alpine types) of the climate types I to VI; *Source:* Pratt and Gwynne 1974

Most of all land, i.e. more than 80%, below 800 m a.s.l. in Somalia, Ethiopia, Djibouti and Kenya falls into the zones IV, V and VI, some into zone III and only a narrow strip along the Kenyan coast belongs to zone II. Rainfall in Eastern Africa is bimodal, divided into two distinct rainy seasons. The long rains occur from April to June; they usually yield more than 60% of the annual precipitation and show an annual variation of 20 to 30% of the long term average. The short rains occur from mid-October to November and show an annual variation of up to 50%. If a drought is defined as the complete failure of one rainy season, it occurs in Zones IV to VI two to three times in ten years. If it is defined as the complete failure of two consecutive rainy seasons it occurs two to three times in thirty years. Complete failure of four consecutive rainy seasons might occur once in thirty years, i.e. once during the economically active life span of a pastoralist.

Rainfall, all other factors being equal, determines plant growth. Table 2 gives some coarse estimates of forage production of different vegetation components together with a value for the permissible off-take of the biomass produced. Permissible off-take has been defined as the proportion of the total biomass produced, which is useable as animal feed, if range deterioration or degradation is to be avoided (Schwartz, 1991).

Table 2: Rainfall and estimated potential forage production [kg DM*/ha/year]

Rainfall [mm/year]	DM Production Herblayer	DM Production Herblayer + Shrublayer	Permissible Off-take [%]	Growing Period [days/year]
100	450	600	25	35-65
200	1080	1600	30	55-85
300	1710	2600	40	70-120
400	2340	3600	50	125-175
500	3160	4600	50	150-220

* = Dry Matter; *Source:* Schwartz, 1991 (modified after LeHouerou and Hoste)

Biomass production in the herblayer, which is the major source of forage for cattle, sheep and donkeys, ranges from close to 500 kg/ha to just over 3000 kg/ha at mean annual rainfall values of 100 to 500 mm. The shrub layer, which is the preferred forage source of goats and camels contributes another 30% of the amounts produced in the herblayer. Permissible off-take increases with increasing rainfall from 25 to 50% of the annually produced biomass. Actual off-take through overstocking, however, often exceeds these values by far, leading to impaired vitality of the range vegetation, to shifts in the number and composition of desirable and undesirable species, to long-term reduction of biomass production and ultimately to soil degradation and erosion.

Table 3: Eco-climatic zones in Eastern Africa and their potential for livestock production

Zone	Potential Production Systems
I	Only limited potential for livestock production, mainly forests
II	Intensive milk and meat production with pure bred exotic cattle; wool and mutton production with pure bred exotic sheep; goat milk production [stocking rate 1 SSU/1.5 ha]
III	Intensive ranching with crossbred and pure bred exotic cattle, also dairy ranching; wool and mutton production with pure bred exotic sheep; goat milk production [stocking rate 1 SSU/2.5 ha]
IV	Extensive beef ranching with crossbred and indigenous cattle; meat production with crossbred and indigenous sheep and goats; goat milk production [stocking rate 1 SSU/4 ha]
V	Extensive ranching with indigenous cattle, sheep and goats; semi-sedentary pastoralism with cattle, sheep, goats and dromedaries [stocking rate 1 SSU/15 ha]
VI	Migratory subsistence pastoralism with cattle, sheep, goats, dromedaries; sales of immature cattle for fattening and sheep and goats for slaughter; sales of hides and skins [stocking rate 1 SSU/40 ha]

1 SSU (Standard Stock Unit) = 500 kg live weight = 2 TLU (Tropical Livestock Unit)

Most damage is done during the dry seasons, and particularly during drought years when the standing biomass is declining anyhow. It is important to note that the duration of the growing periods per year rarely exceeds five months and is, in the drier parts of the region, often less than two months. The implication of this is, that the seasonal variation of forage availability is aggravated by a seasonal variation of forage quality of an equal or even larger proportion.

Table 3 summarises in broad categories the potential for livestock production in the six eco-climatic zones. Increasing aridity leads to more and more extensive land use and livestock production systems. This is best demonstrated by the changes in the estimated potential stocking rates, ranging from one standard stock unit (SSU) per 1.5 ha in zone II to one SSU per 40 ha in Zone VI. Numerically the figures are correct for the drier zones only if they relate strictly to the average rainfall year and the total biomass produced during such year. Considering variations between seasons and years and, even more, the recurring droughts such calculations become irrelevant. Nevertheless, crop and livestock production has developed over many centuries in these areas and the indigenous systems appeared to be stable in supporting a considerable human population until recently.

LIVESTOCK PRODUCTION SYSTEMS IN EASTERN AFRICA

A large variety of livestock production systems can be found in Eastern Africa. In areas with higher potential mixed farming systems of all sizes of operation dominate. Production of milk and meat and the use of animal traction for subsistence purposes as well as with market orientation are practised with indigenous, improved and exotic breeds. Feedlot systems also occur in such areas; they usually large scale operations producing meat, occasionally milk, with a strong market orientation. Both systems use manufactured feeds and forage crops to a large extent.

Landless, urban systems abound in all townships and cities throughout Eastern Africa. They are usually small scale and produce milk, occasionally beef and animal traction for an urban market. The feed base is urban waste, road side grazing and to a limited extent purchased feeds. Livestock production

integrated in tree crop and plantation systems occurs to a very limited extent at the Kenyan coast where milk production under coconut and in sisal plantations is practiced by a few enterprises.

All systems mentioned sofar are of little relevance for the dry lowlands of the region, where pasture based livestock production is the dominant land use system. Pastoral production systems can be found at all scales of operation. Milk, meat, hides and skins, animal transport are the main products for traditional and modern systems alike; whereas manure as fuel, fresh blood for human consumption, as well as a multitude of ritual and social functions of livestock are characteristical of the traditional systems alone.

Table 4 summarises some key descriptors of traditional and modern pastoral systems. Common to all traditional systems is the use of communal land as pasture, whereas they differ in the degree of mobility of herds and households. With increasing aridity of the environment mobility increases and reaches the extreme in the opportunistic migratory pastoralism, often called horizontal nomadism (Johnson, 1969), which utilises the most marginal areas in the region. Modern production systems combine livestock ownwership with land ownership or with modern forms of land use rights such as short and long term leasing and are therefore without exception sedentary systems.

Constraints on livestock productivity in the traditional production systems can be divided into three different categories: normal constraints, disasters and long term, irreversible changes such as increasing population pressure and constant loss of pastoral lands. The first two have always been part of the systems and adaptive strategies have developed to compensate for their effects. The third group is of more recent origin and largely beyond the control of the pastoralists.

Normal constraints are seasonal, annual and spatial variation of rainfall and, accordingly, seasonal, annual and spatial variability of quantity and quality of the available forage. Figure 1 gives an example of the seasonal differences in available forage in an ungrazed experimental enclosure in a dwarf shrub pasture in eco-zone V in Northern Kenya (Herlocker, 1980). Other normal constraints are endemic diseases, helminth burdens, external parasites and losses through predators and stock theft.

Normal constraints can reach disastrous proportions from time to time. Rainfall variability can turn into drought, endemic diseases into epidemics and stock theft into tribal or civil war, which in turn can result in catastrophic stock losses for individual stock owners or even whole groups of pastoralists.

Table 4: Pastoral Production Systems in Africa

Traditional systems	
Agro-pastoralism Zone III and IV	combining crop production and grazing of domestic stock on individually owned and on communal land in the immediate vicinity of a permanent homestead for subsistence and marketing
Sedentary pastoralism Zone IV	grazing individually owned domestic stock on communal land in the vicinity of permanent homesteads throughout the year
Semi-sedentary pastoralism Zone IV and V	grazing individually owned domestic stock on communal land in the vicinity of a permanent homestead for part of the year and long-distance movement of the herds during the wet season or growing period
Migratory pastoralism (Nomadism) Zone V and VI	grazing individually owned domestic stock on communal land and moving herds and homesteads as seasonal forage supply demands
Modern systems	
Commercial ranching	grazing domestic stock on individually owned land for marketing
Group ranching	grazing domestic stock on group owned land for subsistence and marketing
Contract grazing	grazing individually owned domestic stock on contracted land

TRADITIONAL ADAPTIVE STRATEGIES

As an insurance against such events pastoralists strive to increase stock numbers, in order to provide security in case of losses, to leave a remainder of feasible size, to rebuild his herd. Thus, the expansion of herd sizes in "normal" times, not stricken by drought, disease or unrest, is a rational strategy and not a projection of prestige, social status and wealth. Although it is true, that parallel to increased numbers of animals, an increased social standing for the owner will develop, this has to be seen as a favourable by-product of an effort to safeguard future survival.

Traditionally, risk-reducing adaptive strategies are herd diversification and herd dispersion. Herd diversification is practiced as an insurance against major disease outbreaks since the different domestic species are generally not susceptible to the same pathogens. Beside this, the different dietary preferences of the various domestic species also allow for a better utilization of pastures that may not be suited for one or the other domestic herbivore species. Herd dispersion is a second risk-reducing strategy, which is frequently practiced in traditional systems. Stock owners separate their herds and have them herded in areas sometimes up to several hundred kilometres apart; this is primarily a measure against forage shortages and raiding. If the family is large enough, the different herding units are managed by its members, and family reunions and rearrangements of the different stock sections take place either during the rainy season or during certain ritual occasions.

A related form of dispersion, although of a different significance is the formation of stock alliances and stock patronages that is independent of family size and social status. Individual animals or small groups of animals are given out to other stock owners who are either needy or in some way entitled to compensatory claims. Often the animals are never recovered by the original owner, but in times of hardship the son or even grandson might reclaim some or even all of the loaned stock from the recipient's heirs. This risk reducing strategy is common among all pastoralists whose social organization is based on clan and ageset structures and should be regarded as a system of social security rather than an actual management tool.

The most conspicuous adaptive strategy of migratory pastoral production systems was, and still is, the mobility of households and herds. The migrations which are dictated by the availability of forage and water can follow various patterns but are always characterized by the combination of individual stock

ownership and communal land use. This combination does not usually promote sustained-yield resource exploitation whenever land becomes scarce, and in particular when dry-season grazing reserves are no longer accessible. If confined to rainy season pastures throughout the year, the mobility of pastoral households and herds will be reduced to only minor moves, for hygienic or ritual reasons, since energy expenditure for a major move is not compensated for by a significant improvement of pastures.

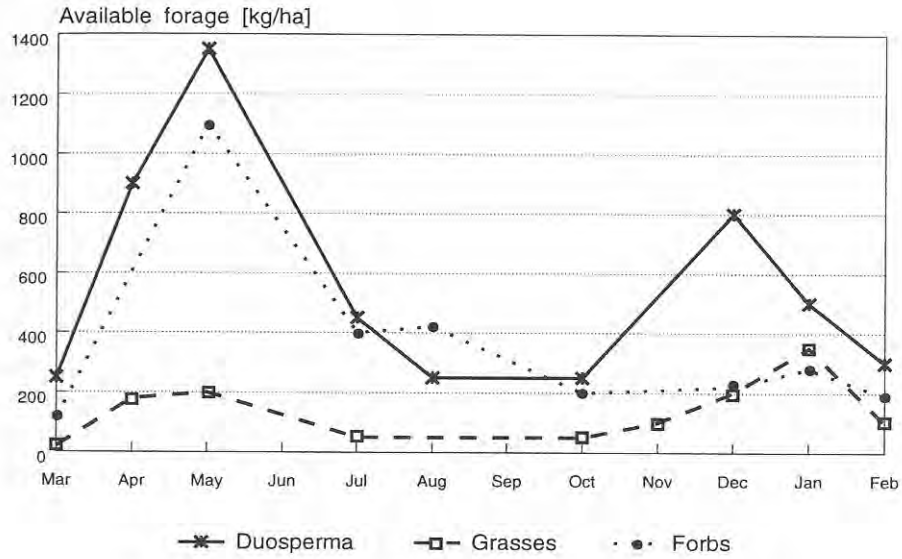

Figure 1: Seasonal changes of available forage biomass in a non-grazed experimental exclosure on a pasture dominated by the dwarf shrub *Duosperma eremophilum*

The most important production targets of traditional pastoralists are listed in Table 5. All traditional adaptive strategies aim at realising these production targets. The production or development targets of the national governments in the region and/or development aid organisations, however are different and often conflicting.

Table 5: Targets for pastoral livestock production

Pastoralists	National Governments
maximising subsistence products (milk, meat, blood, skins, work)	promote national self sufficiency of food production (meat, milk)
meeting social obligations (bride price, stock alliances)	generate export products (meat, fibre, skins)
providing disaster insurance (drought, epidemics, raids)	alternative land uses (tourism, irrigation agriculture, forestry)
marketing surplus products and live animals (various cash requirements)	resource conservation and rehabilitation

STATUS AND TRENDS IN PASTORAL LIVESTOCK PRODUCTION IN EASTERN AFRICA

Traditional pastoral production systems have remained stable for a long time, particularly through flexible responses to short-term variations of the climatic conditions. Today, however, numerous demographic and economic changes of long-term nature occur which trigger adaptive changes likely to transform this system significantly. The most salient feature is an emerging precedence of market oriented production over the traditional subsistence production. The major changes in the system are as follows:

- Increased population pressure: Pastoral populations are increasing steadily in the whole region. These increases are at slower rates than in agricultural and urban groups, but may reach as much as 2% per year, which is no longer compatible with the human support capacity of the land.
- Losses of pastoral lands: A constant loss of pastoral land has to be noted. Competing land use systems such as commercial ranches, rainfed and irrigated agriculture and National Parks and Reserves occupy increasingly the small pockets of high potential land within the pastoral areas.
- Reduced mobility: Increases of the pastoral population and simaltaneous losses of communal pastures are leading to a reduced mobility. Deterioration of the internal and external security aggravates this.

- Environmental degradation: The major effect of these developments is a general, but locally often severe environmental degradation, particularly around permanent settlements, mechanized water sources, mission stations etc. Although it can be generally stated that semi-arid to arid pastures show a remakable recuperative potential in times of good rainfall, it cannot be denied that irreversible destruction of range vegetation has occurred and is spreading.

STATUS AND TRENDS IN PASTORAL LIVESTOCK PRODUCTION SPECIFIC TO SOMALIA

In Somalia in particular, developments have taken a more specific course. Livestock movement was never very extensive in Somalia, as it was restricted as much as possible to traditionally demarcated ranges known as *degaans*. Movement across *degaans* was usually observed only in dry years or in the very dry inland areas. Recently, induced by intensive water development, commercialisation and emigration of labour, herds became more and more attached to semi-permanent settlements in the vicinity of watering points.

A phenomenon related to increased sedentarization in Somalia is the enclosure and privatisation of formerly communal range areas by the pastoralists themselves. This practice has gained momentum through water development, the accelerated breakdown of social structures regulating range utilisation, changing government land tenure policies which promote agricultural activities in marginal areas, commercialisation of forage production, the emergence of an urban milk market and other factors.

Agro-pastoralism is the predominant land use system in the inter-riverine areas in Southern Somalia and has proved itself an enduring and resilient adaptation to semi-arid environments. In the Bay region a total livestock biomass of more than 8,000 kg/km^2 has been reported in the most intensively cultivated areas of the country. Presently similar systems are expanding to both the upper and lower Jubba region. Seasonal cultivation of rainfed crops combined with open-range livestock herding is common in the North-West region and is also increasingly found in the Central Rangelands.

The change from a long ranging and highly mobile herding system to a short-range and semi-sedentary one bears the potential for both negative and positive effects. Amongst the most obvious negative effects are:

- the increased risk of environmental degradation,
- increased production risks for the individual herd owner as well as for the industry as a whole due to the disappearance of traditional adaptive management strategies,
- and the accelerated breakdown of social structures which previously served as a form of social security system within herding communities.

The emerging trends toward short-range herding systems have definitely deleterious effects on range vegetation and soils. Severest impacts are found around permanent wells and boreholes and in the immediate vicinity of permanent settlements. They are, however, limited spatially to a small section of the total range. Range enclosures and privatisation on the other hand may lead to more widely spread damage. Grazing pressure on the residual open range is becoming exhaustive, migrations have to be rerouted, some migration routes may be closed permanently, thus increasing pressure on others, and, since areas with higher potential are usually enclosed first, the residual open range areas possess lower support capacities and are prone to faster degradation.

Enclosed range areas, although generally of slightly higher potential than the open range, are not immune against diminishing range condition, since stocking densities are rarely matched to the carrying capacity but rather to the needs and demands of the stock owners, which often results in overstocking. Additionally, erratic spatial rainfall distribution during certain seasons or years may reduce forage growth in some enclosed areas and lead to temporary but severe overstocking and irreversible degradation. This may be aggravated if the breakdown of traditional resource-sharing attitudes in the pastoral system prevents emigration of herds from private lands.

Dry land farming, which is expanding within the agro-pastoral context, has adverse effects on range condition and soils. Land clearance and the sparse and temporary ground cover provided by annual crops favour increased erosion and often lead to irreversible degradation of range areas (desertification).

The consequence of all these effects, beside the inevitable range degradation, is a slow decline of herd productivity, reduced size of individual livestock holdings and productive land, and an increasing drought susceptibility of the whole system.

MODERN ADAPTIVE STRATEGIES

At this point it should be noticed, that the term "modern" does not apply solely to recent or present developments, though for most African pastoralists it coincides with the respective dates of independence. All changes that are presently regarded as modern, or until recently "not known" to the traditional system, already had their preparatory phases during the colonial era, in which nomadic herdsmen had been classified as belonging to the dark ages. Therefore, in order to understand why modern adaptive strategies are mostly directed at non-pastoral sectors, it is necessary to recognize this process as intrinsically political rather than the result of rapidly changing environments. Except for animal health services, which are few and far between in most pastoral areas, "modern" herdsmen will seek, at least partially, improvements of their livelihood in activities other than livestock rearing.

Particularly those pastoralists that became impoverished after the devastating droughts in the 60's and 70's, who in earlier times may have been able to reestablish themselves in the pastoral sector through various social mechanisms (stock alliances, stock patronages), will nowadays turn to irrigation agriculture, where projects are in operation, seek wage labour (usually in low-income brackets) or attempt to live on famine relief. These alternatives, especially the latter two, are of steadily increasing importance since the recuperative potential of the traditional livestock economies is declining, for the already indicated reasons. On the other hand, many wealthy pastoralists have successfully invested in non-pastoral sectors by engaging themselves in trade and business using the structures of the remnant economy to stimulate local markets for foreign goods. Formal education and training is seen as another form of capital investment since it increases the chances for jobs in the higher income brackets, that in turn are the only ones to allow reinvestment in the pastoral sector. Thus, the recuperative potential of the pastoral sector is augmented by non-pastoral activities, though limited to small portions of the population. Today, roughly two thirds of pastoralists world-wide live below the poverty line, that is to say, are not self-reliant in terms of food production. Only a very small minority of the pastoral population is affluent enough to diversify their economic activities into non-pastoral sectors.

DEVELOPMENT OPPORTUNITIES

Pastoral livestock production systems increasingly fails to secure food supplies for a rapidly increasing population. Given the present demographic and economic tendencies, it is obvious that these trends will not be reversed in the foreseeable future.

While sedentarisation and range enclosure can have various negative environmental impacts, they may also offer opportunities for improved land management, permanent investments into land productivity and the application of innovative technologies. Small favoured areas in the range lands such as run-on areas and drainage lines may be used for forage and/or food crops, agricultural by-products may become available in increased amounts to stabilise feed supplies during the dry seasons, deferred grazing systems and small scale water harvesting schemes may be feasible for specific groups such as enclosure herders, range livestock associations and agro-pastoralists.

If increasing sedentarisation is to have some positive effects on pastoral livestock production, three sectors have to receive particular attention:

- Improvement of livestock productivity: The productive potential of herds under traditional pastoral management is very rarely fully utilised. A great number of the biological contraints are known and various means to reduce the effects of these contraints are well tried. Routine animal health programmes are most easily applicable and usually have immediate positive results. However, very little solid information is available as to whether such inputs can be paid for with the anticipated increases in production.
- Improvement and management of pastures: The management of natural pastures is restricted to maintaining adequate stocking rates and practising some form of grazing rotation. If pastoral areas are sparsely populated and include access to reliable dry-season pastures, this presents no problem. Neither of these two conditions can be met at present. Long-term protection of larger range areas is impossible to achieve without a large police force. Compulsory destocking, which has been suggested frequently in the past, would further reduce the already narrow base for subsistence of the pastoral population.

- Stratification of the pastoral economy: It is common practice to talk about carrying capacity in connection with grazing animals. In a pastoral economy where animal numbers should be in a stable proportion with the number of people whose subsistence requirements have to be met, the same term has to be applied to the human population. At present the human support capacity in the dry lowlands of Eastern Africa is grossly exceeded. Since neither primary productivity (pasture) nor secondary productivity (livestock) can be easily improved, it is of highest importance to relieve the pastoral systems by developing alternative means of livelihood in the non-pastoral sector of the national economies.

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MOBILE LIVESTOCK KEEPING IN SOMALIA: GENERAL SITUATION AND PROSPECTS OF A WAY OF LIFE UNDERGOING FUNDAMENTAL CHANGE

Jörg Janzen

INTRODUCTION

Nowhere in Africa is nomadism, or rather mobile livestock keeping[1], of such great significance as in Somalia. The only country in the Asiatic part of the Old-World dry belt[2] in which mobile livestock keeping enjoys comparable importance is Mongolia.

Somalia has a population of about 6-7 million people living in an area of some 638,000 km², which is roughly 1.8 times the area of Germany. An estimated 50 % of the population are engaged in mobile livestock keeping, with differing degrees of variability in the location of animal production and residence over time. The other half of the population comprises town dwellers and farmers to roughly equal parts (MLFR/GTZ, 1990:2), but these usually maintain considerable contact in a variety of ways with the rural and nomadic areas. It is becoming ever more difficult to differentiate between the various groups in clear statistical terms because, as can readily be observed, there is a rapidly unfolding process involving the formation of numerous transitional and combined forms of nomadic and sedentary ways of life in the rural sector.

In order to illustrate the great economic significance of mobile livestock keeping in Somalia, it would be helpful first to quote a few figures. The Somalis, who constitute no more than 0.83 % of the population of Africa in an area only 2.1 % of the total, keep 43 % of the camels, 10 % of the goats, 5 % of the sheep and 2 % of the cattle of the entire continent (MLFR/GTZ, 1990:3). In absolute terms, the estimated numbers of livestock in 1989 were approximately 6.3 mill. camels, 19.5 mill. goats, 11.8 mill. sheep and 4.6 mill. cattle, together amounting to the equivalent of approximately 13.1 mill. tropical livestock units (TLUs) (MLFR/GTZ, 1990:4; cf. Map 2).

Somalia is an important livestock exporter. The main markets are the oil-rich countries of the Arabian Peninsula, above all Saudi Arabia. Sheep and goats are exported in the largest numbers. The export of camels and cattle has sharply declined (cf. Fig. 1). On average about 80 % of Somali foreign-currency earnings over the past 10 years were generated from livestock exports. The contribution of the livestock sector to the generation of the GNP over the same period was consistently just under 50 %.

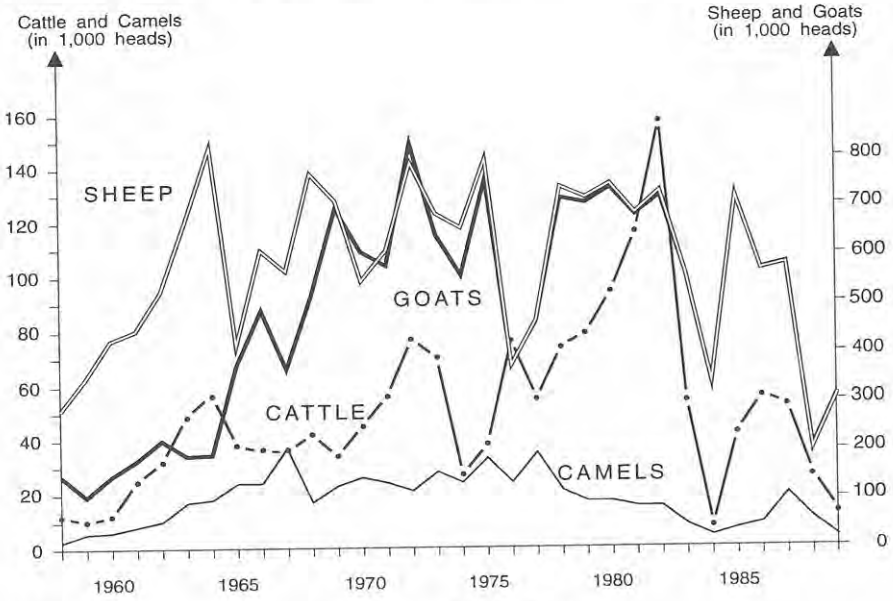

Figure 1: Somali Livestock Export 1958 - 1989

Source: MLFR, 1990:26-28; *Design:* J. Janzen, 1992

The purpose of this paper is to describe the general conditions under which mobile livestock keeping has been and is being pursued in Somalia. This involves more than simply considering the physical and geographical situation: only when legal, social, economic and political (development policy) aspects are taken into account is it possible to gain greater insight into this means of earning a livelihood and the associated development problems.

The primary question to be considered is how the currently established structures and the specific problems of mobile livestock keeping in Somalia came into being. In addition it is intended to illustrate why this way of life continues to be of such great importance for the majority of Somalis and what prospects are open to mobile livestock keeping in the future.

NATURAL CONDITIONS AND AVAILABLE RESOURCES

An important prerequisite for improving understanding of the relationships between man, animals and the natural environment in Somalia is knowledge of the ecological circumstances prevailing in that country.

In physical geographical terms, the Somali peninsula is the eastern spur of the Sahel zone. However, Somalia is by no means a homogeneous region with regard to soil, vegetation and climatic conditions. Although arid and semi-arid climatic conditions prevail on the Somali peninsula, distinct regional differences can be detected within the Horn of Africa with regard to annual variation of temperature and precipitation (cf. Map 1). The causes of this are to be found in the broad meridional extension of the country from approximately 2° south of the equator to about 12° north, and varying orographical conditions, with maximum altitudes of up to 2,416 m in the case of the *Surud Cad* in the North Somali coastal range and low-lying coastal plains in southern Somalia. The seasonally varying effects of the northeast trade winds and the southwest monsoon also have to be taken into account.

Looking at the climatic conditions in a precipitation profile, we obtain the following pattern (cf. Map 1). Measurements of precipitation reach particularly high average annual values on the mountain flanks of the North Somali coastal range. Total precipitation of well over 600 mm is registered to the northeast of *Ceerigaabo* and to the northwest of *Burco*. Immediately adjacent to the north, however, in the narrow coastal zone along the Gulf of Aden, the long-term average values fall to below 100 mm. The highly arid, desert-like northeast is

linked to a zone of particularly low precipitation with values between 100 and 200 mm extending southwestward across the entire central part of Somalia and the neighbouring Ogaden. Average annual values of over 200 mm are not reached again until as far south as the *Galguduud* region. Precipitation increases considerably again with greater proximity to the equator, reaching its highest level, more than 600 mm, in the southwestern interfluve and along the lower reaches of the *Jubba*.

The northeast trade winds play a decisive part in the aridity of northeast and central Somalia, bringing with them hot, dry air from southern Arabia during the northern winter (the major dry season from December to March, the *jiilaal*) with great regularity. Even the moisture-laden winds of the southwest monsoon, which affect the eastern coast of Somalia during the northern summer (the minor dry season from July to September, the *xagaa*), bring only relatively little rainfall. The *xagaa* showers, as they are known, have little effect further inland except for in the south of Somalia, where they can be of considerable significance for arable farming and natural grazing during the minor dry season. The lack of prominent topographical elevations in the coastal zone and cold upwelling water in the shelf region causing coastal fog are primarily responsible for the low amounts of precipitation in the coastal zones of central and northeastern Somalia.

Most precipitation occurs in the form of convection rainfall during the main rainy season (April to June, the *gu'*) and the minor rainy season (October to December, the *dayr*), when Somalia is under the influence of the intertropical convergence zone (ITCZ). The precipitation falling at these times of year is essentially responsible for the condition of the natural pasture and the availability of water in areas away from the rivers.

Recurrent, but usually regionally limited periods of drought are typical of Somalia. They are a consequence of the high variability of the precipitation. Such dry periods constitute a major problem for the farmers and nomads, because they not only lead to production shortfalls but frequently also result in catastrophic losses of crops and livestock.

In much the same way as the prevailing orographical and hygric conditions, distinct regional differences can also be established for the temperatures (cf. Map 1). In northern Somalia the highest values are recorded during the summer months and the lowest values during the winter months. In southern Somalia, however, close to the equator, the maximum temperatures occur in the second half of the main dry period in March, and the minimum temperatures during the

minor dry season in July. The highest average annual temperatures measured are 30.6°C at *Luuq* in southern Somalia and 30.1°C at *Berbera* on the north Somali coastal plain. The lowest long-term average annual value is 17.6°C at *Ceerigaabo* in the north Somali uplands. Whereas hot and dry weather is typical of the interior of the country, unpleasant hot and humid conditions prevail in the vicinity of the coast.

The nomads respond to temperatures being too high or too low by temporarily moving their location. For example, the northern Somali coastal plain along the Gulf of Aden is virtually uninhabited during the hot summer months. The livestock keepers stay on the cooler elevated tablelands during this time. At the start of the cold winter months, relocation takes place in the opposite direction (see Map 3).

In order to understand the prevailing soil and vegetation conditions it is important to take a brief look at the geological constitution of the Somali peninsula. The wide plateau areas of north, central and the northern part of southern Somalia, sloping down gradually from the northern Somali coastal mountains across the Ogaden towards the Indian Ocean in a southerly direction, largely comprise geologically young marine sediments (mainly Upper Jurassic and Middle Eocene limestone, gypsum and anhydrites). Mostly shallow soils of a yellow to orange colour have formed on this source rock. In certain parts of the country where sandstone formations lie on the surface, such as in the Hawd area of East *Hiraan*, red sandy soils are also widespread.

The south of the country is dominated by extensive lowland plains along the lower reaches of the only two perennial rivers in Somalia, the *Shabeelle* and the *Jubba*. Deep alluvial soils and adequate precipitation offer favourable conditions for rainfed and irrigated agriculture (see Map 3). The fertile lowland plains along the rivers are also the traditional dry pasture regions for the nomads. The luxuriant grass vegetation provides a good basis for fodder, particularly for cattle. On account of the distribution of the tsetse fly, however, their use is restricted to the dry season.

From the Kenyan border in the south to just north of *Hobyo*, the coastline of Somalia is accompanied by a quarternary dune belt. In the south it is still relatively narrow, reaching its greatest width, several tens of kilometres, in its northern part, in central Somalia (cf. Map 1). This quaternary dune region is subject to more intense utilization than the surrounding plateau areas. An agro-pastorally oriented population pursues mobile livestock keeping here, in combination with rainfed farming. The main cultivated crops are sorghum and red beans.

In parallel with the predominant climatic and pedological conditions, the vegetation also varies greatly throughout the country. Sparse semi-desert vegetation on the coastal plain along the Gulf of Aden and at the northeastern tip of the Somali peninsula, found especially on the edges of dry river beds (*toogs*), gives way gradually to denser thorny savanna formations to the south and northwest. On the upland plains of northern and in the coastal zone of central Somalia there are extensive grasslands, which are of great significance particularly for raising sheep.

The more humid south of Somalia is characterized by dense thorny savanna vegetation. Tree pasture provides a good basis for keeping camels and goats. Cattle raising is most widely distributed in the south of the country on account of the available grass vegetation. The dense acacia stands in the quaternary dune zone running parallel to the coast in southern Somalia and in large areas of the interfluve have been greatly reduced due to extensive clearing to make way for rainfed farming and for the purpose of obtaining charcoal. The increased density of thorn bushes resulting from this reduces growth of grass vegetation and hampers access of animals to large areas and has a negative effect on mobile livestock keeping.

TRADITIONAL WAY OF LIFE OF THE MOBILE LIVESTOCK KEEPERS

The Somali people remain to this day in the majority a nomadic society, comprising a multiplicity of numerically significant clan families, clans and their subgroups. Each ethnic group formerly possessed precisely delimited grazing lands with the associated watering places. On account of the seasonally changing conditions with regard to the availability of pasture and water, the nomads are still today to a large part reliant on long-range migratory movements with their livestock and households, often across national borders (cf. Map 3). In the course of searching for the best pasture land and the most abundant water sources, armed conflicts were a frequent occurrence; it has been possible to bring these largely under control, but only after the country gained its independence.

In central and northern Somalia the means of earning a livelihood takes a primarily nomadic form. The south of the country enjoys more favourable vegetation, soil and climatic conditions, and is dominated by a semi-nomadic population, apart from the neighbouring sedentary, often negroid population on

either side of the *Shabeelle* and *Jubba* rivers engaged in arable farming. Although rainfed agriculture (the main crop being sorghum) is quite significant in large areas, here, too, mobile livestock keeping is usually the most important constituent of economic value creation. The division of labour within the (frequently polygamous) families of the semi-nomads is even more greatly differentiated than among the pure nomads because the production conditions for cultivation often demand further seasonal segregation of the working members of the family group.

In numeric terms, the most important herd animals in nomadic livestock keeping are goats, sheep, camels and cattle; these are all to be found throughout Somalia, but in different proportions of the total stock on account of the differing ecological conditions in the various parts of the country (cf. Map 2). Whereas dromedaries can be observed in considerable numbers even in the very arid northern regions due to their undemanding nature, the distribution of cattle, for example, is particularly dependent on the availability of good pasturage and watering opportunities, as is the case in the south and northwest of the country. Goats and sheep are to be found everywhere in Somalia. Sheep are most widely distributed in the coastal region of central Somalia with its predominance of grass vegetation, but also on the flat upland areas of northern Somalia. Goats occur in combination with sheep husbandry, and are clearly the dominant animal in areas of higher relief and in regions with dense thorny savanna vegetation.

In the nomad's traditional economic system, the keeping of livestock is primarily aimed at supplying the subsistence sector with livestock products, especially with fresh milk and milk products. The animals, and this used to apply above all to the large livestock, represent the pride and wealth of their owners. The animals are not kept merely for the purpose of nutrition but also as a means of payment on all conceivable occasions, for example in response to demands for blood money or for paying a dowry. The overriding production objective is therefore to obtain a numerically large herd, which is often achieved at the expense of the quality of the livestock. Moreover, the owner of a large herd has a better chance that at least a small proportion of his animals will survive in the event of the droughts that repeatedly occur and can be used as a foundation for the rapid build-up of a new, large herd. In addition, the nomads used to suffer greater losses than they do today as a result of predators, infectious diseases and theft.

CHARACTERISTICS AND BACKGROUND OF THE STRUCTURAL CHANGE IN MOBILE LIVESTOCK KEEPING

The recent changes that have taken place in nomadic life in Somalia are many-faceted, but only a few aspects which are important for understanding the present situation shall be discussed here.

During the British and Italian colonial period and in the first nine years after independence, there was still relatively little external influence on the nomadic habitat. However, this situation was to change rapidly after the socialist revolution of 1969. The new regime took up the fight against tribalism and ignorance. All tribal lands were nationalised and attempts were made to deprive the traditional leaders of their power. The consequences were legal uncertainty and greater mistrust on the part of many nomads with regard to the new government. In some cases traditional areas of jurisdiction lost their meaning, because above all nomads from politically and militarily influential clans took it upon themselves to claim the right to use water and fodder resources to which they previously had no access.

In order to make rapid progress towards the stated aim of a just, socialist system of government and society, the regime proclaimed one of its primary objectives for future development to be the settlement of as large a part of the nomadic population as possible. The great *Dhabaadheer* drought of 1974 proved supportive of this goal. In 1975 about 120,000 nomads who had lost the basis of their livelihoods, mainly originating from the northern parts of the country, were settled in six large-scale settlement projects, these being three farming projects and three fishing projects, by "voluntary compulsion" with Soviet support (cf. Haakonsen, 1979; Labahn, 1982:81-85; Mohamed and Touati, 1991:63 ff). Despite considerable efforts on the part of the government, all of these projects must today be classed as failures, due to overhasty implementation, serious planning errors and above all the nomads' aversion to tutelage and control (cf. Janzen, 1984:162-168).

Since that time there have been no more new government-planned settlement projects. Other problems, such as the loss of the Ogaden war and the resulting waves of refugees into Somalia from 1978 onwards, laid claim to the organisational forces and especially all financial resources of the country.

As a result of the increasing commercialisation of the livestock economy due to a lhigh demand for livestock from the oil-rich Arabian countries and the infrastructural opening of parts of the nomadic habitat, the process of

independent, uncontrolled settlement of nomads was accelerated, in northern and central Somalia in particular (cf. Mohamed and Touati, 1991:63 ff). As these people normally persisted with animal husbandry, the outcome was an early aggravation of the ecological problems, especially in the northern and central parts of the country and above all in the immediate vicinity of the settlements.

The growing market orientation in the livestock-raising economy has above all brought with it a variety of changes in the socio-economic sector in the regions mentioned above. Among other things it can be observed that the lucrative trade in livestock has created a stratum of wealthy livestock owners. These are generally people who belong to an influential clan and have been able to put this advantage to use for their own private economic interests (Stern, 1988a, 1988b). One example of how this appears in practice is that zones of private usage are simply marked out in the traditional areas of jurisdiction (*degaan*) of the clans or their subgroups, where according to tradition grazing is organised on the basis of community interest and customary law. Such appropriation of clan territory manifests itself not only in the construction of private water gathering facilities such as open catch basins or cement-lined, covered cisterns (see colour plates), but also in the creation of wide-ranging enclosures of good pasture land for use as private reserve pasture during the dry seasons (see colour plates). Less influential nomads are clearly disadvantaged by being often deprived of the best natural grazing land in this way. Moreover, the erection of such fences constitutes an impediment to established geographical mobility patterns. The ousting of less influential nomadic families to marginal, less productive grazing locations may result in overstocking and overgrazing of these areas and play a considerable part in the degradation of the vegetation and soils.

There are, however, other factors which have taken effect in the areas in which the nomads live. As a result of the political opening to the West following the break with the Eastern Block in 1978, Somalia received considerable amounts of development aid from Western donor countries and international organisations. Although the bulk of the financial aid benefited the development of irrigated agriculture, a variety of projects were also implemented in the nomadic areas. In this context, two projects under the name of "Rangeland Development Projects" are particularly worthy of note. The primary objective of these projects was, and still remains, to improve the production conditions for export-oriented livestock husbandry, with the main emphasis on measures to protect pasture land.

Within the scope of the Northern Rangeland Development Project, large reserve pasture areas were created for periods of drought, new watering places established and livestock cooperatives set up on the principle of rotational grazing (Janzen, 1984:160-162; Swift, 1977:275-305). This large-scale project certainly contained a number of promising approaches to change. However, a lack of basic research, insufficient involvement of the nomads in the planning and implementation of the project, disregard for rotational grazing, private enrichment of certain nomad groups and interference with the migration of nomads who were not organised in the cooperatives, to name but a few of the main problems, meant that the project was doomed to failure.

In the second, more recent project in central Somalia, the Central Rangeland Development Project (see Map 4), the intention was to avoid all too massive interference in the way of life and economic system of the nomads, as in the case of the first project. By improving water supplies and setting aside up to 30% of the area under the auspices of the project as pasture reserves for periods of drought, accompanied by veterinary services, it was hoped to be able to improve the production conditions and to contribute to the preservation of the pasture areas (cf. among others Mascott Ltd., 1986).

To conclude the description and analysis of the situation in Somalia, attention should be drawn to one aspect of the recent changes to the nomadic habitat which will constitute a major problem in the future development of the country and hence represents a special challenge: **the control of desertification**. This must be recognised primarily as being a consequence of inappropriate land utilisation, and therefore appears first and foremost to have its roots in socio-economic and development-policy factors.

The research into structural changes in agriculture undertaken by the author in the rural regions of Somalia between 1982 and 1989 also provided greater insight into the background to the desertification process. The impression was gained that mobile livestock keeping cannot be made causally responsible for the in some cases disastrous destruction of vegetation and soil, as is frequently maintained, but instead above all the national development policy which is oriented towards the interests of the urban upper class. To this were added ecologically inappropriate political decisions, such as the construction of deep wells in certain clan regions, by means of which the government of the time intended to secure the political and military loyalty of those groups.

It was possible to observe that signs of desertification had stayed within certain limits up to that time in those parts of the country in which the autochtonous patterns of land use by the nomadic livestock keepers were still largely intact, based on precise knowledge of the physical conditions and characterised by a high degree of mobility. In contrast, in those areas in which there had been massive intervention in the established structures by external influence, symptoms of desertification could be observed, in some cases serious.

There are many causes behind this. The most important reasons for advancing desertification are listed below.

- The continuing expansion of livestock numbers despite the recurrent droughts and the resultant losses, above all due to the implementation of government and private veterinary measures, on the same area of pasture land or even, in zones bordering the cultivated regions, on shrinking areas of land.
- The settlement of nomads in an urban or rural environment, supported either directly or indirectly by the government, in some cases involving the taking up of arable farming in marginal areas and other non-pastoral activities (retail trading, haulage business, itinerant working at home and abroad), while at the same time retaining at least part of the livestock husbandry activities, predominantly in the immediate vicinity of mostly new rural settlements with high-yield watering places and in the towns.
- The reduction in migration distances covered in a seasonal rhythm, among other things resulting from the settlement process, as a consequence of the restructuring of the herds (particularly observable in the northern parts of the country) to the disadvantage of ecologically compatible camels and in favour of more easily marketable small ruminants (goats and sheep), but also in part due to political and military restrictions on cross-border migration to the Ogaden region, which lies within Ethiopia but is inhabited by Somalis and is claimed by Somalia.
- The orientation of nomadic animal production towards the market, particularly in large parts of northern and central Somalia, as a result of which high-yield deep wells and large water collection basins have been dug almost everywhere by the government, as well as cisterns installed by the private sector (see colour plates), enabling people and animals to stay considerably longer than before in the vicinity of these watering places, long into the dry season.

- The large-scale expansion of irrigated agriculture into the pasture areas along the *Jubba* and *Shabeelle* rivers traditionally used by nomadic livestock owners during the dry seasons.
- The rapidly increasing felling of certain types of acacia for the production of charcoal in the northwestern parts of the south Somali interfluve area, intended to supply the fast-growing urban population, with the negative consequence for livestock keeping of the further spread of thorn bushes and a reduction in grass vegetation.

Each of these processes of change necessarily leads to greater concentrations of livestock in smaller areas, promoting the formation of points of desertification and, ever more frequently, the desertification of entire areas.

The question thus arises as to how these detrimental changes to the ecological balance can be counteracted, and what practical action could be taken by the government and development agencies.

PROSPECTS FOR MOBILE LIVESTOCK KEEPING AND RECOMMENDATIONS FOR DEVELOPMENT POLICY

The changes occurring in mobile livestock keeping as outlined for the example of Somalia also apply in structural terms to many other countries of the Old-World dry belt. None of these countries - with the exception of the relatively thinly populated oil and gas-rich states of North Africa and the Arabian Peninsula - can normally afford not to make use of their wide-ranging steppe and savanna regions for nomadic pastoralism. On the contrary: it is essential to find timely resource conservation strategies in mobile livestock keeping for these often greatly overused natural pastures.

The various regionally specific forms of mobile livestock keeping continue to represent an economically significant sector in these countries. Not only do they provide millions of people in rural regions with a means of economic existence, thus counteracting the rural exodus, they also make a major contribution to the generation of urgently needed foreign currency for the national budget - a factor that particularly applies to Somalia.

In the opinion of the author it can be considered an undisputed fact that mobile livestock keeping is an "optimum active human adaptation to the physical environment of arid and semi-arid areas, and is probably the only possible way of putting the barren pastures of these regions to economic use without an immense expenditure of capital" (Scholz, 1986:113). This fact is

frequently not adequately recognised nor taken into account by representatives of the urban elites of these countries, nor even by development experts. Instead, to suit the interests of the urban upper classes, priority in national development planning is usually given to costly and prestigious projects promoting irrigation, industry and infrastructure.

In view of this situation it should be a primary task of experts concerned with questions of mobile livestock keeping to continually emphasise to the local decision-makers the benefits of this method of husbandry under the conditions applying in the Old-World dry belt. Neither government-enforced settlement programmes nor technocratic pasture farming systems imported from the industrialised countries constitute appropriate development concepts for the arid zones of the Old World. It would make more sense, on the other hand, to adapt autochtonously established land-use systems of mobile livestock keeping to the requirements imposed by the changed ecological, socio-economic and cultural conditions, and to develop them further in modified form. Apart from securing basic needs, low-cost measures aimed at promoting self-help should also allow for improving the possibilities for marketing the livestock.

There can be no uniform concepts that can be applied to all "nomadic countries"; the regional differences are too great. However, certain aspects do have supraregional applicability, and these should therefore be taken into account in planning.

Firstly there is the principal requirement to ensure the maximum possible geographical mobility for the livestock owners, because this is the only way of guaranteeing the greatest degree of **conservation of resources** and **renewal of resources** with regard to soils and vegetation. In every rural development plan, care must always be taken that the migratory movements related to animal husbandry are not impeded. Particularly when expanding the area of arable farming, it is essential to ensure that the spatial requirements of the livestock owners are taken into account. Where nomads regularly move across borders between neighbouring countries, legally binding agreements should guarantee the greatest possible degree of freedom of movement. The large-scale fencing of privately used reserve pasture areas must also be seen as an impediment to the movement of livestock for the majority of nomads. With regard to the utilization of the pasture lands, care should be taken that a sensible combination of various types of animals not only ensures that the vegetation is used sparingly and selective overgrazing is avoided, but also that the best possible use is made of the available biomass.

Government tutelage of nomads has not paid off anywhere - as confirmed by numerous examples. The lesson to be learned from this should therefore be to keep intervention by governments in the nomads' habitat to a minimum. The fact should not be overlooked, however, that the infrastructural development of rural areas, for example, and the provision of corresponding services (water supplies, transport routes, and wherever possible mobile medical and veterinary facilities, not to mention education) is barely possible without government-financed programmes. Governments should also aim to ensure that basic supplies of everyday products are available at fair prices within the areas in which the nomads live.

One particularly important point is the preservation of the nomads' extensive traditional knowledge of their natural environment, but also of their skills in the breeding, keeping and care of their livestock. Greater efforts should be made to record and scientifically investigate these proven methods so that they can be used in the practical planning and implementation of development projects.

Under no circumstances should the mistake be made to view the development of mobile livestock keeping in isolation. On the contrary, it should be considered as an integrated part of a comprehensive regional development concept, in which a self-help component enjoys a high status. It would also be appropriate to promote non-pastoral activities in order to offer young nomads opportunities for employment in the rural regions. Not least, it should be remembered that detailed, interdisciplinary regional research before and during the implementation of a development measure could make a major contribution to the success of the project.

Although there may be many obstacles to be overcome before these recommendations can be translated into practical action, efforts should be made to ensure their realisation. The proposals made here could play a part in developing modified pastoral farming systems on the basis of traditional forms of land use. It is greatly to be hoped that the above recommendations might contribute to the attainment of sustained development in the nomadic regions and hence that the mobile livestock keepers might gain their rightful place in the modern development process.

NOTES

1 The term mobile livestock keeping is used to refer to all regionally specific transitional and mixed forms ranging from pure nomadism to sedentary pastoralism. Terms such as nomadism, nomadic pastoralism and migratory pastoralism are used synonymously. The same is true of semi-nomadism and semi-sedentary pastoralism. Agro-pastoralism is a semi-nomadic economic method including arable farming, usually rainfed agriculture.

2 The Old-World dry belt extends from the Atlantic coast of North Africa to the steppes and desert areas of Central Asia.

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THE CENTRAL RANGELANDS OF SOMALIA: NATURAL ENVIRONMENT AND PATTERNS OF LAND USE

Stephan Baas and Pay Drechsel

INTRODUCTION

The Central Rangelands (CR) cover about 147000 km² or roughly one quarter of Somalia, and as the name implies, they lie in the middle of the country between latitudes 3° and 8° N. Due to their geographical position, the CR are politically and strategically a very important part of the country. They embrace three of the 17 regions of Somalia: *Hiraan*, *Galguduud* and *Mudug*. The border between these regions and Ethiopia runs straight through the Ogaden and has so far not been recognized by the Somali Government, because it represents an arbitrary line dividing traditional Somali tribal territories beeing the reason for the continuous armed conflicts threatening the security and influencing the development in the CR.

The following facts characterize the Central Rangelands as compared to total Somalia (Mascott Ltd., 1986):

- they are amongst the driest regions in Somalia;
- they are poorly endowed with fertile soils;
- they have in general medium to low potential for intensive livestock and crop production;

- they possess 10 percent of the nation's croplands and 41 percent of all abandoned or fallow land;
- they have none of the "highest potential" land in Somalia and only 5 percent of the best 25 percent of land;
- they support 9 percent of the urban population, 13 percent of rural people, 19 percent of the nomadic people and 14 percent of the country's total population of 6.7 million;
- they sustain 11 percent of the nation's cattle, 23 percent of its sheep, 42 percent of its goats, 22 percent of its camels; these figures account for an estimated 31 percent of the total 35 million animals in Somalia or - expressed in terms of livestock biomass - for 18 percent of the total;
- they are about average in terms of endemic wildlife species;
- they have, besides the *Nugaal* and *Bari* regions the most poorly developed infrastructure and communications system of any part of Somalia. Only one surfaced road crosses the area; all other roads are rough tracks. Some major towns on the main road had been linked by telephone or telegraph with *Muqdisho* but even these connections were distroyed during the months of civil war.

Recent figures on population structure in the CR are not available and even estimating the present distribution is very difficult, because the political situation since 1988 has unleashed a huge surge of migration all over Somalia. The last reliable data are from 1983/84, when the population was estimated to be about 922,000, of which 22.5 percent was classified as urban, 33.2 percent as rural and 44.4 as nomadic (Mascott Ltd., 1986). The highest concentration of people was and is found in the *Shabeelle* river valley. The majority of people in the CR belong to the *Hawiiye* and *Darood* clan families. These two groups are rivals for the dominance of government responsibilities since early 1991 when the Barre regime has collapsed.

The physiographic characteristics of the CR are determined by the following major landformations (Figure 1). The largest area, the Interior Plateau or "*Mudug* Plain", is a more or less flat tableland that gradually slopes from the Ogaden plateau down towards the Indian Ocean (300-100 m). Naylor and Jama (1986) in their detailed study on the *Hobyo* district divide the *Mudug* plain into interior plateau and interior basin. For the purpose of an overview the *Mudug* plain is treated here as one landscape unit (Abdullahi, 1990; Mascott Ltd., 1986).

Only in the extreme north of the CR do elevations rise to 600-700 meters. The territory has a gentle micro-relief associated with limestone bands interlayered with sand. Towards the Indian Ocean the plateau merges into the 10 to 40 km-wide Coastal Ridge which is subdivided into an area of stabilized

sand dunes and the ridge itself. The ridge runs parallel to the ocean and rises to 300 m above sea level. This landform is absent from 60 km northwards of *Hobyo*, where the *Mudug* plain joins directly to the coast. South from there the ridge is clearly marked by a steep slope towards the Coastal Plain which appears as a 8 to 35 km-wide strip along the sea shore seldom exceeding 50 m in elevation. Adjacent to the west of the *Mudug* plain, the *Hawd* region forms an exceptional landscape with its deep, red, sandy soils and several endemic plant species. The most distinctive feature of the CR is the 30-45 km-wide *Shabeelle* river valley, which is bounded by a distinct escarpment. A 4-7 km-wide section along the river forms the actual floodplain and sandplains cover much of the region between the latter and the escarpment. The *Shabeelle* enters Somali territory north of *Beledweyne* and splits *Hiraan* into two dissimilar physiographic regions.

The following chapters seek to provide a more detailed picture of these major land formations within the CR of Somalia. Special consideration is given to the natural environment, the patterns of land use and the influences of these upon the ecosystems. It should be emphasized that the physiogeographic units as proposed here are for basic orientation only. Within each unit different mosaics or sub-units occur which reflect small-scale changes in vegetation composition, in soil distribution and in land use intensities. Given the objectives of this article, such factors cannot be adequately considered here (for a closer view see: RMR, 1979; Wieland, 1987; Kuchar, 1987, 1989; Naylor and Jama, 1984; Holt, 1986; Herlocker and Ahmed, 1986; Drechsel, 1986; Baas and Adow, 1991). Neither is it intended to supply any detailed analyses of specific socio-economic problems, as such aspects are thoroughly covered in the other articles of this volume.

PHYSIO-GEOGRAPHIC FEATURES OF THE ENVIRONMENT

Climate

The CR lie, as well as the whole territory of Somalia, between the two subtropical anticyclonic belts. Consequently, the annual north-south oscillation of the Intertropical Convergence Zone (ITCZ) and the Intertropical Front (ITF) are the most important factors in the succession of the weather seasons. With regard to the CR, they are responsible for a bimodal rainfall pattern and varying airflows throughout the year (monsoon character). Four seasons can be distinguished. After the long dry season *jiilaal* from December to March with

dry, hot northeasterly winds, the main rainy season *gu´* follows, lasting from April to May/June. This is followed by the short dry season *xagaa*, which is characterized by strong southwesterly winds. Finally the short rainy season *dayr* lasts from September to November. The length of the rainy seasons becomes shorter and more accentuated towards the north. In general, the ITF is not as well defined as in West Africa and squall lines, which are a feature of the wet seasons in the Sahel itself, are unknown in Somalia. Rainfall occurs as pseudo-random showers within suitably moist air masses. The showers themselves are of relatively small dimensions and as they originate from cumolo-nimbus development, show a very high spatial variability (FEWSD, 1988). In addition there is a high coefficient of annual variation in rainfall (Table 1). The average annual rainfall decreases from 300 mm in the most southern parts of *Hiraan* to 100 mm per year in the northern areas of *Mudug*. The average annual temperature is 28°C with a small monthly range of ± 4°C. The level of evapotranspiration is, based on Penman's equation, around 180 mm/month. In short, these criteria form a type of hot and arid climate, which puts clear limitations upon the economic use of the area, comparable to the West African Sahel.

Table 1: Rainfall distribution in the Central Rangelands

Ecological subzone	Station	Av. annual rainfall (in mm)	Range Max. (in mm)	Range Min. (in mm)	Source
Coastal plain	*Hobyo*	192	618	63	Swift, 1979
Coastal ridge /Inland	*Ceel Dheere*	280	-	-	Herlocker and Ahmed, 1986
Riverine	*Buulobarde*	338	711	96	FEWSD, 1988
	Beledweyne	266	650	45	FEWSD, 1988
Inland plateau	*Ceelbuur*	209	541	8	FEWSD, 1988
	Dhuusamarreeb	148	251	15	FEWSD, 1988 and 1989 data
	Gaalkacyo	149	-	-	Swift, 1979

Geology

Marine sediments of Upper Jurassic to Middle Eocene limestone, gypsum, anhydrites, and partly marl and evaporites, build the major geological formations of the Interior Plateau. The stratification of limestone and gypsum results in sudden changes from one to the other within short distances and with very small differences in topographic height. RMR (1979) describes the gypsum and evaporite areas as ancestral drainage zones which stagnated at the major coastal fault. Extensive gypseous areas exist e.g. northeast and south of *Gaalkacyo* and between *Dhuusamarreeb* and *Ceelbuur*. Large deposits of anhydrites are in the northwestern parts of the CR. Of special interest are large deposits of sepiolite (meerschaum) near *Ceelbuur* (Stahr et al., 1990); sepiolite also occurs in the soil clay mineral fraction in other parts of the *Mudug* Plain (Drechsel, 1991). Besides the marine sediments of mainly limestone, important geological features are the clayey *Shabeelle* river deposits and the non-salty continental Jesomma sandstone formation which forms the *Hawd* landscape with its typical deep, red, sandy soils. The Coastal plains are composed of aeolian and marine sediments dating back to the Quaternary and Pleistocene (Pozzi et al., 1983) which until recently (geologically speaking) formed the ocean floor (Naylor and Jama, 1984). These sediments overlie pink to brown limestone, which is often exposed by erosion and occasionally raised into low ridges running approximately parallel to the sea (Herlocker and Ahmed, 1986).

Soils

A major factor in soil formation is the weathering process which reflects climatic conditions. The arid to semiarid climate in the CR determines the extensive occurrence of typical semidesert soils, which were weakly developed in limestone, gypsum or in more or less unconsolidated sands.

The main soil types in the Interior plateau are shallow orange-toned sands over limestone and gypsum, classified as Regosols and Arenosols, according to the classification of FAO-UNESCO (1988). They are mainly composed of red quartz sands, originating from the *Hawd* area, and are - to differing degrees - mixed with pale coastal sands and lime particles. The wide distribution of these sands is said to go back to the Pleistocene or earlier, when the Horn of Africa was affected by the East African pluvial periods. There are several indications for considerable changes in precipitation and ecology, especially in northern and north- eastern Somalia during that time, but the amplitude of these oscillations seem not to have been as high as in the Saharan desert belt at the same time

(Gabriel et al., 1989). The sand mantle varies greatly both in grain size and depth, but over most of the areas it is thin with the underlying limestone clearly visible. Bedrock often crops out and in many cases the stone content of the soils is high. The intensity of the red color increases from the coast towards the Ethiopian border and the *Hawd*, but spatial variations in soil depth also influence the color. It is generally stronger orange or redder where it is deeper, and paler where it is shallow with much limestone visible.

In depressions or dry valleys as well as around small watercourses, the soils consist of sandy loams and in some sections of clays, to which have been added the products of weathering washed down from the surrounding bands of limestone or gypsum. They are often high in salt content and in some sections there are accumulations of clays. A large area which consists of these types of soils is located north of the coastal ridge in the *Hobyo* district. Naylor and Jama (1984) named this area the "interior basin"; it is characterized by a wide distribution of salt lakes and gypsum basins.

In contrast to the parent material of all the other soils of the CR the sands of the *Hawd* are deep red, and derive from the continental Jesomma Sandstones. They are free of easily soluble salts, but their nutrient status is fairly low. The *Hawd* is either flat or very gently rolling, and most of the area has little surface drainage as all rain soaks immediately into the sands. Nevertheless there is a series of broad shallow steps which proceeds downward to the east. Some of these steps include broad (1-5 km), shallow (5-25 m) bowls which have slightly heavier soils (loamy sands) due to inwash.

The soils of the *Shabeelle* floodplain were developed from fine-textured, recent or older river deposits. The materials were derived mainly from the erosion of soils which originate from carbonate-rich materials of the Upper *Shabeelle* areas. According to the FAO soil figure of the world (FAO-UNESO, 1988), the soils are classified as Vertisols, Fluvisols, and partly as Solonchaks. The Vertisols are widely irrigated, but the variation of their physical properties poses problems for soil management: in the dry state their high clay content shrinks and they become very hard, whereas with increasing moisture the clays swell and no drainage is possible. These soils contain different amounts of powdery gypsum and soluble salts, especially in the subsoil. Adjacent to the floodplain, the fine- textured river sediments gradually change to limestone rubble and fragments. Towards the steep slopes of the valley, soil depth decreases and besides Calcisols and Cambisols, shallow and stony Regosols and Leptosols occur. Representative soils of the CR between *Buulobarde* and *Gaalkacyo* are described by Drechsel et al. (1989).

Western *Hiraan* (west of the *Shabeelle*) has virtually no sand. Almost all the land is a complex of low limestone outcrops with pockets and small plains of silts. Gypsum plains, recognizable as areas of very light-colored surface, are found in West *Jalalaqsi*. Unique to the West *Hiraan* are basalt plains which support areas of rich brown stony soils, especially west of *Buulobarde*.

The soils in the Coastal plain range in texture from medium to coarse sand at the surface (Naylor et al., 1984), to sandy loam at a depth of 1 m. They are white to very pale in colour, show little horizontal development and are weak to moderately alkaline but not saline. RMR (1979) reports soils to be generally deep, fine-grained silty, orange sands with unconsolidated surfaces susceptible to wind erosion and gullying on slopes. This probably refers to grassland which occurs on the eastern flank of the coastal ridge between the plain proper and the large, ridge-top dune field (Herlocker and Ahmed, 1986).

The soils of the Coastal ridge are shallow sand over limestone. These soils have some silt content and a pale orange color. There are limestone bedrock outcrops in several places. The soils are mainly composed of quartz particles with a negligible limestone component (RMR, 1979). The silt in these soils causes them to cap, while the carbonates tend to consolidate them. Both of these factors induce water erosion and gully formation (Wieland, 1987). On the east slope deep canyons have been cut through the upper limestone rock and into the rock below which is a poorly consolidated white beach sand. The west slope, which is less steep, is also undergoing severe erosion. Its soils are deep orange sands which have a low silt content. Stabilized sand dunes as deposits of older Pliocene run parallel to the ridge itself. They extend from the southern boundary of the CR to about 60 km north of *Hobyo*. These soils range from deep reddish-brown, loamy sands (Herlocker and Ahmed, 1986) to pale orange sands with a low silt content (Naylor and Jama, 1984). The dunes slope towards the west from the higher coastal ridge to the east; the area is 40 km wide at its maximum. A gentle topography and the deep sandy soils result in little surface runoff.

Vegetation

On the rangelands, the vegetation as the main resource of the economy is of outstanding interest. The current vegetation patterns in a rangeland area reflect the coming together of several influencing factors: differences in climatic parameters, soil attributes, topography and land use intensities. Consequently, the mosaic-pattern of the vegetation, as received hypothetically from a small

scale-figure, is at any given moment as variegated as the chance combination of these factors. As mentioned previously a detailed presentation and analysis of such vegetation structures cannot be offered here. Regional studies on vegetation are given in the articles mentioned before; the potential of economic use of the vegetation is discussed in the contribution "Range Resources and Range Condition in the Central Rangelands of Somalia" (Baas, this volume). The focus here is upon a brief description of the major vegetation types which occur in the CR. The definitions are used in accordance with Pratt and Gwynne (1977) and Kuchar (1989). In addition, their spatial distribution - in the context of the outlined regions and landform units - will be mentioned, as well as the most important plant species. An illustration is given in figure 2.

Before taking a closer look at the different types of vegetation in an area as large as the CR, one general tendency should be highlighted: the height of the vegetation layers and their basal cover, decreases - with the exception of the coastal plain - from the southwestern to the northeastern regions, due to climatic factors. In the following presentation the various types of vegetation are ordered according to their extent and importance to the CR.

Bushland

This type of vegetation is outstanding in the CR in that it covers approximately 80 percent of *Hiraan*, 60 percent of *Galguduud*, and would potentially cover up to 80-90 percent of both regions (see colour plates). Its proportion in *Mudug* is somewhat lower, as in the northern region, the climatic conditions limit the extension of bushland to mainly the more mountainous regions in the northwest (RMR 1979). Bushland is absent in the coastal plain and the floodplain of the *Shabeelle* river. "Bushland is characterized by a well developed tall-shrub and tree layer at 2-5 m with emergents to 10 m. This shrub/tree layer averages in a 30-50 % cover with 15-40 species per stand though usually dominated by a few or even a single one of these" (Kuchar, 1989). Different *Acacia* and/or *Commiphora* species are the most frequent dominant and subdominant genera to be found on both sand and limestone series. *Grewia, Euphorbia* and *Terminalia* species are other frequently occurring subdominants. Outstanding in its spatial distribution although hardly ever a dominant is *Acacia tortilis*. Key plants limited as dominants to sandy soils are *Cordeauxia edulis* in the *Hawd*, or *Acacia edgeworthii, Acacia ziziphispina* and *Boswellia microphylla*. Dominant key plants which identify limestone series are *Acacia reficiens, Acacia senegal, Acacia mellifera* and *Anisotes trisulcus*. For gypsum areas, species of *Suaeda, Limonium* and *Salsola* are typical. Most species in the bushlands of the CR are

deciduous though some (e.g. some *Acacia, Terminalia, Cordia* and *Ziziphus* species) retain their leaves into the dry season. About 5-10 percent of the bushland flora is evergreen. This evergreen component, which rarely exceeds a 2 percent cover, is disproportionately important in getting livestock through the dry season. The most important evergreen species are *yicib*, *Cordeauxia edulis* in the *Hawd* (Kuchar, 1987), and species of *Boscia, Cadaba* and perhaps *Satanocrater* on limestones. A dwarf shrub layer is also usually well developed in bushland. It is not as rich in species, and tends to be more strongly dominated by a few low shrubs. Outstanding is *Indigofera ruspolii.*

Also part of the bushland but rather negligible in its impact on the livestock economy is a herb layer. It has two components. The first is an ephemeral growth of annual forbs and grasses, extremely variable in amount and composition, and very much a seasonal phenomenon. The second component, perennial grasses, has a great potential significance in the livestock economy as it is a good index of range condition in the bushlands. But in general, grass cover is not high and cannot provide a large amount of feed for stock. The basal cover of the grass layer averages in about 1-2 percent in the bushlands, but is of very uneven distribution. In general, overused areas and areas a few kilometers around permanent water sources have no perennial grass cover left. The overwhelmingly dominant grass genus is *Aristida* which cannot be ranked as high-quality forage. Less abundant perennials are species of *Panicum, Sporobulus, Cenchrus* and *Lepthotrium.*

Dwarf Shrub Grassland

This vegetation type may be described as "grassland, often sparse grassland, set with dwarf shrubs not exceeding 70 cm in height, sometimes with widely scattered larger shrubs or stunted trees" (Pratt and Gwynne, 1977). With regard to the *Hiraan* Region, Kuchar (1989) stated that: "areas dominated by low shrubs (< 1 m tall) and with little or no overstory can safely be said to be strongly altered plant communities, usually in poor condition". Parts of the basalt plain in western *Hiraan* are the only area in *Hiraan* which support this type of vegetation. The dominant dwarf shrub is *Duosperma eremophilium*. A vast area of this type of vegetation is located east of *Dhuusamarreeb*, and belongs to the landscape unit of the interior plateau (see colour plates). This region also seems to have previously been a bushland area, which degraded largely during the *Dabaadheer* drought of 1974/1975. In its present habit and condition it appears to be rather stable again, although endangered, since it is greatly preferred as rainy season pasture. The history of the adjacent dwarf shrub grassland areas, in the northern

Mudug region (RMR 1979), is not exactly known. Most frequent in both regions are species of *Indigofera, Triumfetta, Iphionia* and *Pavonia*; the most common grasses are species of *Aristida* although they fail to exceed 5 percent canopy cover. Shrubs occurring singly or in small groups are mainly species of *Acacia, Commiphora* or *Jatropha*.

Shrubland

This is "land supporting a stand of shrubs usually not exceeding 6 m in height, with a canopy cover of more than 20 percent. Trees, if present, contribute less than one-tenth of the canopy cover, the ground cover is often poor" (Pratt and Gwynne, 1977). Natural shrublands in *Hiraan* appear to be restricted to parts of the *Hawd*, especially the east-central area, and are closely related floristically to the typical *Hawd* bushlands. The reason for the dwarfed stature (canopy at 1-2 m) is not known, but may be related to the nutrient-poor soils. Most other Shrubland areas in *Hiraan*, the bulk of them in the *Shabeelle* valley, are consequences of land overuse and/or fallow following shifting cultivation (Kuchar, 1989; see colour plates). This is also true for the shrubland areas in the stabilized dune belt of southern *Galguduud* and *Mudug*. Important species in these areas are nowadays *Indigofera ruspolii, Acacia nilotica, Dichrostachyus cinera, Solanum jubae* and *Acacia horrida* (Herlocker and Ahmed, 1986). Different shrubland communities are interspersed in the dwarf shrub grassland area in the central part of the interior plateau in *Mudug* (RMR, 1979), and are probably due to the low precipitation rates. Leading species are *Acacia* and *Commiphora* shrubs as well as some species of *Indigofera* dwarf shrubs.

Grassland

This vegetation type is "land dominated by grasses and occasionally other herbs, sometimes with widely scattered or grouped trees or shrubs, the canopy cover of which does not exceed 2 percent" (Pratt and Gwynne, 1977). The largest, connected grassland area in the CR is the coastal plain (see colour plates). The vegetation is characterized by a height of 30-40 cm and a 13-24 percent foliage cover. The coastal plain vegetation was found to be dominated by *Indigofera intricata, Leptothrium senegalense, Cyperus chorrdorhizus* and *Cenchrus ciliaris*. Other important species were *Sporobulus ruspolianus* and *Panicum pinifolium* (Naylor and Jama, 1984; Herlocker and Ahmed, 1986).

In the other landform units there are three basic types of grasslands which can be found here and there. Firstly, pockets of grassland, mostly *Aristida*, perhaps fire-derived and at least in some cases fire-maintained occur, for

example, on the *Hawd* sands east of the river escarpment. Secondly, very slight, broad depressions occur on alluvial plains, supporting mostly *Sporobulus*. Thirdly, *Echinochloa* grassland areas are to be found on the floodplains of the *Shabeelle* river (Kuchar, 1989).

Woodland

Woodland may be defined as "land supporting a stand of trees, up to 20 m high, with an open or continuous but not thickly interlaced canopy, and a canopy cover of more than 20 percent. Shrubs, if present, contribute less than one tenth of the canopy cover. Grasses and other herbs dominate the ground cover" (Pratt and Gwynne, 1977). True woodland may once have been common in *Hiraan*, mainly in the river valley and in the area west of the *Shabeelle*. It may have been composed largely of *Terminalia spinosa*, perhaps with other *Terminalia*. Relicts of such woodland exist in the far west, but since these are prime timber species, they were probably the first to be eliminated by settled pastoralists as they colonized the region. Those areas still having such trees, which are threatened by charcoal burners, need urgent protection. A second woodland type, also present only in vestiges of its probably dominant past distribution, is the *Acacia nilotica* woodland on the alluvial plains of the *Shabeelle*. These plains have undergone more ecological impact than any other area of the CR, and though finding anything resembling the original climax vegetation is unexpected, some stands still exist in *Jalalaqsi* and southwards into *Jawhar* (Kuchar, 1989).

All the above-mentioned patterns of present-day prime vegetation types are subject to continuous impact from humans and are frequently disrupted by cropping, or in some areas degraded through overgrazing, especially around permanent water points and settlements. As land use by people is a major contributor to degradation, the patterns of economic activities as they affect the land shall be described in the following chapter. The risks and degree of degradation to the different landform units shall also be mentioned.

LAND USE PATTERNS

Extensive raising of livestock is the chief economic activity in the Central Rangelands. It makes use of the range in a variety of ways and is, in terms of ecological stability, the best adapted of all forms of land use in the CR. Four livestock species are bred here: camels, goats, sheep and cattle. According to the Mascott Ltd. report (1986) the CR supported an estimated 882.000 camels,

417.000 cattle 7.182.000 goats and 2.409.000 sheep in 1985. In some regions many producers also grow crops. This practice is integrated with stock raising in a complex and apparently effective way.

For the purpose of an overview, four major zones with different land use systems may be defined (Holt, 1986; Mascott Ltd., 1986; Abdullahi, 1990):

- The interior thornbush zone: nomadism, mainly camel and goat economy,
- The agropastoral zone: pastoralism and dry-land farming,
- The smallholder crop/livestock zone in the *Shabeelle* river valley: floodplain cultivation and pastoralism,
- The coastal plain: migratory pastoralism, mainly sheep economy.

The spatial distribution of these land use systems is introduced in figure 3. In the following sections, each single zone will be briefly described.

The interior thornbush zone

This zone consists of the Interior Plateau the *Hawd* and western *Hiraan*, in general the drier parts of the CR. Nomadism is the overwhelming economic activity. As the vegetation offers more browse than graze, the most important animals are camels and goats. In addition, sheep are kept for the purpose of using all available ecological niches, to minimize production risks and for the meat, which is preferred for human consumption. Cattle are rare in this zone and more or less limited to an area close to the *Shabeelle*.

The availability of labour is the important factor in a household, and determines the type of livestock a family can actually own and manage properly. It is common that a newly married family possesses only smallstock until their children are old enough to herd large stock, thus permitting their parents to diversify their livestock holdings (Bourzat, Zessin and Baumann, 1989). Livestock is seen as a store of wealth, assuring the subsistence of the families, and easing financial pressures like bride prices, funeral sacrifices, feasts and other social obligations.

Traditional grazing areas exist, but there is no private ownership of the range. The *degaan* - the traditional grazing area for a certain group, family or clan - defines the home range in the wet season. During droughts or prolonged dry seasons this home range is left and more widely dispersed food and water resources are sought. But in general, long-distance movements and dispersion of herds are much less frequent than is usually assumed in the Central Rangelands. Studies by Howze (1989) and Baas and Adow (1991) regarding 8 districts

indicated that most herders kept their animals in a single area, rather than moving them over large distances. The nomads preferred mobility around a single water point to moving between different wells. Nevertheless, the frequency of movements was fairly high.

The prime production aims are subsistence with regard to milk and meat and the selling of animals in order to buy mainly sorghum, rice, sugar and tea. Foodstuffs account for 80 to 90 percent of all expenditure (Abdullahi, 1990; Schwenk, 1986; Baas, own survey data 1989). The costs for watering the animals during the dry season are another important factor. In general, the tendency towards commercialization is increasing with regard to both the selling of animals to professional traders and the access to water. To reduce the dependence that results from raising livestock alone, the nomads tend to adopt several risk-spreading strategies: scattered small- scale cultivation, mainly of watermelon (Table 2), where the natural environment allows, or employment of a family member in a larger town are the most common practices.

The problem of land degradation in this zone does not yet seem to be dramatic. Is this huge area of the CR severely overstocked? There has been much debate on this question. CRDP (Central Rangeland Development Project) ecologists say no, as well as do the pastoralists (Howze, 1989). Most of the range is described as being in fair condition (Kuchar et al., 1985; Naylor and Jama, 1984; Herlocker and Ahmed, 1985; Wieland, 1987). Nevertheless there are some overexploited areas, as well as general signs of degradation, and evident factors which may cause it to worsen. For example, nomads appear to believe that wealth and social prestige are proportional to the number of livestock owned. They try to increase herds or flocks by excessive breeding until they are reduced by disease or natural disasters such as droughts. This practice is likely to cause problems for range conditions in the long run as various degrees of degradation are already apparent in all landform units and in all vegetation types.

Visible changes in vegetation composition are the first signs of degradation. Valuable range plants disappear and invader plants increase (c.f. Baas, this volume, tables). Typical invader plants common in overused areas or around wells and permanent settlements are: *Calotropis procera*, different *Solanum* species, *Commiphora incisa*, species of *Jatropha, Loewia glutinosa* and *Anisotes trisulcus*. The final stadium of degradation in rangelands is the complete

destruction of plant cover is barren land. Until now this final stadium of degradation has occurred only as isolated incidents in limited areas and extensive desertification phenomena like in the West African Sahel are fortunately scarce. The deciduous plant cover seems to be protected from severe overuse by defoliation, but the evergreen plant species, as the major forage resource of the dry season, are definitely threatened. Examples are *Cordeauxia edulis* in the *Hawd* (Kuchar et al., 1987; Drechsel and Zech, 1988) or *Boscia minimifolia* and *Cadaba glandulosa* in the *Mudug* plain. Altogether these represent the most important dry season fodder plants, although their palatability is not very high (Drechsel and Assefa, 1991; Baas and Adow, 1991). They are even avoided during the rainy seasons.

Another acute threat comes from the strong increase in the construction of *berkeds* (cement-lined water reservoirs) and water development activities since the mid-1980s. This mainly pertains to the *Hawd* region where *berkeds* can be easily constructed, due to the sandy soils (Baas, 1991). *Berkeds* can offer water permanently, if they are supplied by tankers throughout the year, and since this is common practice, overgrazing is the consequence. A continuously growing network of *berkeds* might result in the previously minor process of degradation becoming an extensive one.

Measures to protect the range from further degradation should be carefully planned and implemented while the range is still productive.

The agropastoral zone

This zone coincides more or less with the zone of stabilized sand dunes along the coastal ridge, but to some degree it is also scattered in western *Hiraan*. Two principal, but interrelated types of land use are practised in this region: pastoralism and shifting cultivation, while the practice of both livestock raising and cultivation, defined as agropastoralism, characterizes this region in particular. This closely integrated system of livestock production and shifting agriculture has been practised in the area for hundreds of years. In the coastal districts north of *Ceel Dheere*, 20 - 40 percent of households own farms (Tylor, 1983) while in *Ceel Dheere* 70 percent do so (Holt, 1986). Howze (1989) however, received a slightly different impression, which is given in table 2; the main cropping plants, the grade of subsistence and figures on average farm size are also included.

Table 2: Selected factors related to agricultural practices, by district (According to: Howze, 1989; Baas, survey 1989)

ITEM	*Buulo barde* (zone 3)		*Jala-laqsi* (zone 3)		*Ceel Dheere* (agropastoral zone 2)		*Xarar-dheere* (agropastoral zone 2)		*Hobyo* (agropastoral zone 2)		*Ceel-buur* (agropastoral zone 2)		*Dhuusa-marreeb* (zone 1)		*Caabud-waaq* (zone 1)	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Respondent grows crops:																
Yes	25	51	25	50	20	40	37	74	11	22	31	62	3	44	0	0
No	24	49	25	50	30	60	13	26	39	78	19	38	44	94	21	100
Respondent grows																
Cowpeas	11	44	10	40	20	100	37	100	8	73	28	90	3	-	-	-
Sorghum	19	76	24	96	8	40	14	38	3	27	14	45	1	-	-	-
Watermelon	1	4	2	8	1	5	13	35	4	36	3	10	3	-	-	-
Maize	6	24	5	20	0	0	0	0	0	0	0	0	0	-	-	-
Sesame	6	24	9	36	1	5	0	0	0	0	0	0	0	-	-	-
Cotton	2	8	0	0	0	0	0	0	0	0	0	0	0	-	-	-
Mean size of farm (in ha)	3.2		5.8		1.9		2.5		1.3		1.6		?		-	
Does farmer sell produce																
Yes	9	36	9	36	4	20	3	8	1	9	1	3	0	-	-	-
No	16	64	16	64	16	80	34	92	10	91	30	97	3	-	-	-

Figures on crop yields per ha and year vary between 50-300 kg (Mascott Ltd., 1986) and 1230 kg (Holt, 1986) for an average year for cowpeas. The estimates for sorghum production vary between 100-400 kg (Mascott Ltd., 1986), 400-450 kg (Walshe, 1988) and 590 kg (Holt, 1986). The differences in these figures probably occur in correlation with the high variation in precipitation from year to year. CRDP estimates that these crops provide approximately 30 percent of the food requirements of the Central Region's population.

Crops are grown in thornbush-fenced enclosures to prevent stock from entering. Single plots are cultivated for three to eight years, depending on soil fertility. Fertilizers are not used. Thereafter the farm is fallowed for 15-20 years although it may be used to confine livestock as long as the thorn enclosures can be maintained. For at least the last two hundred years, the primary shifting cultivation areas have moved across the region in a wave-like manner. Typically, a particular productive area of land is densely cultivated by many agropastoralists, until all productive land in that locality has been exhausted. Then a mass movement to another area takes place and after probably 100 years (locals

claim 25-50 years) the original locality might be settled again. The RMR (1979) survey identified about 210,100 ha of "cropped or recently cropped land" on the coastal ridge out of which 171,900 were concentrated in the inland stabilized sand dune area (= 12,8% of the region) and 38,200 ha account for the ridge itself. More recent figures are not available but an increase can be expected (Herlocker, 1986; Holt, 1985).

According to the traditional land tenure system all rangeland is communal and public, but rangeland once enclosed by a fence belongs to the person(s) who built it. Governmental efforts to establish a license system for leasing land have failed and the traditional system is still respected by the local communities (Holt, 1986).

Only a very small proportion of farmers do not own livestock - probably only 5-10 percent. Livestock owners typically raise a mixture of camels, goats, cattle and sheep, in which sheep are the least abundant. The livestock provide subsistence milk and meat and are increasingly sold as the economy becomes more market-oriented (Holt, 1986). Such sales provide most of the cash income. The herds rely on grazing communal rangeland around the cropping areas for much of the year but benefit greatly during the dry season from cropping activities. Then it is evident that livestock raising is integrated into the cycle of agriculture: local cowpea and sorghum residues are excellent fodder and the animals clean up the fields for future cultivation.

The pure pastoralists move over larger distances with their herds and, compared to the agropastoralists, are much more mobile. They move in an annual cycle between the southern parts of the inland plateau, the central ridge and the coastal plain - the latter being of importance to cattle and sheep. The cycle is determined by the outbreak of harmful flies, the *riibi*, in the thickets of the central ridge and *gilmi* in the coastal plains. *Riibi* can transmit a disease often causing the death of animals, especially of camels; *gilmi* seems to be less dangerous. The flies appear soon after the first rains and attack both people and animals. During this time ranging on the interior plateau is preferred. In the late rainy season the flies die and the herds move back to the central ridge or, especially the grazing animals, return to the coastal plain. A one-year movement cycle was described by Elmi (1989). It is said that the life cycles of the flies - coincident with peak vegetation growth - maintain the "good" range condition in those areas affected. Future problems for the livestock component of both the agropastoral and pastoral systems in this area will probably arise, as the area of available communal rangeland is steadily decreased through fencing and privatization.

Agropastoralism and desertification

Clearing and cultivation can rapidly cause serious degradation in areas where rainfall is low, windspeed is often high and soils are highly erodible sands. The loss of plant cover promotes wind erosion and results in sand dune formation. Several active sand dunes were formed from 30 to 200 years ago due to intensive agropastoralism (Holt, 1986; Walshe, 1988; Shown in Figure 1). Mascott Ltd. (1986) assumed a yearly loss of 75 to 110 mm of soil in cropped areas. Both in the past and present, the establishment of dense areas of agropastoralism has caused and is still directly causing localised desertification. Measures such as strip cropping, live fencing with *Commiphora incisa* or *Commiphora hadai*, the saving of certain plants from being weeded (especially *Cenchrus ciliaris*), and other extension programs (Holt, 1986; Holt et al.,1987) need urgently to be implemented. An additional and serious problem results from water erosion and gully formation affecting the slopes of the ridge.

The smallholder crop/livestock zone in the *Shabeelle* river valley

The RMR (1979) survey identified 128,600 ha of "cropped or recently cropped land" in the alluviums and alluvial plains of the *Shabeelle*, which account for appoximately 40 percent of this area's total size, but for less than 1 percent of the CR. In the areas close to the *Shabeelle*, irrigation with river water provides the basis for cropping, while further away rainfed agriculture is dominant (see colour plates). The mean annual discharge of the river at *Beledweyne* is 68,3 m/sec, but decreases rapidly further downstream. The river flow varies largely with the seasons. Between *Beledweyne* and *Buulobarde* the *Shabeelle* flows within high banks and floods occur only when the water level exceeds 5 m (see colour plates). Although this happens rarely, it did e.g. in 1987. Normally irrigation is done by pumping. South of *Buulobarde* the outstanding topographic characteristic of the river is that its basin lies higher than that of the surrounding plains. This permits a gravity-driven system of irrigation.

Some information on production levels are given in table 2. According to Mascott Ltd. (1986), the fields are on average smaller in this zone than those on the sands of the stabilized dunes. This conflicts with replies received by Howze in his series of interviews with randomly selected persons. Whether this difference reflects a new trend or whether it results from varying methods of data collection, cannot be answered here. The tendency towards smaller fields seems to be more realistic in view of intensively used irrigated areas. The fallow periods are shorter and thorn fences are either poorly constructed or absent. The owners tend to reside close to the fields and are therefore able to limit damage caused

by livestock. The main crop in northern *Hiraan* is sorghum; maize and sesame are more important towards the south. There, a double crop system is common on irrigated areas: the main crop sequence is maize in the long rainy season *gu'* followed by sesame in the short *dayr*. Since water salinity increases with decreasing water level, irrigation during the low flow periods leads to problems with soil salinity. Pastoralists and locally also agropastoralists use the areas more distant from the river, but they need access to the river for the watering of their animals.

In terms of ecology, three unique features distinguish the area, especially the alluvial plain, from the rest of the CR. It has (1) a long history of intense settlement and cultivation, (2) a long history of uninterrupted use by livestock, and as a result of these, (3) it deviates vastly from its natural vegetation state, exhibiting a thoroughly depauperate flora, and the poorest range conditions (see colour plates) of the three regions (except active dune areas). The range conditions improve with increasing distance from the river towards the escarpment. The reason for the degradation is mainly shifting cultivation, which has turned the plains into a mosaic of cultivated fields and fallow. There has been no effort to rehabilitate land through post-cultivation measures, which is not surprising in view of the lack of institutionalized private land ownership. Chronic depletion of tree cover through wood gathering for domestic use or charcoal burning, and the unremitting impact of heavy stocking have prevented the development of anything even approaching reasonable post-cultivation cover. Wind erosion creates deflation patches of hard gravelly surface which plants find almost impossible to colonize (Kuchar, 1989). Water erosion is confined to gullies and the area within approximately 100 m of the river. Some more serious water erosion problems occur in the larger inter-valley areas between river and escarpment, especially in *Buulobarde* district. There, broad wadis and alluvial fans cut across the valley sands, where intensive cropping has been possible due to the better water supply. Apart from the *Gawaan* ridge - which is a steep slope and part of the coastal ridge - this area is the only part of the 3 regions with significant water erosion on rangeland.

An additional burden for the environment of these regions which should not be underestimated, results from the high number of refugee camps there. They are mainly located in the vicinity of *Beledweyne* where thousands of people with an urgent demand for firewood are living. Protection of environment and reforestation should have a high priority in these densely populated areas. Aspects of reforestation were described by Drechsel et al. (1989).

The Coastal Plain

The major economic activity in this region is migratory pastoralism supplimented by a negligible sector of traditional fishery. Cattle, sheep, goats and camels are kept, but sheep dominate while camels are relatively few. Livestock movements reflect the occurrence of rainfall and subsequent spatial and temporal patterns of available forage, outbreaks of biting flies and the presence of permanent dry season water sources. The grazing animals - sheep and cattle - use the coastal grasslands nearly all year round.

The history of the last 40 years shows that the current production pattern is a response to commercial pressure and incentives, and that the system is steadily changing. In this region commercialization began during the 1950s and 1960s with transport on *dhows*, traditional wooden boats, from the port of *Hobyo* to Aden. The early 1970s brought the introduction of truck transport for the haulage of smallstock, and herd owners engaged in a dual strategy of pastoral production: large-scale sheep-herding for export markets provided their cash income; keeping goats, cattle and camels helped to meet the familys' immediate food and transport needs, and thereby minimized the cash costs of supporting the family. In the early 1980s, ambitious plans were developed to open the port of *Hobyo* for large-scale exports as the market situation was estimated to be good (Mascott Ltd., 1986). But these plans have clearly failed. The coastal economy does not appear to be booming since the late 1980s. On the contrary, in 1989 at least the northern parts of the coastal plain seemed to lie outside of the interests of any group. The settlement of *Hobyo*, appearing on every figure of Somalia, looks more like a village that is being slowly abandoned. The economy in these northern areas seemed to be in a process of reorientation rather than in one of development. Further south, the above mentioned trend towards commercialization is apparently more established because the distance to the capital city of *Muqdisho*, with its immense demand for meat, is shorter.

The most important geomorphological process acting on the coastal plain is the wind-borne movement of sands, which has resulted in the many mobile sand dunes, dune tracks and blowouts in this narrow coastal strip. Nevertheless most of the area is rated as being in "fair" or "good" range condition. Changes in vegetation composition were observed but were not present to an alarming degree. "Poor" range conditions center around villages or wells and result from overgrazing (Herlocker and Ahmed, 1986).

CONCLUSIONS

In summary, it should be stressed, that nomadism is doubtlessly the form of land use best adapted to these arid ecosystems. Nevertheless there are - common to all zones - strong tendencies towards sedentarization and a shift away from the pastoral economy. This, from one point of view, reduces the population pressure in the pastoral production sector, but on the other hand it also reduces the labour which is needed to be mobile and ecologically adapted. The trend towards commercialization has been mentioned. This may increase participation in terms of a higher cash income, but it also increases the dependence upon market development and reduces economic flexibility. The results of the recent development trends cannot be clearly predicted. But even these few aspects show that a synthesis has to be found between wishes, possibilities and environmental constraints. Traditions and new ideas have to be carefully combined to ensure the further existence of this production sector; this goes hand in hand with an effective use of the CR as a whole.

The systems of agropastoralism and smallholder crop/livestock production are potentially more productive than pastoralism alone, but their application is clearly limited to the more humid areas and there is strong evidence that they can rapidly cause erosion and desertification, if certain preventive measures are not adopted. Future concepts or strategies are needed which support and connect all the systems discussed here so as to ensure their continued productivity.

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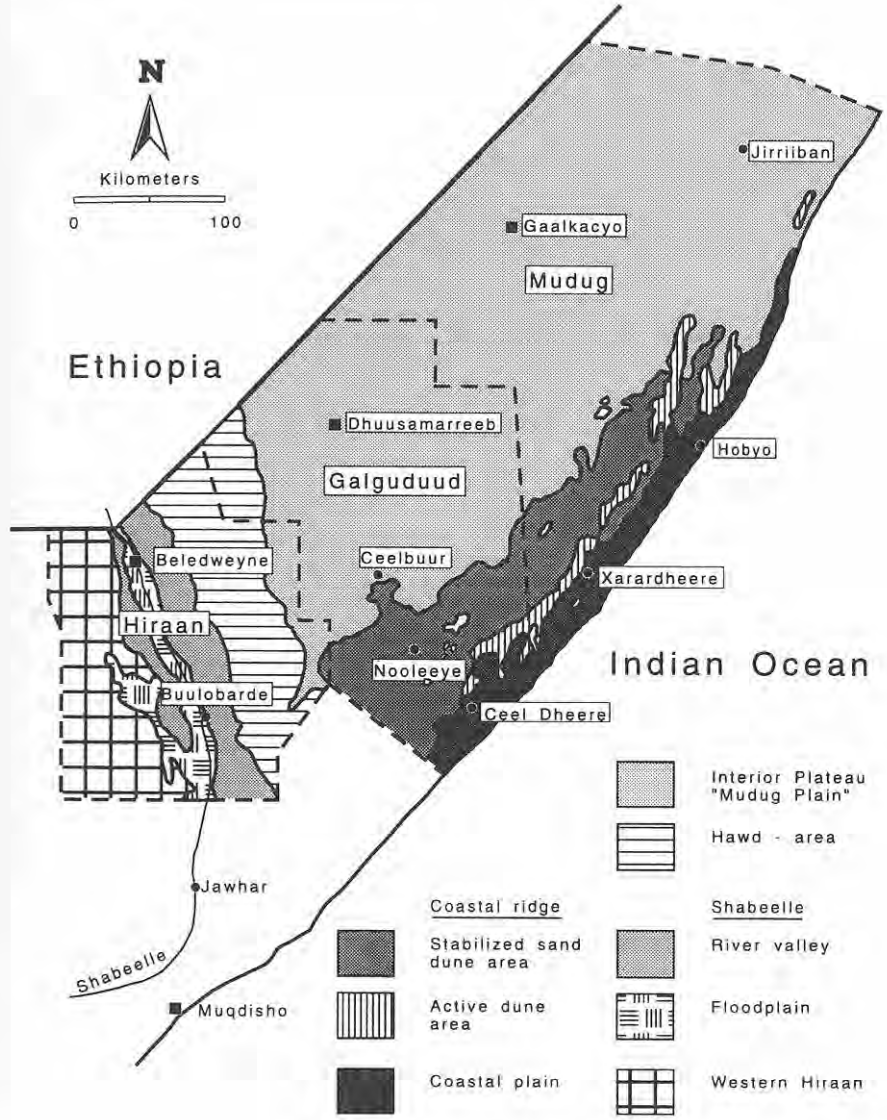

Figure 1: Landform units in the Central Rangelands

Design: Pielert, 1992 according to Baas, 1991

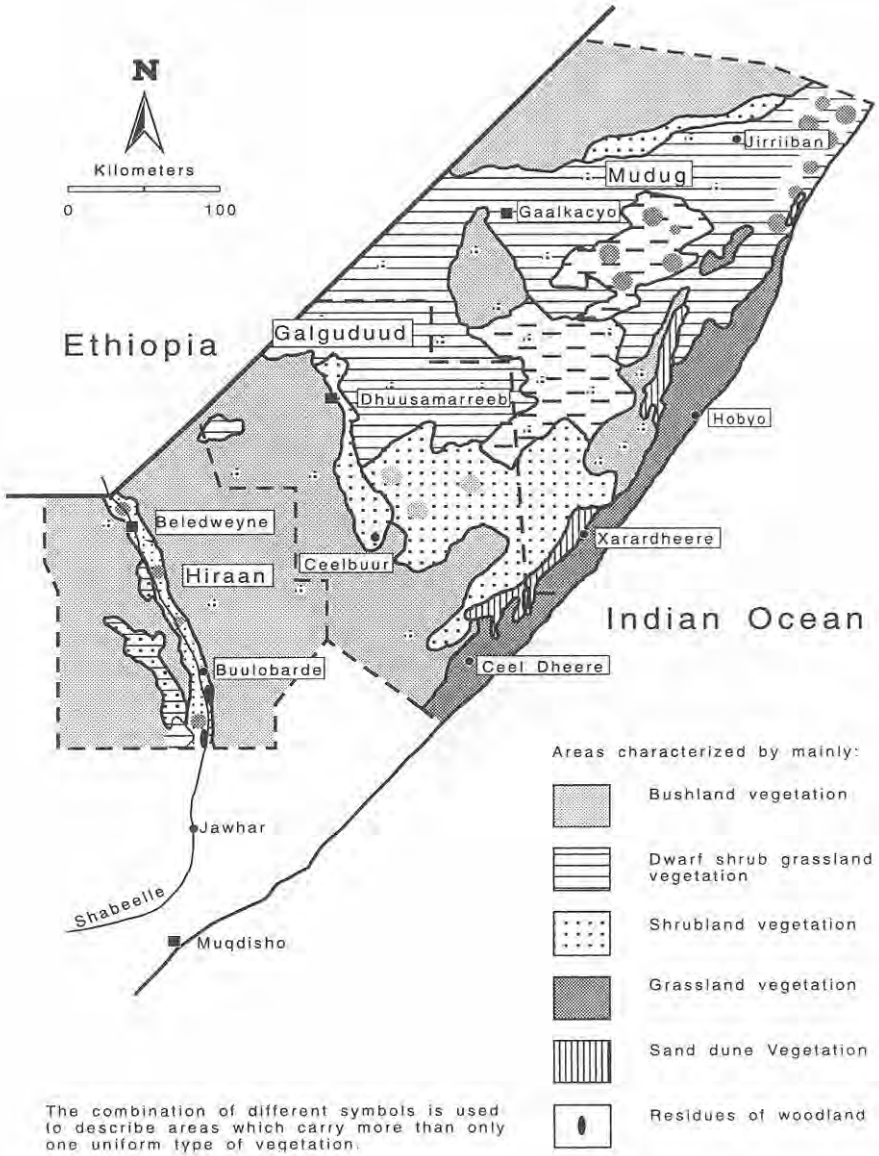

Figure 2: The distribution of vegetation types in the Central Rangelands

Design: Pielert, 1992 according to Baas, 1991

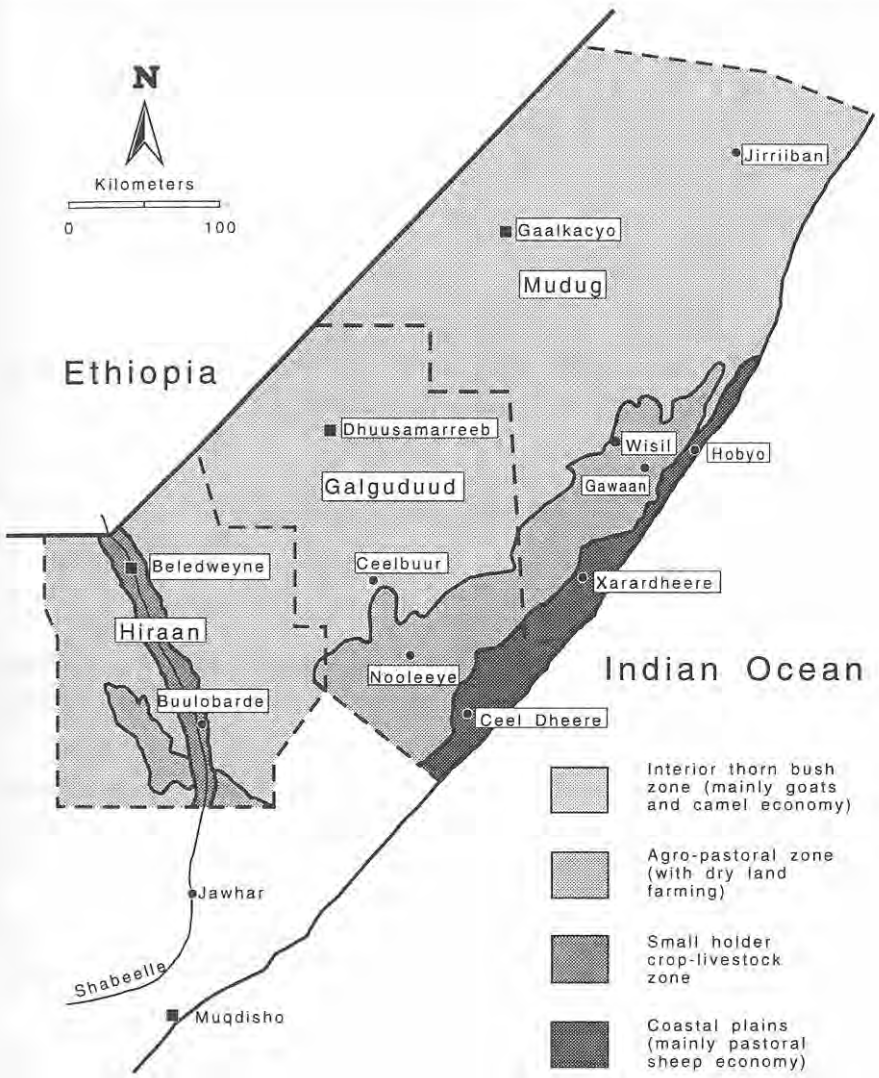

Figure 3: Patterns of land use in the Central Rangelands

Design: Pielert, 1992 according to Baas, 1991

LIVESTOCK POLICY IN SOMALIA: PAST AND PRESENT STATUS AND FUTURE PROSPECTS

Ahmed M. Abdullahi

INTRODUCTION: ROLE OF LIVESTOCK INDUSTRY IN ECONOMIC DEVELOPMENT

Somalia is a typical nomadic country in Africa. The majority of the country's population are nomadic herders, pastoral livestock production is the main foreign exchange earner and sizeable commercial sales from national herds have been routine for decades.

The pastoral livestock sector can therefore be regarded as modern rather than traditional. A large part of herders are in a phase of transition from a traditional subsistence-based system to a market-integrated commercial system.

Somalia's entire economy is dependent on pastoral livestock production. An estimated seventy-five percent of its population lives in rural areas of which roughly 50 percent are estimated to be nomadic pastoralists. The pastoral livestock sector supports between 60 to 80 percent of the population.

Livestock contributes directly to foreign exchange earnings and government revenues through export related fees, export and domestic taxes. As extensive technical and economical reports mention, exports of live animals have generated

no less than two-thirds of Somalia's foreign exchange earnings since 1975, with the exception of 1976, the year following the *Dabaadheer* drought (1973-1975). Exports of all animal products, including live animals, meat, hides and skin (but excluding fish), generated over 80 percent of Somalia's foreign exchange in six of the last seven to nine years. The livestock sector achieves this fairly cheaply since capital inputs into it are minimal. Moreover, despite the tremendous importance of pastoralism for the majority of the population and of the livestock sector for the country's economy, only a very small percentage of the national budget is allocated to programmes benefiting livestock pastoralists or the development of the livestock sector (Janzen, 1991; Samatar, 1985).

The national economy is overwhelmingly based on traditional livestock production, i.e. the nomadic pastoral sector. The livestock herds are probably the most readily exploitable economic resource of the country, so that clearly the livestock sector should be a matter of prime importance in all development efforts. If Somalia is to make progress in economic development, good performance of the livestock sector is vital.

Over the past 10 to 15 years Somalia's per capita production of beef, mutton and camel meat has remained essentially unchanged at 20 to 23 kg (FAO, 1972, 1978, 1984, 1989). If this relatively low level of production does not improve, there will be problems because of the projected doubling for the country's population by the year 2010. Increasing production through larger livestock numbers alone is not a realistic possibility.

The livestock trade, known to have started in the area of today's Somalia as early as the 1300s, escalated in the 1950s with the oil boom, and the increasing demand for live animals in Saudi Arabia and other countries of the Arabian Peninsula. Until the mid-seventies, Somalia was the world's largest exporter of live animals. In 1985 it still ranked third after Australia and Turkey in the number of exported sheep and goats (FAO, 1985, 1986). Livestock exports, as mentioned in various reports and studies, provided during the late 1970s and early 1980s for between 59 and 91 percent of the country's "official" annual foreign exchange earnings, the range determined largely by external conditions (Holtzmann, 1982).

It should be noted that in general, the volume of livestock exports, with the exception of increased cattle exports in the early 1980s (1980-1982) has been no higher in recent years than it was in the early 1970s (Jeffy and Weli, 1985).

LIVESTOCK DEVELOPMENT POLICY IN SOMALIA: CHANGES IN THE 20TH CENTURY

Since the second half of the 19th century, changes have taken place steadily due to governmental political interventions of the colonizing powers. Changes continued with the transfer of the power to the new national government after the Second World War.

In this century, pastoralists have enjoyed very little political clout and therefore have little say in the formulation and implementation of policies affecting them. Pastoralists have made limited advances compared with almost all other groups. Even today they occupy peripheral social, economic and political positions and have little influence on most of essential relevant political and developmental decisions. It has been stated that Somalia may be one of the few countries in tropical Africa that does not have any national policy for the supporting to the traditional pastoral livestock sector (Haldermann, 1985).

In many African countries pastoral nomads head the list of rural peoples who are resistant to change. This attitude of resistance, whether described as a "cattle complex", as in the case of pastoral nomads, or as "super-lazy" and "fatalistic", as in the case of peasants, has been very much exaggerated.

In addition to accusations that the pastoral nomadic population is conservative and resists change, they have also been blamed for the drought. It is perhaps unsurprising, therefore, that the measures suggested by the project for the development of traditonal pastoral livestock sector, appear to have an underlying objective, namely to settle the pastoral nomads. Under such pressure the pastoral system of production is affected by the difficulties that these people are facing in a rapidly changing world.

Looking at attitudes towards pastoral nomads, one must agree with Swift (1977) that they are confused. But the most prevalent attitude is that at present government officials and development specialists, often regard them as "backward and irrational people, a burden on the state and inevitably destined to be changed into something more modern".

Although the vast majority of the population of Somalia still reside and make a living in pastoral livestock areas from which comes a very large part of the national wealth past development strategies have given inadequate support to the rural areas, resulting in a deterioration in the quality of rural life. Development plans recently have given varying degrees of attention to the

contribution of the livestock sector. Nevertheless, it is clear that the quality of life among the pastoral population has not improved in proportion to this sector's contribution to the national economy.

The contribution of the pastoral livestock sector to the national economy of Somalia has been hindered by the type of planning on which Somalia has embarked since independence. All planning in the livestock sector has lacked an integrated approach and have been mostly composed of uncoordinated projects; animal resources were isolated from agricultural production. It has been reported that the state and the powerful livestock merchants have conspired against the interests of rural pastoral producers (Aronson, 1980; Samatar, 1989). With regard to this, it should be said that even during the previous military regime's "socialist phase" enforced settlement of pastoralists was undertaken with the aim of transforming their production into that of a "modern sector based on scientific production and management" (SDR, 1974). This policy, however, entirely, was not supportive to pastoralism: During the "socialist" phase the livestock sector was the only major economic sector to remain in private hands, despite a wave of nationalizations.

The pastoral livestock sector has undergone considerable disintegration and change in the last two decades. The pattern of pastoral livestock raising shows signs of drastic changes taking place which will have far-reaching implications for the entire socio-economical system. With increasing commercialization and a social shift away from the tradtional pastoral way of life based on family and on socio-economic cooperation between groups, social ties and control are weakened resulting in the collapse of the whole traditional social system. At this stage one can only speculate on the speed and extent to which the traditional social framework is disolving.

Furthermore, as elsewhere in East Africa, the amount of land under cultivation is increasing at the expense of free rangeland for livestock. This is having marked consequeneces for land tenure practice. Fencing is being promoted not only to protect crops but as a labour-saving device in herding, since fenced animals need less supervision, thus increaseing labour productivity (Behnke, 1988).

Looking at the position of the pastoral families in Somalia today, it is clear that the land pressure is increasing rapidly due to the new land tenure system, and due to human and livestock population pressure, both of which have increased in the last two decades (cf. Holt, 1985).

Since rangeland and water are the determining factors of production, enclosing land means that communal land is becoming less available for all herders. The main burden of such privatization and enclosures of communal rangeland are carried by those pastoral families excluded from their traditional means of production. Consequently privatization of communal land will produce a large number of dispossessed families whose future will eventually depend on the ability of the national economy to absorb their labour. At present there is no sector of the economy which might be capable of absorbing this volume of excess labour. In reality it will be some time before the Somali economy recovers to the point where it was when livestock was the mainstay.

The above-mentioned changes in the socio-economic framework and in land use have also been accompanied by a series of other changes. One important change is the altertion of the species composition of herds. Fewer cattle and camels are being raised and more small ruminants (sheep and goats) are being kept to provide live animals for sale. Recent research studies show that net cash incomes from small livestock in northern and central Somalia account for 65 percent of total families' cash income. Breaking this down into income by species, reveals that goats are by far the largest source of cash income for most of families in central Somalia. In the northern part of Somalia, where sheep are predominant, it is likely that sheep are the major component of families' income. Data on total species numbers and the numbers of families raising mixed herds in central and southern Somalia indicate that the shift towards small ruminants (goats and sheep) and away from large ruminants (cattle) is likely to continue as reported e.g. (Janzen, 1988). A shift from sheep to goats among small ruminants is likely to last.

Less milk is being used for family subsistence, leaving more for young animals (calves), thus improving their state of nutrition and chance of survival. Yet, in 1987, milk still was estimated to provide 32 percent of the annual caloric intake of households (Abdullahi, 1989). Market foods, purchased from the receipts of livestock sales, contribute more and more to the diets of pastoralists today.

There are indications that families are becoming increasingly dependent on the exchange of livestock and livestock products for non-pastoral foodstuffs and other consumer goods (Abdullahi, 1989). Dependence on non-pastoral foods makes pastoral families vulnerable to unfavourable terms of trade.

Fewer animals are being used for reciprocal and redistributive networks of animal loans, gifts, and other transfers, and are being sold instead. Social relations traditionally based upon livestock exchanges have been weakened further, and the society's autochthonous mechanisms for redistributing animals to those in need is said to be breaking down.

Increasingly, herds are being restructured to contain as large a breeding nucleus as possible. Older female small stock with reduced chances of reproduction are sold immediately. Reproductive females are sold as a last resort at times of extreme need. It was noted that during the dry season a large number of pregnant animals were slaughtered at the *Muqdishu* slaughterhouse.

Neglect of the traditional sector

Pastoral nomads represent about 50 percent of the population of Somalia. The animal wealth of the country is mainly held by the pastoral nomads. They own an estimated 95 precent of the domestic animals. Nomadic livestock is the major source of meat for local and export markets, and therefore, whenever there is reference to the contribution of the livestock section to the Somali economy, this largely refers to the contribution of the nomads. However, in spite of this major role of the nomads in the national economy, the livestock sector has not been given the attention it deserves by the government. The Five Year Development Plans (1960-1985) compeletly neglected the nomads, and their share in the government investment budget plan was insignificant (less than 2 percent). The major objective of this plan was to increase livestock production to beyond self-sufficiency, in order to export meat and live animals and other livestock products.

An evaluation of the previous Five Year Development Plans shows that these have had several shortcomings, with regard to the livestock sector:

- They lacked a coordinated approach to the problems of development, and livestock resources were dealt with separetely from agricultural production.
- The share of the livestock sector in the plan's budget fund was insignificant.
- The plans did not include any projects for the direct improvement of pastoralist's living conditions.

The fact that less than two percent of total government expenditure is allocated to this industry means that there has to be some reorientation in the economic policy of the government if development in the livestock sector is required.

The sector can, apart from providing subsistence for about two-thirds of the population, also contribute to Somalia's capital reserve, which is essential for any further development. This means that the sector must increase production and productivity. So far, Somali livestock owners have gone about this without any significant assistance. However, under the present circumtances this sector will need help to fulfill the above-mentioned, urgently required objectives.

LIVESTOCK DEVELOPMENT PROSPECTS

There is no clear-cut answer to the future of Somalia's pastoral people and consequently the country's future livestock sector policy. The sector's future prospects are complicated by the present civil war as well as by the destruction of all the basic infrastructure. It will take time and extensive technical aid to reestablish and to run the national economy.

It is generally agreed that the livestock sector has entered a process of radical change, which is still continuing. The key question is when and where will the sector stabilize and how will or should development alter the existing land use system. To plan a long-term development policy of the sector requires some speculation about the nature and future role of livestock activities. This is necessarily a somewhat difficult undertaking but essential.

The key factor will be whether it remains sufficiently profitable to keep livestock as a principle income-earning occupation. The economic expectations of livestock owners should be compared with the income potential in alternative activities. Real incomes are relatively moderate for those employed in *Muqdisho* and livestock would need to generate a comparable income to be worthwhile. This would necessitate not only to ensure that raising livestock is as such that each livestock owner is able to maintain a large enough herd to generate sufficient income.

A good understanding of the resource economics of livestock production systems and livestock development is essential in estimating whether economically, socially and ecologically a profitable system can be established and sustained or not.

Somalias's future livestock sector is likely to look very different from the present one. Two related social factors point the way of future development and livestock policy in Somalia. A central position in this discussion is taken by Boserup (1965) who argues that people in extensive systems of production (such as the livestock system) will not adopt more intensive methods of

production without some kind of pressure. Their reluctance is related to the use of labour. This extensive system is characterized by a high return from labour and low return from land. An intensification process that increases productivity from land is paid for by decreasing returns from expended labour. Obviously, farming households will not enter into such a situation without reason. Boserup argues that it is the demographic pressure that brings about such a change. Population growth and the absence of alternative employment opportunities in other sectors will eventually force farming families to give priority to increasing land productivity at the sacrifice of their labour.

Although this scenario may not entirely explain the situation in other African countries, nevertheless, it is valid in the case of spontaneous enclosures in the central rangelands of Somalia. Human population and livestock numbers have increased over the last two decades (Holt, 1985). The resulting pressure on natural resources (rangeland) is encouraging the adoption of new strategies to increase land productivity.

As commercial herds grow in size, their owners often manage to obtain de facto private control over de jure communal land (Behnke, 1988). In the communal system of land tenure, effective control of rangeland is contingent on the ownership of livestock which can exploit this common resource. It is also contingent upon having access to scarce water which makes pasture usable for animals in certain seasons. Thus, even if the traditional land tenure system were to remain unchanged, commercial herd owners can take effective control with the increasing sizes of their herds. This position is further strengthened when large commercial operators invest in the development of private water resources. This may eventually result in unstable rangeland use in which access to pasture is restricted, based on herd size, local political influence and the legal ownership of scarce water. The impact of such a new land tenure system will increase the speed of emigration by the present large number of small herders existing under the subsistence level.

The government should help to ensure that livestock-related enterprises should remain not only viable but also competetive with other sources of income. Since there are too many families in the livestock sector a substantial reduction in the total number of familes will be necessary to enable those who remain to maintain the financial viability of their livestock herds in the future. Migration towards urban areas and into the international labour market is therefore likely to continue.

Recent research studies have shown that intra-community wealth differences among the pastoralist families or household groups in Somalia do exist. This implies that producers vary considerably in the size of their livestock holdings, in their access to essential elements of production, and in income and expenditures, in resulting different sales numbers and marketing strategies. Greater wealth opens increased possibilities of access to purchased livestock inputs (veterinary care, medicine water, etc.). In contrast small stock owners must struggle to provide the minimum necessary for subsistence. This dilemma of a limited resource base among the poor pastoral families is further aggravated by the threat to herd survival by drought conditions.

But it is necessary to keep in mind that pastoral nomads are very sensitive to the carrrying capacity of the land. The pasture is not yet wholly monopolized by individual or group (tribal) management units, and the self-regulatory nature of the system of pure pastoralism keeps the system of production in action.

Conceptualising the situation as such, integrated development plans which have a more positive approach to the improvement of the existing systems of crop and livestock production, will lead to real development which would have a positive impact on the quality of life of the indigenous people.

There is no clear-cut policy reconciling all the various aspects of pastoral livestock existence. The pastoral livestock sector's lobby or representatives lack the necessary experience enabling them to influence change. The situation might become very difficult if herds continue to increase at their present rate, if profit does not increase, if the carrying capacity continues to decrease, and if no controlled system of land use and pasture management is forwarded by the government. It is important to note here that the profit from these herds was never and still is not very high . However the profit to be gained from livestock herds, whether owned by pastoral nomads or other groups, has not yet approached zero. Until that happens herds will continue to grow in size. Planning in this area is in chaos and needs reconsideration, starting with basic issues like the concept of development itself.

The scope for developing pastoral systems is extremely limited. With time, institutional changes and technical improvements may one day provide a more ample subsistence and income base but hardly adequate for all today's pastoralists and their progeny.

It must be recognized that there are too many people dependent on range resources and livestock industry as at present. While the population is rising, resources are shrinking. As the logical consequence, the human carrying capacity of the land must be optimized and the excess people drawn away from the sector (a planned redundancy scheme). This must be accompanied by destocking (planned reduction in female stock scheme). A one-sided and fragmented technical approach will not alone be successfull. If the trend of spontaneoues enclosures and the commercialization continues, it will eventually push more and more families out of the sector. Remaining herders possessing rangeland may carry out strategies able to better land use, range management techniques and innovation packages.

From a socio-economic viewpoint, land degradation and the collapse of the existing traditional pastoral system can be viewed as a consequence of human decision-making as applied to land use and control. Decisison-making is influenced by perceived incentives and disincentives within differing time horizons in the framework of the existing policy to another.

Human rather than livestock development is the task in the pastoral livestock sector (Jahnke, 1982). The present form of livestock production can be only marginally improved upon. A certain degree of aridity towards the migratory form of land use with livestock is the most efficient. Human development does not mean teaching pastoralists better methods of stock-raising, but making them fit for occupations in other zones or sectors, so that arid zones are not overexploited and continue to be a valuable resource in the national economy.

As mentioned above, the critical factor in this sector is the excess number of pastoral herding. The pastoral livestock sector cannot sustain or feed all the familes presently deriving their incomes or subsistence from livestock. One fact is certain: many people would abondon livestock raising given an alternative. The question of who will leave the sector raises the question of wealth distribution and livestock distribution among the different social groups.

The challenge is clear: the future government must itself decide whether to undertake measures for which it will be difficult to obtain popular support, or to take no action, and allow the gradual and inevitable ecological degradation of the range on which the livestock sector depends, thereby inviting the famine and misery which must surely follow.

TOWARDS SUSTAINABILITY

By definition, the principle of sustainability poses the question of the time factor of the development process. No attempt will be made here to go into the intricacies of the concept of sustainabilitiy. The reader is referred to Redclift's suggestion that sustainable development meets human needs and is capable of maintaining economic growth and conserving natural capital (Redclift, 1987, 1990). Instead of probing into the difficulties and complexities of the concept as such, here it is only attempted to outline what sustainable development in the Somalian pastoral livestock sector policy would require during the 1990s in terms of political accommodation, participation of and incentives for the livestock owners, and with regard to shaping the future of pastoral people and consequently the pastoral livestock system.

The following are prerequisites for a sustainable development of the pastoral livestock sector, which permits people and their animals live into harmony. Development of the livestock sector can only be successful in the long term, if development projects are economically, socially, politically and ecologically sustainable and if the appropriate scheme is to substitute the existing social structure. Otherwise it is doomed to failure before it begins.

Political sustainability

A political settlement between the different tribes and the future government is essential for large-scale environmental rehabilitation and conservation in all the areas where pastoralism is dominant. Peace alone will not solve the problem of degradation. The processes which underlie the problem remain. After a decade with two or three major famines, wars, as well as economic devastation, the pastoral nomads and the their resources are exhausted. It cannot be expected that the pastoral nomadic society will propel itself into innovative development by its own inherent qualities. The role of the state and the tribal ongoing negotiations are critical in breaking the vicious circle of environmental degradation. However, merely replacing one major tribe with another in *Muqdisho* would not bring about much improvement nor cutting of the present territory of the Somali Republic into two or more new tribal state formations.

A constructive challenge facing Somalia is to find a political formula within which efficient development and political administration could be combined with power-sharing among tribes,- not only between the educated elite of the various tribes but also with the thousands of nomadic societies and with the authorities at community, district and regional levels.

Socio-economic sustainability

The limited resource base of small stock owners and disparity in the relative prices of livestock products and non-pastoral commodities are particularly to the disadvantages of poorer herd owners who cannot increase herd revenues at need. Realities have driven many indivduals or entire families with small herds from the pastoral livestock sector. The free labour potential of these households, however can only be utlized within the livestock sector to a very limited extent. Improvement in the income of particularly poor livestock owners can therefore only be achieved by selling off their labour, if at all possible, to other production sectors. In many cases the level of saleable skills among the traditional pastoralists limits their alternative employment opportunities.

As already discussed above, the commercialization of the livestock sector during the last decade has accelerated the rate of emigration of livestock owners. There has been a growing imbalance between herders' food needs and limited herd resources. Recurrent drought and the civil wars have reinforced the exodus of herders from the livestock sector.

With government's help livestock enterprises could become not only viable but also competetive with other sources of income. There are too many families in the livestock sector and a substantial reduction in their number of families will be necessary to enable the fewer remaining livestock families to maintain financially viable livestock herds in the future. It is therefore likely that migration towards urban areas and into the international labour market will continue.

Land use systems and ecological sustainability

Like many other African countries, Somalia does not have an explicit national policy on land tenure and land use control for the pastoral livestock sector area. There are often discrepancies between formal, i.e. governmental aims and locally recognized and accepted land tenure traditions. For livestock producers this creates uncertainties regarding access to water and dry season grazing. It can be said that confused tenure relationships often encourage overstocking which, in the long run, negates much of the gain from otherwise sound interventions.

Land tenure is extremely important. Legal rules related to the use, transfer and inheritance of land must be specified, and instruments for enforcement established. In order to facilitate long-term sustainability, the rules must be designed to encourage household investment in permanent structures which inhibit overgrazing and tree-cutting, stabilize vegetation and increase land productivity

The physical, biological and technical aspects of sustainable land management receive increasing attention in Somalia, both from the Ministry of Livestock and from international donors. It is generally agreed that the point of departure for improving and developing a sustainable land use system should be an understanding and assessment of the previous abolished traditional system of rangeland management.

Ecological indicators show that previous technical interventions have only accelerated or aggravated already existing degradation and created more pressure on rangeland than it can sustain. These measures generally were administered in a top-down fashion, with no involvement of the pastoralists themselves.

Although there is still some potential for developing sustainable livestock production areas in Somalia, the realization of this would require massive external support. One drastic intervention measure would be to take seleced tracts of land out of production for some years. The exhausted rangeland in Somalia requires a fallow period to restore soil fertility before going back into production.

SUMMARY AND CONCLUSION

Somalia, is essentially a livestock-dependent country. The livestock sector will remain the mainstay of the Somali socio-economy, since 45 percent of the country's total land surface of approximately 623,000 square kilometres can be considered as exclusively rangeland; nearly 90 percent falls into the category of potential rangeland. Potential alternatives for this land are nearly nil since the soil is not suited for any use other than grazing. The livestock sector should, apart from providing subsistence for about two-thirds of the population, also contribute to the capital reserve in the country, which is essential for any further development. This means that the sector must increase productivity. So far, Somali owners have gone about this without any significant assistance; however, the above-mentioned objectives, cannot be achieved without help.

The fact that less than 2 percent of the total government expenditure is allocated to this sector indicates that there must be some radical changes in the economic policy of the government if development in the livestock sector is to proceed as planned.

The pastoral livestock sector, which has stood the test of time for centuries, is now threatened by new developments which stem from an increase in livestock numbers, the rapid increase in population, the evolution of urban settlements, and groups of sedentary livestock owners who are enclosing range areas for their private use.

The livestock sector in Somalia is presently characterized by various basic factors. First has to be mentioned the increasing human and livestock population in the last decades. A second point is a growing shift from subsistence to commercial animal production and a consequent shift in food consumption patterns. Another characteristic is the pressure on natural resources and locally existing traditional systems. Finally the low viability of families with undersized herdsis a further important factor leading to the migration of family members or the total abandonment of the livestock sector.

As a consequence of the existing situation some major changes are likely to develop in the medium term. There will probably be a further fall in livestock productivity and the competition between subsistence and commercial production in the livestock sector will rise. A decrease in families' direct subsistence from herds in favour of cash income will face an increase in income and wealth disparities. The result of this will certainly lead to a higher rate of migration of sizeable numbers of families from the traditional livestock sector to urban areas.

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THE CENTRAL RANGELANDS DEVELOPMENT PROJECT (CRDP) - AN APPROACH FOR THE IMPROVEMENT OF RANGELAND CONDITIONS AND INCOME GENERATION IN A PASTORAL AREA

Karl-Hans Zessin and Dahir Abby Farah

INTRODUCTION

Of the three major multi-laterally funded projects aimed at developing the livestock sector in Somalia, the Central Rangelands Development Project (CRDP) was the second project in the nomadic living-space with a development concept based on a range management approach.

The concepts of the earlier Northern Rangelands Development Project (NRDP) and the later CRDP took shape in the wake of the calamitous Africa-wide drought of the early 1970's, in which as much as 30 percent or more of Somali livestock died between 1973 and 1975. Technically, both projects also continued with perceptions and policies on rangeland development that have their beginnings in the 1960s.

Activities to develop natural pastures - or rangelands - started late in Somalia. Beginning in 1966, with assistance from the United Nations Development Programme (UNDP) they eventually led in 1974 to the UNDP/

FAO Rangeland Conservation and Development Project. The major objectives of this programme were to establish range management services, to experiment with soil and water conservation and forage production, and to investigate means of increasing livestock productivity and offtake. Although the project was prematurely terminated in 1976 due to the UNDP financial crisis, its concepts and findings, little researched as they were, nevertheless did heavily influence the design of the subsequent NRDP, carried out between 1977 and 1985, and of the later CRDP, carried out between 1980 and 1990.

In the 1970s the livestock sector furnished about 80 percent of Somalia's overall foreign exchange earnings. The NRDP as well as the CRDP therefore put strong emphasis on the creation of governmental organizations and agencies which could act to promote the livestock sector, this being the principal source of national wealth. The Central Rangelands, for example, provided about 20 percent of sheep exports, 40 percent of goat exports and between 10 to 20 percent of camel and cattle exports. Dependent on livestock as the most important sector, one of the country's main macroeconomic objectives in promoting rangeland projects was to increase the number of high-quality livestock for export. The stabilization and improvement of resources needed to increase this output of quality animals was then expected to also gradually improve the economic position of the pastoralist population.

Control and enhancement of the rangeland resources towards this end was viewed as a bureaucratic activity requiring government intervention. For this, the National Range Agency (NRA) was established under Somalian law in 1976 and given full responsibility in 1979 to control the conservation of game, wildlife and forests. The NRA was given considerable powers. Established as a semi-autonomous organization under the Ministry of Livestock, Forestry and Range (MLFR), with the General Manager of NRA reporting directly to the Minister of MLFR, it had exclusive authority to open or close grazing reserves, to establish grazing associations but also to exert pressure on pastoralists to conform. From the viewpoint of pastoralist's development, the NRA's Department of Range and Environment is the most important. The Department contains divisions which plan, implement and enforce various programs for land, plant and water conservation, plan and direct the formation of grazing associations and monitor the activities of grazing cooperatives. Agents of this NRA department were essentially authorized to act as "range police" (USAID, 1986).

The NRA was designated as the implementing agency for the NRDP as well as for the CRDP. Its General Manager, at least initially, acted as Project Manager for both projects.

The central concept of the NRDP and subsequently of the CRDP was based on the perception that the rangelands were deteriorating because of overstocking and poor management. This decline had to be arrested by immediate and extensive measures to increase the offtake of live animals and by range management measures to provide some balance between livestock requirements and forage supply. The idea was to change the opportunistic grazing practices of independent and traditional herders into "better management" through a planned, disciplined and fairly rigid system of controlled grazing. The introduction of a basically public pasture tenure system was thus seen as the central measure for providing such grazing control.

The focus of the NRDP was essentially limited to vegetation management and resources conservation. Based on a western-type, technocratic range model its measures centered on range protection, sufficient water supply and veterinary services. Grazing cooperatives and livestock associations were formed as local institutions to implement controlled grazing. Grazing cooperatives were favored by the military and initially socialistic government as the preferred method for adjusting pastoral land tenure towards anticipated modern conditions and grazing restrictions. Pastoralists were to join cooperatives to which grazing land was then allocated by the administration. Grazing associations, in contrast, had stronger indigenous roots in Somalian land tenure. Grazing associations, later renamed Range and Livestock Associations (RLAs) represent the interests of those families who traditionally use a given grazing area (Somali: degaan) and within it, the same permanent water points and dry season grazing areas. RLAs were organized by the project by forming committees composed of elders, other respected pastoralists of the degaan, local government and party authorities as well as religious leaders. The pastoralists of the degaan elected the committee members who met at intervals to decide on the management of their grazing territory and its rules. This RLA system fitted better into the system of village and district councils and it allowed transhumant herding groups from outside the association region the right of limited grazing in the territory - a practice that the cooperatives did not permit. District Range Assistants, employees of the NRA, supervised the grazing operations and activities of the associations and also provided a certain amount of extension assistance.

NRDP activities were hampered by considerable delays in recruiting staff and management but the project nevertheless managed to initiate a dialogue with pastoralists. The key grazing-management components of the NRDP, centering on the demarcation of town, village, famine and range grazing reserves to be managed by RLAs, were taken over in the CRDP design. This central range management model was further complemented by stabilizing measures (veterinary and water services) and components to strengthen government services (veterinary, NRA, forestry).

CRDP PROJECT BACKGROUND

In November 1976 the Government of Somalia (GoS) invited the World Bank to untertake a project identification mission in the Central Rangelands. The GoS accepted the missions's report and project preparation started in January 1977. Appraisal was completed in early 1978, a loan approved in April 1979 and as from June 1980, phase I of the CRDP was launched for a period of 6 years. Due to initial delays in the implementation, this phase was eventually extended until the end of 1989.

Phase I of the CRDP was established as a multi-donor project with funding from the International Development Association (IDA), the International Fund for Agricultural Development (IFAD), the United States Agency for International Development (USAID), the Overseas Development Administration (ODA), the World Food Programme (WFP), and the GoS. IDA and IFAD contributed loans of US $ 8 million and of US $ 7 million, respectively, and supported the non-formal education and training components, the building program and part of the administrative and management support to the NRA. The USAID grant financed the range and stockwater development components, part of the formal education and training, the range studies, soil conservation and grazing cooperatives components, technical assistance to NRA headquarters and the range monitoring unit and stockwater service, except for categories covered by IDA and IFAD. The WFP provided food for unskilled labourers. The GoS agreed to contribute to local salaries and was expected to take over all local salaries and allowances by year 4 of the project. The ODA subsequently withdrew as a donor and its commitments for the veterinary and forestry components, the vehicle maintenance workshop and part of the formal training at the Livestock and Range School were taken over on an amplified scale by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ).

Following the recommendations of the evaluation report at the end of phase I (World Bank, 1989), a phase II was appraised and funding was approved for a further 6 years by the World Bank and the African Development Bank. Implementation of this phase, however, never really materialized, as the civil war, previously confined to the north of Somalia, also erupted over the rest of the country and effectively terminated all project activities. The veterinary component, for example, had to curtail its field activities from August 1989 for serious security reasons and withdrew in December of that year from its headquarter in *Beledweyne*, which was subsequently destroyed in October 1990.

The original objectives of phase I outlined in the Staff Appraisal Report (World Bank, 1979) were to:

- consolidate and improve rangeland and livestock production;
- improve pastoralists's income; and
- encourage, by improved range management, the gradual concentration of pastoral communities, as this was considered conducive to the provision of social services.

The project area, located between latitudes 3°10'N and 7°40'N, was demarcated in the east by the Indian Ocean and in the west by the de facto border with Ethiopia. It comprised the administrative regions of *Hiraan*, *Galguduud* and *Mudug*, a total of 149,000 km^2. The major physiographic regions were a grass-and herb-dominated coastal plain, a central region with a series of benches rising from the coastal plain with a low bush, grass and herb cover, a shrub-covered upland plain (*Hawd*) that merged with the central plain and in the south the low hills and alluvial plains of the *Shabeelle* valley.

The population of the project area was estimated at 544,000 of which 75 percent were directly involved in livestock production. The livestock population was estimated at 1.0 million camels, 0.9 million cattle, 1.2 million sheep and 3.9 million goats.

PROJECT DESCRIPTION

The objectives of phase I at the time of appraisal, were to be achieved by a variety of implementation and investigation activities. The key measure was the range development program, which was to begin with aerial and ground resource inventories of vegetation, geology, soils, human and animal populations, habitations, water points and cropping activities. Findings from these surveys were to help determine grazing reserves, form Range Livestock Associations (RLAs) and develop stockwater supplies. Three types of grazing reserves - famine, range and town/village reserves - were to be established by grazing associations and after agreements were reached between NRA, local government and the grazing associations regarding the use of the reserves.

The third stage was a range monitoring unit to establish a record of range conditions, which could serve as a basis for range management. Stockwater was to be developed by placing 32 boreholes or surface water ponds.

A non-formal training component was to survey the pastoral communities and carry out an extension programme which would inform the pastoralists about the objectives of the project. This component would be responsible for the formation of grazing associations. Simple educational materials would be produced and field staff would be trained and upgraded.

The scope of the rangeland management activities was optimistic and ambitious. Thirty percent of the rangelands in the project area were to be put under controlled grazing in the form of guarded reserves. That meant that, for example, 45 town and village grazing reserves of 400 km² each had to be established, about 4 reserves per district. A further 20 range grazing reserves of 900 km² each and one famine grazing reserve of 600 km² in each district were planned. Each reserve had to undergo the detailed and difficult process of forming a grazing association prior to the reserve's establishment and a plan to determine the technical details for the use of the reserve had to be established.

In order to overcome the acute shortage of NRA staff trained in range management, a formal training component was planned. At the technical level a Livestock and Range School and at the university level a Range Department at the Faculty of Agriculture of the Somali National University had to be established. The university department would provide a B.Sc. programme in range management. Twenty man-years of post-graduate scholarships overseas and on the job training for range monitoring counterpart officers additionally had to be provided.

The purpose of the rangeland studies and trials component was to observe the effects of grazing systems and range improvement experiments like burning or bush clearing. It would perform range grazing trials and range improvement experiments and develop a forage analysis laboratory for determining fodder quality. A taxonomist would run the National Herbarium. Soil and water conservation measures were to be demonstrated and experiences with grazing cooperatives in Northern Somalia were to be evaluated.

The NRA forestry department was to be strengthened and shelterbelts of 10 km² each were to be established at the three regional capitals *Gaalkacyo*, *Dhuusamarreeb* and *Beledweyne*, each with a tree and forage plant nursery.

A veterinary services component was to organize a central diagnostic unit, make guidelines for collecting and dispatching diagnostic samples, conduct a national disease survey, monitor vaccination campaigns, train counterparts and support a Technical Director of Veterinary Services.

The NRA was to be strengthened by the provision of senior technical management personnel, the formation of range monitoring and stockwater services and by the construction of a central and three regional vehicle workshops. Staff housing, offices, and equipment were to be provided. One NRA

headquarters, with the central workshop in *Muqdisho*, and 3 regional and 7 district centers were to be constructed as well as a central veterinary center and two satellite laboratories in the project area.

From the beginning general concern and doubts existed with regard to such a massive and relatively rigid approach which, in effect, attempted to replace existing nomadic ways by placing grazing control on certain areas and restricting grazing in the reserves. Several donors felt that something was seriously wrong with the appraisal and the general concept. While the appraisal report expressed an expectation of large and immediate benefits, the donors, at best, expected only long-term and predominantly indirect benefits within the short project lifetime. More important for the course of the CRDP they felt that the immediate, large-scale and rigid implementation of technical interventions could not be sufficiently backed up and justified by available data and information.

On these grounds USAID subsequently attempted to modify the approach, not the objectives, of components it supported. The modifications basically emphasized activities that would initially have more of a survey/investigative/ pilot character rather than focusing on full-scale implementation. Strongly opposed by the NRA and officially never adopted by USAID as an alternative design, these concepts were nevertheless soon taken over by other donors and were instrumental in modifying the design and policy of their project implementation.

Lastly, an animal production expert was added by USAID to survey traditional livestock management methods, to develop management procedures to improve animal production skills and to train Somali staff to extend improved techniques, when identified, to the pastoralists.

Thus, the CRDP, as originally formulated, was a complex, multi-component and multi-donor project which extended over approximately one fifth of the land area of Somalia. From the beginning, however, implementation of activities as outlined at appraisal was difficult. Organization and management structures were too weak and inefficient to guarantee planning and proper control of resources and staff. Work which was begun lacked any semblance of control or coordination. Communication between project components was lacking, progress of components took place in a vacuum as satellites without liaison. Most important, it became more and more evident that reservations concerning the validity of a number of project objectives were justified. There were no or inadequate data available on which the first managerial interventions could be based. Knowledge about the pastoralist's natural and socio-economic environment was either non-existent or extremely limited.

As a consequence, a consensus began to develop that the original objectives could not be attained within the six year period and that the direct and indirect benefits expected from the interventions would only be insignificant. In addition, security problems in the western areas of the CRDP dictated that range survey activities be relocated from the *Beledweyne*, *Dhuusamarreeb* and *Gaalkacyo* districts to those of *Buulobarde*, *Ceel Dheere* and *Hobyo*.

In order to solve these problems, a mid-term review was agreed between donors and the GoS, which was carried out in March and April 1984. After all major aspects, including certain controversial issues, were examined and after some initial reluctance on the part of the GoS could be overcome, specific changes in the project design and management were agreed. These included:

- modifications in the design of the project so that most components were to be implemented on a district to district basis. *Buulobarde*, *Ceel Dheere* and *Hobyo* were identified as first priority districts.
- Improvement of management by:
  * the appointment of a full-time project manager responsible to the General Manager of the NRA;
  * the establishment of a Project Management Unit and the recruitment of an expatriate Field Manager (subsequently funded and posted by the Australian Development Assistance Bureau) and
  * the setting up of a Steering Committee composed of representatives of the donors and appropriate GoS institutions.
- Reformulation of the plan of operations for the veterinary component, to concentrate on survey work, and for the water component to put emphasis on the utilization of surface water supplies and on the rehabilitation of existing water sources.
- Transfer of responsibilities and funding of the formal education component from the CRDP to the Faculty of Agriculture, Somali National University.

With this review, discussions between GoS and donors were started on a irregular but continuous basis, concerning important factors in the pastoral economy that were either ignored in the original project formulation or had changed as a result of a significant shift in GoS policy.

The re-designed and scaled-down project from 13 to 3 districts showed steady improvement and a better general performance. While project objectives officially were not changed, a modified approach began to evolve as project

staff gained more experience. For example, views changed with regard to developing grazing reserves, seen at appraisal as an activity that would produce direct benefits. Reserves increasingly were regarded, in an experimental light, as an instrument to provide a continuous link and cooperation between pastoralists and project. By the end of phase I, there was still no proof of the CRDP's working assumption that reserves would improve rangelands. Furthermore, the notion that range management and improvement would directly and immediately lead to enhanced livestock production changed to a feeling that considerably more knowledge was required about production systems before such a statement could be made and acted upon. In short: activities generally less intended immediate implementation, and increasingly took on an investigative and study character.

Implementation and achievements

An aerial resource inventory of the entire Central Rangelands was completed. In the three priority districts, ground surveys of range resources, livestock numbers, boundaries of traditional grazing areas (*degaans*), water requirements, livestock diseases and traditional livestock management were completed.

Up to 1985, three surveys of pastoral communities were conducted. Some of the results may be questionable in detail due to the survey methodology used and due to difficulties in obtaining reliable answers from pastoralists who, in the early stages of the project, were suspicious of GoS intentions. Still, valuable baseline information was collected on a wide variety of topics, particularly demographic.

Range management plans were completed for 23 *degaans*. Based on these range management plans, Range and Livestock Associations were formed in 14 of the 23 degaans. Within RLA areas a considerable number of interventions were implemented: 23 grazing reserves and 7 village conservation areas were established. The physical infrastructure of RLA degaans was improved by 22 boreholes, eight of which were of good quality, 34 catchments to collect surface water for watering lifestock, 9 river water access points for livestock at the *Shabeelle* river, 6 shallow hand-dug wells, 22 upgraded existing shallow wells, 3 regional and 7 district tree nurseries, 12 village shelterbelts, 13 cement-lined surface water catchments, 18 village tree planting programs, stabilization of 8 sand dunes and 3 water erosion control sites.

Only a minority of RLAs introduced and maintained successful rest-rotational grazing schemes. RLAs were more instrumental in, for example, the maintenance of water catchments and the implemenation of smaller-scale interventions and trials. For example, two agro-silvo-pastoral trials were established at RLA sites in *Nooleeye* and *Buulobarde* and one water spreading trial site at *Aboorey*. Two species elimination trials were carried out, a seed multiplication unit was formed and eight agropastoral case studies were carried out on demonstration sites on private farms in the *Ceel Dheere* district.

In total more than 40 demonstrations, including fodder-crop anti-erosion strip farming, tree and live fence planting, water harvesting techniques, sand dune stabilization and range rehabilitation through temporary exclosure of livestock were conducted.

An animal disease survey was completed and a disease monitoring programme was started using 55 Nomadic Animal Health Auxilliaries (NAHA) in the 3 priority districts.

A Department of Botany and Range Management was established within the Faculty of Agriculture, from which 46 students graduated with B.Sc. degrees by 1989. Three CRDP staff completed overseas training in Australia and 4 in the US. A further 8 students enrolled in studies in the US. Five staff members were sent to Kenya for master degrees in organization and management. A large number of CRDP veterinary and forestry staff received advanced and short-term training, on the job and overseas.

Subsequent to the mid-term review, another consultant report (Mascott Ltd., 1985) and a highly successful workshop on future range/livestock development strategies for the Central Rangelands in March 1986 (Wieland, 1986) helped to identify future project activities. The consultant report, in particular, pointed out the increasing role of agropastoralism and range enclosures in parts of the Central Rangelands and was instrumental in making the project face these issues. Consequently, starting in 1987, work was initiated in the three additional priority districts of *Jalalaqsi*, *Xarardheere* and *Ceelbuur*. In these districts agropastoralism and farming was extensive. As interventions in these areas was expected to offer better chances to increase productivity than in the pastoral system, project emphasis in the later part of phase I and in the design of phase II shifted towards these districts with large portions of agropastoralism.

In phase I, progress was made in two of the three additional priority districts in the fields of range analysis, sociological investigations and animal production. Range management plans were prepared.

DISCUSSION

Among international donors, livestock projects are generally not considered highly successful. Particularly with regard to arid Africa, a widespread belief exists in a legacy of failure to develop pastoralism that seems to have caused some in the development community to write off pastoralists completely. In the minds of many of these Western development planners, nomadic pastoralism in sub-Saharan Africa has been associated for decades with famine and ecological degradation, a permanent crisis that ranges from overpopulation and overgrazing through problems of veterinary health to lack of social control and the sectoral and topical immobility of pastoral societies.

For several reasons, this perception of pastoralists has also come to prevail among governmental officials in many African countries where pastoralism exists, at least regionally, as the predominant way of life.

Somalia's position, however, is atypical of African countries in these two aspects. With pastoralists constituting the overwhelming majority of the population and most members of government, the civil service and the modern sector being of pastoral origin, the national policy, though not without its complications, is not hostile to pastoralism per se. Furthermore, the international donor community was committed to supporting the nomadic sector. The CRDP demonstrated a multi-donor response to assisting rangeland development, with sizeable financial investments and long-term project commitments.

However, even without major obstacles and neglect from Government or donors, the performance, achievements and impacts of the CRDP have still been mixed. Donor views, internal reviews of consultants, and a series of modifications during the implementation of project phase I, illustrate that from the very beginning there was a general concern on the part of development planners, researchers and project implementors regarding the institutional structure of the project, its management capabilities and its anticipated performance. More important, the weak technical basis and assumptions which served to justify the type and scope of scheduled project activities, were seriously questioned.

Project performance clearly reveals project strengths and weaknesses with regard to its institutional structure and operation. Discussions about the underlying assumptions which led to the project, on the other hand, still continue.

The overall institutional achievements of the CRDP have been mixed. Continuous unsolved logistics problems, particularly of fuel and equipment, lack of incentives -both financial and professional- leading to low staff morale, and unsatisfactory coordination between components and donors, all indicate

major deficiencies in project management. The project in consequence never worked at its full capacity; after a salutary high following the mid-term review in 1984, performance declined as the project progressed in time.

Nevertheless, the NRA and subsequently the CRDP, after its separation from the NRA in 1987, began to develop into agencies capable of taking on more and more of the tasks developed for them. Given that the Somali rangelands had received very low priority in livestock research programs, including those of the International Livestock Centre for Africa (ILCA), and acknowledging that serious efforts to address research and technology of rangeland development in Somalia has only really started since the early 1980s, both agencies gained structure and format. Permanent project staff increased substantially. This increase did not necessarily correspond to an intensification of project activities and may have increased the quantity of support staff, to the disadvantage of quality, commitment and the real needs of technicians. The country nevertheless was beginning to develop a cadre of capable range technicians, whose experience improved with the activities carried out in the field. In-country training, provided by individual project components and by the formal education training component was instrumental in this. The external training programme, in contrast, did not produce the desired results, as a considerable number of trainees did not return to Somalia. However, at the end of project phase I, the number of really qualified and committed technicians was still small. The CRDP was unable to attract or keep Somali staff of a sufficiently high calibre. The problem of low salaries was drastically exacerbated by hyper-inflation when Somalia began to pass through a period of political upheaval not foreseen at the time of the project design. This situation neither promoted good staff performance nor could work output be expected to increase as required. As additionally a large portion of the technical expert group, specialists with the longest and greatest experience with the CRDP, had left the project by mid-1989, project activities were further affected.

In short, the project, at the time of its maximum momentum had a structure in place able to collect and analyse data on range and livestock; it had started to identify areas which were of major interest to the local populations, where it could intervene successfully. The animal health services, livestock/crop linkages, water point construction and sand dune stabilization were such areas. For organizational and political reasons this momentum, however, could not be maintained.

Economic benefits were limited, quite understandably, considering the investigative/pilot character of project activities following the redesign of the project. Measurable benefits were limited to some veterinary, water and agropastoral improvements. Forestry and soil conservation efforts were certainly environmentally beneficial.

Results from the range management measures, in contrast, were largely unquantifiable but extremely valuable. Despite the basic problems of doing research in Somalia and the initial opposition of the GoS towards the reorientation of project activities away from massive and large-scale interventions towards pilot-investigative measures, this latter approach helped to accumulate the knowledge essential to better understanding the pastoral production system. A relationship based on a trust between grazing associations and the Project Unit was established. This awareness and cooperation from the local population was reflected in the feedback it provided, which was used to adjust the project's course, particularly in major areas such as agropastoralism, shallow or hand-dug wells and agroforestry. Using the Range and Livestock Associations to test rather than to forcefully implement range management activities, the project began to develop a multidisciplinary and practical approach which began to combine the priorities of the local communities with the technical disciplines. Examples of this basis-oriented project approach include detailed investigations and testing of location-specific measures in the areas of Yicib research, live fencing, buffalo grass and mung beans in the agropastoral system, and dugouts rather than boreholes, disease incidence information and the NAHA program in the pastoral system. Knowledge in the above areas began to accumulate and to improve the technical base for recommendations to improve range and animal productivity.

The CRDP's achievements, in summary, have to be seen from a technical and research standpoint. After considerable modification of the original design shifted the project policy away from implementation and towards investigation, it was this accumulation of baseline knowledge which helped to identify or exclude further potential measures in the rangeland sector. A 1987 evaluation report (USAID, 1987) adequately stressed this point and the learning process which the GoS and donors had to undergo, summarizing that the "CRDP was making a valuable contribution to the educational, scientific and technological basis for future implementation of improved rangeland management practices in Central Somalia".

Beyond project performance itself, there still remain some major fundamental questions concerning the conceptual foundation underlying a project for rangeland development. Somalia has little choice: the country is rangelands.

Production and output from this resource are limited. The rangeland vegetation has a low dry matter productivity, and there are large seasonal and annual variations in productivity due to low and erratic rainfall. Dependent on this monocultural livestock economy, the country's desire to exert centralized control over this single resource may be understandable. In this situation the pastoral sector has to accomodate a possible conflict between the economic needs of the country to increase GNP and export earnings and the objectives of the pastoral producers. Their objectives range in the short-term from subsistence with participation in the market place to satisfy old and new consumption, to longer-term needs to keep up livestock numbers for regeneration and for survival over long cyclical periods of drought. Attempts to introduce "modern" range management methods were primarily aimed at improving the macro-economic situation of the country and did increase the government services for livestock as the country's only viable resource. Such an approach also - deliberately or otherwise - facilitated the government's ambition to better control and settle the nomadic population, an aim in line with the policies of a military central government.

Such a strongly institutional development approach, in which the National Range Agency or the CRDP are the bricks and mortar of development, is understandable from the point of government, which is interested in directing and enhancing livestock production for export. But this set up does not guarantee that producer needs are adequately considered nor that the major problems which restrict the sector are correctly identified. A development program oriented towards responding to the government's perception of a general crisis, rather than following detailed development planning based on long-term monitoring and research activities, will not consider the pastoral producers as the target beneficiaries - rather as secondary or "effect" beneficiaries.

Manipulation and/or coercion of pastoralists, however, is not only unethical but also inefficient. Only the experience of producers themselves of the consequences of their actions provides a rational basis for development. Realistic recognition must therefore be given to pastoralists' abilities to know and advance their own best interests, to control change processes and to realize the benefits of change as directly and fully as possible. The best development approach seeks to avoid disrupting existing, albeit imperfect ways until it can be demonstrated that new ways are better, low-risk and appropriate. This approach appears logical and obvious. It is, at the same time, painstakingly slow.

It is wrong to condemn nomads as a negative, ecologically and culturally minor deviation from sedentary lifestyle, whose imperfections must be "fixed" by technical interventions. It is also wrong to restrict views on structural issues by addressing only the political-sociological phenomenon of pastoralists. A mere conservationalist approach, which romantically portrays nomadism as the superior way of life of a proud, independent people, who must be kept free from the destructive influences of modern civilization is a-historical. With change inevitable, it is really a question of how change is applied. It is the mode, speed and control over the direction of change that determines the well-being and fate of pastoralists. Neither the "technical fix" nor the "structural fix" schools of thought have so far been able to identify workable and proven development measures. This paucity of alternatives and the sensitive nature of the dessicated lands involved here make clear the need for a cautious, conservative and trial-oriented approach to nomadic rangeland development.

"Help", or "development" from externally funded projects must at least be thoroughly tested and of low risk to be acceptable in the nomadic context. This excludes the transfer of pre-formulated interventions, developed elsewhere. Know-how must be developed and alternatives tested by working within the system.

In retrospect, it appears that the CRDP's greatest strength was to have eventually followed such an investigative/pilot approach rather than embarking on large-scale, rigid and "military" interventions.

Following this approach it soon became clear that several of the assumptions underlying project appraisal were seriously flawed. Building on these assumptions, the project would have found itself quickly at an impasse.

Two major areas are briefly addressed here: that of the target group and that of the range model.

It was soon apparent that the CRDP's notion of pastoralism as a traditional, simplistic and somewhat static, low-input/low output system, which could be corrected straightforwardly and would generate short-term successes was outmoded (Mascott Ltd., 1985). The opposite is true: taking the terms 'traditional' as a starting point and 'modern' as a temporary final point within a transformation process of a society, then no "traditional" sector exists in Somalia. All aspects of nomadic live are affected by 'modern' conditions and thus are 'modern'. Various internal and external factors have led to a loss in grazing areas, local high stocking densities, an increase in the number of settlements and increasing integration into the national and international markets. Investments in agriculture, schooling, urban migration and emigration are indicators of changes in the

production orientation of pastoralists. At least a partial transition from a purely subsistence to a commercial system has taken place as an autochthonous response to external stimuli, among them predominantly the opportunity to export livestock to the Arabian Peninsula. The rangelands attract investments, livestock merchants, former migrant workers and private entrepreneurs recognize the nomadic sector for its investment possibilities, for example, in water catchment systems and cisterns, from which water is sold for cash. Nomads are today faced with new sets of problems resulting from these changes. As subsistence pastoralism is not only a particular mode of production, but embodies the complex features of a total social system, including production, consumption, distribution and exchange in interactive ways, changes in production orientation towards producing live animals for sale and having to pay for some imputs, like water, formerly free, have caused the entire system to react. The CRDP collected evidence of the chain of reactions that has been set off: pastoralists become more and more integrated into a consumer goods market, their diet begins to change away from subsistence food towards markets foods (Abdullahi, 1990); species composition and herd sizes are geared towards providing live animals for sale (Ahmed and Thurow, 1988) and as a consequence of the commercialization of the livestock sector, small subsistence holders are liquidated in favor of larger, commcercialized holders (Swift, 1977; Hoben, 1983). With only larger herds being economically viable in a commercializing environment, changes in the land use patterns of rangelands are likely. Common land and water are becoming increasingly unavailable to many herders. Rich and powerful herders increasingly de facto privatize communal land by fencing off sizeable areas of pasture (Behnke, 1988). In this case, the core of the problem is not addressed by attempts to control grazing, based on the old "natural equilibrium paradigm", developed for a common pasture system where all herders have equal rights of use and responsibility to maintain the range.

The equilibrium model is, in any case disputed, and views of specialists in the field do not universally agree on the effectiveness of rangeland management measures based on this model.

Livestock numbers in Somalia are stated to exceed the carrying capacity of the rangelands by three to eight times (World Bank, 1979; MLFR, 1986), a biological impossibility, as herds many times the size that experts call the maximum thrive and continue to expand.

Some of these contradictions are explained by differences in the definition of the term "carrying capacity". Demographers define it as the population size at which the population stops growing. Range scientists have borrowed the term but have given it a different meaning or rather a range of meanings which imply an optimal stocking density rather than a maximum (Mace, 1991).

However, population dynamics of pastoral herds may not follow the ecologically oriented concepts of demographers or range scientists concerning the "carrying capacity" of the range population biologists or range scientists. Such concepts often assume that herder's self-interests will cause them to overuse common grazing land, rendering this form of pastoralism unproductive and ecologically damaging. Programmes based on this premise are not addressing the real problem. If highly variable rainfall rather than absolute livestock numbers is the main factor which controls the dynamics of the ecosystem, then measures which focus on vegetation management, communal projects like group ranches, grazing-control, rotation schemes and reduced herd sizes do not address the actual problem. If livestock population dynamics are governed by climate, then measures seeking to establish a stable stocking density through vegetation management alone will fail. Herds which are rebuilt by traditional pastoralists as fast as possible after a drought and are inevitably knocked back again in subsequent dry years use range most efficiently in this case. Livestock numbers only temporarily reach a level that will seriously harm the range. Theoretical models of livestock economists support this notion of optimal use of range in years with "average" range conditions. Common property grazing systems (Ciriacy-Wantrup and Bishop, 1975) by property rights will be stocked more heavily than those with closed access; higher stocking rates thus will not achieve an economical optimum but produce a maximum output (Jarvis, 1984). It is possible for pastoralists to produce in these years more per hectare than commercial ranches without contradicting the overgrazing argument. This is not to say that no overgrazing occurs; in fact overgrazing is likely to occur in most communal range systems and and it would be irresponsible to claim that no long-term damage is being done.

All points of argument indicate that our knowledge of range ecology is too incomplete to justify in the name of development aid the use of unproven interventions to forcefully change a system, perhaps to the point of no return, - a system that may be more efficient and less damaging than any planned alternative.

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THE CENTRAL RANGELANDS DEVELOPMENT PROJECT (CRDP) - VETERINARY COMPONENT

Karl-Hans Zessin, Cord Heuer and Wolfgang Schrecke

INTRODUCTION

The veterinary component, together with the forestry, the vehicle maintenance workshop and part of the formal training components were projects undertaken by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) as its contribution to the multi-component and multi-donor Central Rangelands Development Project (CRDP). At the time of the CRDP appraisal (World Bank, 1979), the British Overseas Development Administration (ODA) was the original co-financier of these components; when it withdrew, the GTZ took these over. With some delay due to this change of donors, the first GTZ expatriate specialists were posted in 1982.

Most of the CRDP components were administered from the respective departments of the National Range Agency (NRA), which was designated as the CRDP executing agency. However, as NRA did not possess a department of veterinary services, it was decided to base the veterinary component in the Department of Veterinary Services in the Ministry of Livestock, Forestry and Range (MLFR) and to second it technically to the CRDP. The team leader of this component was thus responsible to both the Director General for Animal

Health in the MLFR and to the General Manager of the CRDP. This dual administrative structure not only complicated project management, but initially different views between the MLFR and CRDP concerning the tasks of the component also had to be settled.

The original tasks of the veterinary component, outlined in the appraisal report, were to organize a central diagnostic unit, establish guidelines for the collection and dispatch of diagnostic material by the regional field services, conduct a national disease survey of major epidemic diseases, test the results of vaccination campaigns, train counterparts, and support a Technical Director of Veterinary Services in the MLFR to advise its Director of Veterinary Services.

The original objectives aimed to reduce pressing constraints in the set-up and functioning of various departments of the government veterinary services and were in line with the MLFRs policy, which emphasized mass campaigns and massive inputs. However, with the start of CRDP implementation it became apparent that these tasks were not consistent with the specific objectives of the CRDP to consolidate and improve rangeland and livestock production. For this, from the technical point of view, planned individual activities were separated from each other without a logical connection. More important, they were designed to fill single gaps and rectify some of the many separate deficits of the trouble-ridden government veterinary service but not to provide a sound basis for improvements in health and production of the nomadic livestock.

For example, a central diagnostic labaratory simply waits in the capital of *Muqdisho* for samples to arrive from the field; because samples were voluntarily submitted rather than systematically collected, only a small number of animals were covered and the sample was not at all representative of the true disease situation in the project area. Considering the millions of stock numbers living in the diverse ecological zones and production systems in Somalia, the execution of a thorough nationwide disease survey would have been impossibly complicated and have consumed all project resources. Furtheron, such a survey, had it been taken at a point in time, would not have given information about the dynamics of diseases. Moreover, a survey focusing only on diseases would not have provided essential links between disease, production and economics.

Massive logistic support was called for to carry out extensive and expensive vaccination campaigns against diseases for which there was no basic information of any kind. Such campaigns based on "informed professional opinion", i.e. a whole list of diseases all assumed to be equally widely distributed and of equal importance, would have been unspecific and ineffective.

Like in other parts of Africa, where the quality of veterinary services had deteriorated progressively during the last decade, the situation in Somalia is such that squandering of resources on mass measures would have pushed government veterinary services beyond the limits of their increasingly scarce financial and infrastructural resources but would not have assisted in satisfying the demands of nomadic producers for efficient, adequate, practical and timely animal health care. In these complex nomadic systems, the provision of animal health care involves much more than a narrow concentration on "diseases". In fact, the health of animals is affected by a variety of factors ranging, for example, from rangeland conditions, management systems and socio-economic conditions to technology. Thus, the approach for providing animal health care must begin with identifying the conditions under which care has to be developed and applied.

In consequence of this realization, objectives stated at the time of appraisal were reformulated, so as to make the project concept more concrete, practical and systematic. In particular, the reformulation emphasized that increasing the logistic inputs to various veterinary service departments does not automatically produce more efficient work. More vehicles and therapeutic and diagnostic equipment would not have improved the veterinary care system in Central Somalia, where all district veterinary officer posts were filled by inadequately trained and poorly motivated veterinary assistants with little hands-on experience in field situations. The conclusion was that unless basic data were available to help identify the need for and scope of veterinary measures, the animal health service would continue to work inefficiently and to have no impact on the disease situation in the field.

After attention had been called to these concerns in the CRDP donor review in 1984, the reformulated plan of operation was agreed on between the GTZ, CRDP and MLFR and became operational for the period 1984-87. The plan of operation outlined a sequential program. In a first step, essential constraints on the nomadic production system were to be determined. After these had been identified and analysed, veterinary interventions against them had to be tested and evaluated in a second step. This systematic approach, which basically aimed to strategically concentrate resources against actual existing problems rather than assumed ones, also eventually influenced the policy of the Ministry. The MLFR conceded that the "necessity to establish priorities for the best use of limited financial and technical inputs would be the best avenue to demonstrate tangible advantages in veterinary service to the livestock owners" (Mohamed, 1986).

PROJECT CONCEPT

The first step of project work was based on the concept that an accumulation of knowledge about the condition and the development of the nomadic systems was of the utmost importance. While these investigations emphasized animal health problems, they also attempted to generally identify constraints in the livestock production systems. For this approach it was first necessary to develop an understanding of the problems and then to identify and test solutions against them.

Project work thus followed a logical structure: the investigation phase began with an analysis of the development situation of herds. This led on to an identification of constraints, the testing of solutions in the animal health sector and to the implementation of training programs for the extension of effective interventions in the field. This transfer of solutions in the form of, for example, therapeutic measures for livestock, accompanied by supportive measures by the governmental veterinary service, was seen as instrumental to the subsequent implementation phase of the project. The precondition at all stages was that analysis had to precede solutions. Solutions were to be developed based on the results of the analyses. In short, rather than adhering to the prevailing wisdom that veterinary interventions, developed elsewhere under different conditions, would also be applicable to the systems of the Central Rangelands, the project sought to develop specific solutions to the region.

Project work was structured along the following lines: the investigative phase had to, at first, be multi-disciplinary and systems oriented. It had to exceed the narrow disciplinary borders of traditional veterinary specialization. In addition to information about animal health, data on animal husbandry, production and economy were to be collected. Secondly, an analysis of how health and production interact had to precede the formulation of measures. Interventions and solutions were to be based on the results of the analysis and had to be appropiate to the nomadic systems, which were to be improved rather than superceded by another system.

To achieve these aims the following measures were implemented (Doppler, 1986):

- An infrastructure necessary for the implementation of field work was established. For this, and in contrast to other CRDP components, located in the capital *Muqdisho*, the veterinary component established its infrastructure in the field. A component headquarters with a regional diagnostic laboratory in *Beledweyne* and two smaller sub-laboratories in *Dhuusamarreeb* and *Gaalkacyo* were built and equipped.

- Counterparts (veterinarians, veterinary assistants, support staff) were trained in-service in appropriate methods and tests in the field and in the laboratories. From the beginning, distinctions between expatriate and local staff and between personnel working in the field and those working in the laboratory were avoided. All project personnel carried out regularly field duties on a revolving basis in addition to specialized assigned jobs in the laboratories.
- Surveys were carried out on animal diseases and livestock productivity to
  * determine the prevalence and incidence of the most important animal diseases,
  * collect information about the nature and distribution of the most important livestock production systems in the project area,
  * investigate the prevalent production systems and to determine herd structures and production parameters in the different systems, and
  * estimate the economic importance of the different animal diseases investigated.
- A system of herd monitoring or species monitoring was established in order to develop and test appropriate veterinary measures aimed at improving animal health and productivity.
- Means were explored for transferring the results of analyses to the field and for evaluating possible strategies to implement surveillance, monitoring and an early warning system for animal diseases.
- A concept was prepared for the selection and training of Nomadic Animal Health Auxiliaries (NAHAs) and to establish a revolving drug fund .

The first project phase, between 1984 and 1987, focused on the "Surveys" and from 1988 onwards on the testing and recommendation of inputs and intervention measures under field conditions ("Monitoring"), the evaluation of an early-warning system for animal diseases ("Surveillance") and on the training and support of NAHAs.

Project activities started with field surveys and the analysis of their results for the priority districts *Hobyo*, *Ceel Dheere* and *Buulobarde*. Somali project personnel, trained during these surveys, then conducted similar surveys in the *Dhuusamarreeb* and *Gaalkacyo* districts along the Ethiopian border, using the two district sub-laboratories. Meanwhile, the surveys in the 3 priority districts were followed by a surveillance system for selected herds and animals. Using the relationship established between project officers and nomadic herders during the surveys, specific livestock sub-populations were closely surveyed in order to detect early the outbreak of diseases or any other significant deviations in the health and production status. Information from such an "early warning system" would

quickly be transmitted to the Ministry in *Muqdisho* and/or to the respective district veterinary station. The purpose of such up-to-date information on local problems was to permit more and more site-specific treatment and control programs to be launched. These would replace the previous, undirected "blanket" campaigns. For such an early warning system to be effective, however, a fast system must be set up for collecting data, collating and analyzing these, and disseminating results and recommendations for action.

Before such intervention measures can be implemented, they must be tested under field conditions. The monitoring scheme would offer an opportunity to test inputs on a pilot basis.

Surveys and monitoring are project activities based on techniques which the veterinary profession has developed and established during the last decades (Schwabe, 1984).

The Nomadic Animal Health Auxilliary System (NAHA), in contrast, was a new and innovative measure. Its formulation was based on an evaluation of the surveys and combined with empirical knowledge gained in the field. The NAHA system was seen as essential for extending and transferring knowledge and techniques from the project to the nomads. The system was designed to improve the situation in two problem areas: first, government veterinary services never were directed at promoting the health of the overall herd. At best, sporadic care was given to individual animals within a herd, which is insufficient to improve the herd as a whole. Secondly, although some disease data were collected in the baseline surveys, there remained an extreme paucity of qualitative and quantitative information, particularly ongoing disease information. The objectives of the NAHA system therefore were twofold: clinical services and therapeutic measures were to be improved in terms of availability, accessibility and efficiency for nomadic livestock owners through the employment of auxiliaries. Secondly, disease "intelligence" information collected by NAHAs was expected to form part of an ongoing disease surveillance system to enhance veterinary services at the *degaan* level by more target-oriented and effective action in disease control and prevention.

The concept envisioned the NAHA as an independent, informally trained person of pastoral origin and not employed by any government service or project. Being independently employed, he would be an auxiliary in that his work would complement the official services. As a person living himself in the pastoral environment, the NAHA could fill the gap in veterinary services at the individual animal and flock level. With regard to surveillance he could provide

a link greatly needed but usually absent in pastoral environments: through the NAHA information on diseases and other production constraints at the micro-level would be accessible to the disease intelligence unit at the macro-veterinary level. Strategically, his position was seen as vital for shifting the prevailing veterinary focus away from highly centralized, rigid, often unduly costly and untargeted attempts to carry out "blanket" measures towards a more resource-efficient, problem-specific and locally flexible approach.

IMPLEMENTATION

The design and plan of operation for the investigation activities built on experience gained by GTZ in prior projects for example that undertaken in the southern Sudan between 1977 and 1982 (Zessin and Baumann, 1982). Several shortcomings of this earlier project with regard to sampling design and survey methodology were considerably improved in the CRDP veterinary component: technically, due to the lack of any kind of sampling or list frame of flocks, a non-probability sample of clusters (herds) was taken in an attempt to cover the study districts as completely as possible. Within each cluster or herd sample, a defined sub-sample of 20 individual animals, stratified for species and age groups was drawn non-randomly. The animals in this sub-sample were marked with eartags for identification in follow-up investigations. By using this sampling strategy, biological samples (e.g. serum, faeces, blood slides) and measurements (e.g. body weight) were taken from a sample proportionally representative of the mix of sheep and goats in each flock, and of the age and sex distribution within each species in each flock at the start of the investigation.

Additionally, a systematic flock inventory was taken of each flock at each study date. Concurrently, demographic patterns of the flock, as well as economic, husbandry, and management data were collected by means of a structured questionnaire. From 1985 to 1987 a total of 382 investigations of 126 mixed sheep and goats flocks were carried out in the districts of *Buulobarde*, *Ceel Dheere* and *Hobyo*. In 81 flocks these investigations were repeated 2-8 times. Thirty-nine cattle herds and 33 camel herds were also investigated several times over at least 12 months.

A longer follow-up study on small ruminant flocks was started in 1987 in the additional districts of *Beledweyne*, *Gaalkacyo* and *Dhuusamarreeb*. It continued until the project was forced to terminate in 1990. This study included 60 flocks of which 48 were examined regularly up to 19 times at intervals of 2 months. In addition to biological specimens and bodyweight, breeding data were recorded

from the constant herd sub-sample of 20 animals. The offspring of these animals was ear-tagged and their weight, first lambing (kidding) age, and eventual fate were monitored regularly. Due to the untimely termination of the project and a relatively high age at first parturition of about 2 1/2 years, these data on reproductive performance remained meagre. As in the previous survey, the serological tests in this study, carried out on 3877 sera, tested for brucellosis and mycoplasmosis (4 strains). Additionally, these sera were tested for trypanosomiasis (*T. evansi*), chlamydiosis (*C. psittaci*), Q-fever (*Coxiella burnetti*) and the two viral diseases *maedi-visua* and *caprine arthritis encephalitis* (CAE).

In 1987, a cross-sectional study of 260 pastoral flocks was carried out for a detailed description of production and management systems, flock demographics and productivity, and animal reproductive and productive performance (Bourzat et al., 1988). The "rapid herd appraisal method" of ILCA (International Livestock Centre for Africa) was used. Project activities in the field of "surveillance" concentrated initially on regular interviews of the Nomadic Animal Health Auxiliaries (NAHA). The systematic investigation of disease outbreaks was started in 1989, as an additional surveillance activity. Reports of 12 outbreaks were reported to the MLFR by December 1989.

The project also carried out a number of case studies. The efficacy of the locally produced Rinderpest vaccine was tested on some 120 cattle using an ELISA test which was standardized for cattle sera from Central Somalia. The prevalence of bovine tuberculosis (TB) was compared between cattle from households with and without at least one person with clinical pneumonia. Prevalences of bovine TB reactors were also obtained from cattle populations in refugee camps and riverine villages in the *Shabeelle* valley of the *Hiraan* region. In the *Beledweyne* abattoir testing for lungworm and hydatid cyst infestations in small ruminants was carried out; and around the town of *Beledweyne*, cattle were examined for clinical and subclinical mastitis.

In 1989 the effect of strategic deworming after the onset of the rainy season was investigated in 15 flocks. An anthelmintic was applied to half of all animals in a flock about 2 weeks after the onset of the gu´ rains. For a total monitoring period of 6 months thereafter, all sheep and goats in the flock were weighed and reproductive data, offtake and losses recorded at monthly intervals. However, due to the termination of the project this clinical trial was not completed. Only preliminary and crude analyses could be done.

The NAHA programme started in 1986 and was interrupted by the civil war in 1989. Actively involved in the NAHA selection process were the Range and Livestock Associations (RLA) in traditional grazing reserves (Somali: *degaan*), and "village" committees, in their role as administrative bodies of rangeland areas, in 13 other *degaans*. Their involvement was expected to provide community recognition and cooperation. They were provided with general criteria on how to select NAHA from among their communities: NAHAs must be young, somewhat literate, intelligent and innovative; all personal attributes valued among Somali nomads. The literacy requirement was not too difficult to meet, as a mass literacy campaign launched after the 1974 revolution had successfully reached even the most remote areas. Leaders, elders, Koranic teachers and religious leaders were not considered as they could not be expected to work impartially.

Training seminars of 1 week to 10 days in each *degaan* were conducted at the most convenient times of the year for pastoralists to participate, namely after the rainy seasons, when herds seldom migrate. In the training seminars, lectures and demonstrations were given in Somali, or on rare occasions, translated simultaneously from English into Somali. Teaching staff consisted of regional and district veterinary officers, project veterinarians and assistants, CRDP extension and range officers and collaborative field researchers from the Faculty of Animal Husbandry and Veterinary Medicine at the National University. All teaching personnel presented prepared lectures to which they were assigned. Teaching, a combination of formal and conversational lectures and practical demonstrations, was on the basic anatomy and physiology of goats, sheep, camel, cattle, and also included diagnosis, a clinical course and therapeutic measures for important prevalent diseases, the role of ticks in animal health and principles of tick control. Principles of preventive veterinary medicine were stressed. Practical classes covered clinical examinations, administration of drugs, castration techniques and post-mortem examinations.

Refresher courses for each district were conducted one year after the seminar. Of 54 trainees, 53 completed training and became NAHAs for 15 *degaans* in 3 districts. As the husbandry of small ruminants is a particularly women's task, at least one woman NAHA was trained per village or *degaan*.

After training, NAHAs were provided with a set of basic equipment, consisting of an emasculator, syringes, needles, post-mortem knife and sterilizing equipment in a leather shoulder-bag. Essential veterinary drugs like antibiotics and antibiotic sprays, rather than dressing material, trypanocidal drugs and

acaricides were provided by means of a revolving Veterinary Drug Fund (VDF), jointly established by the MLFR and the project. A publicly recognized person, usually the head/chairman or another member of a village committee or RLA, had to bear the legal responsibilities for drugs used by the NAHAs and the payment involved. Drugs were to be sold at cost price, plus some percentage markup for transport and waste.

The tremendous demand for services helped NAHAs to generate income and brought them into contact with large numbers of herds. Livestock owners were willing to pay in kind or cash for the services.

NAHAs were visited regularly every 2 months; used drugs were replenished after accounting, and drug usage records kept.

For the surveillance aspect of the system, disease record forms and a questionnaire were introduced and employed at each visit by the project personnel. Using easy-to-use record forms, designed and provided by the project, NAHAs were instructed on how to keep basic records separately for each individual herd/flock visit, e.g. the number of animals with a certain disorder, number of animals treated, amounts of drugs used. These forms were intended as an additional check, not as a replacement of the key interview with the questionnaire. Quantitative and qualitative data on all disease aspects were regularly collected with this questionnaire. They afforded information on seasonality, age patterns, endemicity or relative economic importance of individual diseases, as well as insights into prevalent husbandry techniques on the *degaan* level. Besides answers to organized questions concerning the presence or absence of and factors contributing to disease, informal comments were solicited, to gain folk knowledge and perception of diseases.

The surveillance aspect of the NAHA system emphasized a two-way channel of communication, i.e. information transfer through the NAHA to the project and vice versa. NAHAs reported their activities and observations, the project gave further instructions in therapeutic drug usage, distributed materials on disease control, etc. Each visit with NAHAs comprised partly a review and partly a discussion of existing knowledge.

This methodology differed from other systems, in which livestock owners are interviewed directly. The NAHAs were purposely used as an intermediary party between the livestock owners and project personnel, in a first step towards a planned system of ongoing "grass root" veterinary services and intelligence.

RESULTS AND DISCUSSION

Setting up and operating the veterinary component entailed an important learning process for the CRDP, the department of veterinary services of MLFR and for the donors. The dual partner structure with both the MLFR and the CRDP acting as partner project executing agencies, and the fact that the component's operating base at *Beledweyne* was located some 300 km away from CRDP project headquarters in *Muqdisho*, gave it some flexibility in such matters such as financial planning and procurement. Other CRDP components were directly dependent on the CRDP management with regard to procuring essential commodities such as fuel and equipment as well as salaries, per diems and travel expenses. Constant management deficiencies severely affected the efficiency of these components and contributed to the generally unsatisfacory performance of the CRDP as a whole. By maintaining some relative autonomy in these matters, the veterinary component was able to implement a larger number of activities more coherently and continuously. Nevertheless, there were some CRDP and MLFR management shortcomings, particularly delays in the flow of contracted counterpart funds and topping-up allowances, which had a very negative impact on staff performance and the sustainability of activities.

The component developed and operated a system of supplying regular and reliable information on animal health and production, and a basic veterinary scheme to improve animal health care and disease intelligence in the field. It was the role of the MLFR and the CRDP as counterpart organizations to carry on and develop these systems to implement appropriate animal health and production measures on their own. Over-reliance on donors and expatriate personnel and eventually the collapse of administrative structures as civil disorder increased and finally civil war broke out, prevented this essential taking-over of responsibilities by the national organizations.

Project activities were abruptly terminated by the civil war, so that quantifiable benefits generated by the project were limited. Still, much was accomplished from an investigation and research point of view: the information collected provided a better understanding of the animal production systems in Somalia and the usefulness of a variety of measures was tested.

Overall, the CRDP veterinary component represented a progressive step towards providing better veterinary services to pastoralists. While concentrating its main effort on disease investigation, it also collected pertinent demographic and other collateral data on herds, as well as economic and social information on nomadic households. In addition, an innovative system of collecting

epidemiological intelligence and delivering "grass root" veterinary services - the NAHA system- was initiated and subjected to a preliminary evaluation (Baumann, 1990).

Experts analysed the investigation data during and after the project phase in 30 detailed reports (Central Rangelands Development Project - Veterinary Component. Technical Reports. Deutsche Gesellschaft für Technische Zusammenarbeit, Department 422). Some data collected were not sufficiently complete in some aspects for a full descriptive assessment but could be considerably enhanced in value with use of modeling as an additional analytical tool. Descriptive assessment, modeling and other analytical approaches supported and reinforced each other, permitting several hypotheses to be tested on the performance traits of herds (Zessin, 1991).

Lastly, through first detailed analyses, links could be established between diseases and production (Heuer, 1991). Research findings showed that goats were generally more adapted to the arid conditions of Central Somalia than sheep, despite their on average higher mortality and lower kidding rates. Goats were able to compensate for losses during droughts more efficiently than sheep by increasing the annual production of offspring from an average rate of 73% to 111% when abundant rains followed the drought in 1986. Goat flock sizes, which were reduced by almost 50% due to the drought, were re-established after about 12 months. Sheep numbers did not recover so quickly.

Comparative analyses of the effects of management, rainfall and health showed that management and rainfall had an almost equal impact on animal body weight and both were as closely related to body weight as to the age of animals. Health, measured as percent packed cell volume, was the predominant reason for some animals in a flock being heavier than others. That effect was consistent in all flocks. On the other hand, the serological tests showed very little evidence for the contagious diseases mentioned above. It was therefore concluded that diseases occur primarily sporadicaly and are non-contagious. Consequently, animal health services should provide curative clinical treatment of individual animals. Herds are herded separately from each other which may explain why contagious diseases show very little spread between herds. The serum results show that, as a consequence, only low levels of immunity build up in herds, leaving them largely unprotected once contagious diseases strike. Therefore, some prophylactic measures like vaccinations as well as vaccinations in case of disease outbreaks are also important. However, following the results of the serum tests, such vaccinations should concentrate on specific problem herds or areas, rather than regularly cover entire regions.

The essential feature of an animal health service under such circumstances is its accessibility for herd owners. The NAHA system was therefore a step in the right direction. However, the NAHA's diagnostic and treatment skills need to be strengthened in terms of being more demand- and problem-oriented. Their training must be designed to meet the actual situation in the field and be carried out on the job rather than through formal classroom lectures.

Another important finding was that the herd nutrient status can be determined by measuring the serum urea values of small ruminants. Animals within a flock had similar serum urea values but these were different from those of other flocks (intra-class correlation = 0.7). Results of 4885 tests from sheep and goats in *Hobyo*, *Ceel Dheere* and *Buulobarde* clearly showed that serum urea values differed between seasons and rangeland vegetation zones. Average flock serum urea values were also correlated with annual lambing rates for sheep and kidding rates for goats. Hence, herd average serum urea measurements may have merits for predicting rangeland vegetation conditions and may provide an alternative to the more elaborate range vegetation monitoring.

The methodology of the project's prospective studies was appropriate to derive crude estimates of flock offtake, birth rates and flock mortality. However, the fact that flock sub-samples always consisted of 20 animals, no matter what the size of the herd, overemphasized animal health effects in small flocks as compared to large flocks. For example, in a 40-head flock each animal had a 50% chance of being sampled, but only a 12.5% chance in a flock of 160 animals. Thus, large flocks were less likely than small flocks to be rated positive for a contagious disease if the flock contained only few positive animals. Sampling proportional to flock size, i.e. the size of the sub-sample is a fixed proportion of the total flock, would have been a better alternative here.

The purpose in repeatedly sampling the same animals was to obtain data on the dynamics (incidence rates) of contagious diseases. It was of interest to observe how many sero-negative animals became positive within a defined period of time. The disadvantage of this sampling approach was that such a sub-sample was only representative of the flock at the beginning of the investigation. Over time, it remained static, while the flock composition developed dynamically. Since it now is known that contagious diseases are relatively rare in Somalia's livestock herds, it may be better if future livestock population studies sample a new sub-group of animals, representative of the herd, each time sampling is carried out. Such an approach would constitute a repeated, crossectional sample.

As in most livestock populations, mortality in Somali herds occurs primarily among young animals during their first months. Project findings revealed that the discrepancy between mortality in young animals and adults was particularly large in goats: 18 - 21% of goats died from disease under one year of age as compared to 3 - 6% among older animals. In the future, age-specific mortality causes can be determined by comparing the parameters of lambs and kids that die with those that survive. Under the infrastructural conditions of Central Somalia it would not be feasible to examine animals shortly before or after death as only sporadic visits to herds are practicable. A study of lamb/kid mortality therefore has to include all young stock present in a flock. Lambs and kids that die between two visits then are compared to those alive in terms of their health and disease status. As flock factors are likely to have an important impact on the young stock mortality, such a "total flock" approach is appropriate for the purpose of causal investigations on mortality.

In view of the difficulty in encountering acutely ill animals in the course of sporadic herd inspections, retrospective studies of case herds or animals compared to healthy (control) ones are more relevant under the specific conditions in Central Somalia. For example, etiological factors of frequent abortion can be studied in a case herd by sampling the affected herd and one or more control herds. This approach requires good communication between herders and investigators. Project experience has shown that pastoralists have a viable interest in reporting herd disease problems if in turn they receive adequate assistance at reasonable cost. In Central Somalia project experience shows that it is feasible to think about the implementation of such a system of disease surveillance with an active, service-oriented approach. Area-wide surveillance can only be achieved by means of an established NAHA network and a reporting system that is adapted to the capabilities and understanding of such para-veterinary personnel.

The NAHA system was the first structured primary animal health care system under African pastoral conditions which did not limit auxiliaries to giving vaccinations or operating veterinary drug dispensaries, but which focused on their usefulness in multi-linked, epidemiological disease surveillance. The programme provided lessons and experience that will be valuable in establishing a practical and sustainable level of veterinary care under African pastoral conditions, e.g. re-orientating the role of government veterinary services and emphasising the involvement of local private forces. The case of Contagious Caprine Pleuropneumonia (CCPP) may serve as an example. CCPP was seen by the MLFR as a disease of utmost importance against which mass vaccination campaigns were attempted at all times.

The NAHA system and parallel serological studies allowed the patterns of this disease to be compared. CCPP also was the most reported disease by NAHAs. However, contrary to the MLFR expectation of an epidemic course of the disease, NAHA reports revealed a different course: that immunity was developing in goats recovering naturally from the disease and that there was a relationship between drought-like conditions and a "CCPP-like" disease pattern. A seasonal distribution of the disease, with higher frequency in the dry seasons, an age relationship with animals older than 2 years at highest risk, and the rather endemic course of disease were further characteristics of CCPP as reported by NAHAs. The serological evidence in essence confirmed these findings. Based upon these results a control program if necessary at all, should be different from the prevalent mass vaccination campaign. Such a program would permit resources to be concentrated while at the same time controlling the disease more effectively.

The start of civil disturbances and the eventual civil war forced all project activities to be abandoned; the logical development of the project was therefore not completed.

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LABOUR RESOURCES IN PASTORAL PRODUCTION: SOME IMPLICATIONS OF INCREASED TRADING

Aud Talle and Ahmed M. Abdullahi

INTRODUCTION

This article focuses on the organization and management of labour resources within the pastoral production system of the central rangelands of Somalia, with particular reference to the gender-based division of labour and changes in these relations. The paper does not primarily aim at a quantitative description of task allocations, but rather has a qualitative approach which tries to explain and analyze significant traits of this system and how they are affected by changes.

A significant feature of the pastoral economic system is that the principal source of property and wealth (i.e. the herds of livestock) is on the move and so are the owners of this property. The families migrate between seasonal grazing areas and water sources with their herds and flocks of animals, often covering large distances during these moves. The differing characteristics and needs of the pastoralists' animals, as well as variations in ecological conditions, necessitate the use of different migration routes and demand a heavy labour input from the nomadic household. Pastoralism under arid conditions is a delicate adaptation and certain 'balances' must be kept between the variables herd size and

composition, pasture and labour force. The latter, in fact, is a key variable for the viability and prosperity of this system. In the present article it is the relationship between herd and labour which will be highlighted.

Within the Somali pastoral production system land rights are held communally; in principle access to pasture, water resources and salt licks is acquired through territorial affiliation and by negotiations between local kin-based groups. Access to livestock and labour, on the other hand, is mediated by the patrilineal kinship organization but effectuated through the institution of marriage. Livestock and labour as production assets are managed and administered by the individual families. As labour is mainly reproduced within the family through marriage, recruitment of personnel is strongly affected by the 'development cycle' of the family as well as by demographic dynamics. For example, a newly established family without their own offspring yet or one with only girls will have difficulties in meeting the necessary labour requirements to manage their herd successfully. Hence, they will usually cooperate with other families or borrow personnel from close relatives. One of the main incentives for families to live together, in fact, is the need to pool and share labour resources. Within the pastoral production system in the central rangelands there is little tradition of hiring labour or recruiting manpower outside of the extended family. Herding and care of livestock is regarded as an activity that requires trust and confidence in partnership, and should accordingly not be left to 'alien' people.

The economy of the Somali pastoralists has become more market-oriented lately. There are indications that the families are becoming increasingly dependent upon exchange of livestock and/or livestock products for non-pastoral foodstuffs and consumer goods (cf. Abdullahi, 1990; Talle, 1991). The commercialization of pastoral economies in tropical Africa has proven to have consequences for the division of labour as well as for the allocation of labour resources both within and between households. Labour, traditionally a 'free' production asset in these economic systems, has become into a commodity in many places (cf. Talle, 1988). Although labour is not yet extensively marketed in the pastoral areas of the central rangelands, it does seem that a reconceptualization of the division of labour and a reallocation of tasks is taking place as a consequence of the commercialization processes.

METHODOLOGY AND DATA COLLECTION

The data upon which this article is based have been collected in three different administrative districts in the central rangelands, i.e. *Beledweyne*, *Buulobarde* and *Ceel Dheere* and have been collected by qualitative as well as quantitative methods. The basic tools in this multi-methodological approach have been participant observation, in-depth and open-ended interviews, sample surveys and socio-economic questionnaires. Although environmental conditions, common experiences, and traditions have contributed to developing an overall homogeneous pastoral husbandry system for the mangement of livestock herds, individual herders have nevertheless developed their own particular modifications of the system depending on personal preferences and local circumstances, as can be seen by the wide variations in the composition of flocks and herds. In the following, unless deemed important for the argument, we will not systematically distinguish between the three different research loci as we consider that the pastoral production system, as practised in these various areas, exhibits a rather uniform pattern despite the individual variations.

CHARACTERTISTICS OF PASTORAL SYSTEMS IN CENTRAL SOMALIA

The central rangelands comprising the three regions: *Galguduud*, *Mudug* and *Hiraan*, consist mainly of dry bushland, with stretches of grassland along the coast and in certain inland areas. The average annual rainfall, which is seasonally concentrated, amounts to 100-200 mm in most places; but the pattern of rainfall is erratic in amount, timing and distribution, with severe drought periods occurring in between 'normal' years. The soil, being skeletal and shallow, is not suitable for extensive cultivation. Farming activities are mainly found along the banks of the *Shabeelle*, a permanent river that flows across *Hiraan* Region. Some dryland farming is also practised in other parts of the region, particularly in the vicinity of towns and trading centres.

An overall tendency in the central rangelands, as in other parts of Somalia and elsewhere in east Africa, is that acreage under cultivation is spreading at the expense of available pasture resources with marked consequences for land tenure practices, among other things (Janzen, 1991). Spontaneous, unregulated enclosure of land is presently a commonplace practice. This is done both as a labour-saving device in herding, since fenced animals need less supervision, and to increase land productivity (cf. Holt, 1984; Behnke, 1988). Those who can afford it, such as commercial farmers and livestock traders for example, hire

labour to enclose large areas thereby securing to themselves exclusive rights to these areas of land. Individual farmers and pastoralists attempt to use the same strategy, but due to labour and cash shortages they cannot manage to fence the same amount of acreage as the more wealthy. Enclosure practices as observed in some places in the central rangelands resemble of virtual land-grabbing to the benefit of the wealthy herd owners. An obvious consequence of this enclosure process is that large numbers of people are loosing their basis of production and are thus being driven out of the pastoral sector. The only means of survival for those who become destitute is to take employment, but the chances of getting employment within the pastoral sector have so far been meagre. Hence many of the propertyless migrate to the towns, or to the Gulf States in search of work. Over the years there has, in fact, been a steady outflow of manpower from the rural pastoral areas towards the urban centres, but the rate of emigration has gained momentum in the last few decades (Janzen, 1986). Recurrent droughts and a general decrease in herd productivity, a consequence of unfavourable conditions for the animals including lack of sufficient labour to care for them, has made it ever more difficult for people to make a living off their herds. Furthermore, the civil war ravaging the country during the 1980's most likely has reinforced herders' decisions to abandon the pastoral way of life. Young people, in particular men, also travel to urban centres for education and some are undoubtly attracted by the town and the less circumscribed life they live there.

The pastoral families rely on their animals - camels, goats, sheep, cattle and donkeys - for their existence. The livestock herd provides them with food, cash, social security and cultural status. But to meet these demands the household has to ensure that the herd and flocks reproduce themselves at a certain rate. Above all this means that the depletion of female animals by slaughter, natural wastage and marketing should be kept low so as not to restrict the necessary rate of reproduction. As the Somali pastoralists live in an extremely hazardous environment, the best long-term strategy to ensure a steady reproduction of the herd is to increase the total number of animals to a level with a good margin for bad years or sudden calamities. Various herding and management techniques to minimize risks - such as dispersion of the herd, herd specification and diversification and livestock exchanges - are part of such a strategy. Production strategies to ensure a high rate of survival for female animals and a reluctance to sell productive livestock on the market are well-known in pastoral areas of eastern Africa (Schwartz, 1986; Talle, 1988; Zessin, 1991). An outcome of such management practices is a high percentage of female animals in the herds. Herd structure figures from the central rangelands show that the pastoral families

keep an optimally effective breeding herd for the environmental circumstances they live in. According to our own data from *Beledweyne* the ratio of males to females is some 1:5 for camels and 1:10 for sheep and goats. Neither old animals nor young male stock are kept in excess; they are either culled or sold. Recent research findings indicate that the herds in this region of Somalia are gradually being structured away from providing the pastoralists with subsistence products such as above all meat which was consumed in larger quantities earlier, and towards providing herd products which may be used in exchange for non-pastoral foodstuffs (Abdullahi, 1990). Until the last few decades pastoralists in this area marketed a wide range of products from their herds - hides, skins, clarified butter (*ghee*) and live animals - to meet their needs for grains and other goods. In the late 1950s and early 1960s with the oil boom in Saudi Arabia and the Gulf States, a specialized, single-commodity, commercial pastoralism is emerging (Mascott Ltd., 1986).

The composition of the livestock herds kept by the households in the areas from which our data derives, is most commonly a combination of camels and goats and/or sheep. The internal ratios of the species in the various herds, however, depend upon both the ecological conditions of the residential area as well as the cultural traditions and economic orientations of the families. In the more commercialized parts of the region, the rearing of sheep and goats appears to be gaining ground at the expense of the camel, while in more traditionally oriented areas the social and economic benefits of a large camel herd are still appreciated. The kind of stock the household chooses to concentrate on will have consequences for the allocation and management of labour resources. Cattle and donkeys, which are far less widespread among Somali pastoralists than camels, sheep and goats, are found mainly among the agro-pastoralists in the wetter parts of the region, above all along the *Shabeelle* river and in the grassland zones of the region. A few groups of pastoralists keep donkeys as beasts of burden, chiefly for transporting camel milk to the market. With respect to management of personnel, it should be emphasized that the more diversified the herd is, the heavier the demand on the households' labour resources.

To the Somali pastoralist the camel is the most valuable animal of all, and a large camel herd is a sign of strength, power and prestige. As a form of property the camel is strongly associated with patrilineal kinship, which is a major structural principle in Somali society and culture. The Somali population is divided into a number of clans and lineages to which people belong through paternal filiation. Membership in the father's descent group gives people a

strong sense of belonging and identity. Kinship affiliation does not only determine descent and inheritance, but also residential preferences. Thus people living together in one locality are usually related to each other by patrilineal ties. As far as the Somali pastoralist is concerned, camels are not primarily disposable animals. Their value lies in the material and social survival capacity that they offer the families that keep them. The camel, which in Somali culture represents the image of continuity and reproduction, is a source of security in case of drought and misfortune. In being able to sustain prolonged periods of drought, a recurrent phenomenon in the area, camels have a great potential for survival. Furthermore, as the animals have been handed down from generation to generation, closely following human genealogies, they embody the continuity that links the Somalis to a glorious history of survival in a harsh but familiar environment.

Sheep and goats, in comparison, are to a far larger extent saleable and disposable animals. Male kids and lambs below one year were regularly slaughtered to increase the milk yield for human consumption. This practice has changed somewhat in recent years as sheep and goats have become the main animals marketed by the Somali pastoralists (cf. Abdullahi, 1990). The export of sheep and goats has become so important in some areas in the central rangelands that families have virtually stopped milking the ewes in order to save milk for the lambs to grow fat so they will fetch a good price on the market (Mascott Ltd., 1986). Via the market system, sheep and goats have thus acquired a value they did not have within the traditional context where they were mainly defined as subsistence animals and inferior to the camel in all aspects.

The dichotomy of the pastoral production - the existence of both a subsistence and a prestige/exchange realm - is reflected both in the sexual division of labour as well as in residence rules. The nomadic residential units (*reer*) are normally composed of a group of closely related males with their families: father and son(s), brothers or cousins on the father's side. The size of the unit may vary from 2-3 to 5-6 nuclear families or households (5-6 members each) depending upon area of residence and season. More than half of the members of a family are under 15 years old (Abdullahi, 1990), giving each unit a relatively high number of dependents. Besides the security and social gratification of living together with other people, the families comprising a local group often cooperate in herding activities, particularly in the herding of camels, but also in other productive activities in the homestead such as collecting water or transporting camel milk. One-family homesteads are quite uncommon, except periodically and among people living within easy reach of trading centres and who often combine livestock keeping with some agriculture.

In general the composition and organization of the local nomadic group is flexible in the sense that families amalgamate or disperse according to their individual needs or preferences. Families also split or join internally in order to maximize the use of available labour resources so as to satisfy the needs of the animals. As to labour resources, a 'young' family without grown-up children is, for example, far more vulnerable and dependent upon cooperating with other families, than 'older' and more well-established families. In the central rangelands men as young as 21 years of age are recorded to have founded their own, independent households. Any pastoral family strives to become self-sufficient in personnel, thereby increasing their autonomy and independence in decision-making concerning the management of their herd. This is an ambition that can be realized only after several years of marriage and successful reproduction, i.e. when the children of a couple are grown and in turn have reached marriagable age. Since the households reproduce their own labour force, their success or failure as independent production units essentially to a large extent depends on their own fertility.

We mentioned in the beginning that the various species of animals that the pastoralists keep require different movement patterns. This is due both to differences in their natures and in their requirements with regard to grass, water and terrain as well as to irregular ecological conditions. The diversified movement of people and animals necessitates a periodic split-up of the production unit (family) into two groups: the camel camp, and the sheep and goat hamlet. The camels and their herders move over vast distances, while the sheep and goat hamlets are more sedentary and unless unusually severe conditions prevail, they remain closer to the home area in their seasonal movements. This division of the domestic unit during periods of the year requires both flexibility in household composition - which, as has been noted, is an inherent characteristic of pastoral adaptation - as well as a sufficient labour force to deal with the various tasks.

THE DIVISION OF LABOUR

In the context of pastoral production, the concept of labour has a bearing on two major areas of activity, i.e. herding - the control and nurture of animals on the range, and husbandry - the expansion and growth of the herd. It implies not only the actual physical tasks needed to bring the animals to grazing, water, or the market-place or to tend sucklings in the homestead and carry out milking or slaughtering, but also the realm of decision-making that goes with these activities.

The social division of labour among pastoralists in the central rangelands is largely based upon gender and age. Tasks and productive activities are defined either as 'female' or 'male', and specific tasks are assigned to adults, adolescents or children accordingly. Gender and age are thus the two intersecting factors which together stipulate appropriate work for young girls, adult women, adolescent boys and so on. People have a clear ideology of the division of labour and to a large extent this governs the allocation of tasks within the pastoral household. In everyday life, however, people often find themselves forced to compromise with these ideals for pragmatic reasons. Yet certain cultural boundaries of appropriateness cannot easily be transgressed without severe social costs. Most people are, for instance, reluctant to let women perform typical 'male' tasks, such as moving and living with the camel herds. This shows that the allocation of personnel has some profound qualitative aspects, in the sense that one person cannot automalically be substituted for another. Each specific task, be it herding kids, shifting camel herds or milking goats, requires a certain category of person to carry it out. Thus labour allocation is not only a matter of a sufficient number of people in relation to the size of an animal herd and its particular needs, but is just as much a matter of the right kinds of workers in terms of age and gender to undertake each task. The division of labour within the household, then, is not only a question of economics, but is also of cultural organization which is important for people in making order out of the chaos of life.

The gender-based division of labour in a Somali pastoral family is one where in general the women care for and tend the sheep and goats, and the men are responsible for the camels, except for the transport camels which women traditionally attend. The cattle may be looked after by both sexes, although men more commonly care for these animals. Donkeys, being chiefly transport animals, are the responsibility of women. Since it is the women who are normally in charge of the flocks of sheep and goats, the periodic division of the domestic group into a camel camp and a sheep/goat hamlet, means that women live for long periods without the company of adult male family members. This implies that women customarily have quite extensive decision-making power in the management of family resources. Although they will consult their husbands, in principle women are free to sell, exchange or slaughter any of the family's sheep and goats if need arises. Women's close association with and their traditional extensive decision-making rights over this part of the family herd, however, appear to have become curtailed by the recent commercialization of small ruminants.

Women and girls, as well as young boys under the age of 13 - 14 years, herd, tend and milk the flocks of sheep and goats. They care for suckling animals, help kids and lambs to find their mother at suckling time, and separate lambs and ewes in the night enclosures, among other activities. These are all daily chores related to the reproduction of the herd not only in a biological, but also in a 'social' sense. The 'reproduction of animal domestication' (Dahl, 1987:249-50), so important for a successful pastoral enterprise, is typically a female domain of responsibility. Women also regularly water sheep and goats; they even provide water for sick, weak or young animals who cannot walk the distance to the water sources. Adult men are very seldom seen in the company of small livestock except when they bring them to the market for sale. Once at a watering place a man was asked why he, and not his wife, was bringing the goats to the water. He explained that he had divorced recently and hence, for the time being, had no other grown-up person to take care of this task. He had to do it, he said, because his children were still too young for such a demanding undertaking as watering animals, but added emphatically that herding sheep and goats is not a man's work. By tradition, Somali men's involvement with sheep and goats is minimal in all aspects. Thus men, in contrast to women, have little specific knowledge about the personal characteristics of the individual animals or of their genealogies. In places where the commercialization of sheep and goats is far advanced, however, men appear to take a more active part in the management of these animals. Among other tasks, they supervise and participate in watering them, make sure that they receive medical treatment when needed, see to it that they are regularly dipped with insecticides and so on. Men's concern with the well-being of the sheep and goats flocks means that they put more work into the management of these animals but it does not automatically mean that women are relieved of their share of this work. On the contrary, both men and women seem to work harder in order to produce the highest possible export quality of these animals. As sheep and goats are women's traditional area of responsibility, they are the ones that will most likely be burdened with extra work when these animals acquire a market value. Additional labour expended on this part of the family herd may in fact be perceived as a continuation of the traditional female role.

Besides their substantial involvement in herding activities and in the reproduction of the herd, women perform all domestic chores: they tend children, collect water and firewood for domestic use, process ghee, clean and smoke milk containers, cook *soor* [porridge of sorghum, millet or maize, a daily staple in nomadic households - daily staples in some households are, however,

rice and wheat flour], erect and dismantle the houses when shifting camp, make building materials, ropes and milk vessels, and attend to any other task that might arise within the homestead. [The dwellings (*aqal*) of the nomadic homestead are easily transportable structures made up of a frame of bent sticks covered with woven grass mats which are fastened to the frame by yards and yards of rope. Ropes are made from the bark of the maydhax tree, which before being plaited or twinned into ropes, are softened by soaking, chewing and colouring. All ropes in a Somali houshold are prepared by women and girls who make them when out herding, in the homestead or on their way to the market. The manufacture of milk vessels (*haan*) is particularly labourious and work for an expert. Some of the more skillful women sell milk vessels in the markets. Others may sell vessels or mats to subsist. Single women in urban centres are often the producers of such handifcraft items.] For instance, it is women, who bring the camel milk to the market and sell it. At least in the areas where camel milk trading is widespread, women also regularly buy purchased foodstuffs, a job that men in fact may do in other places. Who does the shopping in the household seems to be a matter of convenience, rather than being dictated by strong cultural prescriptions.

The livestock expertise of Somali men focuses on the camel; they herd, water, milk and shift with the camel herds. These are activities which take place away from the homestead locality. Therefore men in general, except the old ones, very seldom remain at home during the daytime. The camel herds move across vast stretches, particularly during the dry season when pasture resources become depleted near settlement areas. Camel trekking-cum-herding is labourious work and a rough life; the herders walk long distances daily, bring the animals to water during the night, sleep in hastily erected shelters and survive solely on camel's milk (they never cook food). An added burden for the camel herders is the constant conflicts and skirmishes with other people over water and pasture resources en route. Mainly due to the amount of hardship that the work involves, camel shifting is held to be an appropriate task for the younger men in the family. Only they are considered to have the necessary physical strength and stamina that is required to cope with this part of nomadic life. The older men, when possible, prefer to remain at home; but they visit the camel camps regularly to consult and give advice to the young men, and to inspect and evaluate their work. The close association between men and the camel herding bush-life in Somali culture causes even men who do not literally move with the camel herds to disassociate themselves from the homestead area and household activities. This they do by physically leaving the place during

the day or parts thereof. Since another important aspect of male life is to keep informed about water and grazing conditions in the own territory, adult men are busy touring and familiarizing themselves with their physical environment. The continuous exchange of information between men, and the constant updating of this knowledge, is a necessary and integral part of their role as prime decision-makers on herd management and pasture utilization. Men seek information not only from other herders, but also from sedentary cultivators and townspeople as well as from women. Male work activities further entail fencing homesteads, digging wells and carving wooden household utensils. Fencing homesteads and digging wells are tasks that sometimes are paid for in cash if labour is available. The growing number of propertyless pastoralists may provide the labour for such work in the future.

Camel herding, particularly during dry season migrations, is an activity that more than any other work requires extensive cooperation and partnership. In fact, the requirements of the camel herds to a large extent still govern the daily routines and the spatial movements of pastoral families. Ideally, women only deal with camels to a limited extent. However, in those areas, such as in some parts of the *Beledweyne* district, where camel milk trading is widespread, women sometimes milk the camels. They say this is to help the men. This particularly occurs when there are no grown-up sons around to assist in the milking (Talle, 1991). Traditionally, women may actually milk the odd milch camel left in the hamlet while the rest of the herd is away at distant dry season pastures. The only camels in the family herd that women customarily care for, however, are as noted transport camels, which they use for collecting water and moving camps and sometimes to bring the milk to market.

In order to fully utilize the range and its resources the pastoral families in a large part of the central rangelands shift residence several times a year. During the short rains (*dayr*) when the rainfall tends to be very local in distribution, families move frequently to exploit ephemeral water pools and green forage sprouting on shrubs and bushes. In the long dry season (*jiilaal*), when water is scarce everywhere, the families become dependent upon a few permanent water sources and at least some parts of the household may become relatively settled, though far from sedentary. On the contrary, in this season of short watering intervals for the animals and more extended migrations in search of water and pasture, the tasks of herding and watering are very labour-intensive indeed. It is estimated that in this period activities like herding and watering take up around 40 to 55 per cent of the total household labour expenditure. While labour is not necessarily critical for herding, it is very much so for watering. The labour

required to herd one animal is sufficient to herd several; within certain limits the number of animal in a herd may thus grow without a directly proportional increase in labour. Watering, on the other hand, especially from deep wells during dry periods, requires additional labour input for each extra animal. In some areas during the dry season it takes 2 to 3 days to water a flock of one hundred sheep and goats because wells have to be dug by hand day and night to yield sufficient water. Except in the coastal plains of *Ceel Dheere* and along the river banks of the *Shabeelle*, which are shallow well areas, the structure of most of the wells requires that the water be hauled up by buckets. This work demands a lot of time and able-bodied men and entails extensive cooperation between households.

The life and economy of the pastoralists in the central rangelands are above all determined by seasonal variations. The rainy seasons are the slack periods when people and animals prosper, rest and feast; whereas, the dry season is a period of heavy work, little food and worries. This period is a critical point in the yearly cycle when any mismanagement or miscalculation may have disasterous implications for the survival of the people and the herd. In order to secure a sound management of their herd, it is imperative for the households to be able to mobilize the necessary labour input during this crucial period.

CHANGES IN THE DIVISION OF LABOUR

The changes in the pastoral production system due to the increased market sales of live animals and livestock products, particularly camel's milk, have had some very specific consequences for the allocation of labour resources within the family, not least for the sexual division of labour. As noted, because of the recent commercialization of sheep and goats men have become more involved in this formerly female-dominated domain of pastoral production and accordingly, they have begun to assert their rights to these animals with greater force. Among other things, this is reflected in the fact that men take much more of a personal interest in the well-being of these animals than before. The growing involvement of men in the management of sheep and goats may prove to have adverse effects on female autonomy in household decisions.

Further, we have noted that it is women who are in charge of the trade in camel milk and of trade organization, even though camels are associated with men and recognized to be 'their' animals. Men customarily milk the camel, but bring the milk to the woman for storage, processing and sale. Somali women have always had a prominent role in the redistribution of all milk produced in

the household. Milk is regarded first and foremost as 'food' and is a product that is strongly associated with femaleness. Among the pastoral groups that market camel milk on a regular basis, women also often milk camels. Some animals are set aside particularly for them to milk and to use for trade purposes. The deep involvement of women in the camel milk trade appears to be leading to some readjustments in the division of labour within the family and also to a heavier burden of labour for women. Women are becoming involved in a wider range of pastoral production, especially in those activities that may be considered subsistence oriented. Milk production primarily is so, irrespective of the fact that a certain percentage is marketed. The camel milk trade has given women some new and enlarged resposibilities as far as household production is concerned.

This trade has influenced the life of the families concerned in other profound ways. For example, they began raising donkeys exactly because of the camel milk trade. In the very beginning, when milk was sold on a lesser scale, the families would bring it to market on camels (a few still do). However, women found this exceedingly troublesome. Camels, being animals of the bush and generically semi-wild, are on the whole difficult to control. Transport camels must be tied and led by ropes, they walk slowly and, worse still, they are easily frightened in crowded places. Therefore, instead of loading the camels, women often carried the milk containers themselves; considering the distance they had to walk this was an unsurmountable task for many of them. Donkeys, although they carry far less, are easier to drive than camels and once they are on the right track, they walk by themselves, fast and efficiently. It was the women who introduced donkeys into the community. "We asked for them", they said, "but the men bought them". Even the men appreciated the labour saved by transporting the milk on donkeys. A donkey can carry two milk containers, and a woman can easily drive two donkeys, enabling her to transport 4 containers as opposed to only one formerly. Previously, the fact that milk was transported by womanpower severly limited pastoral households' chances of increasing the amount of their product offered for sale or of maintaining a steady supply. In this respect the introduction of the donkey has made the trade more efficient in terms of the quantity sold, and the women of a homestead take turns in bringing the milk to the marketplace.

A severe problem in keeping donkeys in an arid environment like the central rangelands, however, is that they have to be watered at least every other day. This requires both extra labour, which is taken on by women, and a higher degree of sedentary residence closer to water sources. The watering and the

herding, to the extent that that is required, is then the responsibility of the women. As donkeys are often left to graze on their own, it is not unusual to find women out searching for runaway donkeys.

When pastoralists commercialize products, certain changes in the division of labour are likely to ensue. In the central rangelands both female and male tasks have been extended, and while some of these tasks are new, others are reallocated within the household. With respect to the latter, it seems to be more common for women to take on male- defined tasks rather than the reverse. Research on commercialization in subsistence-oriented economies often show that the women's burden of labour increases disproportionally to that of the majority of men.

It has been noted that in pastoral societies commercialization has led to an acceleration of the rate of emigration of both male and female pastoralists, though women are somewhat less affected. The exodus of men for wage-labour purposes seems to have particular consequences for the rearing of camels, which need daily attendance by able-bodied males. Even the rearing of sheep and goats may suffer for the lack of male labour, particularly during the dry season when watering of small livestock is acutely important. The lack of sufficient male workers to herd and water camels obliges households to give up rearing these animals, and either to switch to a concentration on sheep and goats, or to give up pastoralism completely. There were a substantial number of households with a noticeable shortage of male labour in the areas surveyed. Observations from other pastoral areas in tropical Africa indicate that the outflow of the male labour force is highest during the dry season, when the labour demand for watering and herding of the stock is also most acute. The absence of adult men during critical periods of the yearly cycle seems to increase the work load of women and those remaining at home (cf. Sperling, 1987). The survival of pastoral production systems in the arid lands of Somalia, as elsewhere, is founded on organizational and territorial flexibility. Maintaining this flexibility is no less than a prerequisite for their survival. As a consequence of market integration, the pastoral production system in the central rangelands appears to be becoming less flexible and thus more vulnerable. The galloping inflation in the country during the last few years has made the families more dependent upon an unpredictable market. A shortage of labour, both quantitative and qualitative, is one of the factors hindering the performace of vital pastoral activities and threatening pastoral livestock productivity in these areas.

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ECONOMIC EVALUATION OF PASTORAL PRODUCTION SYSTEMS IN AFRICA: AN ANALYSIS OF PASTORAL FARMING HOUSEHOLDS IN CENTRAL SOMALIA

Ahmed M. Abdullahi

INTRODUCTION

Livestock production systems in tropical Africa range from traditional pastoral nomadism to integrated systems with crop agriculture. In many areas, the nature of livestock production systems corresponds with the stages in the development of land use. Virgin land is usually exploited first by livestock and then used for crop production, with eventual integration of livestock and crop production (Hawkeseworth, 1984).

Pastoral nomadism in its various forms can be assessed as a well organized system of land use and a rational adaptation of human use of forage and water in the vast marginal and fragile rainfall areas in tropical Africa (Cossins, 1985; Mascott Ltd., 1986). However, there is very little known about the economics at the level of household in pastoral production systems (Eicher and Baker, 1982). Despite this, interventions which call for increased cash expenditures for developing household systems are frequently proposed. The implications of such interventions for different groups of households need to be evaluated

carefully, however, before any measures are introduced. For this, bench mark data on the welfare of pastoralists and the income and expenditure patterns of different groups of pastoral households have to be examined.

This paper addresses the premise, that significant wealth differences among pastoral households and groups appear to exist, which have profound effects on their access to the essential elements of production, on patterns of income and expenditure and on marketing strategies. This is in line with hypotheses by Konczacki (1978), ILCA (1980) and Grandin (1983), who argue that wealth differences among the pastoral societies exist which fundamentally affect production, management and marketing. An examination of economic relationships in nomadic pastoral production can provide insights into interdependencies and different management and marketing behaviors among pastoral groups or households of varying wealth status.

Aim and Scope

The paper's main objective is to evaluate the pastoral household economy and patterns of marketing in terms of family cash needs and income strategies in pastoral groups or households at different wealth levels. In a quantitative field study of pastoral farming systems, the smallest herding and management unit of pastoral herds in central Somalia was found to be the household. Apart from the grazing land which is communal for all herders, livestock capital and household labour are the essential endogenous resources of pastoral farming household, and determine the extent of herd productivity. Herd products, particularly live animals, milk and meat, are used for subsistence, are marketed, or used in for socio-economic relations. These activities are essential to the nomadic way of life. Through them economic needs are met, and economic and social relationships are created, sustained and influenced.

Within this framework, this paper specifically aims at:

- identifying determinants affecting the level, structure and seasonal pattern of incomes and expenditures among different wealth groups and households;
- evaluating institutional, cultural and environmental attitudes which may be influencing pastoral farm systems development towards possible land use intensification.

The scope of the paper is limited to the Somalian example of pastoral farming households in arid areas of tropical Africa. The pastoral production systems in selected areas of the central rangelands of Somalia are used as

examples. All grazing animals are covered within the scope of the paper but emphasis is given to small ruminants and camels, as the most important and most valuable species in the pastoral farming systems studied.

Approach

A farm perspective "Farming Systems Approach", was employed to collect quantitative information on the interactions and dependencies between herd resources, household labour, offtake from herds and incomes and expenditures of pastoral households in Central Somalia (Sandford, 1983). In particular, the hypothesis was tested that wealth differences exist between pastoral households or groups which essentially determine their access to basic means of production and influence their patterns of income and expenditures.

In order to describe the patterns of income and expenditure of different wealth groups, an attempt is made to identify the degree of wealth stratification among the households studied. It is assumed that livestock holdings are a valid measure of the actual wealth status of households or household groups. Since statistical mean values per household often mask substantial differences in household size, households were grouped not according to mean livestock numbers but according to livestock numbers per household members, using metabolic weight equivalents. For this the ratio "Tropical Livestock Units" to "Active Adult Male Equivalents" (TLU/AAME) was used. [In tropical animal husbandry, the "Tropical Livestock Unit" (TLU) is commonly taken to be an animal of 250 kg weight. For more discussion on the method of calculating the Tropical Livestock Unit see Jahnke (1982). An "Active Adult Male Equivalent" represents the average daily food energy requirements of an active African adult male based upon FAO recommendations (1968), i.e. 2,530 kcal.] Based on this ratio sample households were divided into two wealth groups or wealth levels. Small herders are defined as having between 0.1 and 6.5 with an average of 3.0 TLU per active adult male equivalent, and large-scale herders as having between 7 and 12.5 with an average of 8 TLU/AAME. The differences in the size of livestock holdings thus calculated determine the relationships between

- the resource base (herd and household size) and income,
- subsistence and animals sold ,
- subsistence and the commercial production of milk, and
- possible and adequate development prospects.

The size of livestock holdings is thus assumed to have a major impact not only on the livestock production system itself but also on the success of farm household income, its ability to ensure the continued basis of production and its influence on development decision-making.

Study Area and Sample Households

Although environmental conditions, experience and tradition have developed an apparently overall uniform pastoral husbandry system for the management of flocks of sheep and goats, individual herders have nevertheless developed their particular modifications to this system according to their aspirations. The wide variations in the composition of flocks is a good example of such individual modifications. The proportion of sheep or goats in flocks reflects the herder's preference for either species. It further reflects species suitability for socio-ecological conditions in the different pastoral zones in the study areas.

The study was conducted in two areas of the central rangelands of Somalia, *Buulobarde* and *Ceel Dheere*. The number of investigations executed and livestock inventories in each study area are summarized in table 1. All flocks of sheep and goats surveyed were inspected at their night enclosures near the pastoral household dwellings.

Table 1: Study areas and livestock inventories

District	No. of Hhds*	No. of sheep	No. of goats	No. of camels	Total in TLU
Buulobarde	55	985	3739	493	965.4
Ceel Dheere	49	2617	2602	386	907.9
Total	104	3301	6341	879	1873.3

* Number of households questioned.

Source: Abdullahi, 1989

HOUSEHOLD ECONOMICS

The Resource Base

Production resources are comprised of grazing land, which is communally owned, individually held livestock herds and household labour. Constraints for a pastoral household's viability in regard to these resources lie in the amount and quality of grazing land, in the size and composition of household herds and the availability of household labour. Individual pastoral households operate exclusively with their two endogenous resources, livestock as capital and household labour. Exogenous resources like credits and hired labour are not used. The interrelated quantities of household herds and household labour, are therefore the essential elements determining household welfare, marketing strategies and perhaps development possibilities. Communal grazing land is beyond the direct control and influence of individual herders. This dichotomy is often claimed to lead to the so-called "overgrazing syndrome" which essentially is not so much the consequence of ignorance of herders, but rather the result of a process by which too many people efficiently maximize their individual chances of survival.

Livestock as a production factor for subsistence, cash and as a store of wealth is linked to questions of livestock ownership of different households or groups and the possible implications of unequal distribution. Table 2 summarizes the factors contributing to the inequality of livestock ownership. The size of households is identified as an important variable affecting both absolute total livestock numbers and livestock units as well as the diversity of livestock species. Correlation coefficients between total household size and the number of sheep, goats and total TLUs are only 0.55, 0.35 and 0.63 respectively but all are significant at the 99% significance level.

The age and gender structures of herds are characterized by a high proportion of breeding females. The production aim of such structured herds is principally guided by immediate needs for milk and long-term needs for saleable surplus offspring. Herd structures show that herders keep, as far as possible an optimally effective breeding herd. Neither old animals nor surplus young stock are kept in excess; they are either culled or sold (Figure 1). Herds are in consequence structured less in order to provide for pastoralists subsistence, but rather, increasingly, to provide herd products which may be used in exchange for non-pastoral food items.

Household labour, after livestock herds, is the second endogenous household resource. Herd sizes and household labour are positively correlated. The available household labour capacity is an important factor in production and determines the type and number of livestock species that a household can actually hold and manage. Labour under traditional pastoral conditions can be seen as a constraint in the dry seasons with shorter watering intervals of herds and more extended migrations in search for water and pasture.

Table 2: Correlation coefficients for the relationship between household size, livestock species and ownership

Variables	Age of Hhd.head	LEs*	No. of camels	No. of goats	No. of sheep	Total TLU***
Age of head	1.00	0.32	0.25	0.29	0.18	0.41
Hhd.size**	0.37	0.41	0.39	0.55	0.35	0.63
Camels	0.27	0.39	1.00	-0.35	-0.21	0.32
Goats	0.19	0.14	-0.15	1.00	-0.18	0.20
Sheep	0.11	0.09	-0.14	0.17	1.00	0.11
Total (TLU)	0.41	0.41	0.25	0.19	0.08	1.00

* Labour equivalents, ** Household size, *** Tropical Livestock Unit, all significant at 99% level

Source: Abdullahi, 1989

It is apparent in the households that the tasks of family members are clearly determined and gender and age related for different livestock species. Children less than 14 years of age and women are basically responsible for grazing and herding small ruminants while men are solely responsible for camels and cattle. In the context of herder's perspectives, camels play an eminent role in the Somali pastoral culture. One observer writes that:

"...the camel is associated with the motherland and with liberty. It is associated with men, who are considered to be cultured but wild, whereas small stocks are associated with women being uncultured but domestic." (Abokar, 1984)

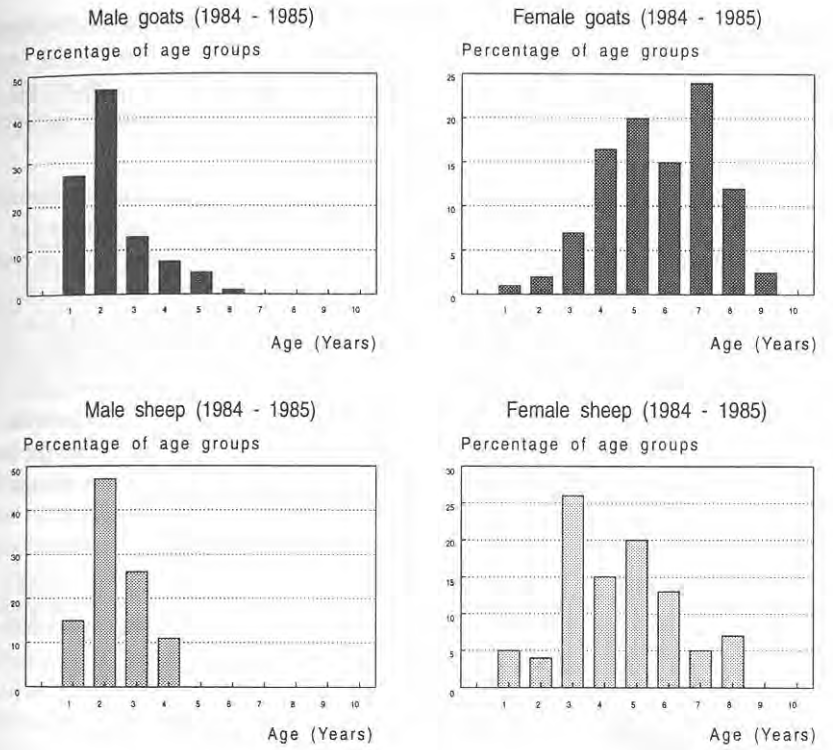

Figure 1: Relative distribution of age groups for male and female of goats and sheep for slaughter at *Beledweyne* slaughter house (1984/85)

Source: Zessin, 1986

Cash Revenue and Expenditure

Incomes

The economic evaluation of pastoral households is based on the 1986/87 farm-household cash flow pattern analysis. The total income of a household is comprised of income from sales of livestock and livestock products and of additional income drawn from non-farm household activities. In order to underline the importance of subsistence production and to compare it to the actual cash flow, both types of incomes were calculated. The net household incomes are calculated from the total sales of livestock and livestock products

from which all expenditures for livestock inputs are deducted. Subsistence production, as far as home consumption of products from household herd, payments (religious slaughtering, etc.) and receipts in kind are concerned, is computed as subsistence income assessed at market prices (Schäfer-Kehnert, 1984).

Sheep and goats are the most important cash-generating species for pastoral households (Abdullahi, 1989). Fig. 2 indicates that small stock accounts for 76 percent of the net cash income in small households and 59 percent in large ones. Small households own proportionally more small stock than larger households from which they derive more than 70 percent of their income. A breakdown of this income into its major components reveals that goats are by far the largest source of cash income of all households. The goat enterprise provides 59 percent of net cash income from livestock in small households and 44 percent in large households. Sheep raising is the next most important source of net income in small households. Of the total net income from livestock, it contributes 16 percent to small households and 8 percent to large-scale households.

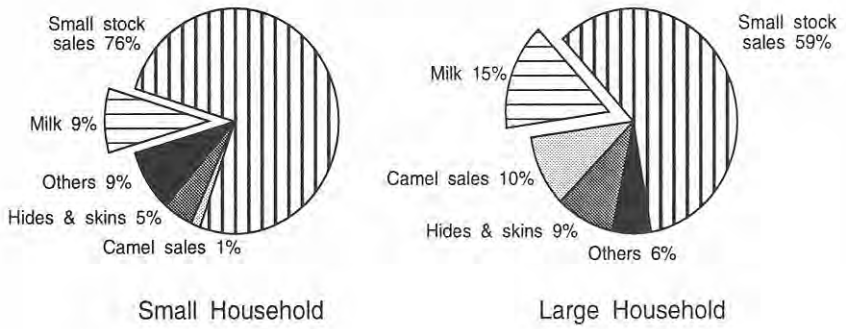

Figure 2: Mean annual sources of cash income of pastoral households studied, *Buulobarde* and *Ceel Dheere* samples (SoSh; 1986/87)

Source: Abdullahi, 1989

It is interesting to examine the relationship between subsistence and cash income from livestock. In all household types, subsistence accounts for a considerable portion of total production; on average more than 40 percent. Subsistence production is still vital but no longer of major importance. The

ratio of livestock production for subsistence to that for cash income, can be used as an indicator of the degree of market integration (commercialization) that has taken place in the last 30 years. This ratio shows that increased market integration has led to reduced subsistence production.

Expenditures

The shift from subsistence to commercial animal production is accompanied by shifts in food consumption patterns. In commercialized livestock economies, high protein animal products are exchanged in most cases for high caloric food grains at favourable rates when substitution costs are calculated solely in terms of caloric equivalents (Konczacki, 1978; Behnke, 1985; Abdullahi, 1989).

Historically the dietary dependence of pastoral peoples upon their livestock was virtually complete, except during periods of severe droughts or other catastrophes. Even in recent times it has been estimated that, depending on the type of species predo-minantly used in nomadic pastoral herds, the milk from camels and cattle, cover between 25 and 60 percent of the dietary needs of East-african herders (World Bank, 1981; Evangelou, 1984; Schwartz, 1986).

In recent decades non-pastoral food items, however, have been consumed in increasing amounts in Somalia and elsewhere in tropical Africa. This trend is claimed, at least in Central Somalia, to be due to a decrease in livestock productivity in terms of milk and meat and also to a shift from a subsistence milk-surplus-system to a sale or commercial live animal system, both for domestic consumption and for export (Behnke, 1985; Abdullahi, 1989).

Total caloric intake consumed annually of milk and meat, being the classical pastoral subsistence products (Table 3), contribute respectively only 18 and 2 percent to small households, and 32 and 6 percent to larger households. On average, all households studied cover between 60 and 80 percent of their annual caloric intake by non-pastoral foods, mainly grains and sugar/tea.

Table 3 also makes it quite clear that it would be difficult for pastoralists to subsist without grains, grain products and sugar/ tea. Even households with a sufficiently large number of animals do not abstain from using non-pastoral products to cover the main part of their protein and energy requirements. Approximately 80 percent of total expenditures are spent on food. Sorghum and sugar/tea account for 31 and 23 percent respectively. Approximately 11 percent of all food expenditure is spent on fat oils as the third most important item.

They contribute a substantial portion to the daily caloric requirements of pastoral households. Even at the height of the rainy seasons, grains, grain products and sugar/tea are the main foods and every household has access to them. Despite seasonal differences in the availability and prices of market foods, grains, grain products, cooking oils and sugar/tea have been regularly purchased in increasing amounts during the last decades.

Table 3: Mean annual caloric-energy supply by food sources in pastoral sample households studied (1986/87)

Source	Small households annual caloric-intake		Large households annual caloric-intake	
	(MJ)	(%)	(MJ)	(%)
Milk	4,769.1	22.2	11,725.6	32.2
Meat	737.1	3.4	1,956.4	5.4
Grains	7,827.7	36.5	13,090.6	36.0
Sugar/tea	7,204.6	33.6	8,303.3	22.8
Others	931.6	4.3	1,319.6	3.6
Total	21,470.1	100.0	36,395.5	100.0

Source: Abdullahi, 1989

A family's food consumption is balanced between the need for sufficient caloric energy and the prices of the commodities during the annual price cycle. Figure 3 shows that, when an average minimum annual expense on purchased foods and non-food items of SoSh 50,000 per household is assumed, cash revenues of large herd owners are more than sufficient to cover these expenses. Enough surplus funds remain for other investments. Smaller herd owners, however, are often unable to earn this much cash. Total average expenditure of these small households is about SoSh 55,006.9 while revenues earned from livestock is only SoSh 47,396.3. This is an excess of expenditure over earnings in the range of 9 percent.

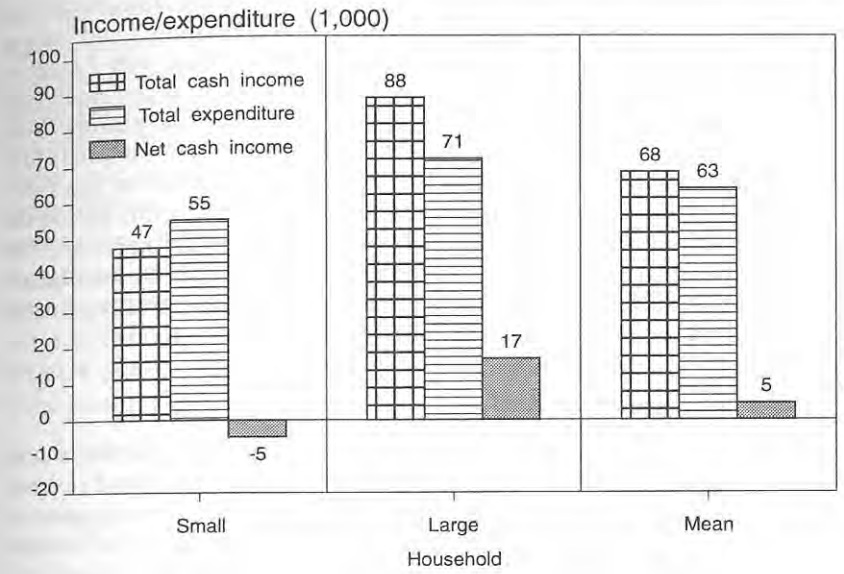

Figure 3: Pattern of cash income and expenditure of pastoral households studied (*Buulobarde* and *Ceel Dheere*, SoSh; 1986/87)

Source: Abdullahi, 1989

Cash-flow Patterns

The general theoretical pattern of cash inflow and outflow over one year in the households surveyed can be depicted as follows (Abdullahi, 1989):

"High inflow occurs in all areas studied during the Ramadan-Hadj months which, during the investigation period, covered the months of early May through July and August. Livestock sales in the areas increase before and during this Ramadan period. A second but shorter period of relatively high cash inflow is around October when people, venerating to their ancestors, make their periodic sacrifices to God and the Prophet Mohamed. Every year at this time a celebration feast (Mawliid = month of Prophet's birthday) is usually held when members of a lineage assemble to hold a communal sacrifice in praise of their ancestors.

High outflow occurs in both types of household and in all areas studied in the months of the long dry season *jiilaal*, starting in late December and lasting until early April. In this period, milk yields drastically decrease, with a smaller quantity available for domestic consumption or for sale. There is no demand for live animals from the Arabian Peninsula. Domestic prices for non-pastoral food items normally rise during this time while those for meat and live animals fall. Most of the remittances from relatives in the urban areas are sent at this time, when the demand for cash in the pastoral areas is high. During this period the cash balance among small herd owners is low or even highly negative. The period is apparently bridged by credits from local shopkeepers or by remittances from urban areas rather than by savings. The latter appear to be only possible for larger (wealthier) households."

Summary of Household Budgets

The analysis shows that herders with larger herds generate a higher annual cash revenue than those with smaller herds, indicating that household revenue increases with the number of animals owned. Since large households possess bigger livestock holdings than smaller households, a larger number of animals can be sold from these herds. Small herd owners are forced to buy and sell on a contingency basis. Due to their limited herd sizes and structures they are in no position to approach animal sales systematically and to maximize a profitable commercial exploitation of their herds. When selling livestock and buying consumer goods, they are far more at the mercy of unfavourable price fluctuations during a year than larger households, who may themselves (in many cases) rise to the position of traders in livestock and consumer goods. In some cases poorer pastoralists have to advance livestock to village livestock traders in exchange for consumer goods, essentially granting them an interest-free loan.

This study also shows that most small herd owners are continuously in debt during the year. Their cash revenue covers only 90 percent of all annual expenditure and is by no means sufficient to meet the household's cash needs for food, clothing and other daily needs as well as for veterinary medication and water. In this situation these households are not in a position to adopt new production technologies to any significant extent (if at all). Without doubt, this has led in a number of cases to migration of such households out of the rangelands and into the urban areas.

This dilemma of a limited herd resource base among small households is further aggravated by the fact that herd survival is threatened every 5 to 6 years by drought conditions (Figure 4). Disastrous droughts every 20 to 25 years, with lesser and briefer but still serious drought spells every 5 to 6 years in the

interim, result in arid Central Somalia in average livestock losses of between 30 and 70 percent. Given the biological and environmental factors of low fertility and relatively high mortality (World Bank, 1981; Abdullahi, 1989) in herds, small herds cannot grow substantially over years. Under these fixed natural conditions, and in the current technological state of production, small herders have little chance building up their herd resource base. Perspectives for improvements in income from these herds under conventional management, without any innovations in husbandry, are consequently limited. Given the limited resource base of small herds, herders have little opportunity to keep pace with the rising inflation in the country by increasing sales from their herds further. These economic factors of limited resource bases and disadvantageous relative prices are driving family members or entire families with small herds from pastoral areas.

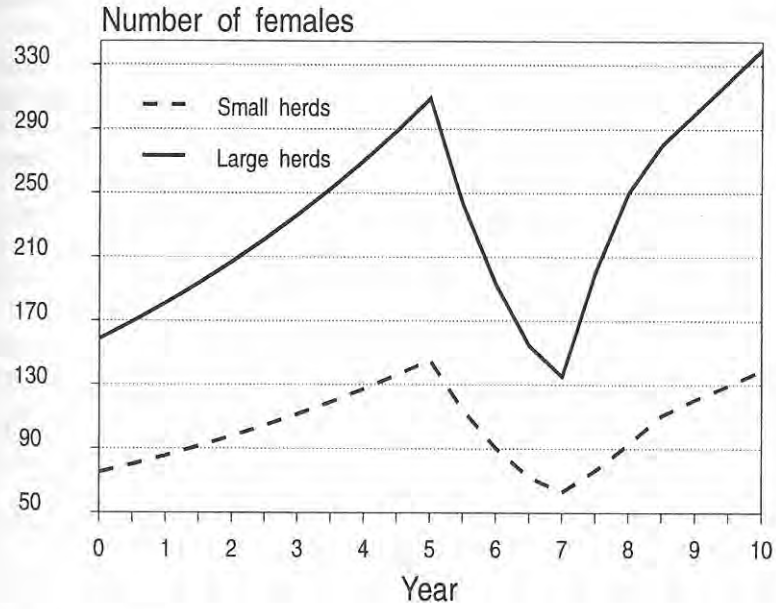

Figure 4: Hypothetical herd growth of female sheep and goats of pastoral households studied, 1986/87

Source: Abdullahi, 1989

LIVESTOCK TRANSACTIONS

Livestock uses

It is clear that pastoral households depend to a large extent on market transactions to satisfy their subsistence requirements (World Bank, 1981; Grandin and Bekure, 1983; Abdullahi, 1989). They trade livestock for foods to supplement both the quantity and quality of diets. These households are engaged in a variety of livestock transactions both for acquisition and for disposal of stock. The transactions are an essential part of the pastoral life; through them economic needs are met and economic and social relationships are created, sustained and influenced. Animals are sold, exchanged for other animals, are gifts/help and are used to fulfill religious obligations. The proportion of livestock used for these purposes depend on three main factors:

- the size of the household;
- the proportion of each species in the total household-herd; and
- the relative value accorded a livestock species with regard to its subsistence and socio-economic roles.

Data on transactions of livestock for different household sizes are provided in table 4. The table shows the proportion of the total value of each livestock species sold and consumed by both types of household. The table makes it clear that livestock products from large herds are used for home consumption or are sold in comparable amounts. Small herders, in contrast, consume only about one-third, while up to two-thirds of their total livestock production must be sold. Camel milk still plays a sizeable role in large-scale households both for cash and subsistence, while the role of camels for small producers is limited mainly to transport purposes.

Table 4: Estimated relative proportion of livestock species sold and consumed in different pastoral households of Central Somalia (1986/87)

	Small household proportion of total value (in %)		Large household proportion of total value (in %)	
Category	Sold	Consumed	Sold	Consumed
Goats	37.2	15.2	18.5	23.8
Sheep	19.6	10.2	8.2	14.6
Camels	0.0	0.0	3.5	2.3
Milk	5.8	3.6	9.5	13.6
Total	66.3	33.7	42.1	57.9

Source: Abdullahi, 1989

The low level of camel sales underlines the value placed on keeping camels rather than selling them. In general, large livestock in Somalia, and camels in particular, command more esteem in terms of social status, and social contacts than small stock. Camel symbolism plays an important role in the Somali pastoral nomadic culture. As camels have a multiple role including milk production, transport, social and a saving functions, regular sales of camels are practically out of the question for herders.

Livestock Disposals

Reference has been frequently made to the different attitudes of herders towards sheep, goats and camels. Information gathered on the disposal of sheep and goats in the two types of household is summarized in tables 5 and 6. Larger households sell approximately twice as many animals annually as small herders. Real slaughter (home subsistence) for the small household type is also low, indicating that these pastoralists often even abstain completely from home slaughter. They prefer to use these animals in exchange for grain, grain products and sugar/tea. Considerable differences are also apparent with regard to religious slaughters. It appears that small herders dispose of more animals for religious purposes than do larger households (Tables 5 and 6).

In Table 7, total herd offtake is broken down into commercial (sales and home consumption) and non-commercial (religious slaughter, *sako* [Table 5] paid animals, etc.) slaughter for both types of household for the reference year 1986/87. The "high" proportion of sheep removed from small and large herds, i.e., 26.9 percent and 30.5 percent respectively as well 25.2 percent and 35.8 percent for goats indicates a high sales rate for these species during the reference period. These rates are partially inflated due to the prolonged long dry season *jiilaal* and the complete failure of the *dayr* rains, which forced herders to dispose of more live sheep and goats than usual. In a "normal" year, sheep and goat sales are probably less than these rates.

To summarize: The investigation has shown that there are wealth-related differences in the way pastoral households groups manage their livestock capital. It seems that large-scale producers are in a position to slaughter a greater number of animals from their herds. Small herd sizes do not enable small herders to do the same.

Table 5: Mean annual herd disposal of goats in sample pastoral households (1986/87)

Type of disposal	Small household		Large household	
	Number	Percent	Number	Percent
Sales	13.0	52.0	22.0	48.9
Sub. slaughter	2.0	8.0	10.0	22.2
Gifts/help	2.0	8.0	5.0	11.1
Religious slaughter	4.0	16.0	6.0	13.3
sako paid animals*	4.0	16.0	2.0	4.5
Total	25.0	100.0	45.0	100.0

* *sako* is the annual donation given to the poor people in accordance with the Koran.
Source: Abdullahi, 1989

Table 6: Mean annual herd disposal of sheep in sample pastoral households (1986/87)

Description	Small household		Large household	
	number	percent	number	percent
Sales	3.0	25.0	6.0	30.0
Subsistence slaughter	2.0	16.7	4.0	20.0
Gifts/help	2.0	16.7	3.0	15.0
Religious slaughter	5.0	41.6	7.0	35.0
sako paid animals*	0.0	0.0	0.0	0.0
Total	12.0	100.0	20.0	100.0

* *sako* is the annual donation given to the poor people in accordance with the Koran.
Source: Abdullahi, 1989

The survey also shows that camels in the pastoral households studied are not commonly slaughtered for home consumption other than for special rituals and occasions. Although small and large herd owners may dispose of about the same proportion of their herds, large herd owners of course sell more animals in absolute terms. An unequal distribution of livestock among pastoralists may facilitate the creation of a marketable surplus of animals, but is by no means a

necessary condition for it. All herders irrespective of wealth keep a marketable surplus of stock beyond what they need for subsistence as a precaution against emergencies. Surplus rates, however, differ considerably with herd sizes (Mascott Ltd., 1986).

Finally the study shows that the use of livestock varies according to the species and its role in the pastoral system. In the survey areas, most pastoralists use some stock to meet social obligations, as opposed to using livestock for food, directly or indirectly. It should be underlined that livestock is employed for social as well as economic uses. Both roles are rational and necessary for the welfare and basic social relationships of pastoral communities. Economic management is usually at most an attempt to accumulate stock for food needs during the long dry seasons rather than to market animals for cash when available. The importance of various types of stock for different purposes may be used as a guide as to how pastoralists will most likely attempt to increase their herds in the future. We expect that livestock for economic use will increase and prevail over that kept for food and social purposes.

Table 7: Relative non-commercial and commercial disposal of goats and sheep in sample pastoral households in 1986/87

Description	Small household	Large household	Mean household
	(%)	(%)	(%)
Goats			
Commercial disposal	15.5	25.6	20.6
Non-commercial disposal	9.7	10.2	10.0
Total	25.2	35.8	30.6
Sheep			
Commercial disposal	11.4	20.3	15.8
Non-commercial disposal	15.5	10.2	12.8
Total	26.9	30.5	28.6

Source: Abdullahi, 1989

SUMMARY

Economic parameters, calculated for differently sized pastoral herds, support the evidence that herders with undersized herds are subjected to a displacement process: a household's income (revenue) increases with the number of animals owned. Close relationships between the wealth level of a household and its expenditure patterns are apparent. Larger expenditure is associated with wealthier households. Disposals from small herds are apparently not sufficient to meet many households' cash requirements. Income from herds below an economically viable size only cover about 90 percent of reported annual expenditure.

Herd products, particularly live animals, milk and meat, are used for subsistence, for sale in markets or for socio-economic relations. These activities are essential to pastoral life. Through them economic needs are met and economic and social relationships are created, sustained and influenced.

The paper showed that a relationship between the resource base (wealth level) and herder's income, expenditure and consumption patterns does exist and that herders are aware of this relationship. It seems evident that farm household revenues increase with the number of animals owned.

It is shown that households organize and utilize their resources to achieve not only subsistence, but also a surplus for commercial use; the latter however is only possible for pastoral households with large herds. The paper links the bio-technical resource base with the socio-economic realities facing pastoral households. The evidence seems to confirm the hypothesis that differences in the levels of wealth between pastoral families ultimately determine their access to the means of production.

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THE NOMADIC HERD - EXAMPLES FROM SMALL RUMINANT FLOCKS IN SOMALIA

Holger Nauheimer

INTRODUCTION: WHAT IS A HERD?

In pastoral production systems, economic decisions revolve around the livestock herd. Improving the welfare and the output of the herd is the central target of the nomad's daily consideration. Specially in flocks of small ruminants, production and health of single animals are less important than the demand of the entire herd.

This chapter presents descriptive data on livestock herds and methods determining herd structures and their periodical and irregular changes. Data from different investigations carried out from 1984 to 1989 in the Central Rangelands of Somalia are provided and compared with information about pastoral systems in other sub-Saharan countries. Livestock transactions are analysed at different levels in order to give some insight into the economic and social decisions made by herd owners.

Some basic definitions of terms used in livestock surveys are provided below.

- Livestock herd: group of animals of one or several species kept together at the same location, tended by the same person or group of persons, and basically fed on the same resource. In times of scarce resources, the herd

can be split into sub-units. The animals in a livestock herd may be owned by one person or by a group bound by family, social or economic ties. The herd is the economic base for the nomadic family household.

- Herd demographics: size and composition of a livestock herd; frequency of species, sexes and ages within the herd.
- Herd dynamics: rates of change in herd composition, e.g. birth rate, mortality rate, offtake.
- Fecundity rate: number of animals born alive in a specified population (i.e. the herd) divided by the total number of mature female animals in that population.
- Mortality rate: total number of deaths occurring in a specified population and in a specified time period divided by the average number of individuals in that population. Mortality rate can be broken down for sub-groups of the population, e.g. young and adult animals.
- Offtake: removal of animals from the herd by accident, death or on purpose (sale, gifts etc.).
- Productive offtake: offtake which is converted into advantages (cash, meat, social or religious obligations)
- Unproductive offtake: offtake which cannot be converted into any form of advantage. This includes losses, accidents and in Islamic societies, all other unintended deaths. In non-Islamic societies fallen animals are often utilized for meat consumption and therefore retain some of their value.

In Somalia, and in all arid and semi-arid countries of sub-Saharan Africa, a mixture of livestock species is included in nomadic herds. Goats, sheep, cattle, camels and donkeys are found in different combinations. Climatic and environmental conditions, economic power, production targets and social values are reflected by the size and composition of the flocks. Discussion about the production patterns of nomads has been continuous, since Herskovits' (1926) "Cattle Complex", in which he put forward the opinion that nomads main purpose in keeping large livestock herds is for social prestige. This discussion originally was centred to cattle nomads, but it had been used also for small stock and camel herds. Studying the dynamics of nomadic herds helps us to understand the variety of production targets and the reasons livestock owners have for maximising the output of their enterprise.

In the arid and semi-arid zones of the sub-Saharan countries, small ruminants outnumber by far the other livestock species in nomadic herds. The reasons for this are obvious: the short reproduction period, the lower economic risk with regard to animal losses, the possibility of conversion into cash and the high

adaptability to different habitats of sheep and goats accounts for their superiority over other species. Management of small ruminants is labour-efficient and can be delegated to even the youngest members of a nomadic family. In times of food shortage, animals can be slaughtered and may contribute to the diet of a small family, while the amount of meat obtained when a camel or a cow is sacrificed necessitates some form of meat preservation. The milk of goats is an important source of the human nutrition. Goats and sheep can graze complementary on the same pasture. While goats prefer feeding from shrubs and bushes, sheep mainly graze on the ground. A large number of observations by Schwartz et al. (1985) have established, that the preferred feeding height of goats is one meter from the ground, but large animals can reach up to two meter. For this reason, the carrying capacity of a given area is higher for mixed herds of goats and sheep than for a flock consisting of one species only.

Camels fulfill various requirements. They are used as draught and work animals, for example in oil mills and for ploughing. For a nomadic herder, animals for carrying household equipment and tents are an indispensable prerequisite for independent decisions on movement. In many countries (not in Somalia) they are also used for riding. The milk of camels is an important source of human nutrition. Since their lactation period is much longer than that of goats, camels and goats kept in one flock or in two herds close together provide a complementary supply of milk for the nutrition of the family and, if abundant, for sales on nearby local markets. The reproduction period of camels is usually two years; at around six years of age a female camel has her first parturition. For this reason it takes a much longer time to build up a camel herd and to compensate losses after the effects of drought or diseases. Because camels are highly adapted to extreme habitats, not resistant against diseases, and individual camels are very valuable, they are well suited as a capital investment.

Cattle are not well adapted to environments where water is scarce. In contrast to small ruminants and camels, they have to be watered every one or two days. Therefore it is impossible to shift a cattle herd through areas with no watering facilities. Additionally, their requirements for feed quality is high. In regions where these requirements are met, their capacity to convert grass into milk and to utilise agricultural residues and by-products, cause cattle to predominate over other livestock species. Like camels, cattle have a long parturition interval and a high economic value.

METHODOLOGY OF HERD PRODUCTION SURVEYS

Livestock demographic surveys involve little equipment but sizable logistic problems. Other than transport to reach the herds, paper, pens, marking instruments and eventually a pocket calculator, no other equipment is needed than open eyes and ears. Before counting the animals and the interviewing the herd owners, understanding of the specific animal husbandry culture of the target group has to be achieved and while performing the survey, alterations of the original strategy should be allowed. For example, in one of the investigations carried out in Central Somalia, offtake was grouped into categories (see below). When counter-checking the actual number of animals with the sum of the offtake, regularly occuring discrepancies could not be explained until the survey team noticed that part of the herd had been separated and placed near the family's house to supply women and children with milk. This point was then included into the questionnaire. Grandin (1983) describes that in Maasailand certain transactions are considered to be more prestigious than others. Because donating animals is more highly esteemed then acquiring them, producers tend to report giving more animal gifts than they receive.

Methods of assessing livestock herd data can be divided into single and multiple-visit techniques (Grandin, 1983). The data presented in this chapter are obtained from different surveys: rapid herd appraisal in single visits of the herds (Bourzat et al., 1988) and in two continuous surveys based on regular repeated visits to selected nomadic herds (Zessin et al., 1988; Nauheimer et al., 1990, 1991).

Information in livestock surveys are obtained from personal observation and from interviews with the herd owner or, preferably, with the person responsible for herding the animals. It is useful to interview women in pastoral societies because animals are allocated to them for milking. In Somalia, small ruminants are under the supervision of wives and daughters. Camels and cattle are often herded by young boys who know the whole breeding history of the animals, including the births of animals long before their own.

The investigation should aim to collect as much "hard data" as possible . A survey team should count the livestock herd themselves rather than ask the owner for the number of animals he possesses - depending on the culture and the situation, herders may understate or exaggerate or may simply do not know the real figures. The species and sex of each animal should be identified. Recording the age is of the animals more difficult. The investigator has to judge

whether the interviewed person has the same sense of time. Using local terms for seasons will make it easier for the pastoralist to remember in what season the particular animal was born. With well-trained assistants, age classification by dentition is possible and certainly the more accurate method, but since dentition of ruminants is influenced by breed and nutrition, this must be counter-checked against the information from the herd owner.

In single-visit surveys, a large number of herds in different environments and under different management systems have to be investigated to assess an sufficient amount of information for statistical analysis. Using the progeny history technique described by Grandin (1983) and frequently used by ILCA in different countries including Somalia, the interviewed persons are asked about selected female animals. Starting with the year of the interview and going back year by year until the birth of the animal or its entrance into the herd, offspring to which the female gave birth are recorded. Information on sex and disposition is solicited about each offspring in turn. Essential for the successful use of this technique is a common understanding between interviewer and herder regarding terminology of time. In most cases it is more useful to refer to seasons rather than years, since in pastoral societies events are mostly related to the division of the year into rainy and dry periods. The described technique particularly is useful for camels and cattle, as their reproduction period is too long to allow continuous observation.

Multi-visit surveys such as the two major ones in Central Somalia have to be carried out for at least two, or preferably more years in order to facilitate several production periods. This technique can be applied to small ruminants. Selected herds are visited at fixed time intervals, e.g. every second month. During this time, a sample group of animals is observed and production patterns are recorded. To conduct this type of survey successfully, the herd owners participating must be very reliable and the likelihood of meeting their herds on every visit has to be judged before starting the investigation. It is essential in this type of survey that the sample group of animals can be reidentified on return visits. The investigation team in Somalia found, that camels and cattle are recalled by their name. Therefore, marking of these animals was not necessary. In small ruminants, the use of ear tags or tattoos is recommended, but often rejected by the owners. In many nomadic societies, also small ruminants are identified by names.

In both techniques, the interview has to be prepared according to the special animal husbandry culture. It has to include the following features:

with reference to individual females:
- date of first parturition
- number of parturitions
- time interval between parturitions

with reference to the entire herd:
- number of live births in the specified time
- deaths of animals (by diseases, by accidents)
- losses
- slaughter
- fallen animals eaten
- sale or exchange
- religious and social obligations
- acquisition of animals through purchase

HERD SIZE AND COMPOSITION

Influences on herd size and composition

Average sizes of small ruminant herds in nomadic societies may vary as drastically as rainfall in semi-arid lands - in a comparison of two subsequent years the results may differ by 100%. Animal numbers are affected by several factors, the most profound of it being the climate. As it was broadcasted all over the world, the big droughts of the last decades caused big reductions among the African livestock herds. In years with extraordinary rainfall, the induced growth of the pasture gives a good basis for an increase of animal numbers in turn. Figure 1 shows the effect of the 1986/87 drought in Somalia when herds were reduced by 50%. In 1986, the *dayr*, the short rainy season failed to bring any rainfall. The following rainy season, the *gu'*, was delayed, when rain started only in May. Most of the animals survived the first failure of rain, but mortality increased and reproductive rates fell. In March/April 1987, more and more starving animals died. The mortality rate climbed to 30% or more of herds. It was also shown that both sheep and goats were affected by the drought (Nauheimer et al., 1990). In the subsequent year rain was good and many of the surviving females conceived (especially goats). Herds were able to nearly double again within the next two years. Herd growth figures demonstrate the high potential of small ruminant herds to compensate losses within a short time. Herd size is also influenced by the economic decisions of the herd owners. If in need of money, or when livestock prices are generally low, they may increase the number of animals brought to the market.

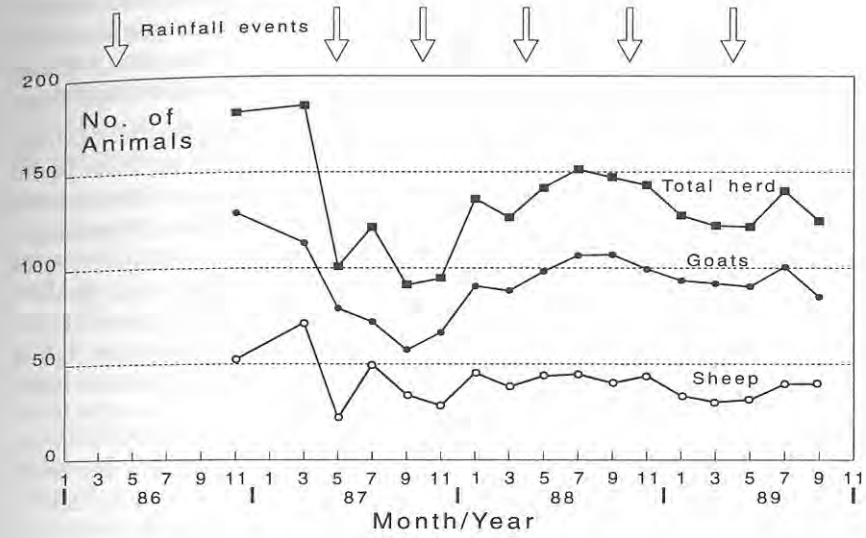

Figure 1: Effect of drought on herds of small ruminants in central Somalia: Total herdsize, no. of goats and sheep as affected by rainfall

Source: Author

During two surveys carried out in the Central Rangelands, a total of six districts were investigated. The data by Zessin et al. (1988) were gathered between 1984 and 1986. The figures presented by Nauheimer et al. (1990) are based on investigations conducted between 1987 and 1989 after a marked period of drought. Within the districts, significant differences in the sizes of sheep and goat herds were observed (Table 1).

Table 1: Herd sizes in districts of central Somalia

Ceel Dheere	113[1]
Buulobarde	166[1]
Hobyo	243[1]
Beledweyne	139[1]/142[2]
Dhuusamarreeb	98[2]
Gaalkacyo	186[2]

Sources: [1]Zessin et al., 1988; [2]Nauheimer et al., 1990

The biggest herds were found in *Hobyo*, followed by *Gaalkacyo*, both situated in the *Mudug* Region, the northernmost and driest area under investigation. The smallest herds were found around *Dhuusamarreeb*, where mainly semi-nomadic herds can be found and owners regular have access to other income sources.

The smallest herd found consisted of 26 animals (*Buulobarde* District). During the survey carried out after the drought in 1986/87, the biggest herd was found in *Gaalkacyo* District with 328 sheep and goats. The biggest herd in *Dhuusamarreeb* comprised 241 animals, and in *Beledweyne* District, 257 animals. Although the average figures are not substantially different (comp. the figures from *Beledweyne* District for the two surveys), the maximum herd sizes observed during the first survey were much higher. The biggest herd sizes found during this investigation, carried out before the drought, were 391 sheep and goats in *Beledweyne*, 424 in *Buulobarde*, 366 in *Ceel Dheere* and 463 in *Hobyo*. About 75 % of the herds visited between 1987 and 1989, contained between 50 and 150 animals. From the herds visited in the pre-drought period, more than 50 % were bigger than 150 animals. Constraints on maximum herd size are discussed by other authors in this book. In general, the number of animals in a flock is mainly limited by two factors: the availability of labour and of grazing area. Only exceptionally are herds with less than forty sheep and goats found in Somalia. To maintain the herd's ability for reproduction and a minimal milk supply, stock-keepers have to be ensure a sufficient number of females. If the herd size falls below a certain limit, only the purchase of new animals can prevent a collapse of the herd. The minimum herd size is therefore higher for a pastoralist who has no additional income source.

One of the most important books dealing with nomadic production systems is the well-known "Having Herds" written by Dahl and Hjort (1976). Like most other authors contributing to pastoral systems research, I am unable not to quote them. In their principal reflections they make a statement which will be still valid for most nomadic societies at the beginning of the next millenium:

"The keeping of large herds is closely linked to the need to protect the household against the effects of drought or epidemics as well as to food requirements during a particular dry period. A sufficient number of animals must survive a disaster in order that the household can exist while the herd is being rebuilt. An understanding of this central feature of traditional nomadic livestock economies is essential both for the comprehension of pastoral land use and for the planning of alternative land uses, such as ranching."

Although the observations of Dahl and Hjort refer to Kenya, the figures presented in the Central Somalia surveys strongly support their view. Presently, in the sub-Saharan countries, the reduction of animals following a period of

drought and starvation (Figure 1) cannot be prevented substantially by veterinary or other means. The main problem when combating results of disaster is the lack of infrastructure. Information about areas extremely affected by drought reach the decision centres late, if not too late. Since in times of drought not only animals, but also people are starving, aid in the first instance concentrates on the basic needs of the population.

Veterinary treatment of sick animals may avert or moderate some losses by supporting the animals weakened by diseases and starvation. Nevertheless, in areas purely depending on pastoralism, additional feeding which would prevent losses by starvation is simply not available in times of scarcity and will clearly not be so in the near future. For the above reasons, no other way than the nomadic principle "as much as possible in times of abundance" will be accepted by pastoralists.

But protection against the threat of drought is not the only motive of nomads to increase their herds. They hold their wealth 'on the hoof' because no other form of investment exists for them. The herd is the equivalent to the 'modern' savings account. This reason for maintaining a big herd is described by Swift (1979):

"In a pastoral economy, each year the herds produce young animals. The females are retained to replace old females and to build up breeding stock; a few males are needed for reproduction, ... the remaining male animals can be disposed of without affecting the reproductive or milk-producing capacity of the herd. These surplus male animals can be eaten, exchanged for grain, cloth or other commodities, or stored 'on the hoof' to be sold or eaten at some future date in case of emergency. ... Where female animals increased above immediate milk needs, there was a also tendency to hold them as insurance, since they improved the chance of an adequate milk supply in bad years, and enhanced the ability of the herd to recover rapidly from drought. Both females and ... males ... are also ... used for other economic purposes, such as an insurance system through loans of animals, and for social purposes such as building kinship links and obligations through such transactions as bridewealth."

Herd composition - species and age groups

Like in other sub-Saharan countries, small stock herds in Somalia are a mixture of both small ruminant species. Most of the herds visited in Central Somalia contained more goats than sheep, except in the northern districts and in *Beledweyne* District. Generally higher numbers of sheep are found in grassland areas, while goats are predominant in bushland areas. Figure 2 shows the average herd composition in the six districts under observation. In *Beledweyne*

District, where the survey was carried out near the river *Shabeelle*, and in the two coastal districts of *Hobyo* and *Ceel Dheere*, with typical grassland vegetation approximately 50 % of the animals in the herds are sheep. In the dry inland districts *Gaalkacyo, Dhuusamarreeb* and *Buulobarde*, on average less than one third of the herd are sheep; but large herds have relatively more sheep than small herds.

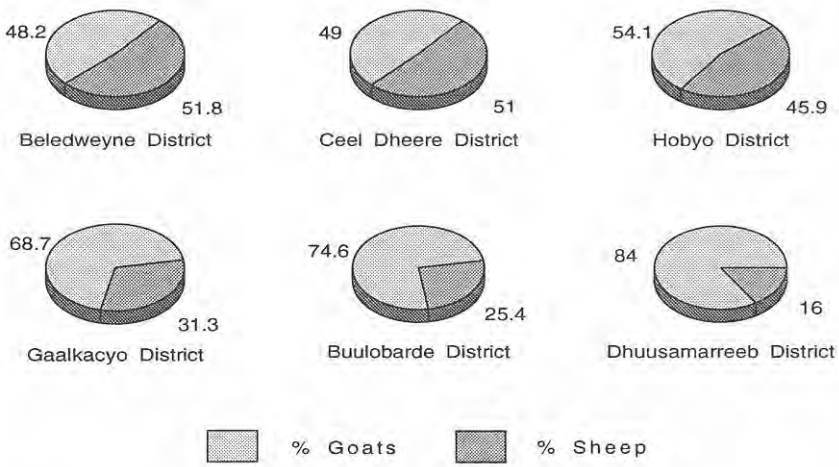

Figure 2: Composition of small ruminant herds in central Somalia
Source: Author

What the motives would a pastoralist have for deciding to concentrate more on sheep than on goat breeding? Generally speaking, nomads in the Central Rangelands try to raise as many sheep as the vegetation of their residential area and their management capacities allow. The family demands milk as the most important staple food. Although a few people maintained, that sheep are also sometimes milked in Somalia, the author saw no evidence for this assertion and it appears most unlikely. It was observed, that the smallest herds often consisted of goats only. Subsistence first! After the family's demand for milk is satisfied, the owner may invest in sheep raising. As sheep offtake rates show, the main production target is to produce male animals which are highly valued on the markets. Wilson and Semenye (1983) compared the ratio of sheep to goats in different sub-Saharan countries with nomadic livestock production. While in

Senegal the ratio was 1.95 and in Ethiopia, Sudan and Mauritania between 1.3 and 1.6, flocks in Kenya consisted of 0.9 sheep per goat. The lowest proportion of sheep was found in Mali (0.4). The corresponding figure for Somalia is 0.95 (Source: MLFR, 1989). In the Central Rangelands, the ratio is much lower. The figures from *Beledweyne, Dhuusamarreeb* and *Gaalkacyo* indicate a ratio of around 0.4.

In this context another calculation of the cited authors is of interest: the average number of small ruminants per human inhabitant of the country was less than 1.0 in Kenya, and between 1.0 and 2.2 in all other countries except Mauritania with 6.4 sheep and goats per inhabitant. With a human population of between 7 and 9 millions, this ratio in Somalia ranges between 2.6 and 3 small ruminants per person. Additionally, 0.8 camels and 0.5 head of cattle per inhabitant are found in the country.

An analysis of herd structures examines also distribution of gender and ages within a herd. To obtain reasonable figures, animals are assigned to age groups; these vary with the method of age classification used. Sex differentiation does not involve any difficulties. Information about age of animals is determined either by interview of the owner or by dentition.

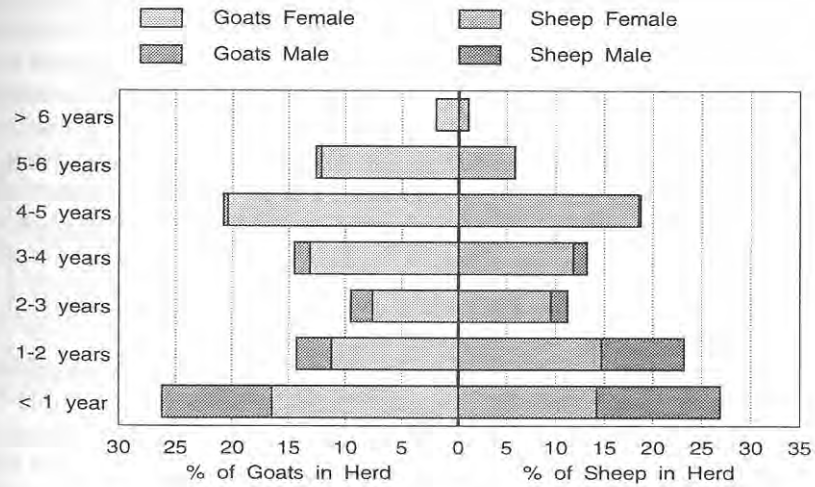

Figure 3: Sex and age distribution in small ruminant herds
Source: Author

The first option requires a common understanding of time periods. Many nomads do not calculate and think in months. If exact figures are not required reference to seasons and years may be sufficient, specially for camels and cattle. Age classification by dentition is, if the staff is well trained, the better option. If it is carried out by always the same person or small group of persons, this method will produce comparable results. Since dentition is very much dependent on breed and nutrition, the estimates have to be counter-checked with information given by herd owners. Figure 3 shows gender and age distribution of species within the herd.

Obviously a large number of male animals are sold or butchered within their first year. Another reduction takes place in their second year, after which most male animals are sold. A small number of male animals over three years old remain in the herd for breeding purposes. The percentage of young animals is by no means constant over the year. As it will be shown below, parturitions are not distributed equally over the year. The major part of herds consists of female animals at reproductive age.

OFFTAKE

The questionnaire which was applied in the continuous survey (Nauheimer et al., 1990) performed by CRDP/GTZ-Veterinary Component was designed on the bases of experiences gained in a previous baseline survey (Zessin et al., 1988). On the first visit to the selected herds the interview focussed on the four preceding seasons. The respective herders were asked about the events in the herd which had taken place during the last year. On follow-up visits the questionnaire asked about the period since the previous visit; herders were interviewed on average every two months.The offtake was grouped into the following sections:

- deaths caused by diseases and starvation
- losses and accidents (predators, traffic accidents etc.)
- household slaughter, i.e. animals used for the family's meat demand.
- ritual slaughter (*rabbi-tuuq*) on the occasion of religious ceremonies
- social obligations / gifts, which can be classified into three categories: *sako* (Arab.: zakat) which is one of the five pillars of Islam. The Koran advises wealthy people to give a share of their property to the poor. As the property of the pastoralist is the herd, the nomads donate animals to people in need. The gift is always given to people outside the family. The *sako* is contributed in Muharam, the first month of the Islamic calendar. *Kaalmo* is a help given to people in need in or outside the family, e.g. if a person marries, the members of his family donate animals in order to help him found a new herd. *Kaalmo* is not connected with a special time of the year. *Hadiyo* is given as compensation to family members or to friends; e.g.: a matron arrives from town and bringing food - in exchange she receives an animal. *Hadiyo* is not related to poverty or wealth.
- animals to be sold are also divided into three categories: *Jer* covers the export animals - male sheep and goats after completing their second year. Somali veterinary law allows only the export of male animals in order to maintain productivity of the country's livestock herds. *Dibaah*, which includes female animals, mostly at the end of their productive period; i.e. five years and older. *Dhaqaleyn*, female animals for breeding purposes.

Figure 4 shows the average offtake rates for adult sheep and goats. Meat only provides a small part of the diet in nomadic families in Somalia. Only five young animals (sheep and goats less than one year old) and 1.5 adult animals are slaughtered annually per family.

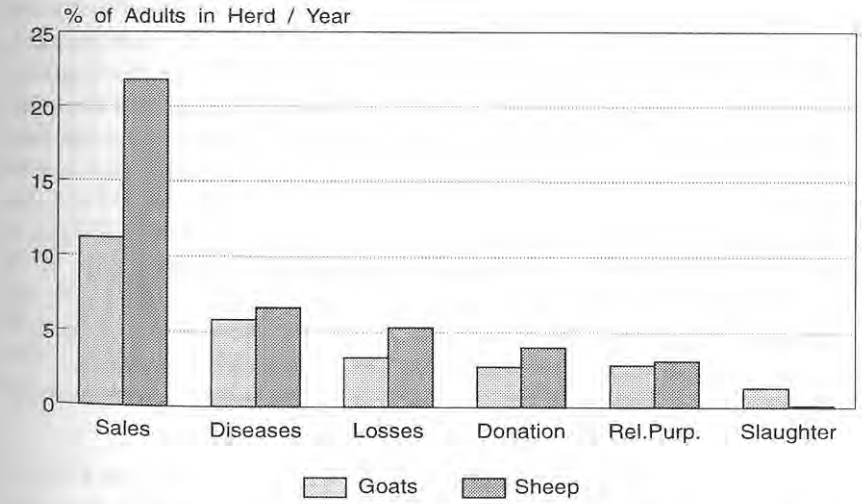

Figure 4: Offtake of adult goats and sheep in small ruminant herds of central Somalia

Source: Author

In Central Somalia, the preference for goat meat is higher than for mutton. In districts where the major part of the herds consists of goats, sheep are only rarely slaughtered for household consumption.

The main causes for losses of young animals (= less than one year old) is disease. Preweaning mortality rates of small ruminants in pastoral herds of Africa in general range between 2% and 35% per year and the mortality rate between weaning and one year of age is around 10%, calculated on a one year basis. However, under good pasture conditions, this rate may be lower. During the post-drought period in Somalia (1987-1989) when above-average rainfalls prevailed, the mortality rate of goats under one year old (including suckling kids) was 18% annually, the corresponding figure for sheep was 10%. In addition, 6-9% of the young animal were lost. According to Bourzat et al. (1988) the highest mortality rates occur during *jiilaal*, the long dry season.

Productive offtake of young animals is low, since the production target is to produce adult animals. Only young male goats are slaughtered at a higher rate in their first months (8-10% of all kids), especially when the milk supply is not sufficient to satisfy both the kid's and the household's demand. Other offtake of young animals amounts to 6% per year.

The annual mortality of adult animals is substantially lower. When favourable climatic conditions prevail, the percentage of adults which die from disease is around 6% per year. Reports from less favourable years indicate that mortality rates may be considerably higher. Zessin et al. (1988) showed, that the crude death rate (= all deaths by disease occurring in one year divided by average herd size in that year) was 18% in 1985, a year with 'average' rainfall. 1986 marked the start of a drought period. The crude death rate in this year was 35%. From retrospective interviews carried out at the end of 1987 it can be estimated that in some herds mortality rates during the drought period exceeded 50% of all animals in the herd. Half a year after the dry period terminated, the age structure of the herds was unbalanced. Especially the cohorts of animals between one and two years of age and of very old animals (more than five years) were nearly totally absent, i.e. the lack of rain increased the mortality rates of the mainly youngest and the oldest animals.

Another 3% of the adult goats and 5% of the adult sheep were lost. Figure 4 shows the offtake rates for adult sheep and goats. 11% of the adult goats and 22 % of the adult sheep are brought to the market for sale. Around 9% of the goats and 12% of the sheep are killed by disease or get lost and 6-7% of the adult animals are taken from the herds for social and religious obligations.

Donations and sacrifices for religious ceremonies are not actually unproductive. These customs does not contribute directly to the household's income, but they serve the strength of the community.

FECUNDITY

Herd growth is only possible, if the number of animals born exceeds the number of animals died or taken off the herd. If the balance is negative, like in times of drought or big epidemics, herd sizes decline. The productivity of a herd is expressed as fecundity, which is the number of offspring born alive per female of reproductive age per year. In the survey, female goats and sheep older than 2 years were considered to be of reproductive age.

The reproductivity of an animal in general depends on two factors: the number of parturitions per year and the size of the litter. Contrary to most other breeds, in which average littersize is between one and two - and in some European breeds even more than two - the Galla goat and the Blackhead Somali sheep very rarely give birth to twins. All observations in the Central Rangelands indicate, that the percentage of twins is less than 2% and therefore negligible.

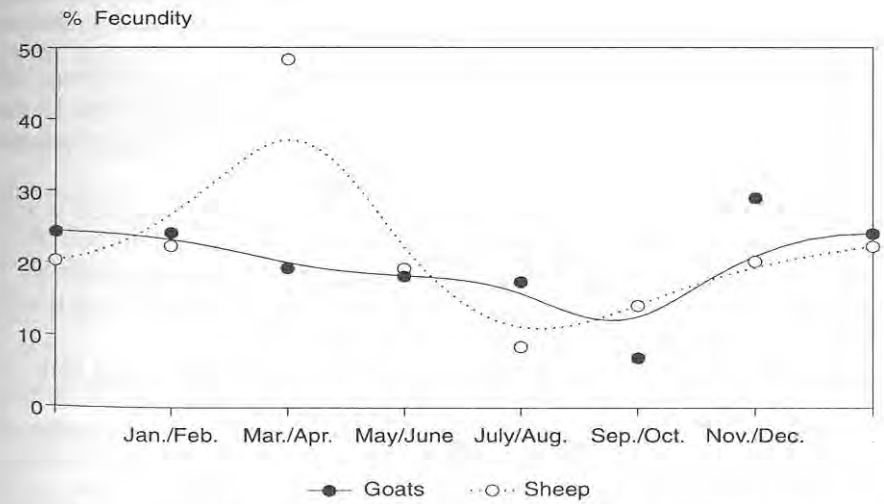

Figure 5: Seasonal variation of reproduction in small ruminant herds in central Somalia

Source: Author

Sheep show a distinct seasonal fluctuation of parturitions (Figure 5). They are very much dependent on the ground vegetation, which is in good condition only during the rainy seasons. Lambs born before the rains start have a better chance, since the milk production of their mothers is supported by the pasture. On average lambs suckle four to five months. At the time of weaning, the next rainy season begins. Goats can give birth throughout the year; seasonality of kidding is not pronounced (Figure 5). This is vital to the nomadic family, who demands a constant basic milk supply.

Total fecundity in nomadic small ruminant herds of Somalia amounts 110% per year in goats and 130 % in sheep. These figures are only reached in times when pasture conditions are favourable due to sufficient rain. In periods of drought, this figure drops and not more than 50-70% of the female animals able to conceive give birth. At the end of 1987, more than 40% of the mature female goats did not kid for the length of a full gestation period after rains had ended a dry year. Most part of the sheep gave birth four months later, at the beginning of the next long rainy season.

CONCLUSIONS

Goats and sheep in the Central Rangelands serve different production targets. Primarily, the nomadic family has to be supplied with protein for which milk from goats and camels is the main source. Goats are primarily raised to satisfy the subsistence needs. Most of their milk is consumed in the family; surplus milk can be sold on the market. According to Abdullahi (1990), the average family size in the Central Rangelands is around 11 persons. This means that a family requires at least 30 lactating goats to ensure only 200g of milk per head daily.

Approximately one quarter of the adult stock has to be replaced yearly. Since even in a year with maximum fertility and low mortality, only 50-60% of the kids and lambs survive their first year, the margin for surplus production of animals is low. In a year with good rains, especially following a drought period, the herd productivity is high enough to compensate losses.

Sheep are raised mainly to generate income. On average, sheep make up 25% of the herds, but 55% of the animals sold for export and 37% of total animals sold. In the nomadic household economy they are the main source of cash income, ranking before goats and their products (milk, hides). Only if mortality rates are low and fertility is high, the output of the herd can be increased.

In the nomadic society, the value of animals is not only measured in monetary terms. Besides their important role in supplying of nutrients and cash for the family, they serve different social, traditional and religious purposes.

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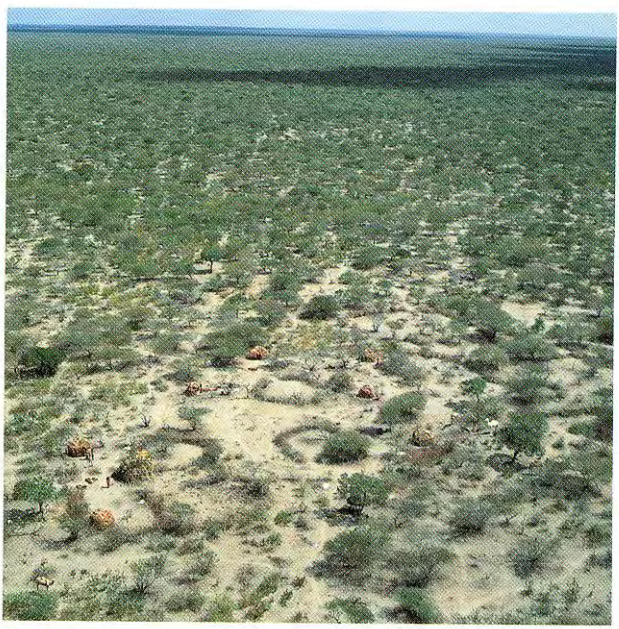
1) Bushland vegetation on the red soil of the *Hawd* area of NE-*Hiraan* at the end of the main dry season *jiilaal*. Termite-hills are typical for this zone (Janzen, 1984).

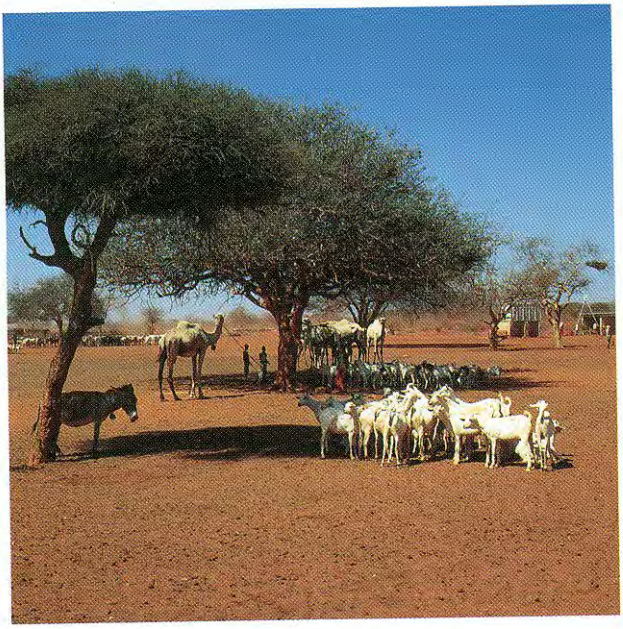
2) Heavily used dwarf shrub area near *Caabudwaaq* at the end of the rainy season *gu'* (Baas, 1989).

3) Dry season *jiilaal* in the dwarf shrub areas of central Somalia. Nearly no fresh fodder remains (Baas, 1989).
4) Undisturbed grassland in the coastal plain east of *Ceel Dheere* in the rainy season *gu'* (Baas, 1989).

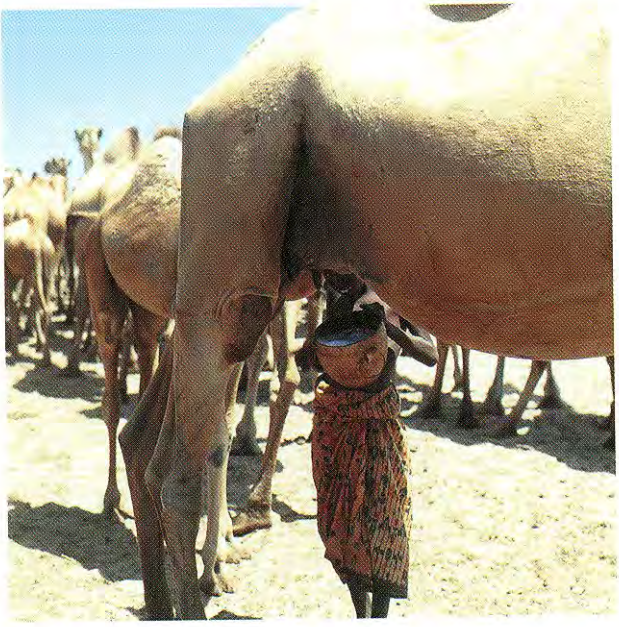
5) Overused grassland around *Hobyo* in the dry season *jiilaal* (Baumann, 1989).



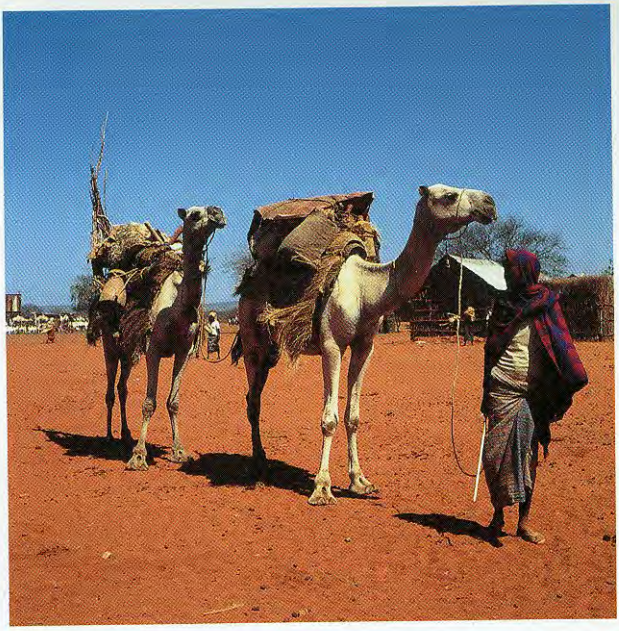
6) Aerial view of a nomadic encampment in the bushland of southern Somalia during the main dry season *jiilaal* (Janzen, 1988)



7) Species diversity and multi-species grazing is an important insurance against disasters such as drought, theft or epidemics since not all species are equally affected by the same adversity (Janzen, 1988).



8) Camel's milk is one of the most important staple foods for many pastoralists. Somali camels have reputation as high yielding dairy stock. A female often produces 2.500 to 3.000 litres in one lactation (Janzen, 1988).



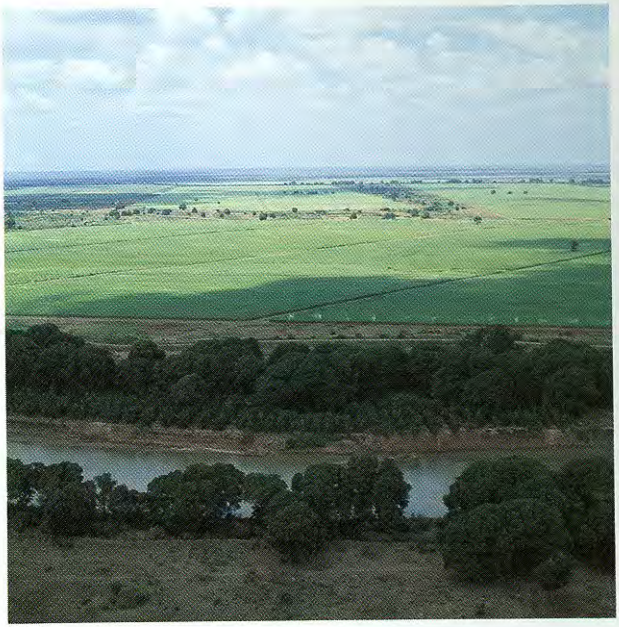
9) Two camels loaded with a complete pastoral household. The characteristic sickle-shaped bundle of sticks on the second animal are the two main supports of the hut which will be covered with the plant fibre mats carried by the first (Janzen, 1988).

10) Drawing household water from *Jubba* river. In the foreground the traditional water containers called *dhiil*, which are plaited from the root fibre of a wild Asparagus species. Camels usually carry 4 of these containers (ca. 100 l) (Janzen, 1986).

11) In southern Somalia large areas of former nomadic pasture land have been converted into rainfed farmland in recent years (Janzen, aerial photo, 1984).

12) After the harvest the crop residues of the farms, here sorghum stalks, are used by nomadic livestock (Janzen, 1988).

13) Along the lower course of the *Jubba* river large scale irrigation projects have been set up in the traditional nomadic dry season grazing land (Janzen, aerial photo, 1988).

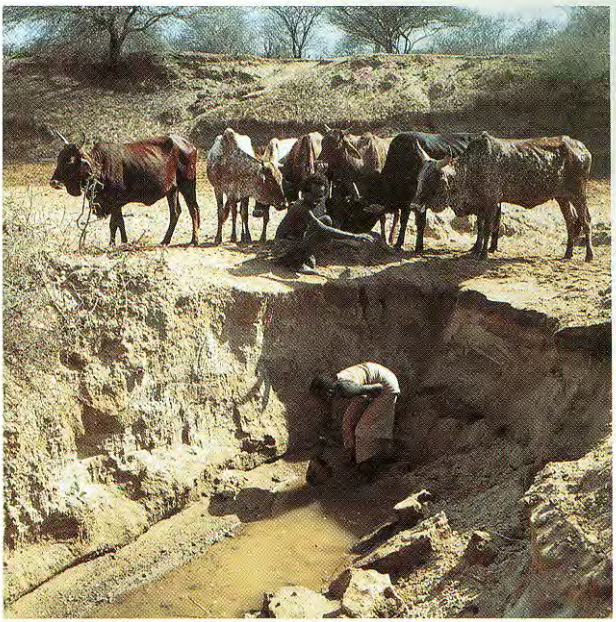


14) Aerial view of a large dry season nomadic settlement in the cultivated zone near *Shabeelle* river (Janzen, 1984).

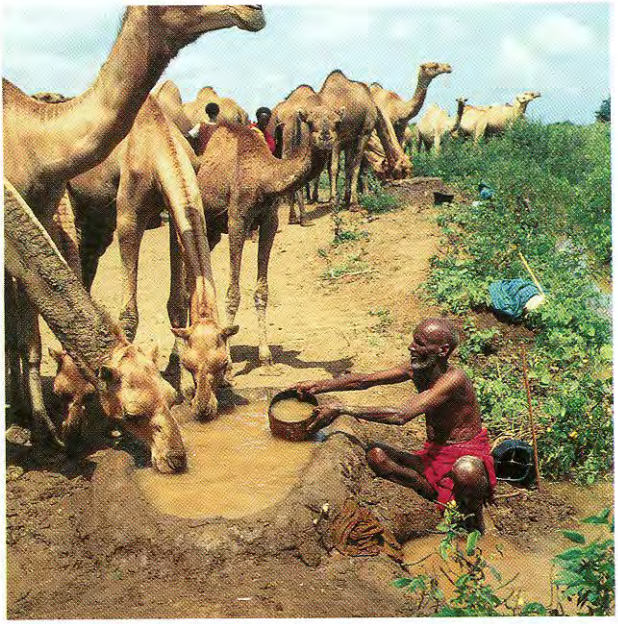
15) A flock of sheep and goats approaching the near-by watering place (Janzen, 1984).

16) Watering livestock is a never ending task. It is easiest done from open surface water, such as rivers or seasonal ponds (Janzen, 1988).

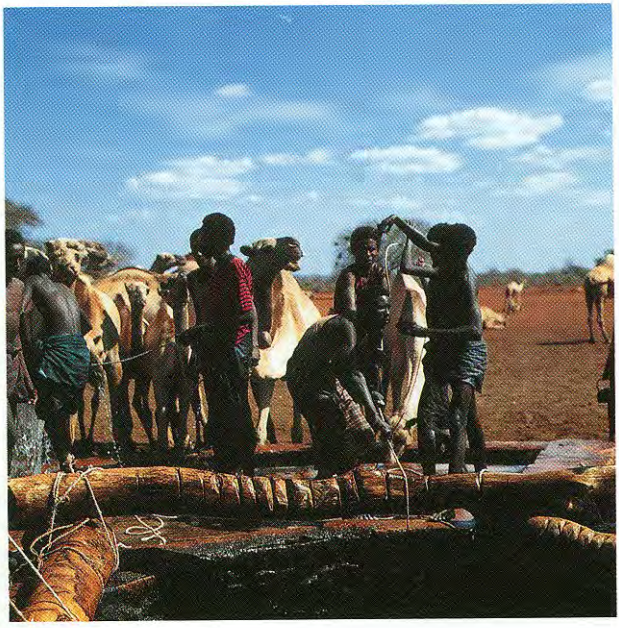
17) It needs two people to lift the water from a shallow well inside a seasonal river. To water larger herds from such wells is a back breaking effort for the herdsmen (Janzen, 1988).



18) In an effort to avoid contamination of the water reservoir and to reduce the danger of crocodile attacks on the animals small channels are dug from the water source to feed small temporary watering troughs (Janzen, 1988).

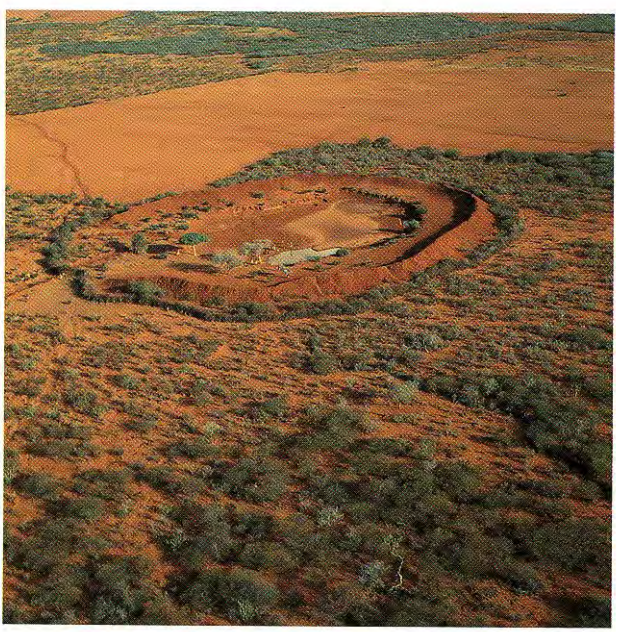


19) A small temporary watering trough for camels made from mud or clay at the end of a feeder channel near the *Shabeelle* river . The water is lifted by hand from the channel into the trough (Janzen, 1989).



20) The continuous friction of rawhide and plaited plant fibre ropes cuts deep notches into a cross beam over the well. Drawing water for livestock can account for more than 60% of the total labour input during the dry season (Janzen, 1988).

21) Wells and boreholes are also meeting places of great social importance, where news and gossip are exchanged, where livestock is traded, and where politics are made (Janzen, 1988).



22) Privately built surface water catchments (*sing.: war*) of nomads and agropastoralists can be found everywhere in the nomadic living space of southern Somalia (Janzen, aerial photo, 1988)

23) Large surface water storage systems have been built in the interriverine zone by the Government/EC. The higher animal concentration has resulted in a degradation of the vegetation (Janzen, aerial photo, 1984).

24) As a result of an increasing commercialisation the nomads could afford to construct water catchments (*sing.: berked*) throughout arid central and northern Somalia (Janzen, 1982).

25) Deforestation of large bushland areas for cultivation purposes often results in soil erosion in the semi-arid parts of southern Somalia (Janzen, aerial photo, 1988).

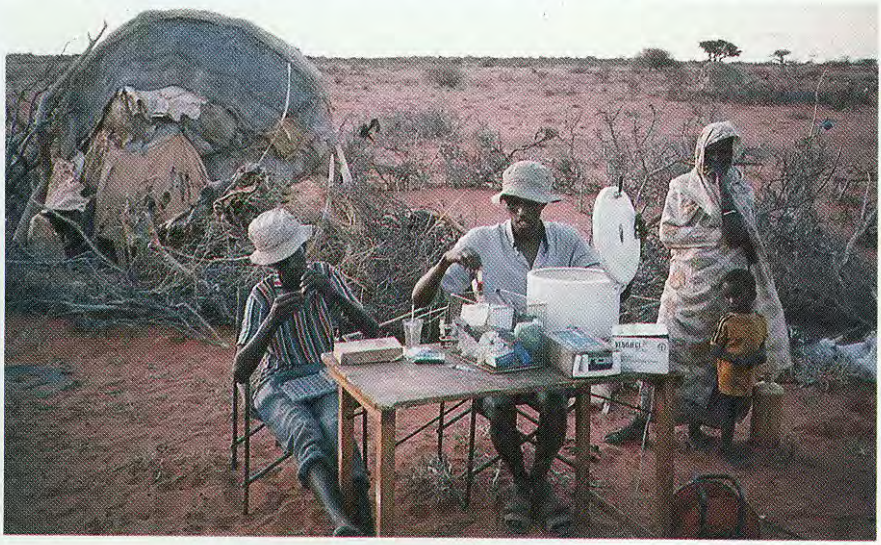
26) In the fossil coastal dune belt inappropiate land use (especially deforestation and overstocking) has led to gully erosion, the formation of bad-lands and active dunes (Janzen, aerial photo, 1988).

27) This example from northern Somalia underlines that the creation of enclosed range reserves is an effective method for rehabilitating the natural vegetation cover (Janzen, 1984).

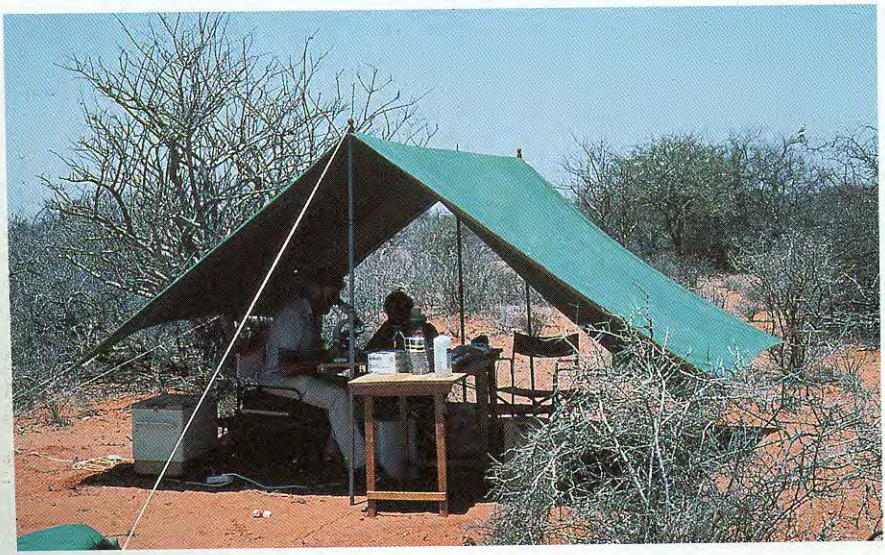
28) Aerial view of parts of the failed nomadic agricultural resettlement scheme of *Sablaale* on the *Shabeelle* river (Janzen, 1984).

29) Age determination of sheep by teeth development at a regular flock visit during the baseline disease and production survey of the GTZ/CRDP Veterinary Component (Baumann, 1987).

30) Blood samples of a representative number of small ruminants are processed at the spot by veterinary technicians of the survey team (Baumann, 1987).



31) The camel herder awaits the results of faeces and blood investigations carried out immedeately after sample taking. (Plates 31 & 32: Baumann, 1988)
32) Examination of bloodsmears for the presence of *Trypanosoma evansi* in camel in the "field laboratory" of the GTZ/CRDP Veterinary Component .



PRODUCTIVITY OF SMALL RUMINANTS IN NOMADIC HERDS

Holger Nauheimer

INTRODUCTION

In other chapters, the quality of nomadic production has been described. In this section, the productive potential of small ruminants is discussed. According to Peters (1987), goats can serve two different functions in the economy of a developing country - first to provide food and raw materials while utilizing ecologically marginal areas and secondly by increasing the income of smallholder families. The same may be said of sheep. Although sheep in general are more adapted to temperate climate than goats, the number of sheep and goats in Africa is nearly equal. In all countries of the Sub-Saharan zone, small ruminants form the major part of livestock herds, and are the most important source for protein for the rural population.

Small ruminants, specially goats, are accused of being a major cause of environmental degradation in Africa. It is not subject of this chapter to elaborate on the justice of this, but some comments should be made in this context. First, a mixed herd will cause less damage to the vegetation than a herd consisting of one species only. Secondly, the nomadic system of shifting the place of grazing according to the demand of the animals and the need of the pasture to regenerate

is an inherited strategy for protecting the land from overgrazing. Thirdly, with regard Central Somalia it can be stated that degradation due to overgrazing is only predominant around settlements and permanent wells.

However, the pressure on the pasture caused by a growing population should not be understated. The obvious problems existing in many countries at the edges of the desert, produced by different factors including rain-fed agriculture, fuelwood collection and animal production, call for a limitation of livestock, and for a better productivity. In the search to meet the growing demand for food from animals, the

"performance abilities ... must be thoroughly understood before attempts are made to increase the productivity of these animals" (Peters, 1987).

To contribute towards this goal, the Veterinary Component of the Central Rangelands Development Project (CRDP) has collected data on the production and health of small ruminants over a period of six years. This data should help fill the information gap which exists with regard to breeds and production systems in Somalia as well as assist in analyzing the impact of factors influencing production. As described, two surveys were conducted in six selected districts of the three regions constituting the Central Rangelands: *Gaalkacyo* and *Buulobarde* (*Hiraan* region), *Dhuusamarreeb* and *Ceel Dheere* (*Galguduud* region), *Gaalkacyo* and *Hobyo* (*Mudug* region). The Districts *Beledweyne* and *Buulobarde* can be classified as riverine, as they are situated near the *Shabeelle* river. *Dhuusamarreeb* and *Gaalkacyo* are dry inland areas, typical in climate and vegetation for major parts of the Central Rangelands. *Ceel Dheere* and *Hobyo* belong to the coastal region; parts of these districts also have dry inland characteristics.

MILK PRODUCTION

In most pastoral systems, the main target of animal production is to satisfy the family's demand for milk. The world's three major nomadic milk producing systems can be found in Somalia: milk production from cattle, from camels, and from goats.

In Somalia, sheep are generally not milked. Dahl and Hjort (1976) reported that in many African pastoral communities which raise small ruminants, only goats are milked. For the nomadic household, the goat is the main source of milk, and consequently, goats are kept mainly for this purpose. A substantial part of the milk is processed into different sour-milk products, butterfat, and

sometimes cheese. Most of the goat milk is used in the diet of the household, and only the surplus is marketed, whereas live animals are converted into cash for daily expenses.

Measuring the milk production of nomadic livestock animals is difficult and only sometimes can milk performance be included in a survey. In the town of *Beledweyne*, Jes (1987) measured an average milk yield of goats between 150 and 200 ml per teat during the morning. Assuming, that the milk yield of both teats and the morning and evening yield are approximately equal, the total amount of milk available per goat and day would be between 1/2 and 1 litre. These values were obtained during the short rainy season of 1987. Ali and Hargus (1986) reported a yield of 200 ml per milking of Somali goats. Ruvuna et al. (1988) measured milk yields of East African and Galla goats in Kenya under standardized conditions. In a lactation period of 12 weeks they recorded a total lactation yield of 50-60 kg, of which 25-35 kg were milked and the rest was consumed by the kids. The exact milk yield was measured by weighing the kids directly before and after suckling. Schwenk (1986) described goats in *Hobyo* District giving 1/4 l of milk in the dry seasons, all of it consumed by the kids. According to this author, only the milk of mothers without kids can be used for human consumption. Male kids therefore are sacrificed frequently. In the rainy seasons the milk amounts 1/2 l, which is shared more or less equally by offspring and man. The figures cited are based on reports of the nomads and their wives. The total milk yield of a goat that gives birth in one of the rainy seasons is nearly double of a doe that bears in one of the dry seasons. These figures are comparable with those for African goats reported by other authors (summarized by Dahl and Hjort, 1976). According to their findings, the average daily amount of milk available for human consumption from goats in sub-Saharan Africa is 0.5-1.5 litres. In the survey carried out in Central Somalia, the length of the lactation period was not recorded. From interviews with herd attendants it can be estimated that the lactation period of goats and sheep in Somalia is three to five months. From the above figures it can be reckoned, that in Central Somalia the total lactation yield of goats is 60-100 litres, of which 30-50 litres are available for human consumption.

All year around, lactating goats can be found near the household. However, the number of lactating goats does not remain constant throughout the year. Many parturitions take place in March, April and May. Consequently, a high number of lactating goats are found in May, June and July. From this figures it can be estimated, that during and shortly after the long rainy season, a herd with

100 goats can provide a family approximately 10-15 litres of milk per day. In the dry months of September, and January-February, the amount available for human consumption falls to less than five litres per day. Depending also on the family size, only households with big herds comprising more than 100 goats would be able to sell surplus milk on the market.

The value of the milk produced from nomadic livestock herds is an important feature of this production system. Cossins (1985) has pointed out, that while the growth from birth to weaning is extremely slow, the production of animal protein and energy per unit area is high in pastoral herds. Therefore it is very difficult to calculate the true productivity of the small ruminant herds. Every attempt to increase meat production from nomadic herds has to consider negative impacts on the milk production and the basic nutrition of the household.

GROWTH AND MEAT PRODUCTION

Meat production can be measured more easily. It is equivalent to the growth of the young animals. To obtain reliable figures, it is sufficient to select a number of kids and lambs and to record their body weight every second month. This was carried out during the ILCA Continuous Survey, a part of the CRDP-Veterinary Component investigations.

Growth is expressed in average daily gain (ADG), which is the weight difference between two subsequent visits divided by the number of the days between these two measurements. The average body weight depends on different factors, of which the most important are:

- breed,
- sex,
- age,
- season,
- environment and nutrition,
- production status,
- health.

Reflecting the herd structure, a stratified species and age sample of twenty animals was selected for laboratory investigations (feces, blood and blood serum). The results of this part of the survey produced the disease parameters and will be presented in an other chapter of this book. Sample animals and their offspring were marked with eartags. Every second month, the weight of the marked animals and their respective offspring was recorded. For the weighing

of the adult animals a mechanical scale ranging from 0 to 50 kg (exactness 0.5 kg) and for the young animals a similar scale ranging from 0 to 25 kg (exactness 0.25 kg) was used. The average daily gain (ADG) of the growing animals was calculated. Adult animals do not grow but in response to the pasture condition their body weights vary during the year. This is expressed as "average daily body weight change".

Breed

For more than 5000 years, goats and sheep have been raised under semi-arid conditions in the Near and Middle East. Research indicates that they were introduced from there to Africa. The harsh climatic conditions called for animals with special qualities and the pastoralist population started to breed goats and sheep suitable for this environment. The breeds have been developed over the last fifty centuries and obviously the main selection criteria were not reproductive ability, but tolerance to drought and the ability to utilize plants with low nutritive value for meat and milk production. Goats breeds can be divided into dwarf, intermediate and large types. Depending on the breed, the average weight of mature female ranges from 10 kg to 75 kg (Devendra and McLeroy, 1982). In general, large breeds are mainly found in temperate regions and dwarf goats are predominant in the humid tropics. The nomadic flocks of the arid and semi-arid areas consist of the intermediate types. Sheep also vary considerably in body size, ranging from 20 to 60 kg female mature body weight. In semi-arid Africa breeds intermediate in size predominate.

In the rural area of the Central Rangelands, basically one breed of goat (White Somali Goat or Galla) and one breed of sheep (Blackhead Somali Sheep, Ogaden or Berbera Blackhead) is raised. Another goat breed, a long-hair type (Arab), is only kept in small numbers in or around towns. The Galla goat originates in Somalia, the Ogaden region of Ethiopia and north-east Kenya. Other names for this type are *Mudug* or *Dhedayar*. It is mainly white in colour and intermediate in size between the desert goats of the Sudan and the small East African goats. Males and females are usually horned, but sometimes the horns are absent in females. The breed is highly adapted to dry environments and raised for both milk and meat purposes. The Blackhead Somali is the characteristic sheep of the Horn of Africa. It belongs to the fat-rumped type of sheep. According to Devendra and McLeroy (1982) it may have been introduced from the Arabian Peninsula. The colour is extremely uniform: black head, white body and legs. Only very few individuals are horned. The neck carries a big dewlap with fatty deposits. The main characteristic of the breed is the fat rump. The animals are raised for meat and skins only. Usually sheep are not milked.

In a study on the same two breeds carried out in northern Kenya, a higher body weight was reported (Devendra and McLeroy, 1982; Carles, 1983; Rutagwenda 1989), the body weight of adult Galla goats ranges between 30 and 40 kg and of adult Blackhead Somali sheep between 35 and 45 kg. However, the maximum weight was 45 kg in both species. Blackburn and Field (1990) also reported on these two breeds and their performance in Kenya. They found an average birth weight in Somali lambs of 2.2 kg and of 2 kg in Galla kids, the 300-day weight was 22 kg in sheep and 17.6 in goats. In the two surveys carried out in Somalia, the average body weight of the investigated animals was lower (Table 1). The average adult body weight of five years old goats and sheep was 28 kg. The mean birth weight of both species was 3 kg.

Age

The growth rate is highest in the first months after the birth of the offspring. After weaning and subsequently during the rest of the growth, the ADG decreases until maturity. Carles (1985) has calculated the average weight and weight gains of African sheep and goats from a representative sample of different breeds. According to his findings, body weight of ewes in Africa ranges from 30-45 kg, and the body weight from does ranges from 20-35 kg. The average daily gain of lambs in the first three months ranges from 75-140 g/day and the respective value for kids is 50-100 g/day.

Figure 1 shows the growth of sheep and goats from birth to the age of five years. The mean body weight of five year old goats and sheep in Central Somalia is 28 kg (Table 1). On average, goats and sheep are equal in weight when mature. Sheep grow faster than goats. At the age of one year, sheep weigh 50 % more goats. Figure 1 demonstrates the different growth rates of both species. Sheep reach mature body weight earlier than goats, and only at the age of five years, is the average weight equal in both species. Why is the growth of goats retarded, despite the fact that the Galla and the Blackhead Somali sheep have the same birth weight and obviously the same growth capacity?

To gain more information about their growth, the average daily gain (ADG) was calculated. During the first two months, lambs gain more than 100 grammes of weight per day (Figure 3). In the same time, kids only have an ADG of approximately 60 gramme (Figure 2). From the third month of their life on, the mean weight gain of both species slows down, but sheep still grow faster than goats. At the age of five months, lambs have a 50 % higher body weight than kids. After this time, the growth rate of both species is nearly equal, goats growing with the same intensity as sheep. At the age of one year and a half year, when the shape of the growth curve of sheep is nearly horizontal, the ADG of goats exceeds the ADG of sheep.

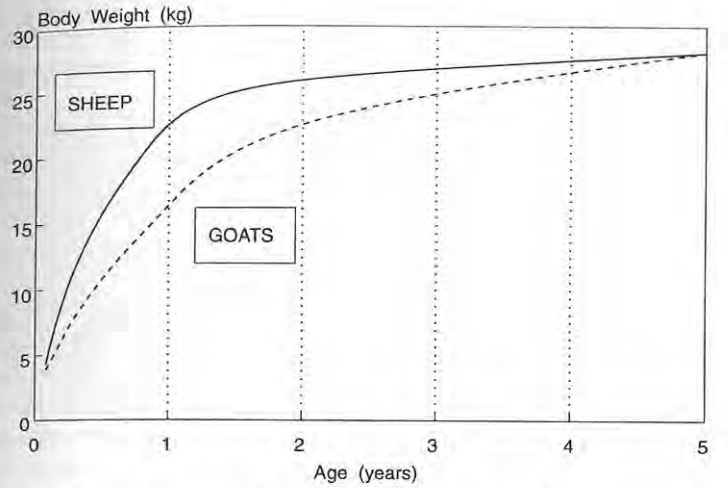


Figure 1: Growth curves of small ruminant in Somalia

Source: Author

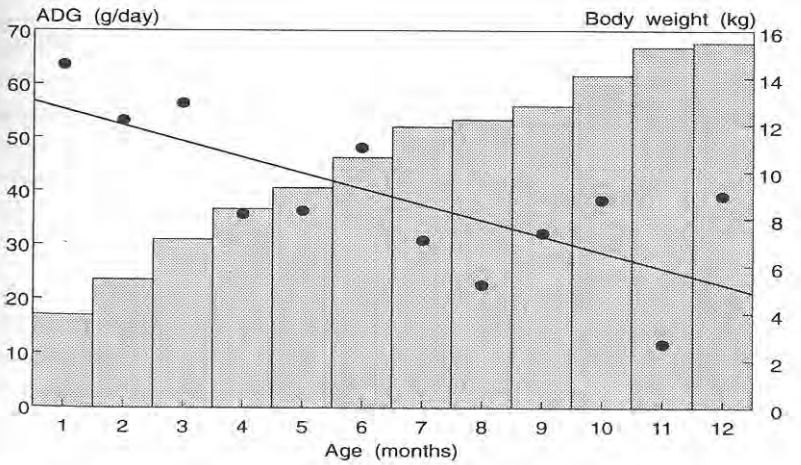


Figure 2: Body weight and average daily gain of young goats (0 - 12 months) in small ruminant herds of central Somalia

Source: Author

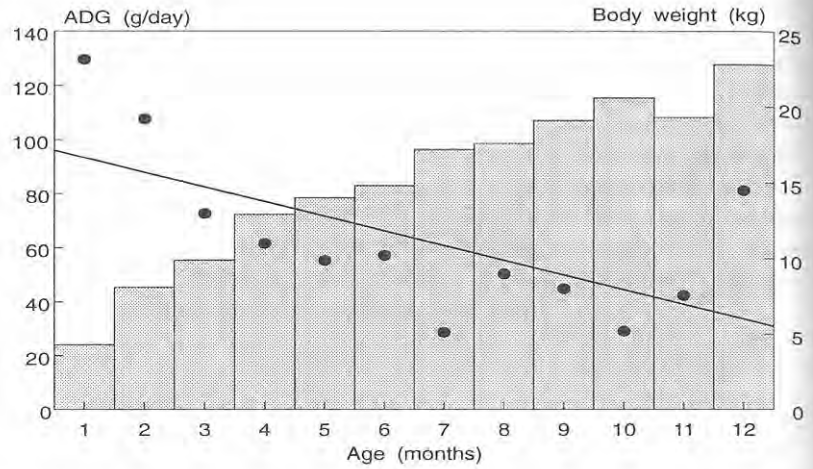


Figure 3: Body weight and average daily gain of young sheep (0 - 12 months) in small ruminant herds of central Somalia

Source: Author

Table 1: Average body weight (kg) of goats and sheep in central Somalia

Age (months)	Goats	Sheep
1	3.9	4.3
2	5.4	8.1
3	7.1	9.9
4	8.4	12.9
5	9.3	14.0
6	10.6	14.8
7	11.9	17.2
8	12.2	17.6
9	12.8	19.1
10	14.1	20.6
11	15.3	19.3

Table 1 (cont.): Average body weight (kg) of goats and sheep in central Somalia

Age (years)	Goats	Sheep
1	15.5	22.8
1.5	22.0	25.8
3	25.1	26.8
5	28.2	28.0

During the first months of their life, the young goats have to compete with man for their food. Only part of the milk is available for the kids, while sheep are not limited in their consumption. In many herds, lambs are allowed to spend the night with their mothers within the same enclosure, while goat kids are generally separated from the does until they are totally weaned. They are permitted only for a short time each day to suckle. Most of the offspring are weaned between the third and fifth months after birth. After that, both lambs and kids have access to the same feeding source - the pasture.

Sex

In general, adult male sheep and goats are heavier than females. The surveys found that in the first year the weight of females and males is equal in both species. After reaching the age of one year, males grow faster. At five years, the castrated male goats and sheep remaining in the herd weigh around 31 kg, while adult females have an average body weight of 28 kg. Uncastrated males exceed 40 kg in weight.

Season

In semi-arid environments, the availability of sufficient fodder varies during the year. In the dry seasons, plant growth is inhibited and the nutrient content is decreases, as most parts are lignifying. Alternative fodder resources like crop by-products are extremely limited and available only for very few herds. Around one week after the onset of the first rain germination starts and pasture growth is initiated. After a period of three weeks without any rainfall the bushes and shrubs drop their green leaves. The litter is still available as a feed resource, but the protein content is reduced. Moreover, it is difficult for the animals to eat small leaves from the ground. Livestock adapted to arid or semi-arid environments may suffer over 25% loss in body weight and show compensatory weight gain

when better conditions prevail (Harrington, 1981). Observations from Mali, in an semi-arid area with mono-modal rainfall distribution showed that during the hot dry season, the body weight of adult small ruminants decreased (Wilson, 1987) The seasonal weight change was ± 4 % of average weight in goats and - 5 % to + 11 % in sheep.

The concept of compensatory growth comprises the idea that ruminants, feeding on different levels over the year, undergo times of fluctuating body mass. It includes phases of rapid growth during rainy seasons, when good pasture prevails. During this time, daily weight gain is high. In times of scarcity, the body mass of adults is turned into energy and weight declines. In growing animals, weight gain is around zero during dry seasons. Figures 4 and 5 show the seasonal fluctuations of average daily gain (growing animals)/ average daily body weight change (adults) as it was observed in central Somalia. The data on which these figures are based refer to years with extraordinary rainfall.

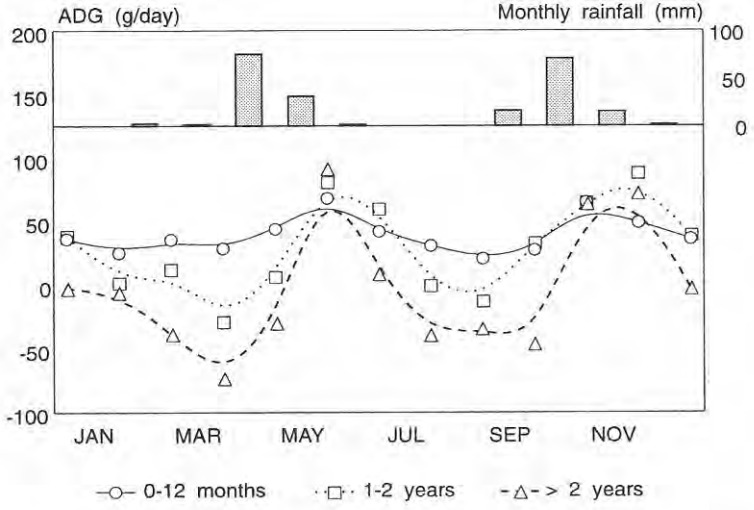


Figure 4: Average daily gain/body weight change of goats in small ruminant herds of central Somalia as affected by monthly rainfall varaition

Source: Author

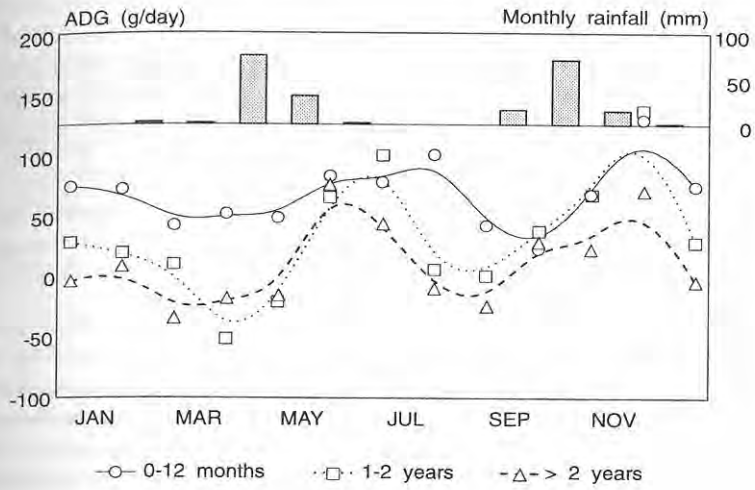


Figure 5: Average daily gain/body weight change of sheep in small ruminant herds of central Somalia as affected by monthly rainfall varaition

Source: Author

It can be concluded, that within an age class, seasonal changes of forage availability constitute the most important factor influencing body weight development and ADG. Suckling lambs and kids grow during the whole year, even in times of scarce fodder resources, then however, weight gain is restricted. It is dependent on the milk production of the mothers. Since sheep are not milked, the whole milk production of the dams is available for the lamb. For a goat's milk, there is a constant competition between the family and the kid. Because of the relative low productivity of the indigenous goats, supply of for milk is insufficient. After weaning, the young animals are dependent on the pasture. Their capacity to convert grass into body substance is high. Figures 4 and 5 show that the young animals (age class 1) gain weight even in the dry seasons, but their ADG is increased after the onset of the rains. Yearlings (age class 2) are still growing, but the ADG is lower compared to the growth of lambs and kids in the first year. At the end of the dry season, the pasture does not support any body weight gain to this sector of the herd, but these animals are able to maintain their body weight. Mature animals (age class 3) do not grow. They have to meet their nutritive requirements for maintenance and performance

(milk and reproduction). Additionally, nomadic livestock regularly walk large distances from grazing to watering areas and back. During dry seasons energy has to be supplied by metabolizing body reserves. Since vegetation growth in Central Somalia is restricted to only a very short time and fodder plants loose their nutritive value soon after rains terminate, the period in which the deposits can be stocked up is very short and or non-existant in times of drought. Adult goats and sheep in semi-arid areas have the ability to gain 50-70 g/day during the rainy season but they loose the same quantity in the dry seasons. In areas with bi-modal rainfall distribution like Somalia this cycle of loosing and gaining weight is repeated twice every year.

Environment and nutrition

The availability and type of fodder depends on the total amount of rainfall which an area receives. Thus biomass production is higher in *Beledweyne* and *Buulobarde* District than in the districts situated further north. Moreover, livestock herds in this area have access to harvested fields and crop by-products, e.g. sesame oil cakes. Animals in the town of *Beledweyne* are also fed with green fodder and sorghum/millet stalks which can be purchased from the market.

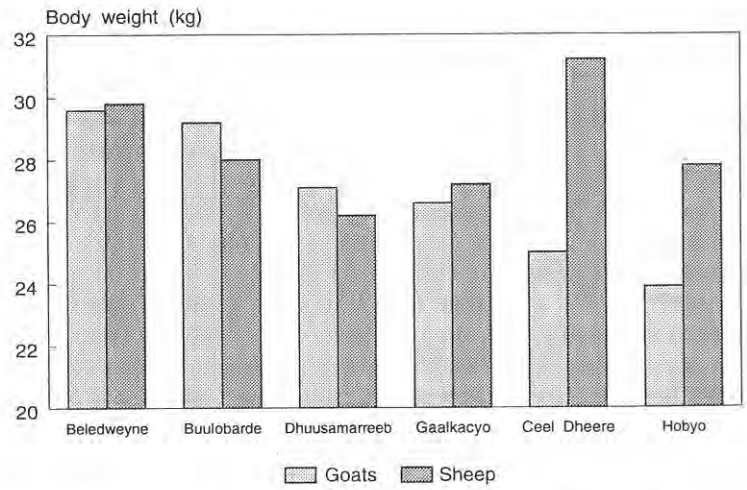


Figure 6: Body weight of goats and sheep in different districts of central Somalia

Source: Author

Because of more a constant feed availability, the average body weight of sheep and goats is higher in *Beledweyne* area than in the two northern districts. Adult animals in *Beledweyne* weigh around 30 kg (Figure 6). The mean weight of goats in *Buulobarde* is 29 kg; the average weight of sheep 28 kg. In *Dhuusamarreeb* and *Gaalkacyo*, the average weight of adult goats and sheep is between 26 and 27 kg. The lowest body weights of goats and sheep are found in *Ceel Dheere* and *Hobyo* district.

Production status

Pregnant animals gain weight due to the developing products of conception (fetus, embryonic fluids and membranes). Especially in the first three months of the pregnancy, the change in body mass is mainly due to increased water storage in the body. Lactating animals may use part of the energy stored in their tissues for milk production and therefore loose weight in times of insufficient feed availability. The process of pregnancy also requires a high amount of energy, which is not available from the pasture alone and has to be supplemented from the body substance. After parturition the animals loose more than 10 kg. Only in the short periods when females are neither milking nor pregnant, and only in periods with sufficient and highly nutritive fodder, can energy be stored in the body. This compensatory growth does not exceed 20 g/day body weight gain. The energy balance of lactating animals is negative nearly throughout the year. Animals lambing/kidding at the beginning of the rainy season have a comparatively better chance of receiving sufficient feed to convert into growth or deposit tissues.

REPRODUCTION

Fertility in goats and sheep is defined as the ability to produce regular offspring. For the animal breeder it is important to produce as many viable lambs and kids from his stock. This does not automatically mean that as many offspring as possible should be produced from a single mother. Females which give birth at a younger age may produce smaller or even no viable offspring. A high rate of subsequent parturitions may cause severe reproductive problems and a total end to further reproduction.

The reproductive performance is dependent on breed, nutrition and management. Most of the sheep and goat breeds of the tropical regions reach maturity at a later age than the majority of the breeds of temperate regions. It

was described in the previous section, that the level of nutrition varies considerably throughout the year. This does not only have consequences with regard to the growth of the animals, but also to their reproductive functions. Severe malnutrition as it is found in years of drought leads to a partial or total failure of ovulation or can cause early abortions. But also in years of normal rainfall with a regular feed basis, the reproductive functions follow seasonal patterns. This is especially true for sheep, which in Somalia mainly ovulate at the end of the rainy seasons and give birth at the beginning of the next rainy season. The reproductive performance is also affected by the herd management. In most of the sheep and goat herds in Somalia, only one uncastrated male per species is present to serve 50 or more females. Smaller herds often not possess a ram (male sheep), or even lack a buck (male goat) so that one has to be borrowed from neighbours.

Generally, data on reproductive parameters may be gathered in two different ways, one being faster but less exact, the other being time consuming and difficult when investigating nomadic herds. The data can be either obtained in a retrospective interview or through long-term observations with single animal records. For the first method it is necessary, that the herd owner or the person responsible for the flock be very knowledgeable on the single animals and their particular history. This person can then be asked about all the earlier parturitions of an animal. In practice, the interviewer should start with a question like that: "Look at this goat. When did it give birth to its last offspring ?" This birth then the preceding one is recorded and so on until the first is reached. If the present age of the animal is known, then the animal's age at first parturition can be estimated. The second method requires identifying single animals after birth by marking (ear-tags or tattoos) or by name. Their reproductive performance is recorded, for as many years as possible, at least three. The first method should be applied to cows and camels, since their reproductive period is too long to record in a follow-up survey (unless the observer is ready to visit the same nomadic herd for six years). Whenever possible, the second method is preferable for small ruminant herds, because of each parturition can be dated more exactly than in cows and camels.

Reproductive performance is determined by several parameters:

- Date of first parturition: In both species of small ruminants, the age of first lambing/kidding is approximately two years and five months, i.e. they first conceive at around two years. However, under favourable conditions, this may occur much earlier. From a selected sample of 15 goats and 7 sheep

which were monitored from birth on, the average age at first kidding was 500 days and the average age at first lambing was 475 days. These animals demonstrate a lower limit of reproduction, which can be conceived under favourable conditions, i.e. in years of good rainfall. Goats in general are older than sheep at their first parturition. In the riverine zone (*Beledweyne*, parts of *Buulobarde*), goats and sheep reach maturity earlier, since feed availability is better and supports faster growth. In this area, small ruminants are younger at first parturition as compared to animals kept in the dry inland and coastal areas (Bourzat et al., 1988).

- Parturition interval: The kidding/lambing interval is the number of days between two successive parturitions. The interval comprises the service period - the period between kidding and subsequent conception - and the gestation period. The average gestation length is five months in both goats and sheep. The service period depends on lactation. The parturition interval was measured in different surveys in Central Somalia. It is approximately 11 months in both goats and sheep in years with good rainfall. The parturition interval may be much longer depending on season and ecological zone. Sheep have shorter parturition intervals in the riverine zones, than those from inland and coastal zones. The subsequent parturition interval is longest after an animal gives birth in the long dry season *jiilaal*.
- Litter size: Twins are very rarely found in Somalia. In both species, less than 2 % of the parturitions produced more than one offspring.
- Number of parturitions/year: This figure is obtained by dividing 365 (number of days per year) by the mean parturition interval (in days):
- Fertility Rate: This figure can be calculated by multiplying the litter size times the number of parturitions/year. It gives the average number of offspring born per adult female per year. For sheep and goats in nomadic herds in Somalia the last three parameters have been calculated as follows:
  - Litter size: 1.02
  - Number of Parturitions: 365/330 = 1.11
  - Fertility Rate: 1.13

A fertility rate of 1.1 to 1.2 corresponds with the fecundity rate calculated under herd dynamics which were discussed in the preceding chapter. It should be born in mind, that these figures are valid for years with normal precipitation. In years of drought, the fertility rate will fall below 1.

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LIVESTOCK DISEASES IN CENTRAL SOMALIA

Cord Heuer

Central Somalia supports 30% of Somalia's camels and 31% of its sheep and goats, but only 19% of the total cattle of the country's population (MLFR 1989). As cattle are much more dependent on permanently available water than sheep, goats and camel, they are mainly found close to the permanent rivers of the southern and Trans-*Juba* regions of Somalia. Hence their importance for the Central Rangelands is relatively low and cattle diseases in this area is not considered a pressing problem. Abdullahi (1990) estimated that 50% of the pastoral income is derived from goats, 30% from camels, 10% from sheep, and 10% from other sources. His study did not attribute any significance to cattle in the pastoral household economy of central Somalia. Therefore, the following discussion focuses on camels, sheep and goats.

DISEASES AS A FUNCTION OF EXTERNAL STRESS FACTORS AND ADAPTATION

The year 1986 was characterized by a severe drought starting with scanty rainfall in the long rainy season (*gu'*), no rains during the short wet season (*deyr*) and delayed onset of subsequent rains in May 1987.

Observations of herd dynamics of small ruminants before, during and after this period showed enormous initial losses, and remarkable recovery once rains reappeared and sufficient vegetation was available. Tables 1 and 2 show the substantial fluctuations in mortality and fertility rates from one year to another, particularly when years of inconsistent precipitation are included.

The drought reduced herds to 50% of their original size, goats suffering more than sheep. Mortality rates in goats increased by approx. 200%, those for sheep by 90%. Nevertheless, as soon as sufficient rains started herd sizes increased rapidly. Mortality declined from 52% to 22% in goats and from 61% to 18% in sheep, and fertility increased from 73% to 111% in goats and from 59% to 133% in sheep. Within 2 years, original herd sizes had been re-established (Zessin et al. 1988 a, Nauheimer et al. 1990). Another study drew an even more dramatic picture: mortality of adult females increased from 16% to 80% due to drought but dropped to 11% during two subsequent recovery years; birth rates dropped from 60% to zero and then shot up to 100% after the onset of rains, which are often more abundant than usual after a drought period (Abdullahi, 1990).

These examples demonstrate the major role climatic factors play as one of the external determinants of productivity and how extremely well adapted small ruminants (and presumably camels) are to such environmental conditions. Disease control measures can only influence a comparatively small proportion of variable factors and cannot be expected to modify the production potential of livestock in central Somalia beyond certain limits. It is this small proportion of variability that animal health planners and veterinarians are tackling with the aim of reducing the pastoralist's risk of losing animals through disease and thereby increasing the country's livestock production.

Some of the most prevalent risk factors for disease will be discussed in this chapter. It must be noted, however, that the quantitative appraisal of the effect of disease and risk factors are derived from a still very small data base and that much more information is needed for an accurate picture of disease events and their effects in central Somalia. Some recommendations on how to approach that task are given at the end of this chapter.

Table 1: Mortality, reproductive rates and seasonality of calving in camels (Baumann and Zessin, 1992)

Standard deviation in parenthesis			
Overall herd mortality (annual death rate, a.d.r.)	17 herds	9.3 %	(7.2)
Mortality of young stock (a.d.r. of camels < 1 year)	24 herds	19.6 %	(21.0)
Mortality of adult stock (annual death rate)	17 herds	5.2 %	-
Birth rate (annual rate of live births)	23 herds	39.7 %	(24.2)
Calving interval (months)	123 adult females	34.0	(12.0)
Age of first calving (years)	116 females	7.0	(2.0)

Proportion of calvings:

- 17% in the long dry season (*jiilaal*)
- 43% in the long wet season (*gu'*)
- 10% in the short dry season (*xagaa*)
- 19% in the short wet season (*deyr*)

ESTIMATES OF MORTALITY AND REPRODUCTIVE POTENTIAL OF CAMELS, SHEEP AND GOATS

The differences in mortality rates between species and subclasses of animals is of particular interest with regard to young stock in general and to goats of less than one year in particular. This is because goats constitute about 65% of total small ruminant herds in central Somalia. A breakdown of mortality rates according to age therefore strongly indicates that priority should be given to curbing diseases and their risk factors among young stock of sheep, goats and camels when research or intervention programs are set up.

Losses among young stock below one year of age are of the magnitude of 20% in camels, 27-34% in goats and 16-33% in sheep, whereas the annual mortality rate among adult camels is 5%, of adult goats is about 9% and of sheep is 12% .

Abdullahi (1990) reported a higher adult mortality rate among small ruminants of 15.8% for "normal years", based on interviews with pastoralists. This, however, may not be quite precise.

Although, death rates of adult animals are substantially lower, herd owners pay more attention to adult stock. This is because their value to the herd is much higher as they represent the breeding stock.

Table 2: Rates of mortality and birth rates of sheep and goats in central Somalia

Source	Abdullahi 1990	Zessin et al. 1988 a	Nauheimer et al. 1990	
Districts	*Buulobarde, Ceel Dheere*	*Beledw., Buulobarde Hobyo, Ceel Dheere*	*Gaalkacyo, Dhuusamarreeb*	
Years	1986/87	1984 - 1987	1987 - 1989	
Remarks	"normal year"	avg. affected by severe drought in 1986	means above avg. because observed in "good year" after '86 drought	
Mortality of young stock			due to:	
			disease	other
- sheep	36.0	33.0	10.4	5.6
- goats		34.3	17.8	9.0
Mortality of adult stock				
- sheep	15.8		6.6	5.3
- goats		15.8	5.8	3.3
Overall flock mortality				
- sheep		22.5	11.1	7.3
- goat		28.3	14.4	7.7
Birth rates				
- sheep	60.0	58.9	133.1	
- goats		73.3	110.8	

Table 3: Potential tick borne diseases based on the prevalence of tick species in central Somalia (Scaramella, 1988)

Tick species	Transmitted agents	Affected animals	Districts in which ticks are found
Rhipicephalus pulchellus	*Theileria parva* (ECF), Nairobi Sheep Dis.(virus)	cattle sheep	*Gaalkacyo, Dhuusamarreeb, Xarardheere, Ceelbuur, Beledweyne, Jalalaqsi*
Rhipicephalus parvus	*Th. annulata/ parva*	cattle, sheep goat, camel	*Gaalkacyo, Dhuusamarreeb, Ceelbuur, Beledweyne*
Rhipicephalus simus simus	*Th.parva, Anapl. marginale, Rickettsia conorii*	cattle,sheep goat, camel	*Gaalkacyo, Beledweyne*
Hyalomma anatol. anatol.	*Th.annulata*	camel, cattle, sheep	*Dhuusamarreeb, Ceelbuur*
Hyalomma anatol.excavat.	*Th.mutans, Anapl.marginale*	camel, goat, sheep,cattle	*Beledweyne, Buulobarde, Jalalaqsi*
Hyalomma dromedarii dromedarii	*Th.annulata Th.parva Babesia caballi Babesia equi*	camel, sheep, horse, donkey	*Xarardheere, Caabudwaaq, Cadaado, Dhuusamarreeb Ceelbuur, Ceel Dheere, Beledweyne, Buulobarde*
Hyalomma impeltatum	*Th.annulata*	cattle, camel, sheep,	*Gaalkacyo, Cadaado, Xarardheere, Ceel Dheere*
Hyalomma rufipes	*Th.annul./parva, Bab.bigemina, Cox.burnetti, Ehrlichia bovis*	cattle, goat, sheep, camel, equines	*Gaalkacyo, Xarardheere, Caabudwaaq, Cadaado, Dhuusamarreeb, Ceelbuur, Beledweyne, Buulobarde*
Hyalomma truncatum	*Th.parva, Borrelia duttonii*	cattle, goat, sheep, camel, equines	*Gaalkacyo, Caabudwaaq, Hobyo, Dhuusamarreeb, Beledweyne*
Ornithodorus savigini	*Th.hirci/ovis, Cox.burnetti, Borrelia spp.*	goat, sheep, camel, cattle, equines	*Gaalkacyo, Hobyo*
Ornithodorus moubata	*Th.hirci*	goat	*Gaalkacyo*

DISEASES TRANSMITTED BY TICKS AND TICK BURDENS

Information of one study (Scaramella, 1988) is available on the distribution of ticks in central Somalia which permits some conclusions to be drawn with regard to the threat for tick borne diseases (Table 3). The study indicated that *Rh.-appendiculatus, Rh.-evertsi-evertsi, Rh. bursa, Amblyomma variegatum, Boophilus spp.* and *Haemaphysalis punctata,* which are vector ticks carrying common tropical diseases, are not present in this area. An enumeration on tick species on sheep or goats revealed 95-98.6% *Rh. pulchellus* and the remainder in decreasing order comprising *Rh. simiae, Amblyomma lepidum, Amblyomma gemma, Hyalomma rufipes*. Developmental stages were identified as 6.4% larvae, 90.3% nymphs and 3.4% adults (Lechner, 1986).

Thus, ticks known for transmitting tropical diseases which are a major problem in other parts of tropical Africa (e.g. anaplasmosis, heartwater, babesiosis) are extremely rare in central Somalia. Theileriosis can be experimentally transmitted by several *Rhipicephalus*-species but its field distribution is almost exclusively associated with *Rh.-appendiculatus* (Robertson, 1976) which has not been recorded in central Somalia so far. There is therefore a high probability that such diseases are of minor importance in the Central Rangelands of Somalia and that Nairobi Sheep Disease (NSD) may be the only remaining health hazard among the tick- transmitted infectious diseases. In fact, NSD outbreaks have been observed in Northern Somalia (Edelsten, 1975) but have not yet been reported from the central regions.

Parasitological testing during a disease survey involving 2527 peripheral blood smears from goats, 1615 from sheep (Zessin et al., 1988 b), 821 from camels, and 959 from cattle (Heuer et al., 1990 a) yielded prevalence rates of tick-transmitted blood parasites of less than 1 percent. *Anaplasma* occurred at rates of 0.9% in sheep, 0.3% in goats and 0.8% in cattle. *Theileria* was found in 0.8% of the cattle, only 0.08% of the goats and in none of the sheep specimens. No *Babesia-sp.* positive smears could be detected. Thus, parasitemia associated with clinical tick-transmitted disease was summarized as follows:

- Infections in indigenous livestock species are usually mild and seldom apparent.
- Infection rates with the investigated genera of protozoa are very low, if at all existent.
- Infections, if occurring, are usually accompanied by low levels of parasitemia, if any.
- Clinical tick-transmitted disease must be assumed to occur only sporadically in individual animals.

In view of the low prevalence of tick species other than *Rh.-pulchellus*, it might appear that the frequency of tick borne diseases is indeed very low in central Somalia.

Serological survey results using the ELISA technique for tick borne diseases showed the following (Caille 1987):

Species	No. of sera	Sero-prevalence of	
Cattle	403	51.85% 71.20%	*Babesia rodhiani* *Theileria annulata*
Sheep	518	67.10%	*Babesia rodhiani*

Low parasitemia rates and high sero-prevalences are a strong indication of a widespread immunity, and therefore explain the low frequency of clinical diseases that are tick borne. The presence of ticks, therefore, appears to stimulate the repeated activation of resistence building processes among the livestock population of central Somalia, and as such is a desirable factor for the maintenance of natural protection. Consequently, human interventions that remove this stimulus, e.g. widespread use of acaricides, are highly contraindicated under these circumstances. They would not only be a burden on herd economics and the national budget, but also pose a potential threat by increasing disease incidence rather than preventing the occurrence of tick borne diseases.

The direct effect of ticks on livestock appears to be minor in general although few data are available (Lechner, 1986). Although infestation of any tick species is limited to individual animals, acaricide treatment of entire small ruminant herds is common. Pastoralists become immediately concerned about even a light degree of tick infestation as they fear disease transmission rather than instant blood loss or direct toxic effects. The demand for more and better acaricides is frequently stated by herd owners.

Because tick infestation and tick-transmitted diseases are sporadic events affecting individual animals, strategic prophylactic approaches (e.g. herd dipping, vaccination) would not be appropriate means of controlling tick borne diseases in central Somalia. Meaningful measures in contrast would include specific treatment of well-diagnosed individual cases and the restrained use of acaricides for severely infested animals.

TRYPANOSOMIASIS

Among infectious diseases, trypanosomiasis may be the one most frequently causing substantial production losses among Somalia's livestock. The common vector of *Trypanosoma* species are tsetse flies which transmit the disease in a cyclic generative process. But disease can also be transmitted mechanically by biting flies, though, the survival of *Trypanosoma* in this way is much shorter, making transmission less efficient. Nevertheless, *Trypanosoma-evansi* mechanically transmitted by flies of the genus *Tabanidae* is the common agent frequently causing livestock disease in areas where tsetse flies are non-existent.

Table 4: Prevalence of trypanosomiasis in central Somalia

Affected Species	Parasitaemia	Sero-prevalence
Source TEST	% (n)	% (n)
Camels		
Baumann and Zessin (1990)	7.20 (821)	
Dirie et al. (1989)	4.20 - 5	
Caille (1987) ELISA[1]		57.60 (257)
Cattle		
Heuer et al. (1990 a)	4.10 (739)	
Caille (1987) ELISA		65.20 (403)
Sheep		
Zessin et al. (1988b)	.00 (1615)	
Heuer et al. (1990b) CFT[2]		4.90 (857)
Caille (1987) ELISA		53.80 (518)
Goats		
Zessin et al. (1988b)	.04 (2527)	
Heuer et al. (1990b) CFT		8.10 (3015)
Caille (1987) ELISA		45.70 (829)

1 = Enzym Linked Immunoassay System Absorbtion; 2 = Complement Fixation Test

Table 4 shows the prevalence of parasitemia and the sero-prevalence in the livestock population of central Somalia. Parasitaemia is relatively frequent in camel and cattle, but very rare among sheep and goats, whereas all species show a marked serologic titre rate. Studies of Baumann and Zessin (1990) and Dirie et al. (1989) of camels in central Somalia showed parasitemia rates of 4.2 - 7.2 % with more than 80% positive samples identified as *T.evansi*. There was a distinct seasonal effect due to higher insect activity in wet seasons, and a higher occurrence in riverine areas. Dirie et al. (1989) also identified geographical areas infested with tabanides near the coast and near the border of central Somalia with Ethiopia. Serologic prevalence rates based on the ELISA test were considerably higher than rates derived from CFT results. The difference may be attributable to the higher specificity of the ELISA, i.e. to the ability of the test to detect positive animals.

Baumann and Zessin (1990) showed that sero-prevalence of *T.evansi* is associated with herd fertility of camels and, although there was no indication of clinical disease among small ruminants, herds of sheep and goats in which trypanosomiasis reactors were detected contained more aborting females than herds without reactors (Heuer et al., 1990 b). There was also some indication that the anaemia status of sheep, goats, cattle and camel tended to be affected by chronic trypanosomiasis (Baumann, 1990; Heuer et al., 1990a and b). No significant effect on body weight, however, could be observed in either study.

Trypanosomiasis is very familiar to pastoralists who call it "*gol*" or "*gosha*" (Baumann, 1990) and know it as a disease occurring in camel and cattle but not in small ruminants. Since no efficient prophylactic measure against non-tsetse-borne trypanosomiasis is available, control fully depends on curative treatment with veterinary drugs. A variety of drugs are applied and are commercially distributed in most East African countries.

Trypanosoma evansi infection is therefore important in central Somalia and its economic effects may be even higher than assumed in the past because chronic infections appear to have greater impact on livestock production than acute clinical disease. Public control must concentrate on efficient distribution of trypanocidal drugs (e.g. a secure supply through import or domestic production), create legal and administrative opportunities for suppliers via the private market, and train para-veterinary staff in appropriate diagnosis and drug handling.

EFFECT OF INTESTINAL PARASITES ON LIVESTOCK PRODUCTION

It has been extensively shown that all livestock species in central Somalia are frequently infested with gastro-intestinal parasites. Rates were as high as 69% in cattle and up to 90% in sheep and goats, and it was suggested that all animals can be assumed to have picked up worms at one time or another because of the close contact between animals in night encampments (Zessin et al., 1988b; Heuer et al., 1990a and b).

Among worm families, *Trichostrongylidae* were most frequently identified in animal feces and were statistically associated with the anaemia status which adversely effects general health. Cancovic (1984) identified *Trichostrongylus spp.* (88%), *Haemonchus spp.* (62%), *Oesophagostomum spp.* (55%), *Cooperia spp.* (44%), and *Strongyloides spp.* as the most frequent worms in Somalia's livestock. Fluke does not exist in central Somalia and little importance is attributed to tape worms and *Coccidia*-species. Case studies on the presence of lung worms in sheep and goats showed rates of up to 51% in herds in *Dhuusamarreeb* and *Gaalkacyo* districts. About half of all small ruminants infested with lung worms at an abattoir had clinical symptoms and pathologic lung lesions (Fischer 1988).

Prevalence rates of intestinal worms were not correlated with body weights in sheep and goats (Heuer et al. 1990 b), probably because the mere presence or absence of worms was recorded rather than the magnitude of infection. Little is known about the source of infection and the dynamics of reinfection with regard to intestinal parasites and the possible risk factors involved. Moreover, initial results of a field trial determining the effect of herd deworming (application of anthelminthics) did not indicate benefits in terms of mean weight gains (Heuer et al., 1991) among small ruminants.

Hence, to date little can be concluded about the economic effects of worm infestation and whether control measures aiming to reduce the infestation rates at herd level are really indicated. It very much appears that the magnitude of infection is generally low, possibly because of partial resistence of local livestock breeds as the result of an immunologic adaptation. Clinical disease caused by entero-parasites may be sporadic and better treated on an individual basis by livestock holders when they occur rather than combatted through the indiscriminate use of expensive anthelmintics on herd level. Treatment of clinically affected animals as identified by the herders is the traditional way of controlling this problem and may be the most economical approach.

POTENTIAL ZOONOSES

Brucellosis

As *Brucella melitensis* is an agent with particular implications for public health, especially in Somalia where about two-third of the milk is consumed raw (Westwater, 1989), serological screening for brucellosis was of concern whenever blood samples were investigated (Haegele, 1978; Falade and Hussein, 1979; Elmi, 1982; Abdullahi, 1986; Baumann and Zessin, 1992; Baumann, 1990; Heuer et al., 1990 a and b).

Table 5: Prevalence of sero-reactors for brucellosis in central Somalia (SAT = serum agglutination test, CFT = complement fixation test)

Source	Year	Species	Prevalence % (n)	Remarks
Baumann and	1985/86	camel	1.9 (913)	SAT
Zessin (1992)			.3 (913)	CFT
Baumann and	1984-87	sheep	.77 (1558)	*B.melitensis*
Zessin (1992)			.96 (1570)	*B.abortus*
		goat	1.19 (2180)	*B.melitensis*
			.87 (2187)	*B.abortus*
				(all SAT)
Heuer	1987-89	sheep	.70 (857)	CFT
et al. (1990b)		goat	.56 (3015)	CFT
				B.abort./melit.
FAO	1980-83	cattle	5.7	*Shabeelle* River
(1986)	1983-86	cattle	4.7	*Hiraan,*
				Shabeelle Dhexe
			0.0	*Mudug,Galguduud*
Heuer	1985/86	cattle	1.9 (477)	*B.abortus*, SAT
et al. (1990a)			1.2 (477)	*B.melit.*, SAT

In central Somalia, all evidence strongly indicates a very low prevalence if not absence of *B.melitensis*, since most results were based on the serum agglutination test (SAT) which has a low specificity, i.e. it is likely to produce false positive results.

Sero-reactors were found more frequently in the riverine areas of *Beledweyne* and *Buulobarde* and during wet seasons. In camels, the frequency of brucella reactors is associated with herd fertility (Baumann and Zessin, 1992) a phenomenon which may be attributed to *B. abortus* rather than *B. melitensis* infections. Brucellosis is clearly not a sigificant livestock disease or a major health hazard for people in the Central Regions. On the contrary, research findings do not substantiate previous concerns of politicians, exporters and importers of Somali livestock products and ofSomalia's trade partners regarding the possible spread of brucellosis.

Tuberculosis

Human tuberculosis (TB) is frequent in Somalia and there is some possibility that people become infected with mycobacteria through the consumption of livestock products, especially raw milk, or from living in close contact with livestock. About 70% of households do not boil milk prior to consumption. However, a survey among the rural population and refugee camps of the *Hiraan* region showed that raw milk consumption or the presence of any species of livestock in general did not increase the risk of tuberculosis in households. However, households purchasing cattle milk from local markets had a 6 times higher frequency of TB than those not purchasing cattle milk. The conclusion that infection spreads through marketed cattle milk, is questionable however, as all other evidence indicates very low infection rates among the cattle population (2.6%, n = 4766); also, mycobacteria isolated from milk of positive cattle were regarded as being apathogenic. None of 7 suspected cultures were identified as *M. bovis* or *M. Tuberculosis* (Westwater, 1989). There was no association between human tuberculosis in households and test-positive cattle.

Hence, it is highly unlikely that the transmission of tuberculosis from livestock to humans is an important way of spreading TB among the rural population.

Chlamydiosis and Q-Fever

Little information is available to date about chlamydiosis or Q-fever which may potentially be spread from sheep or goats to humans. Reports from the Lower *Juba* Region suggest infection rates of 25.8% among sheep with *Chlamydia-psittaci* (Wiegand and Marx, 1984). Such high rates were not found as a result of serum screening in the central regions. Here only 3.18% of a sample of 661 sheep-sera were positive (Heuer et al., 1990b). The last study, however, used a cut-off titre of 1:40, whereas findings from the Lower *Juba* Region were based on a minimum titre of 1:15, thus possibly explaining the large difference. No definite statement can be made at this point about the true frequency of chlamydiosis and its impact on public health in central Somalia, although, its importance is apparently low.

Out of 3016 goats and 857 sheep, only 1 sheep and 1 goat tested positive for *Coxiella-burnetti* in the complement fixation test (CFT) carried out during screening sera for Q-fever (Heuer et al., 1990b). These may well be false positive results due to a lack of specificity in the diagnostic test. In either case, Q-fever does not appear to be a frequent disease in the central regions nor one which is commonly transmitted from animals to humans.

NOTES ON SOME DISEASES DESCRIBED BY PASTORALISTS

Information on the importance of diseases may best be obtained from statements by herd owners, who probably have the most critical and realistic view concerning the frequency and effect of livestock health problems. Data are available from an initial two year phase of disease surveillance by the Central Rangelands Development Project (CRDP). This is based on regular interviews with 53 young pastoralists who were trained as para-veterinarians in basic diagnostic and therapeutic techniques (Baumann, 1990). Their information along with further base line studies are summarized below. Table 6 lists the most frequently reported diseases of sheep and goats by their local names. Matching the "local name" to its medical description in English is more likely to be accurate when the disease produces typical and clear externally visible symptoms (e.g. foot and mouth disease), and it may be rather vague or even misleading when internal diseases of different etiology with unspecific symptoms are described by the pastoral herd owners (e.g. *piroplasmosis*). Consequently, several interpretations of the listed local expressions may be questionable and are marked with (?) in table 6.

Table 6: Most commonly used local Somali terms for small ruminant diseases reported from the districts *Hobyo*, *Ceel Dheere* and *Buulobarde* during 1987/88 (Baumann, 1990, modified)

Local Name	Scientific Nomenclature
abeeb	Foot and mouth disease
afburbur (afow, afour, burbur, waafgaab)	Contagious ecthyma
caal (goryaan)	Endoparasites, worm infest.
cadho (canbaar)	Mange
carar (goof, galleh)	Mastitis
damijo	Lice infestation
darato	Piroplasmosis, lameness, or
racamo, gabgab, jooge	tick paralysis (?), heartwater (?), anaplasmosis (?)
dhicis (dhisow, dhacis)	Abortion
dibiryo	Bloat (rumen tympany)
furuk (turtur)	Pox
gedxume	Lymphadenitis (?)
gol (gosha)	Trypanosomiasis
kud	Anthrax
qanje (tu, riimiye, waraf)	Affections of the central nervous system, (chlamydiosis ?)
rafjac (rafdilaac, gumeed)	Footrot
sambab (agmar)	Pneumonia (CCPP ?)
shilin	Tick infestation
shuban	Diarrhea
waraf (warafqanje, gagab)	Heartwater (?)
xergud	Coughing, sneezing (non-infectious)

Foot and mouth disease (FMD)

There is no doubt that foot and mouth disease (FMD) is endemic in central Somalia. The serotypes O, A and SAT2 have been isolated while other types found in neighboring countries (C, SAT1) may be absent from Somalia (Moallin, 1987). Despite its prevalence, FMD does not appear to cause mortality or substantial production losses according to informations obtained from trained para-veterinary staff (Nomadic Animal Health Auxilaries, NAHAs) of the Central Rangelands Development Project. A mild clinical course of the disease provides solid immunity and precludes subsequent attacks. NAHAs associate outbreaks with specific geographical areas (Baumann, 1990). Nevertheless, because FMD is highly contagious - virus particles may be carried over very long distances by vehicles or steady winds - FMD must be expected to occur in any given spot of the country.

Public control measures, however, cannot be recommended in view of the enormous cost and the doubtful success given a limited infrastructure, the need to keep vaccine refrigerated in the hot climate and the fact that immunity from an inactivated vaccine (such as the FMD vaccine) is only of short duration. Moreover, vaccination reduces naturally acquired life-long immunity and probably renders Somalia's livestock more susceptible to FMD, thus, causing rather than reducing losses through disease.

Footrot

Small ruminants kept on moist ground are likely to develop footrot, an infection of poorly trimmed or soft hooves leading to lameness. Although, this would not seem to be a likely disease to occur in an arid area like central Somalia, footrot is a clinical problem encountered frequently during wet seasons. Somali blackhead sheep and Galla goats appear to be particularly susceptible to footrot because of their soft hoof horn. Adult animals above 2 years of age are more frequently affected than young stock. Fatalities were reported to be low but production losses are not known although likely to be substantial as estimated by NAHAs (Baumann, 1990).

Infectious diseases of the lungs: Pneumonia

The frequency of lung diseases and the production losses they cause are high everywhere among livestock, regardless of whether they occur in high- or in low-efficiency production systems. Affection of the lungs is a composite term for various lung diseases that can be caused by a variety of infectious agents and aggravated by internal and environmental factors.

In Somalia, pneumonia among goats attracts particular attention because it is suspected that in very many cases, this general disease occurs epidemically and is caused by *Mycoplasma Subtype-group F-38*. The local expression *Sambab* is commonly interpreted by veterinarians as *Contagious-Caprine-Pleuro-Pneumonia (CCPP)* and sero-screening and disease surveys for CCPP have been carried out in several investigations. To date, typical pathological lesions of CCPP in clinically affected goats have not been reported nor has CCPP been identified, as the causative organism, in cultures.

Sambab or pneumonia occurs over the whole year with a seasonal peak in the long dry period (*jiilaal*), when animals are under greatest nutritional and heat stress. Disease surveillance reports that the disease occurs three times more frequently in goats older than two years then in young stock less than one year of age (Baumann, 1990). This reflects the approximate age distribution of goat herds. In effect, therefore, all age groups appear to be equally affected. Case fatality was stated by NAHAs to be 59% with a range of 10-100% (Baumann, 1990) which agrees with descriptions of classical CCPP (McMartin et al., 1980; Bari, 1981) but may well be true for most types of pneumonia.

Table 7: Sero-prevalence of CCPP (F-38) among goat herds in central Somalia (herd positive if at least one reactor found during the observation period, cut-off titre used: Baumann 1986 and 1990 = 1:16; Heuer et al. 1990b = 1:20)

Source	Observation Period	District	Herd Prevalence (n)
Baumann, 1986	mean of 15 months per herd	*Hobyo,* *Buulobarde,* *Ceel Dheere*	25% (32 herds) 47% (17 herds) 40% (25 herds)
Baumann, 1990	not stated (mean of 2.2 flock samples per herd)	*Hobyo,* *Buulobarde,* *Ceel Dheere*	18.3% (80 herds)
Heuer et al., 1990b	mean of 9 months per herd (mean of 5.6 flock samples per herd)	*Gaalkacyo,* *Dhuusamarreeb,* *Beledweyne*	8% (60 herds)

Serologically positive goats are considered immune to re-occurrence but are carriers of the agent and potential sources of infection for other goats in the herd (Rurangirwa et al., 1981; Cottew, 1984). Results of herd screening (Table 7) were based on 10-20 goats per flock sample. The classification of "herds positive" was applied if at least one goat had a positive CFT-titre at a dilution of 1:16 (Baumann, 1990) or 1:20 (Heuer et al., 1990b). Since herds were monitored over longer periods and several flock samples were taken from each herd, the resulting herd prevalence rate was likely to be higher the longer a herd was under sero-monitoring. Herd prevalences of different investigations can therefore not be compared.

The fact that sero-prevalence among individual goats as opposed to herds is in the range of 0.43 - 4 % in central Somalia (Baumann, 1990; Heuer et al., 1990b) does not necessarily mean that the disease is rare. In Oman, where F-38 causing pneumonia in goats was reported to be a significant problem, only 2.6 % goats were sero-positive. The agent could be isolated in 80% of such animals (Jones and Wood, 1988).

Traditionally, sambab is regarded by pastoralists as an epidemic disease. The common practice to control further spread is to separate affected goats from the herd, to avoid contact between herds and to avoid grazing in areas where there has been an outbreak. Also traditional vaccination, in which lung tissue is rubbed into fresh dermal incisions of healthy goats is said to be an effective means of preventing the disease (Baumann, 1990).

However, the true incidence of CCPP, its morbidity and case fatality are not known as yet and it cannot be stated with certainty that CCPP really is the cause of Sambab (pneumonia) in central Somalia. CRDP disease survey analyses, based on empirical methods, indicated that herd morbidity rates in *degaans* (grazing areas) were closely correlated to the herd prevalence for sero-positive goats, suggesting that enzootic pneumonia in several herds may be associated with the presence of mycoplasma (F-38) in that area (Baumann, 1990). This evidence, however, is still too weak to conclude that a significant proportion of pneumonia among goats is actually CCPP.

It is certainly too early therefore to conclude that control measures must be introduced against CCPP, e.g. by vaccination. The disease, like other aforementioned potential epizootics, may be infrequent and sporadic and can therefore be treated efficiently with antimicrobials (e.g. oxytetracyclin) when they occur.

Although one of the most frequent clinical diagnoses, pneumonia and causal factors associated with it have hardly been described for other livestock species. A sero-prevalence rate of 4.1% for "Contagious Bovine Pleuro-Pneumonia" (CBPP) among cattle has been reported (Heuer et al., 1990a) but the data were insufficient to associate it with clinical disease or production loss.

Skin diseases

Contagious ecthyma (CE) was repeatedly reported in camel in central Somalia. Etiologically, three types must be distinguished which produce similar skin lesions, i.e. (i) true camel pox (CP), caused by an *orthopox-virus* and associated with generalized skin lesions and up to 10% mortality; (ii) *camel contagious ecthyma (CCE)* caused by a *parapox-virus* producing local lesions and (iii) *camel papillomatosis* caused by the *papilloma-virus*. CCE and papillomatosis are characterized by local lesions and high morbidity without fatality. Economically, only true camel pox was stated to be of significance (Munz et al., 1986 and 1990; Moallin and Zessin, 1988). Symptoms of this disease complex are proliferative skin nodules or warts especially around the lips and nostrils affecting mostly young camels up to 2 years of age. With an incubation period of one week it generally spreads over the whole herd within three weeks . It occurs mainly during wet seasons and is believed to be transmitted by browsing on thorny shrubs. CCE may reoccur but papillomatosis is followed by a life-long immunity. Transmission to humans has not been reported by herd owners (Munz et al., 1990).

In 7 *degaans* of *Buulobarde* and *Ceel Dheere* Districts, CRDP para-veterinary staff recorded CE in 49 sheep and goat flocks over a two-year period, affecting an average of 7.5% animals in the herd. The disease appeared to occur mainly during the long rainy (*gu'*) and the subsequent short dry season (*xagaa*) and in limited endemic grazing areas. Young stock less than one year of age were more frequently affected. The case fatality was estimated at 28%; no immunity was found by NAHAs to develop after infection (Baumann, 1990). These descriptions of disease agreed with observations of Robertson (1976). From an outbreak in sheep in central Somalia, Moallin et al. (1989) isolated ovine parapox-virus.

Abortion

The rate of abortion among small ruminants was very variable from year to year. In a cross-sectional study in 1987, i.e. at the end of a drought period, the prevalence rate was 7% (Zessin et al., 1988b), whereas in the years 1988/89, an annual incidence of 4.6% was estimated with 5.7% in goats and 1.3% in sheep. This calculation included all female animals of reproductive age, i.e. those older than 2 years (Heuer, 1991). A crude prevalence rate of 1988/89, estimated on the basis of disease surveillance information, averaged 3%. In that study, veterinary contact persons (NAHAs) stated that abortion rates were much higher during the preceding drought period (Baumann, 1990).

By and large, abortion rates appear to be relatively low. Even the highest reported rate of 7% must seem acceptable in view of the fact that the annual long dry period during which most abortions are expected to take place precedes the lambing/kidding peak during the subsequent long rainy season (*gu'*). Thus, the majority of high-pregnancy months are during the high-risk period for abortion.

Goats appear to be more susceptible to abortion than sheep. Infectious and non-infectious reasons for abortion in goats have been listed for semi-arid areas in Australia as follows (Merril, 1985):

Infectious	Non-Infectious
* Toxoplasmosis	* Nutritional stress (hypoglykemia)
* Campylobacteriosis	* Goitre (iodine deficiency)
* Chlamydiosis	* Spontaneous (unknown etiology)
* Listeriosis	
* Herpes virus infection	
* Border disease	
* Q-fever	
* Salmonellosis	
* Mycoplasmosis	

Most of these causes have not been investigated in central Somalia and comparison with prevalences in similar areas of neighbouring countries may be misleading. It has already been mentioned above that the serological rates of sheep or goats found with Q-fever or chlamydiosis appears to be low. A potential additional reason for infectious abortion on flock level is chronic trypanosomiasis (Heuer, 1990b). However, statistical evidence is still too weak for definite conclusions. It is necessary to determine causes of abortion by investigating new cases rather than sero-screening of the population because of low abortion incidence.

POSSIBLE FUTURE APPROACHES TO DISEASE CONTROL

Disease control measures by governments classically follow a step-by-step problem-oriented approach as demonstrated in Table 8. Historically, the first aim of most countries has been to eliminate those diseases having the most fatal consequences for the human and livestock populations before allocating public funds to treating the diseases of individual animals. Only after efficient clinical veterinary services had been established and livestock production systems became more intensive, did governments turn their attention to subclinical disease and its association with herd production performance (Blood et al., 1978).

Table 8: The step-by-step approach to problem oriented animal disease control

Step	Problem	Indicator
Area approach	contagious epidemics with high fatality or transmission of animal disease to humans (zoonoses)	mortality and production loss in livestock or morbidity and case fatality in humans
Individual herds and animals	easily detectable clinical disease	clinical disease incidence
Herd management approach	subclinical disease causing production loss	herd performance

Placing Somalia into this perspective, the available information on presence, frequency and effects of diseases to date suggest that highly contagious diseases with low fatality are either non-existent or not a major concern. On the other hand, low disease titre prevalences do not rule out the presence of highly fatal contagious diseases as, for example, Rinderpest. In that case most infected animals die and survivors with antibodies are consequently rare. Little evidence was obtained from regular interviews of paraveterinary staff over a two-year period about the occurrence of such diseases (Baumann, 1990). When cattle, camel and small ruminant herds were monitored over several years, none of them experienced such fatal losses due to an infectious disease (Zessin et al., 1988b; Heuer et al., 1990a and b).

In general diseases appear to occur sporadically, in individual animals or in a small fraction of the herd and do not involve whole herds or populations over large areas (Heuer, 1991). This phenomenon seems plausible if it is realized that environmental hazards play a far greater role than disease with regard to the health of indigenous livestock, as was mentioned at the beginning of this chapter. In view of this, costly area wide control measures, e.g. vaccination, vector control (dips, sprays), herd test-and-slaughter etc., are contraindicated.

The most rational way of cutting down on the loss of animals or livestock products in central Somalia is to establish and support clinical services in pastoral areas. Early experience with the CRDP "NAHA-system" has so far shown that such a system is viable and can be efficient even under such constraints as poor infrastructure and long distances, if adequate use is made of the traditional knowledge and skills of the herd owners themselves. The system calls for the selection and training of 'para-vets' who are recruited from the pastoral society. A vital aspect of government support for the system is a continous drug supply and monitoring of the para-vets (GTZ/CRDP - Vet. Component 1989). Such a clinical service does not have to be fully financed by the government; costs would be shared with pastoral households for whom such a scheme would bring immediate returns.

Another important task is the maintenance of diagnostic units in order to be constantly in a position to carry out disease investigation on site and at the time of occurrence. Besides detecting causes of disease, the primary concern must be

the collection of information on the magnitude of effects of a disease event, i.e. the proportion of the herd affected, morbidity and case fatality rates, species, age and sex of animals involved, speed of spread of infectious diseases, and location, date, herd type, herd size etc. Most of such information can be derived from data collected in the field without sophisticated laboratory equipment. An efficient and cheap diagnostic method is the post mortem examination if carcasses are met soon after death. If disease investigation activities are combined with veterinary interventions on the spot (e.g. treatment, advice), most herd owners will be motivated to report disease events they rate important. With more and better information from such activities, research designs will be more problem-oriented and government interventions can be appraised with more precision and thus be more target-oriented and economical.

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RANGE RESOURCES AND RANGE CONDITION IN THE CENTRAL RANGELANDS OF SOMALIA

Stephan Baas

INTRODUCTION

For a country like Somalia, which has mainly arid environment, and a greater dependence upon livestock exports than anywhere else in the world, information about its rangeland resources is essential for economic planning. Rangelands are fragile ecosystems, and the basis of appropriate management lies in not exploiting their use potential in the short term beyond their capacity to recover. Nowadays however, this natural resource appears to be severely threatened in Somalia. The current political situation and the living conditions are extremely difficult. Since the disastrous end of the Siad Barre era (1990/91), when all foreign aid organisations left, the country and its new decisionmakers are dependent upon the land's own resources more than ever before. There is an urgent need for economic reorganisation. The nomadic sector, as the traditional backbone of the economy, is of course going to be required first to provide the basis. This means an additional burden upon the current and already intense utilization of the rangelands. One of the areas especially affected in this way, is the Central Rangelands. These are amongst the driest regions in Somalia, and they support about 31% of the total 35 million animals in Somalia (Mascott

Ltd., 1986). Even in a situation as hard-pressed as the present one, the demand for increased production has to be carefully weighed against the need for preservation and balance in the natural environment. For that the available fodder resources have to be evaluated to allow an estimate to be made of production potentials. The questions of rising importance are:

- What is the actual production potential of the Central Rangelands?
- Are the range resources adequately managed or are the Central Rangelands overstocked?

The aim of this article is twofold: firstly to describe the criteria which must be used to correctly estimate the grazing capacity of the Central Rangelands or comparable regions where deciduous bush and shrubland vegetation predominate (a summary of the CR's vegetation patterns is given in Baas and Drechsel, this volume); and secondly to provide figures which can serve as landmarks of the status quo in the regions concerned. Hereby the main emphasis is given to the first question. The results may offer reference points for future planning.

AIMS AND SCOPE OF RANGE EVALUATION

Terminology and definition

The "range resources" of an area are often talked about in the work of developmental economists, planners and political decision makers."Range capacity" is the term which is generally used to describe the amount of these resources. But unfortunately this term has a fairly wide range of applications, making it necessary to define its use more specifically.

The expression originates from the concept of "carrying capacity" which is familiar to biologists and wildlife managers as well as to geographers, social anthropologists and economists. Carrying capacity, as understood by the first group (biologists, wildlife managers) is the ability of ecosystems to support animal life. Within the context of the latter three disciplines it is a term mainly used as a measure of a region's ability to support human populations (Ledec et al.1985).

Within the history of rangeland management, "range capacity" was taken as synonymous with "carrying capacity". Both terms were used to describe the number of animals which a certain area could support without land degradation

taking place in the long term. This concept includes the actual available fodder base as well as such factors as the availability of water, biological or physical hazards etc.. The more specific expression "grazing capacity" was introduced to describe only the available fodder base (Zonneveld, 1984:113). However these two terms "have sometimes become erroneously confused" (FAO, 1987:83). Moreover, due to the different schools of use mentioned above, the term "carrying capacity" was occasionally applied with reference to humans (those who keep the animals) by social anthropologists and geographers. Consequently the scale of potential misunderstandings was broad. Nowadays in literature, however, most authors consistently use "grazing capacity" or "carrying capacity", when the interest is focused upon animal populations (FAO, 1987), as opposed to "human support capacity" or "human population capacity" when concerned with human populations. Nevertheless, when dealing with "range resources" it is undoubtedly advisable to clarify in what sense the term is being used. This might help to avoid future misunderstandings in planning activities.

In keeping with the scale of this article the perspective chosen here concentrates on grazing capacity, which is deemed to form the basis for all other viewpoints. A broader perspective dealing with the human carrying capacity of parts of these regions will be given in Baas, 1992. It is synonymous with "fodder capacity" and used as defined for the purpose of range evaluation in the guidelines for extensive grazing from the FAO (1987) as:

"the maximum stocking rate of an animal type with a specific production objective that a certain land unit can support without deterioration during a defined grazing season" (FAO, 1987:84).

Steps for determining the grazing capacity of a certain area of land

Land is briefly defined as: "the biophysical environment of mankind including climate, relief, soil, hydrology, vegetation, fauna and the results of land use" (FAO, 1987:12).

When evaluating land with a view to extensive grazing, the most important component of those mentioned above is vegetation. The influences of all other factors are reflected within the vegetation pattern and its primary production. "Climate and soil do not play the same roles in land evaluation for grazing as they do in land evaluation for cropland, since the vegetation that is used by

extensive grazing is by definition suitable for the local climatic and soil conditions" (FAO, 1987:12). Consequently the steps of rangeland evaluation focus upon the vegetation.

The actual field work to determine the grazing capacity of an area should include at a minimum the following components (see also: FAO, 1987; Breman, van Keulen, Ketelaars, 1984):

- the landscape should be divided into relatively homogenous range units (RU), based on common characteristics of vegetation, soil and geomorphology;
- the vegetation cover and structure should be determined, as well as the species composition of the established land units;
- palatable and unpalatable species must be identified;
- the actual availability of the forage resources to the different types of animals must be established;
- peak biomass production in the different layers of vegetation should be determined (considering also seasonal differences in consumption habits e.g. deciduous and evergreen plant species);
- analysis should be made of the quality of vegetation as animal forage;
- the rainfall and its seasonality must be recorded;
- physical and chemical properties of the soils should be determined.

A way of arranging these components is illustrated in figure 2.

The scale of such a rangeland inventory has to be chosen carefully in order to arrive at land units of a size that is as close as possible to the management units (see FAO, 1987:14). The FAO Guidelines on land evaluation for extensive grazing suggest a scale of 1:250000 as a compromise between the efforts made in data collection and the accuracy of more detailed maps. It is suggested that the results be presented in form of a range resource map. This makes it relatively easy to consider additional aspects such as water availability, range accessibility or range condition which, when summed together make up the actual range capacity. But as these latter aspects are not included in the definition of "grazing capacity" and because of limited size of this article they will not receive further attention in the map (figure 1) provided here.

THE GRAZING CAPACITY IN SOME REGIONS OF THE CENTRAL RANGELANDS - A CASE STUDY

The following chapter focuses on the results of a study on range resources which was conducted during 1989 in the *Dhuusamarreeb* area of the Central Rangelands. (The modes of calculation are described in detail in Baas (1991); the study was generously supported by the GTZ-Veterinary and Forestry Components of the CRDP, as well as by the German Academic Exchange Service (DAAD).) During this research it was possible to combine all of the above-mentioned steps to determine grazing capacity. The calculation is based on 100 mm of seasonal rainfall which can be regarded as average for the long term. The various range units concerned are considered representative for the vast bush and shrubland as well as for the dwarf shrub areas which, when added together, largely coincide with the land use system of the interior thornbush zone (see Baas and Drechsel this volume: Figures 2 and 3).

Besides this detailed case study, a collection of other figures on range resources will be provided, which have been obtained from other regions of the Central Rangelands before 1990 (summarized in table 4).

The division of range units

The area studied includes the districts of *Dhuusamarreeb*, *Balan Bale* and parts of *Mataban*. These are located from 45°30 to 46°50 E longitude, and between 5°-6°20 N latitude, adjacent to the Ethiopian border (Figure 1). In Table 1 the physical features of the environments are described and compared for each of the defined range units.

In addition, the photos in the colour plates part give some impression of the landscapes of these regions. Table 2 provides an overview of the most important parameters of vegetation and biomass production (leaves and fresh shoots) of these areas. The data on biomass production is organized according to vegetation layers. The average vegetation cover, the number of plant species, as well as the dominant and sub-dominant plant species are given.

This information and its structure of presentation build the basis for (a) further examination of the actual grazing capacity and (b) comparisons with other regions. Only the first aspect will be persued further here.

It is important to note that, with reference to the situation in rangelands, it is unrealistic to regard the total potential biomass production as a consumable fodder resource. The difference between the two criteria was often determined by applying the so- called "proper use factor" which was usually set at 30 - 50 percent of the primary production (De Leeuw and Toothill, 1990:13f). However it is suggested here that the factors inherent in the idea of proper use be dealt with separately and in greater detail as this will result in a more accurate estimate of the true fodder base in the different management units. This includes aspects like: permissible offtake per plant (from an ecological point of view), palatability and accessibilty of plants.

The palatability of plants

Not all plants are suitable as fodder. Some plants are avoided completely by one or perhaps every variety of stock, other plants are used seasonally only, while some are selected when and wherever they occur. The nomads are people with a thorough knowledge of these fodder preferences and the selective eating habits of the different types of animals. To obtain information on the fodder suitability of plants a series of interviews with the nomads was carried out. In addition, the fodder preferences of grazing / browsing animals were observed and recorded during the field survey. To avoid misunderstandings concerning the plant names, the interviews were conducted either in the bush where the plants were growing or with the help of branch cuttings. The interviews centered upon the following two questions:

- Which plants are selected or accepted by which stock ?
- What are the seasonal preferences ?

The following rating key was established on the basis of the nomads' informations.

- **H**igh **P**alatability (HP): first preference during rainy season,
- **M**edium **P**alatability (MP): second preference during rainy season,
- **L**ow **P**alatability (LP): end of rainy season when **HP** and **MP** plants are finished,
- **D**ry season **HP** (DHP): dry season preference,
- **D**ry season **LP** (DLP): when nothing else is left,
- **U**n-**P**alatable (UP): never eaten.

(The dry season fodder resources are evergreen plant species, which are avoided as long as leaves from deciduous plants are available.)

All data were collected and classified for each type of range animal separately. Several single ratings ($n \geq 5$) were added to make one final rating per plant and stock. Figure 3 illustrates the degree to which woody plant species are rated palatable for the different types of animals. The dark segments make up the consumable fodder resources, while the white sections represent the unpalatable proportion of vegetation.

The vast majority of vegetation was rated as having high or medium palatability with regards to camels and goats, but was unpalatable or of low palatability for cattle or sheep. This is most evident in the tree layer. There are two factors which explain the different grades of animal adaptation to the thornbush savanna: the first is that cattle and sheep are mainly grazing animals rather than browsing animals as are camels and goats; and the second is, that a considerable part of the vegetation is thorny, which prevents cattle from feeding upon it. The same problem would also apply to sheep except that because of their smaller mouths they - as well as goats - can sometimes browse between the thorns. Our impression was that the nomads often took the question of reach into consideration when rating plants.

The shortage in the supply of fresh fodder during the dry season is outlined by the small amount of consumable evergreen plant species (summed up as **D**ry season high and dry season low **P**alatable: DP). The potential role of leaf litter consumption during the dry season can be inferred (see figure 7).

The number of plant species that are palatable, reinforced by the calculated amount of actual biomass production explains the adaptation of the different kinds of livestock to the Central Rangelands. An initial estimate indicates, that for camels an average of 79% of the fodder potential (kg/ha) in the range units under examination is HP, MP or DHP and only 6% are completely UP. For goats the ratio is 80% to 3% ; for sheep 34% to 30% ; for cattle it is 24% to 63%. The remaining proportions are of LP. Animals vary widely in their suitability to an area. This can be most effectively demonstrated, by comparing the fodder potential of a bushland area with regard to the fodder acceptance of camels and cattle. Figure 4 gives an example.

Nearly the same amount of biomass which is palatable to camels is unpalatable to cattle. In the dry season, the potential resources for camels are four times higher than for cattle. It is evident, that cattle are not suited to bushland. This huge difference in the suitability of animals to the range is lost when the grazing capacity is assessed only in terms of Tropical Livestock Units (TLU). In that case a dramatically misleading recommendation might result for range management planning. If the grazing capacity is calculated solely on the basis of potential biomass production (in terms of TLU), it might appear that the fodder basis for cattle is higher (one head of cattle is 1.0 TLU) than that for camels (one camel is usually calculated as 1.2 TLU; independent of any static correction factor, which might reduce the total calculation basis by 50 or 70%). In fact it is just the reverse.

The seasonal availability of the forage resources

Another point to bear in mind when reckoning the actual grazing capacity is that the young regenerating vegetation should be excluded from the resource calculation, as well as those parts of individual plants, which are out of reach for the animals. In terms of the browsing capacity of camels plants are relevant, which grow higher (or in case of dense Acacia shrubs broader) than 4 m. In estimating the fodder potential of sheep, goats and cattle the maximum range of reach was assumed to be 1.75 m.

The figure for the total biomass of evergreen plant species has to be adjusted by a factor that reduces 70% of the calculated potential. This is because in the case of evergreen plants, only the seasonal increase of biomass can be regarded as a basis for fodder (see also Kuchar, 1987).

By way of a summary figures 5 and 6 illustrate the differences both between and within range potential, fodder potential and fodder/grazing capacity, as part of a seasonal comparison between the bushland area of range unit 16 and the dwarf shrub/shrubland areas of range unit 45/44.

Within this context, "range potential" is defined as the total biomass production in terms of leaves and fresh shoots. The "fodder potential" describes the range potential minus the unpalatable part of vegetation, specific to the type of animal. The "fodder capacity" or grazing capacity is the current consumable and reachable part of the fodder supply.

Figure 5 focuses on the situation during the rainy season and the part of vegetation which is defoliating. The differences in range potential, fodder potential and actual fodder capacity are clear, as are the different supplies for the different animals. What is surprising is, that although there is a smaller potential for range production in the dwarf shrubland than in the bushland area, there is a higher fodder capacity for a mixed herd. Even cattle can find sufficient fodder during the rainy season. This can be explained by the fact that the difference between fodder potential and fodder capacity is less in the dwarf shrub area than it is in the bushland area. There are no parts of the vegetation which are out of reach for the animals. From another point of view, this means that in case of overstocking, the dwarf shrub areas are more vulnerable to degradation than are the bushland areas. The figures concerning the rainy season in the other range units are added in figure 1.

Figures 6 and 7 continue with the dry season in the two range units selected for comparison. Figure 6 shows the amount of fresh fodder available in range units 16 and 44/45. The evergreen and semi-evergreen plant species, which are only selected as fodder during times of shortage, form the basis for nutrition during the dry season. *Acacia tortilis* is, in terms of biomass production, a remarkable plant which is both available and consumed for the greater part of both seasons. For this reason it is recorded separately. The grazing capacity during the dry season in terms of green leaves is much less than it is during the rainy season. The dry season capacity of range unit 44/45 is half that of range unit 16; the bushland areas are therefore better suited for year-round use than the dwarf shrub areas. The extremely low fodder capacity of range unit 44/45 casts doubt on the effectiveness of its use during a dry season. The energy which the animals must expend in moving from plant to plant is probably higher than the energy that might be obtained through feeding. The necessity for seasonal mobility between the different environments becomes evident. But also on a small scale, the practice of wandering is crucial. With regard to the evergreen plant species, there is a large difference between fodder potential and fodder capacity. This is because in evergreen species only the seasonal increase of biomass can be rated as a fodder basis. If browsed bare the plants may die. Consequently it is a matter of management to avoid overusing these species by moving in time.

Figure 7 shows the potential amount of leaf litter, which is calculated here as a function of different, estimated stocking rates (and their consumption) during a prior rainy season. As the basis for this calculation the fodder potential

values per type of animal were taken and the feeding preferences of goats were assumed (Avoidance is lowest among goats.). The fodder potential includes those parts of the vegetation, which are out of reach for the animals during the rainy season (difference between fodder potential and fodder/grazing capacity). The additional potential of leaf litter is impressive in its amount, although it should be pointed out that the actual capacity for use is much lower. A definite value cannot be offered, because the grade of use is not exactly known, especially with regard to the differences between the variuos types of animals. The size of the fallen leaves seems to have a great influence on their availability to the animals.

As observed during the field survey, although litter is consumed by sheep and goats, there remains some doubt about the consumption habits of cattle and camels. It is clear however that it is a considerable resource. There is no doubt that litter is used; it is plentiful at the beginning of the dry seasons, while at their close there is hardly any to be found. According to the nomads even several commonly found plants which are unpalatable in their fresh condition (*Anisotes trisulcus* or *Commiphora hodai*) are eaten as litter. Findings on the nutritive status of litter support its significance as a dry season fodder resource (Baas and Adow, 1991). Further research on this topic is urgently needed (see also: Kuchar, 1987).

The qualitative aspects of forage and grazing capacity in 1989

Table 3 completes the results and presents the grazing capacity calculated in grazing days per season in terms of TLU/type of animal and ha. In this step the direct comparison of the energy and protein contents of the fodder with the animal's needs is also made. The calculations were based on the actual fodder capacity including all layers of vegetation with the exception of litter. For this purpose, collected plant material was analysed for chemical composition and nutritive values according to the "proximate analysis". The metabolisable energy content (ME) per plant species was estimated in compliance with Boudet (1978). Requirement assumptions for animals, taking into account different production levels, were taken from the Range Management Handbook of Kenya (RMHK), table 6. In table 3 the fodder capacity is calculated in grazing days per TLU/ type of animal/ha per season and compared at the different levels of production and criteria of calculation.

The results are compared with the standardized figure: 6.25 kg fodder dry weight per day and **T**ropical **L**ivestock **U**nit. To model reality as closely as possible, a level of moderate production for the rainy season and a level of maintenance for the dry season situation are assumed (definitions were given in table 6). In this case the standardized value of 6.25 kg/TLU/day for animal requirements seems to be reasonable for a first approximation of grazing capacity, if applied at the level of fodder capacity. Of course applying the requirement assumptions introduced by the RMHK can provide more detailed information if the nutritive status of the vegetation is known.

- A closer look shows that the standard value lies fairly close to the level of moderate production in both seasons and in all range units, if compared to the calculation on energy supply.
- It is not as good when concerning the protein supply for the dry season if calculated on the level of moderate production.
- When the level of maintenance (which was assumed to be realistic) is taken as production level of the dry season the findings of the standardized value seem in general to be too low.
- It can be stated that the actual provision of proteins during the rainy season is much higher than the standardized value suggests.

With regard to the production potential, the limiting factor during the dry season, when only the fresh fodder is rated as a resource in these areas, seems to be the energy rather than protein supply. If the potential of leaf litter is included the situation is likely to be different. The results from the study on fodder quality confirmed that there are fairly high amounts of energy in litter, but only very few digestible proteins (Baas and Adow, 1991).

The best fodder basis during the rainy season (assumed as a 60 day period at a level of moderate production) for camels and goats, was located in range unit 47 (0.4; 0.3 ha/TLU), followed by range unit 16 (0.5; 0.35 ha/TLU for camels and 0.6; 0.4 ha/TLU for goats) [the first number is a measure of energy, the second one of protein supply]. For cattle the best fodder supply was first from the dwarf shrub area of range unit 44/45 (0.8; 0.6 ha/TLU) and second from range unit 24 (1.1; 0.7 ha/TLU). For sheep, range unit 47 represented the best grazing area (0.6; 0.4 ha/TLU) and range unit 24 the second best (0.8; 0.6 ha/TLU). The lowest capacity during the rainy season, was found for all kinds of animals in range unit 31 (camel: 1.1; 0.8 ha/TLU; goat: 1.1; 0.8 ha/TLU; sheep: 2.6; 1.9 ha/TLU; cattle: 4; 2.7 ha/TLU).

All these capacities are much higher than the actual stocking rates, if calculated per range unit without regional concentrations.

The dry season situation (assumed as a 120 day period at a level of maintenance) was as follows: for camels the richest fodder basis was available in the bushland areas of range unit 16 (17; 7 ha/TLU). There the most important plants were the evergreen species *Cadaba glandulosa* and *Boscia minimifolia* (the role of *Acacia tortilis* is not included here, see figure 6). For sheep, goats and cattle, range unit 24, which contained *Cordeauxia edulis,* was found to be the most suitable dry season area (goat: 18; 16 ha/TLU; sheep: 18; 20 ha/TLU; cattle: 15; 13 ha/TLU). The lowest capacity for all animals was found in range unit 45/44. The spatial demand for the needs of camels was 52; 27 ha/TLU, for goats sheep and cattle as much as 48-67; 31-38 ha/TLU. In these areas animals cannot survive during the dry seasons. (All values presented above do not include the potential for leaf litter consumption).

Additional findings and conclusion

Other findings of note concerning range management and grazing capacity were:

- Variations in the soils of the different RUs had an influence on the absolute sizes of plants, but not on the biomass production, if correlated to equivalent plants sizes. A very close correlation between dominance (% cover) of woody vegetation, and biomass production was evident. Quick-growing species like annual grasses and annual herbs did not replace a low cover of woody vegetation in terms of biomass production. Their part in production as compared to the total production of biomass, was very small (Table 2).
- It is doubtful whether a calculation of biomass production in arid bushland regions based only on total rainfall is sufficient. One conclusion that can be drawn from the study was, that for more accuracy, statements concerning potential biomass production should be based on both rainfall and vegetation coverage (see also Wijngaarden, 1985).
- The 60 most common and palatable plant species made up 85 - 95% of the units' total fodder capacity for all kinds of the animals studied. These figures justify the recommendation that studies on rangeland fodder production can focus on the most important and palatable plant species.

- In addition, the proportion of unpalatable plant species should be considered as a significant indicator for the ecological condition of the range. Special concern is needed in case unpalatable plant species are some of the more dominant ones (example: *Anisotes trisulcus*, see Table 2).

As a concluding remark to this case study, it seems important with regard to methodology to stress that information of this accuracy could not have been obtained when only satellite data is used or available. Only range potential can be estimated from satellite information. It should also be emphazised that the quantitative analyses of range resources in terms of TLU may well lead to an incorrect assessment of range productivity if the degree of adaptation of the different types of livestock to the particular environments is not taken into consideration. For example the difference in the degree of adaptation between camels and cattle in range unit 16, was higher than 400% (Figure 4). In calculating grazing days mistakes are preprogrammed if this is based on range resources and a standard factor of needs per TLU, irrespective of the kind of animal. The only way to achieve an acceptable estimate of range productivity which is based on the standardized values (6.25 kg/TLU) is to start calculations at the level of fodder capacity per individual type of animal (Table 3).

Results from other studies

Table 4 adds some other figures on range resources for the Central Rangelands. These are derived chiefly from the studies by Naylor and Jama (1984) who dealt with the *Hobyo* District, and from the study by Kuchar (1987), who concentrated upon the *Hiraan* Region.

The first study, although very detailed with regard to the vegetation patterns and environment, must nevertheless be criticized for its handling of production potentials. There is no information on the method of estimation, and the way of presentation is inaccurate (see remarks in table 4). The study neither considers differences between types of animals nor the differences between dry and rainy seasons. This was an "Interim Report"; unfortunately a final version was not available in *Muqdisho* in 1989.

Kuchars study focuses exclusively on the resources available during a dry season. Particular emphasis is placed on the evergreen species *Cordeauxia edulis*, which forms the largest dry season fodder resource in the Central Rangelands and which is to be found in the *Hawd* area. There it is distributed

over an area which accounts for 28% of the total region of *Hiraan*. Kuchars presentation of range resources appears detailed. The calculations are for camels only and distinguish between: (a) different sources of potential fodder; (b) total biomass production and the proportions which are "available" and "accessible"; (c) districts or district segments. The summary provided in table 4 is limited to listing all feed resources per district as compiled by Kuchar himself (Kuchar, 1987:36,37,51). The values are comparable to the dry season values for camels in range unit 24 (Table 3).

In contrast to these detailed studies, which were conducted on a regional scale, a figure by FEWSD (1988) is also given in table 3. This example is added here to compare its accuracy with other sources, in case it is used for an actual project or management planning (see also final chapter). The FEWSD used an equation by Deshmukh (1984) based on precipitation to calculate annual biomass production for Somalia. Such a general calculation as this must be regarded here as unsuitable for the regions of Central Somalia. Unfortunately this method of calculation is common in the development planning as there is a huge lack of adequate data. Its application to this region is very problematic because (a) the equation was developed for grasslands and not for the bushlands or shrublands, that predominate in the Central Regions; (b) if applied to a bimodal rainfall regime a calculation should at least be made on a seasonal basis and not on annual one. If these two objections are taken into account, the potentials calculated on the basis of Deshmukhs equation might be valid for parts of the coastal grassland plain, although Herlocker's results are definitely higher (see table 4).

ARE THE CENTRAL RANGELANDS OVERSTOCKED?

Although this is not the main topic of this article some basic points will be discussed here in order to place the calculated range resources in a practical context. It must be pointed out however, that definite pronouncements on this topic are very difficult to make. No reliable figures are available on stocking densities in these regions of the CR, which could be compared with the current grazing capacities of the rangelands. The only way to approach this question is to assess trends in range condition, which can be regarded as a consequence of stocking intensities.

Some general trends clearly signal land degradation in the four different areas of the CR used by livestock. These are given in Baas and Drechsel (this volume). Range condition ratings by other authors who worked in some regions of the CR are included into table 4. So the focus here remains on the introduced study area.

As mentioned in the introductory chapter, the vegetation is the first indicator to note. Visible changes in the vegetation composition are the first signs of degradation. Increasing erosion is the next stage as protective vegetation cover with its soil-holding root system is reduced.

Deciduous woody vegetation seemes to be protected from severe degradation because the fodder capacity of the dry season limits livestock densities. To some extent the dwarf shrub areas are threatened. The nomads prefer these areas as range, as it is easier for them to move about here than in the thorny bushland. However the dwarf shrub vegetation as well as the vast majority of bushes and trees are usually more or less protected from prolonged overuse because they drop their leaves at the end of the rainy season. When this occurs the animals loose interest in the woody remains - at least in years with "normal precipitation". An exception was the obviously overused area of RU 31. Nevertheless the range condition of most large areas is "fair" or even "good" at least with regard to defoliating woody plant species.

These findings are not valid for the grass layer, which partly undergoes a process of slow decrease, nor do they apply to areas within a 1-3 km radius of a permanent water supply. In these areas, which made up less than three percent of the total area in 1989 (although they are on the increase), clear signs of degradation are evident. Table 5 gives an impression of the vegetation changes which take place in the vicinity of a permanent water supply. The data were obtained from vegetation plots which were located close to several water points. These are defined in the table according to the periods for which they were in use. The figures show that the original plant coverage tends to decrease with increasing length of use. In contrast, the proportion of undesirable invader plants (see also Baas and Drechsel, this volume) increases with the length of use. Neither criteria alone is absolute proof that overuse takes place, but in combination they are. The vegetation obviously changes considerably with the duration of intensive use. These tendencies are reported from all regions of the CR. Baas (1991) pointed out the large extension in the network of places with a permanent water supply in the *Hawd* area. Because of this development, some regions already have an alarming degree of water source density, which will trigger the process of desertification in the long term.

Range unit 31 is also an example for this process. Although this bushland area received the same amount of rain in 1989 as the other range units, the biomass production was only around 60% of that found in the other bushland areas. The coverage of vegetation was around 50% below the values of the other regions.

Watson already described these gypsum areas in the 1979 RMR as those with the highest density of wells and seasonal water reserves. Since then several permanent settlements have been founded. These areas must therefore assumed to be degraded and ecologically threatened.

Evergreen plants, as the favorite dry season fodder, were found to be heavily browsed and severely threatened throughout the regions. The most important species are: *Cordeauxia edulis, Cadaba glandulosa* and *Boscia minimifolia*. In this context the mobility of the nomads is the most important factor for range preservation - it is up to them to move at the right time.

By way of summary it can be stated that the range condition in the areas studied is, in general, still "fair to good". Extensive desertification like in the West African Sahel was absent, but the dry season fodder basis is threatened and thus in a boderline state. In addition, severe land degradation has been reached around some places with a permanent water supply, although it was observed that this is still an isolated and slow process confined to limited areas. Active and carefully planned range management is needed to check this deterioration early and to maintain these rangelands as a basis for future production.

Tasks for the institutions responsible for range management planning

Careful studies on environmental compatibility have to be carried out before any measures or projects are implemented. Compatibility studies must first of all be carried out on a scale in keeping with the scale of the planned projects and management units. It is both urgent and necessary to reconsider the use of large-scale surveys (see for example Higgins et al., 1982; Pratt and Gwynne, 1977; Hübl, 1986; FEWDS, 1988:143) as a data base for activities which are aimed at situations at regional or even local levels. The merits of these studies which undoubtedly advanced scientific research on this topic are not questioned here. At the present stage of (regional) land degradation it is

urgently necessary to collect a more detailed data base on regional and even local level (FAO, 1987), which can serve as a starting point for detailed range management planning. The adaptation of the animals to the natural environment has to be considered, as well as the changes in the seasonal fodder supply, which may vary greatly within short distances as well as between different range or management units.

For future developmental planning, the aforementioned qualitative aspects of range utilization should be taken into account. The attraction of an increasing market economy has to be weighed against the risk of land degradation. Today the system of production is still more or less balanced, but it is already being used at close to its maximum intensity and is therefore highly vulnerable. For this reason it should not be submitted to the uncontrolled and continually changing market interests which follow from an increasing demand for cattle milk and meat.

With regard to the dry season fodder resources it is an important task to support the economy of mobility, as this is the only way to use these resources adequately in the long term without of immense financial investments. As a supporting measure, the reestablishment of evergreen fodder plants and the establishment of protection areas for evergreen species should have priority.

To achieve all of these aims, projects should be carried out as comprehensive package of measures, employing experts from different disciplines. A component which solely adresses range conditions and the development of the range resources should be considered imperative for projects dealing with rangelands. Both modern technical means as well as traditional knowledge from the target groups should be considered basic to constructive development.

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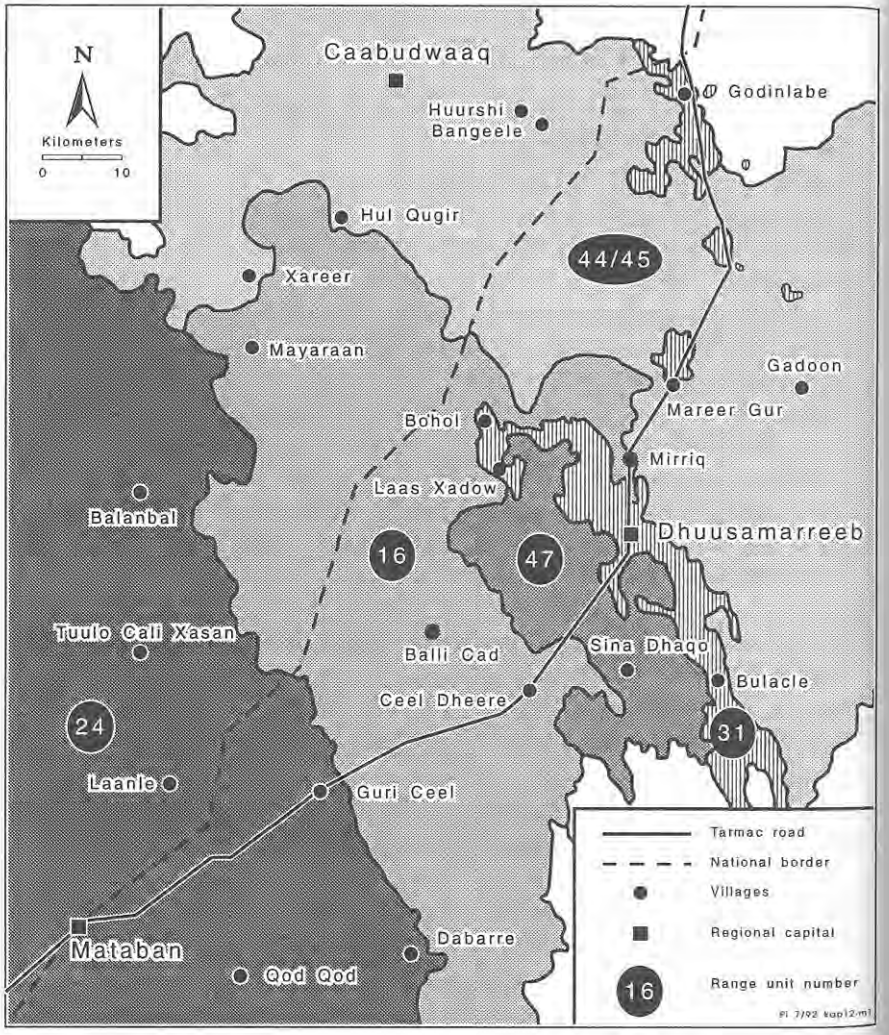

Figure 1: The study area. Peak biomass production and fodder capacity in the different range units after a season with 100 mm of rainfall

Design: Pielert, 1992 on the bases of Baas, 1992

Fodder capacity:	**rainy season**	**dry season**
RANGE UNIT 31 - Range potential: 840 kg/ha.		
Camels:	303 kg/ha	18 kg/ha
Goats:	337 kg/ha	13 kg/ha
Sheep:	141 kg/ha	13 kg/ha
Cattle:	84 kg/ha	7 kg/ha
RANGE UNIT 24 - Range potential: 1403 kg/ha		
Camels:	700 kg/ha	34 kg/ha
Goats:	606 kg/ha	34 kg/ha
Sheep:	475 kg/ha	32 kg/ha
Cattle:	306 kg/ha	31 kg/ha
RANGE UNIT 16 - Range potential: 1360 kg/ha		
Camels:	707 kg/ha	31 kg/ha
Goats:	612 kg/ha	46 kg/ha
Sheep:	459 kg/ha	20 kg/ha
Cattle:	231 kg/ha	11 kg/ha
RANGE UNIT 44/45 - Range potential: 1116 kg/ha		
Camels:	652 kg/ha	16 kg/ha
Goats:	593 kg/ha	12 kg/ha
Sheep:	419 kg/ha	8 kg/ha
Cattle:	384 kg/ha	6 kg/ha
RANGE UNIT 47 - Range potential: 1356 kg/ha		
Camels:	802 kg/ha	22 kg/ha
Goats:	807 kg/ha	18 kg/ha
Sheep:	596 kg/ha	7 kg/ha
Cattle:	279 kg/ha	7 kg/ha

(The numbers of the Range Units were taken in accordance with RMR, 1979.)

Figure 1(cont.): The study area. Peak biomass production and fodder capacity in the different range units after a season with 100 mm of rainfall

Design: Pielert, 1992 on the bases of Baas, 1992.

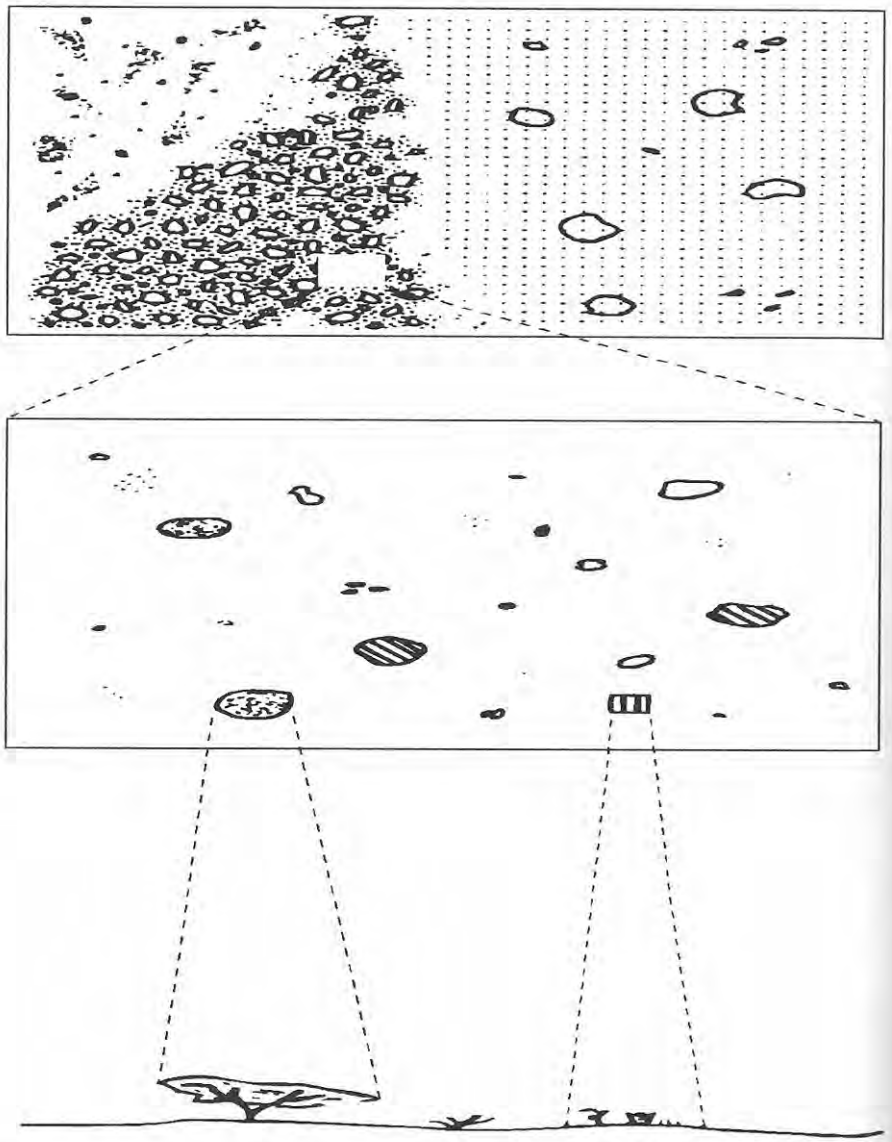

Figure 2: Scheme of an inventory on the actual grazing capacity

Sources: Rappenhöhner, in prep.: National Research Council, 1990:92; Baas and Adow, 1991

III. LEVEL: LAND UNIT PATTERN

Grazing capacity

Aerial photos or satellite images
interpretation: pattern of land - unit distribution
ground check: vegetation structure
species composition
planimetry: quota of land units

estimation of fodder yield and grazing capacity

II. LEVEL: LAND UNIT

Forage quantity

Maximum standing biomass:
(deciduous species: end of the rainy season; evergreen species: beginning of the dry season)

- plant numbers/densities
- growth parameters of vegetation

=> crown volume, potential and available fodder

- rainfall measurement
- soil description

sample plot sizes: 1 - 200 m²

(dependent on densities/layers)

I. LEVEL: FODDER PLANT

Fodder quality

palatability, biomass production and nutritive value of the plant species

- questionaires and observations of plant palatability
- harvesting edible parts of palatable plants; determination of dry weight
- chemical analyses

Figure 2(cont.): Scheme of an inventory on the actual grazing capacity

Sources: Rappenhöhner, in prep.: National Research Council, 1990:92; Baas and Adow, 1991

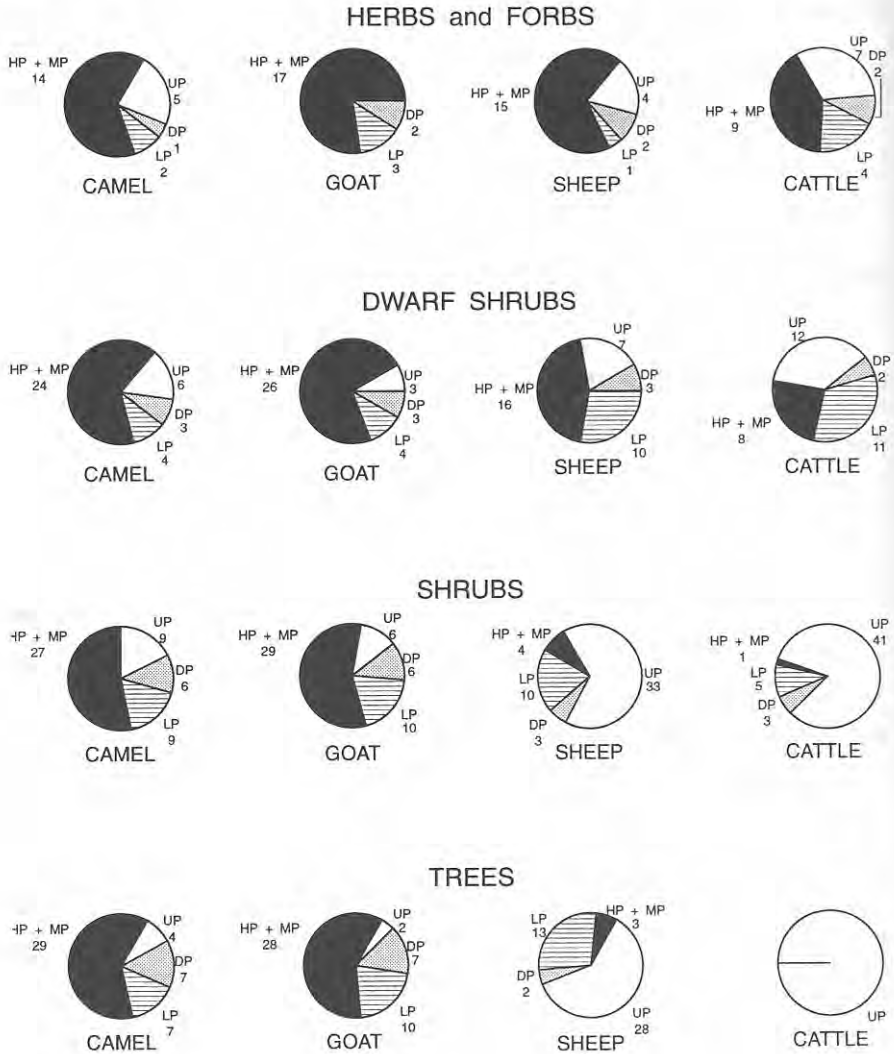

Figure 3: Number of palatable plant species compared per vegetation layer and type of animal

Source: Author

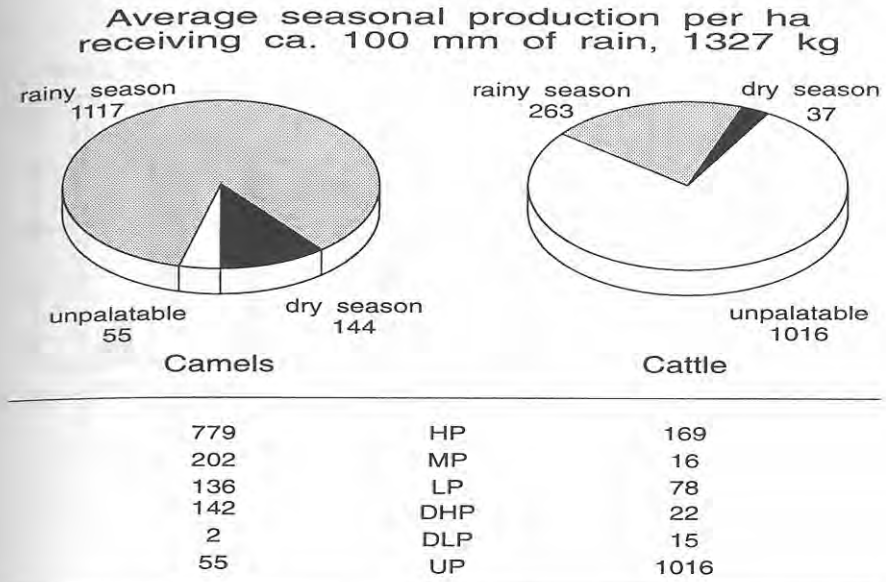

Figure 4: Seasonal range potential RU 16. Comparison: camels and cattle (in kg biomass per ha)

Source: Own survey data

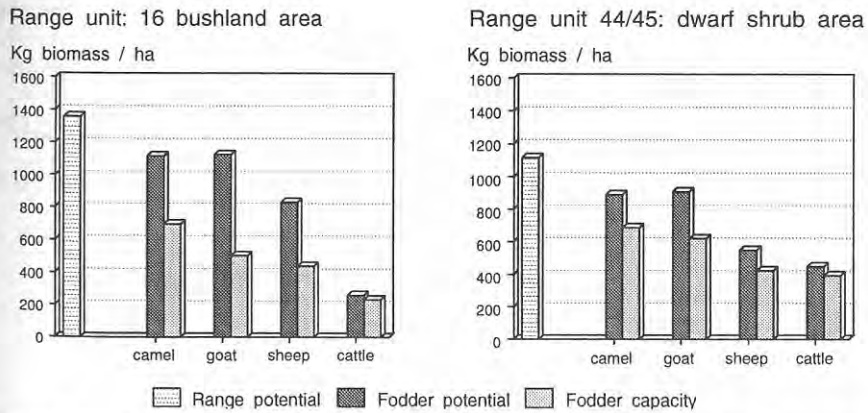

Figure 5: Range potential and proportion of fodder/grazing capacity (rainy season)

Source: Own survey data

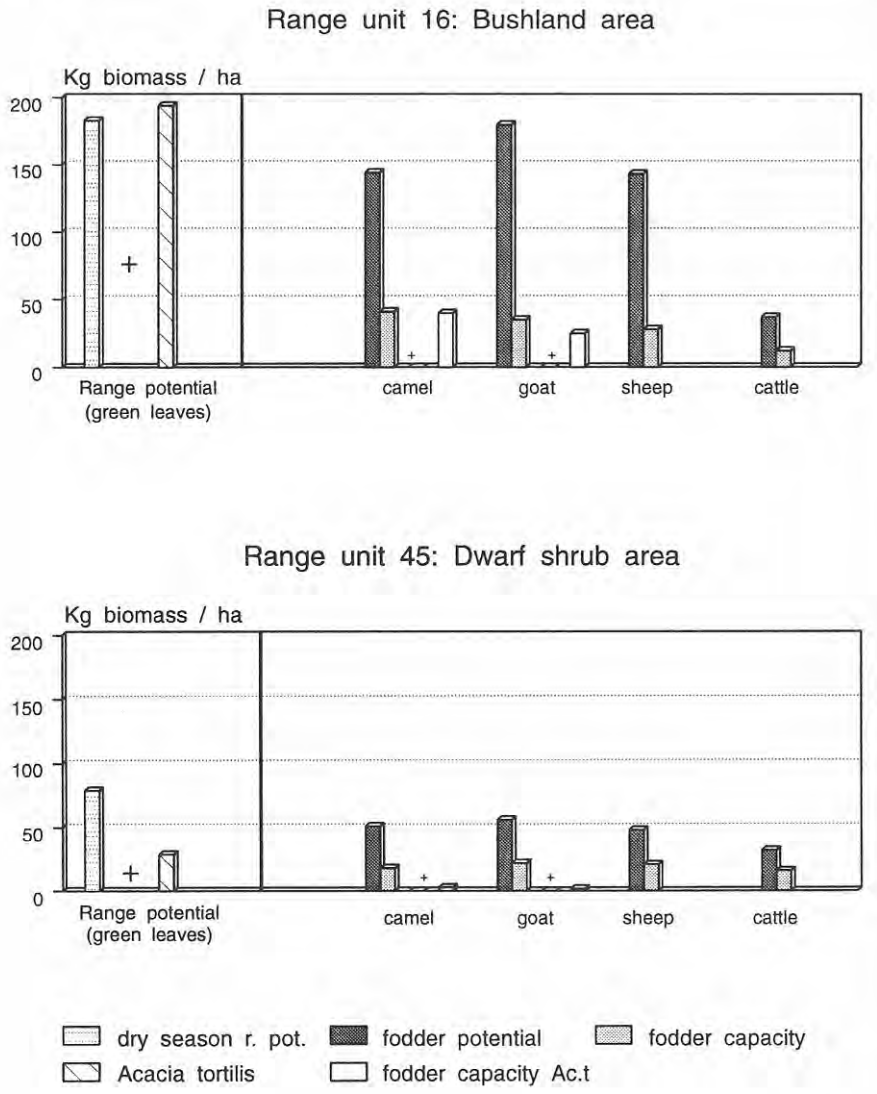

Figure 6: Range potential and proportion of fodder/grazing capacity (dry season)

Source: Own survey data

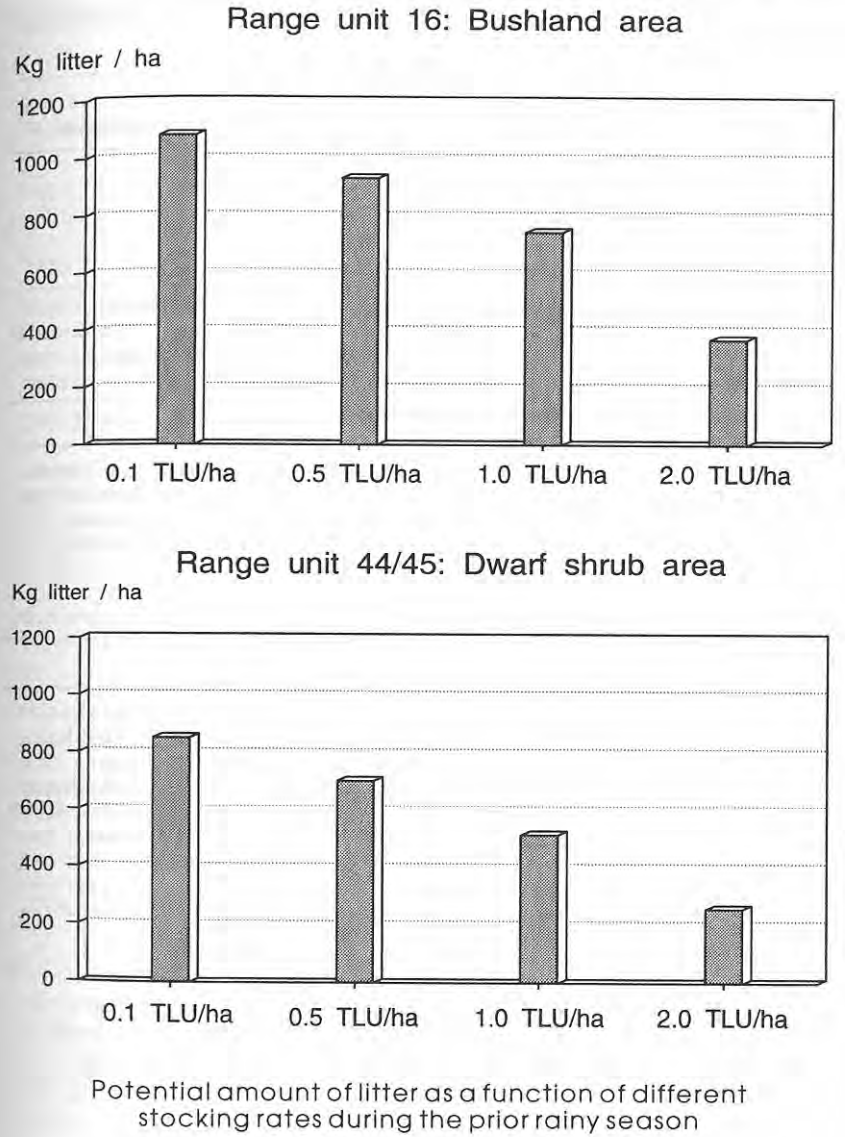

Figure 7: Potential leaf litter

Source: Own survey data

Table 1: The physical features of environment compared for the different range units (RU)

	RU 24 "*Hawd* or red sand area"	RU 44/45 "Sand over limestone area"
RU-size (in km²): Survey area: Total area: Representative for approx.:	 2500 5544 9456	 1600 6120 16840
Geology:	Jesomma sandstone, nubic series, continental sediment, cretaceous-eocene.	Taleh limestone-formation, marine sediment, eocene.
Altitude:	450-300 m	280-240 m
Topography and micro-relief:	Gentle W to E slopes with no micro-relief.	Flat with very gentle W-E slopes. Some slight undulating patterns associated with lime stone bands.
Soils and rocks:	Limestone exposures cover 1-2% of the RU. The rest is covered with deep red sand: eutric Regosol, calceric Regosol.	Stony limestone surfaces cover 5-10% of the RU. The rest is covered with allochthon red-orange sands, mainly calcaric Regosols, Arenosols.
Physiognomic vegetation structure:	Deciduous bushland/ medium-dense wooded shrubland & dwarf -shrub understory	Deciduous dwarf shrubland with few shrubs and nearly no trees.
Drainage characteristics:	Very high water infiltration rate, little drainage development.	Very high water infiltration rate, very little drainage development.

Sources: RMR, 1979; Drechsel, 1986; Baas, 1991

Table 1 cont.: The physical features of environment compared for the different range units (RU)

RU 47 "Limestone series"	RU 16 "Limestone series"	RU 31 "Gypsum area"
 976 976 3452	 2000 2544 5308	 250 830 1678
Taleh limestone formation, marine sediment, eocene.	Auradu/taleh limestone formations, marine sediments, cretaceous/eocene.	Taleh limestone/ southern gypsum, marine/continental sediments, eocene.
290-230 m	300-250 m	270-190 m
Gentle NW/SE slope. ancient peneplain in the south of the RU with numerous small depressions. Well developed micro relief associated with wavy bands.	Gentle NW/SE slope numerous small depressions and hills (5-10 m) in the SE part forming a micro relief.	Flat with a gentle N to S slope. A section across the narrow "shoe-string" zone reveals a shallow channel with a floor 10 m below the surrounding limestones.
Parallel wavy wide bands of limestone and orange toned sands. Sands cover 40% of the area. A few gypsum exposures in small depressions calcaric Regosols, Lithosols, Arenosols.	Appr. 60% of the area is covered by limestone some fragmented & mantled. The limestone is speckled with pale orange termitaria patches and medium to narrow wavy bands of pale orange sand: calcaric Regosols, Lithosols.	Gypsum/anhydrite exposures in massive plates, small secondary fragments and stones cover 85%. Pale-pink gypseous, fine-sandy silt and limestone fragments make up 15% of the surfaces. Lithosols, Regosols, Yermosols.
Deciduous shrubland. medium to low densities in the tree and dwarf shrub layers.	Deciduous bushland/ medium dense wooded shrubland & dwarf-shrub understory.	Deciduous bushland/ shrubland. Low densities in all layers of vegetation.
A few drainage chanels, but generally sandy bands acting as drainage zones.	Narrow sandy bands form the drainage zones, channel development is poor.	An ancestral drainage zone with typical "shoe string" form. Current drainage is not developed on the surface, but some fossil channels and sink holes can be found.

Table 2: The total biomass production (leaves and fresh shoots) and the dominant and sub-dominant plant species per layer and range unit

Layer of vegetation	Number of plant sp.	% Coverage per RU	Kg total biomass/ha	Dominant species	% Density /layer	Subdominant sp.	% Density /layer
RU 16							
Dwarf shrubs	30	9.9	250	*Triumfetta ?heterocarpa*	27.0	*Indigofera intricata*	10.5
				Indigofera ruspolii	22.0	*Sericocomopsis sp.*	3.5
				Indigofera spinosa	21.4		
Woody forbs (and herbs)	19	1.7	56	*Pavonia pirottae*	16.6	*Hibiscus somalensis*	14.5
				Melhania ?incana	15.1	*Pavonia arabica*	12.7
				Blepharis ciliaris	14.6	*Barleria sp.*	7.6
Shrubs	34	9.9	256	*Euphorbia cuneata*	27.0	*Acacia horrida*	7.5
				Ipomoea donaldsonii	20.8	*Grewia penicillata*	6.9
				Anisotes trisulcus	8.2	*Grewia tenax*	4.8
Trees	33	25.5	764	*Commiphora horrida*	25.6	*Commiphora sp.*	5.5
				Acacia tortilis	15.2	*Boswelia microphylla*	4.6
				Commiphora truncata	7.6	*Acacia senegal var.*	3.8
Per.grasses		< 0.5	20	*Aristida kelleri*		*Latipes senegalensis*	
biann.grass			14	*Cyperus esculentus*			
RU 24							
Dwarf shrubs	25	13.5	378	*Indigofera ruspolii*	45.3	*Triumfetta ?heterocarpa*	5.4
				Pleuroptheranta revoilii	21.9	*Indigofera intricata*	4.6
						Solanum ?albicaule	4.1
Woody forbs (and herbs)	21	1.7	43	*Melhania ?incana*	66.7	*Pavonia arabica*	8.9
						Heliotropium sp.	5.6
						Pavonia pirottae	4.0
Shrubs	30	11.8	355	*Cordeauxia edulis*	15.6	*Commiphora lobato spath.*	6.8
				Acacia turnbulliana	14.8	*Acacia zizyphispina*	5.5
				Acacia edgeworthii	9.0	*Ipomoea donaldsonii*	5.3
Trees	29	18.2	527	*Acacia tortilis*	17.6	*Acacia hamulosa*	5.6
				Commiphora horrida	10.0	*Boswelia neglecta*	5.3
				Caesalpinia erianthera	7.0	*Commiphora gurreh*	5.3
Per.grasses		1.0	82	*Aristida kelleri*		*Latipes senegalensis*	
biann.grass				*Cyperus esculentus*			

Table 2 cont.: The total biomass production (leaves and fresh shoots) and the dominant and sub-dominant plant species per layer and range unit

Layer of vegetation	Number of plant sp.	% Coverage per RU	Kg total biomass/ha	Dominant species	% Density /layer	Subdominant sp.	% Density /layer
RU 47							
Dwarf shrubs	22	15.1	384	*Triumfetta ?heterocarpa*	40.7	*Indigofera intricata*	4.3
				Indigofera spinosa	29.7	*Malvaceae ?unknown*	4.1
				Indigofera ruspolii	11.0	*Sericocomopsis sp.*	2.0
Woody forbs (and herbs)	19	2.4	73	*Pavonia pirottae*	31.6	*Hibiscus sp.*	9.4
				Blepharis sp.	16.7	*Pavonia arabica*	6.6
				Melhania ?incana	9.7	*Hibiscus somalensis*	4.4
Shrubs	24	14.7	502	*Cleome sp.*	33.0	*Acacia horrida*	9.5
				Anisotes trisulcus	10.9	*Euphorbia cuneata*	7.9
				Acacia edgeworthii	10.0	*Acacia refisciens*	4.5
Trees	24	11.4	362	*Commiphora horrida*	35.5	*Dobra glabra*	3.6
				Acacia tortilis	24.1	*Boswelia neglecta*	2.8
						Lannea sp.	2.8
Per.grasses		0.2	21	not determined			
biann.grass			14	*Cyperus esculentus*			
RU 31							
Dwarf shrubs	30	4.7	131	*Indigofera intricata*	20.7	*Indigofera ruspolii*	8.7
				Triumfetta ?heterocarpa	19.3	*Limonium cylindifolium*	6.9
				Indigofera spinosa	15.0	*Zygophyllum sp.*	5.8
Woody forbs (and herbs)	16	2.0	73	*Blepharis sp.*	31.9	*Solanum sp.*	9.4
				Pavonia pirottae	17.2	*Aerva javanica*	6.0
				Tribulus terrestris	10.3	*Helioptropium sp.*	5.5
Shrubs	16	8,8	305	*Acacia refisciens*	32.7	*Acacia edgeworthii*	7.8
				Anisotes trisulcus	19.2	*Euphorbia cuneata*	7.8
				Acacia horrida	11.9	*grewia tembensis*	4.0
Trees	14	6.3	263	*Acacia senegal var.*	45.7	*Acacia tortilis*	10.5
				Commiphora ?gowlelo	11.4	*Caesalpinia erianthera*	6.7
				Commiphora horrida	11.4	*Boscia minimifolia*	2.9
Per.grasses		0.4	59	Latipes senegalensis		*Aristida kelleri*	
Biann.grass			14	not determined			

Table 2 cont.: The total biomass production (leaves and fresh shoots) and the dominant and sub-dominant plant species per layer and range unit

Layer of vegetation	Number of plant sp.	% Coverage per RU	Kg total biomass/ha	Dominant species	% Density /layer	Subdominant sp.	% Density /layer
RU 44/45							
Dwarf shrubs	28	18.4	476	*Indigofera intricata*	42.1	*Triumfetta ?heterocarpa*	5.3
				Indigofera ruspolii	20.7	not identified sp.	5.0
				Pleuroptheranta revoilii			3.6
Woody forbs (and herbs)	24	1.2	31	*Pavonia pirottae*	18.9	*Tephrosia uniflora*	7.7
				Melhania ?incana	12.2	*Pavonia kotschyii*	6.6
				Pavonia arabica	12.2	*Heliotropium sp.*	4.0
Shrubs	27	16.8	474	*Acacia edgeworthii*	28.2	*Loewia glutinosa*	7.2
				Commiphora labato-spath.	15.2	*Euphorbia cuneata*	6.6
				Acacia bricchettiana	13.6	*Commiphora incisa*	5.9
Trees	14	2.3	63	*Commiphora ancistrophora*	36.8	*Sesamothamnus busseanus*	8.5
				Acacia hamulosa	16.4	*Commiphora horrida*	7.6
				Acacia tortilis	9.4	*Acacia senegal*	6.6
Per.grasses		0.4	52	*Aristida kelleri*		*Cenchrus ?ciliaris*	
Biann.grass			20	*Cyperus sp.*			

Table 3: The fodder capacity, calculated in grazing days per TLU/type of animal/ha per season; compared at the different levels of production and criteria of calculation

	Standard value			Metabolisable energy			Digestible protein		
	fodder potential kg/ha	fodder capacity kg/ha	grazing days 6.25kg/ha	fodder capacity kcal .ME/ha	graz. days TLU/ha moderate production	graz. days TLU/ha level of maintenance	dig. prt. capacity g/ha	graz. days TLU/ha moderate product.	graz. days TLU/ha level of mainten.
RU 24									
Camels									
rainy season	1013	700	112	1945004	121	177	79060	180	324
dry season	113	34	5.5	66857	4	6	1706	4	7
Goats									
rainy season	1056	606	97	1600560	100	139	65141	149	254
dry season	141	34	5.5	73849	4.5	6.5	1884	4.5	7.5
Sheep									
rainy season	812	475	76	1259556	78	113	50326	106	159
dry season	136	32	5	73849	4.5	6.5	1822	4	6
Cattle									
rainy season	379	306	49	777356	55	90	32577	85	170
dry season	132	31	5	70355	5	8	1688	4.5	9
RU 16									
Camels									
rainy season	1102	707	113	1972066	123	180	74650	170	306
dry season	143	31	5	78948	4.9	7.2	4303	9.8	17.6
Goats									
rainy season	1114	612	98	1680550	105	146	64004	146	250
dry season	179	46	7.4	64607	4	5.6	2990	6.8	11.7
Sheep									
rainy season	831	459	73	1039979	60	93	40282	85	162
dry season	142	20	3.2	53552	3.1	4.8	2621	5.5	10.6
Cattle									
rainy season	261	231	37	594020	42	69	23533	61	123
dry season	36	11	1.8	30605	2.1	3.5	1126	2.9	5.9
RU 47									
Camels									
rainy season	1117	802	128	2300371	143	209	87062	199	357
dry season	90	22	3.5	47012	3	4.3	1928	4.4	7.9
Goats									
rainy season	1190	807	129	2237966	139	194	85006	194	332
dry season	101	18	3	43010	2.7	3.7	1602	3.7	6.3
Sheep									
rainy season	810	596	95	1675173	96	150	63571	134	256
dry season	24	7	1.1	20710	1.2	1.9	710	1.5	2.9
Cattle									
rainy season	307	279	45	727752	52	84	28686	75	149
dry season	24	7	1.1	20710	1.5	2.4	710	1.8	3.

Table 3 cont.: The fodder capacity, calculated in grazing days per TLU/type of animal/ha per season; compared at the different levels of production and criteria of calculation

	Standard value			Metabolisable energy			Digestible protein		
	fodder potential kg/ha	fodder capacity kg/ha	grazing days 6.25kg/ha	fodder capacity kcal .ME/ha	graz. days TLU/ha moderate production	level of maintenance	dig. prt. capacity g/ha	graz. days TLU/ha moderate produc	level of mainten.
RU 31									
camels									
rainy season	568	303	48	869049	54	79	32752	75	134
dry season	77	18	2.9	46926	2.9	4.3	2554	5.8	10.5
goats									
rainy season	644	337	54	897476	56	78	33631	77	131
dry season	77	13	2.1	33168	2.1	3	1634	3.7	6.4
sheep									
rainy season	224	141	23	394932	23	35	15160	32	61
dry season	64	13	2.1	32353	1.9	2.9	1600	3.3	6.4
cattle									
rainy season	94	84	13	203506	15	24	8404	22	44
dry season	25	7.4	1.2	18471	1.3	2.1	677	1.8	3.5
RU 44/45									
camels									
rainy season	889	652	104	1573515	98	143	70023	160	278
dry season	52	16	2.6	25163	1.6	2.3	1132	2.6	4.5
goats									
rainy season	915	593	95	1580538	98	137	63498	145	248
dry season	56	12	1.9	28604	1.8	2.5	1004	2.3	3.9
sheep									
rainy season	545	419	67	1117105	70	100	44621	102	141
dry season	48	8	1.3	22972	1.3	2	844	1.8	3.4
cattle									
rainy season	445	384	61	1008371	72	117	41070	107	214
dry season	32	6	1	15712	1.1	1.8	630	1.6	3.2

(The table includes only the proportion of vegetation which was collected for chemical analyses. This counts for more than 90 percent of the total palatable biomass with regard to all range units. The rainy season values include fodder rated asHP; MP; or LP. The dry season values contain dry season available fodder (DH, DL) but not *acacia tortilis* which offers additional resources mainly to camels.)

Table 4: Range resources in the *Hiraan* region - Dry season fodder potentials (in kg/ha)

Buulobarde and *Jalalaqsi* (Kuchar, 1987)

Total area (in km²)	*yicib* leaf		Non *yicib* evergreen biomass		Green deciduous	
degaans:	total	acces-sible	pala-table	avai-lable*	total	avail.* (59%)
Halgen (1446)	57	47	15	7	7	4
Maxas (2153)	97	87	12	6	6	3
Muqokori (1517)	9	48	11	4	5	2
Aboorey (1216)	76	51	11	5	9	4
Shin (651)	2	1	15	8	14	8
Buulobarde segment (980)	0	0	31	20	9	5
East *Jalalaqsi* (2040)	19	14	17	11	17	10
West *Jalalaqsi* segm.(1101)	0	0	67	57	8	5

Total area (in km²)	Perennial grami-noid biomass		Leaf litter		All feed sources
degaans:	total	usable por-tion*(50%)	total portion*	usable (kg/ha)	acces-sible
Halgen (1446)	176	71	202	121	249
Maxas (2153)	232	101	231	154	351
Muqokori (1517)	292	97	273	139	290
Aboorey (1216)	277	94	251	137	291
Shin (651)	167	80	223	172	268
Buulobarde segment (980)	284	142	153	122	289
East *Jalalaqsi* (2040)	147	64	168	175	273
West *Jalalaqsi* segm.(1101)	334	167	151	121	350

Palatable: All edible material; Available: All edible material available, without lopping to camel. In case of *yicib* essentially all leaf is considered available; Accessible: All available exclusive of *yicib* reserves; *: Available and accessable (definitions by Kuchar).

Remarks: The figures are to be regarded as potential fodder resources, not as true fodder capacity. It is doubtful whether any grasses or grass litter is left over into the dry seasons, because this is fodder of first preference in the rainy season. The values for *yicib* should be adjusted with a factor which accounts for the ecologically suited off-take per season.

The Central Rangelands (FEWDS,1988)

Using the Deshmukh's formula: (peak biomass kg /ha)= 8.488 x annual rainfall - 195,768, the annual peak biomass production in the Central Rangelands comes to 2 t/ha (south) ranging to less than 1 t/ha (north).

Table 4 cont.: Range resources and range condition of the coastal districts

Hobyo district (Naylor and Jama, 1984)

Range unit description and size (in km²)	Most important plant species and characteristic vegetation
Sandy uplands over limestone: Part of the interior plateau (12950)	*Acacia horrida, Ipomoea donald sonii, Indigofera ruspolii, Aristida kelleri, Lepthothrium sen.* (shrub-grassland)
Sandy gypsic uplands over gypsum or lime: Part of the interior plateau (1740)	*Indigofera ruspolii, Acacia edgeworthii, Euphorbia matabalensis, Commiphora spp., Sporobulus ruspolianus, Leptothrium senegalense* (dwarf shrub grassland)
Gypsum basin: Part of the interior plateau (2110)	*Commiphora spp., Acacia edgeworthii, Euphorbia spp., Limonium cylindrifolium, Sporobulus ruspolianus, Chenchrus ciliaris* (dwarf shrub grassland)
Stabilized sands: Part of the stabilized sand dune area (1800)	*Acacia nilotica, Anisotes velutinsis, Dichrostachys cinera, Euphorbia cuneata, Brachiaria somalensis, Leptothrium senegal.* (shrubland)
Shallow sands over coastal ridge: Part of the stabilized sand dune area (2049)	*Terminalia spinosa, Ac. edgeworthii, Indigofera ruspolii, Ac. horrida, Cenchrus ciliaris, Heteropogon contortus* (bushland)
Coastal sands: Part of the coastal plain (2110)	*Leptothrium senegalense, Indigofera intricata, Cenchrus ciliaris, Cyperus spp.* (grassland)

In his report, Naylor provides neither an explanation of his methods of estimation nor a clear statement as to whether the values are for seasonal or annual production! They should be therefore regarded with caution.

Ceel Dheere District (Herlocker et al.)

Coastal plain grassland: 4 seasons proted area	*Indigofera intricata, Cenchrus ciliaris, Panicum pinifolium* (grassland)

Table 4 cont.: Range resources and range condition of the coastal districts

Hobyo district (Naylor and Jama, 1984)

Primary production woody grass in kg/ha		Estimation of range available on the bases of "proper use"	Rainfall during study period	Range condition
540	465	60% of total No further specification	No measurements	Fair - (poor)
700	450	50% of total No further specification	No measurements	Fair
365	560	50% of total No further specification	No measurements	Good
1900 (Except in cultivation areas)	700	?? measurements	No erosion problems	Fair but on 570 km²
1100	900	60% of total No further specification	No measurements	Fair
1260 (Except mobile sand dune areas)		40% of total No further specifacation	No measurements	80% Fair 10% Poor 10% Sand-dunes

Ceel Dheere District (Herlocker et al.)

Seasonal 1171 - 1474 in exclosure	-	No measurements	Basal cover: in: 2.65% out: 1.89%

Of the total region of the coastal plain grassland, Herlocker (1986) found 83% in fair or better range condition and 17% in poor or worse condition.

Table 5: Vegetation changes in the vicinity of permanent water sources with reference to duration of use

Highly frequented places with water supply in use approximately			Places at a distance of > 10 km from water
10 years	5 years	3 years	
A/B	A/B	A/B	A/B
Balli Cad	*Lebi Hiraan*	*Dhumaaye*	
21/44	24/20	34/9	33/7
Guri Ceel	*Dhudhumood*	*Gal Xamur*	
41*/40	27/30	28/10	47/2
Dhuusamarreeb	*Gadoon*	*Siligle*	
13/56	39/37	46/20	26/4
Tuulo Cali Xasan			
17/29	-	-	50/18

A: percent vegetation cover per plot of 200 m²
B: percent of low and unpalatable plants (LP, UP), calculated as proportion at the cover of all plants per plot
* 18.5 % is *A.tortilis*, which is out of reach for livestock

Table 6: Animal Requirements

Animal Requirements

Animal requirements were calculated as kg dry matter forage per tropical livestock unit (TLU) per day. One TLU is equivalent to 250 kg live weight. Considering the types and breeds of livestock prevalent in Baringo District one TLU is equivalent to 1.0 head of cattle, 10 sheep, 11 goats or 0.7 dromedaries.

Animal requirements [kg dry matter forage/TLU/d]

	Maintenance only	Maintenance and production
Cattle	4.8	6.4
Sheep	6.2	7.9
Goats	6.4	7.3
Dromedaries	6.1	7.3

The requirements were calculated at maintenance level, i. e. with no body weight changes and no other outputs like milk or work, and based on the assumption that the available forage contains a minimum of 1.8 mcal metabolisable energy and approximately 40 grams digestible protein per kg dry matter, which is a quality commonly found at the beginning of the dry season on semi-arid and arid rangelands in East Africa.

Production levels assumed for the calculation of dry matter requirements for maintenance plus production

cattle	300 grams daily gain or 2.5 l milk/day,
sheep	80 grams daily gain,
goats	60 grams daily gain or 0.45 l milk/day,
dromedaries	450 grams daily gain or 4 l milk/day.

To achieve these levels of production the available forage needs to contain a minimum of 2.2 Mcal metabolisable energy and approx. 60 grams digestible protein per kg dry matter. Such qualities are available in the herblayer only during the growing phase of the vegetation. In the shrublayer and in particular in larger bushes and small trees qualities in this range can be available for much longer periods. (Source: Range Management Handbook of Kenya)

SOMALIA'S LIVESTOCK ECONOMY: EXPORT AND DOMESTIC MARKETS AND PRICES

Ahmed M. Abdullahi

INTRODUCTION: ROLE OF THE LIVESTOCK SECTOR IN ECONOMIC DEVELOPMENT

Somalia, owing to its geographical, social, climatic and edaphic conditions, is essentially a pastoral country. Although the pastoral sector does not receive full political and institutional commitment, pastoralism nevertheless remains important both for the subsistence of the majority of the rural population and for the entire national economy. Livestock is the mainstay of the Somali socio-economy, since 45 percent of the country's total land surface can be considered as exclusively rangeland; nearly 90 percent falls into the category of potential rangeland. At present opportunity costs of this land are nearly nil since the soil is not suited for any use other than grazing. In the absence of alternative opportunities for local employment of any significance, most people earn their livelihood from pastoralism.

On a macro-level, the role of livestock in the country can be summarized as follows:

- it provides food and material for the population;
- it supplies foreign exchange and government revenue;
- it contributes to the gross domestic product (GDP); and
- it provides employment and income.

Livestock provides subsistence for three-fifths of the Somali population while agriculture provides subsistence for another one-fifth (Hoben, 1983).

Over the past 15 years Somalia's total per capita production of beef, mutton, goat and camel meat has remained essentially unchanged at 21 to 23 kg (FAO, 1972, 1978, 1984, 1989). This relatively low level of production will create problems given the projected increase of its population. Production increases due to larger livestock numbers alone is not a realistic possibility.

On the national level two major livestock marketing flows can be identified, namely domestic- and export- trading. A review of the literature, shows that domestic market research has been neglected in Somalia, particularly no systematic work has been done previously. Somali livestock export trading, in contrast, is described in considerable detail in several recent studies (Swift, 1976, 1977; Reusse, 1982; Holtzman, 1982; Weli and Jeffy, 1985; Mascott Ltd., 1986). The paper will briefly outline the domestic livestock trading. Its main objective is to describe some issues of domestic livestock trading on which in Somalia and particularly in its central rangelands sofar have received little attention. In particular, the paper aims to:

- examine the effects of livestock price variations throughout the year and
- assess the impacts of increased supply and demand on the livestock herders during different seasons of the year.

The paper's scope is limited to rural livestock markets in the central regions; the *Beledweyne* livestock market is used as an example throughout the paper. It is assumed that many livestock markets in northern and southern Somalia are functioning in a similar way than the *Beledweyne* market.

Only very few reliable marketing data are available in Somalia, limiting the amount of detailed analysis that can be carried out. The most reliable and continuous market data for Central Somalia exist on the *Beledweyne* livestock market. Local authorities of all markets other than the *Beledweyne* only keep records of taxes collected on livestock markets but no market data are collected and no market reports are submitted. The market census data of the Beledweyne market in contrast contain the numbers of animals daily sold and their average net prices. However, age and sex of animals brought to the market are not recorded. Livestock prices are recorded as net prices, i.e. price paid to the producer minus tax levy, self-help-fees (fees levied on villagers, markets etc. by district-level authorities for regional development) and dilaal (market broker) commission.

STRUCTURE OF DOMESTIC LIVESTOCK MARKETS

Village and District Markets

According to Reusse (1982), livestock markets are "habitual meeting places of sellers and buyers of livestock and have established themselves at all places of relative significance". A market is an important social occasion where producers exchange up-to-date price information and build social relationships. Beyond that, markets are exposed to all facets of the modern world forming political alterations, cultural attitudes and in particular new consumer habits. Throughout the central rangelands, marketing and market systems show no distinct intra- and inter-regional differences. The location of markets is related to production systems specific for an area and to its export significance. Markets take place every day of the week. They operate under the jurisdiction of the local government which limits any kind of livestock trading to the authorized local markets. However, a considerable amount of sales takes place directly between producers and consumers outside the markets and during the annual migrations of herds. Presumably, the main motive for selling outside offical markets is to avoide paying markets fees.

Markets are scattered throughout the districts, but are located either in or near a town or other centres of some human population concentration. These livestock markets are reserved for livestock and no other products are traded. There are no handling facilities like holding pens, each supplier keeps watch of his animals.

In some livestock markets such as in the *Hobyo* district a market master is positioned at the entry gate to collect an entry fee of between 10 and 15 SoSh per head of sheep, goats or cattle. All markets are registered for local government taxes, self-help-fees and regional development fees. A municipal officer collects taxes and issues receipts for all animals that change ownership in the markets. In addition, livestock taken to another district/region or to another market is inspected by government veterinary officers and is required to possess a movement permit which specifies the number of animals and their destination. This procedure is only applied in cases of disease epidemics when movement is restricted. For export animals vaccinations against CCPP (Contagious Caprine Pleuropneumonia) and sheep pox are compulsory.

In Table 1, markets are classified according to the types of sellers and buyers operating in them and for the purpose for which livestock is bought. It summarizes these attributes for the markets classified in the study area.

Table 1: Characteristics of livestock markets in central Somalia (1986/87)

Type of market (level)	Main seller	Main buyer	Purpose
Village col- lection for resale	small-scale producer* to local	small-scale producer to local traders (*jeeble*)	stock replacem. and breeding, traders (*jeeble*)
District	medium and large-scale producers, traders (*jeeble*, *gaadleey*)	medium and large-scale producers, traders (*jeeble*, *gaadleey*), local butchers, (*mijisleey*) & restaurants	stock replacem. and breeding, collection for resale either in *Muqdisho* or other centres
Regional/ Provincial	medium and large-scale producers, traders (*jeeble*, *gaadleey* and *gedisleey*)	medium and large-scale producers, traders (*jeeble*, *gaadley*), local butchers, *mijisleey*, restaurants, hotels	collection for resale, breeding, for slaughter

* Market surveys showed several cases of small herders who sell in the village markets but also appear regularly at larger markets.

Source: Abdullahi, 1990

The table shows that at the village level the main sellers are herdsmen (producers). The main purchasers are also herders who buy stock for breeding or for replacement, or traders (*jeeble*) who collect stock for resales in Muqdisho or in other export markets. Local butchers do not play a sizeable role as buyers due to the low slaughtered daily number of animals in the villages. In district markets like *Beledweyne* and *Buulobarde*, where approximately between 80,000 and 140,000 live animals are handled per year, the sellers are producers, mainly herders of larger herds, and traders (*gaadleey* and *jeeble*) who buy animals and resell them either at the same market the same day or later. Buyers in these markets are herdsmen, traders, local butchers, open air meat sellers (*mijisley*), butcher cooperatives (*iskashatadfa kawaanleyda*), restaurants and hotel owners. Another important group of buyers are citizens of district or urban centres who use to buy between one to three animals for religious, ritual and ceremonial purposes.

Small ruminants dominate the rural village markets, which often specialize in single species such as goats or sheep. Cattle and camels are generally sold in the larger markets where a considerably higher demand for meat for towns exists. The average number of sheep and goats being for sale in village markets e.g. in *Maxaas* varies between 5 - 10 animals, with somewhat lower figures on some days. As already mentioned, the main supplier of these markets are mainly small producers who normaly offer an average number of 1 to 4 goats or sheep depending on the scale of their herds. These small producers sell livestock to meet their highly urgent short-term cash needs for grains, grain products, sugar and tea (Abdullahi, 1990).

Larger producers who generally sell a greater number of animals at one time, prefer to drive their animals to the next bigger markets to obtain better prices than in the villages. The average livestock prices in villages are generally lower than those in towns. Some of these larger producers even prefer to trek their animals to the capital city of *Muqdisho* where usually the highest demand for slaughter animals, *dibaax* , exists.

The importance of different market levels is reflected by their Market Success Ratio (MSR), i.e. the number of animals sold relative to the number of animals brought to market. The ratio varies for different species and seasons and for the location and purpose of the market either for local use or for export. From observations of different markets in Central Somalia, it can be said that the MSR is generally higher for larger and for export markets than for smaller and for rural markets.

Patterns of the Marketing System

The village livestock markets involve a complex system, collection, transportation and distribution. This basic livestock marketing mechanisms in domestic trading are largely the same throughout the central regions, with most initial transactions starting at the producer's home. The selling system starts when a pastoralist brings his stock to the registered livestock market where *dilaals* act as middlemen between sellers and buyers. *Dilaals* assist buyers and sellers in reaching an agreement over the price by offering the following services:

- they seek a buyer, negotiating a price;
- ensure sellers of a reasonably fair price;
- ensure buyers that the animal is healthy and not stolen.

In return for these services, the *dilaal* is paid by a fee, usually by the seller. Throughout the *Hiiraan* region a modest commission is fixed by the regional

government for these services of *dilaals*. In 1986/87 the fee was 5 percent of sale price which was 10 Somali Shillings (=So.Sh.) per head of sheep and goat and 50 So.Sh. per head of cattle (cf. Tab. 2). For this commission the *dilaal* guarantees the validity of the sale and makes sure that the agreed price is paid. For large ruminants, a guarantee charge called DAMIIN of 100 So.Sh. for camels and 60 So.Sh. for cattle and donkeys has to be paid to the *dilaal*.

For comparison, Dickie and Saygideger (1987) reported that in the Bay Region livestock markets in Southern Somalia, livestock trading are also conducted through local brokers (*dilaal*), who are paid 4 percent of the sale price by the sellers. Here too, the local government collects a market tax levy and other fees, which are also fixed by the regional government.

Stockowner's selling strategy often involves the accummulation of slaughter stock (*dibaax*) to be prepared for higher cash needs in the dry seasons. Marketable *jer* stock (mainly castrated male stock for export) on the other hand is kept only until the known periods of increased demand, such as the Ramadan-Hadj season. *Jer* stock thus generates higher returns per head than *dibaax* stock. *Dhaqaleyn* (older breeding stock) are traded informally and independently of any market place and are generally bartered for other stock. However, how far a stockowner can adhere to this strategy, depends on the size of his herd the number of marketable animals he owns. Small size pastoralists usually cannot keep up such a specialized sales strategy for different classes of stock (Abdullahi, 1990).

Table 2: Tax levy, self-help-fee, *dilaal* and *damiin* charge in *Hiiraan* livestock markets (SoSh; 1986/87)

Species	*dilaal* fee[1]	Tax and self-help fees	*damiin* Charge	*naadi*[2] Charge
Sheep/Goats[3]	10	15	-	-
Camels	50	55	100	40
Cattle	40	25	60	60
Donkey	40	25	60	-

1 Five percent of sale value for all livestock species.

2 When there is a *naadi* (auctioneer), the pastoralists pay the tax fee. *Naadi* or *falisaad* are found principally in the markets of the inter-riverine and tTans-Juba region of Somalia.

3 Sheep and goats are listed together because species were not specified in the *Beledweyne* livestock market data. In the Somali language *ari* commonly refers to small ruminants, regardless of species.

Source: *Maxaas, Buulobarde, Beledweyne* and *Jalaqsi*

LIVESTOCK MARKETS

Pastoralists have three choices where to see for buyers for their livestock:

- in the bush, outside any formal market;
- in the villages at local markets and
- at major district or regional markets.

The vast majority of all livestock is sold in organized markets but small herders rarely venture further than the major market in their region. Most of these stockowners cite inconvenience, length of trip, and high costs involved in moving livestock for long distances, as well as unfamiliarity with non-local markets as the main reasons for not selling in larger district markets where admittedly higher prices are paid. Notably, small scale producers point to the small numbers of animals they can sell at different times to cover regular small cash needs, it therefore does not pay to drive small numbers of stock to distant markets, as costs of trekking livestock to these markets outweighs the possibility of receiving higher prices. Bush sales entail no costs but offer few options for herders. In remote interior areas, perspective buyers are either other pastoralists or itinerant merchants who pass through. All this results that only a negligible amount of livestock is sold outside of formal markets. However, stockowners must consider the cost of taking an animal to larger markets which is mainly a function of distance as well as different demand which exists at different markets. Village markets usually offer greater opportunities to sell sheep and goats than camels and cattle. The demand for large ruminants from villagers (butchers, restaurants, etc.) is limited. Goats and sheep are the preferred slaughter animals as the daily demand for meat is small and because goats and sheep permit butchers or restaurants a greater control over the meat volume they can handle.

Composition of Marketed Livestock

An evaluation of the age and gender distribution of marketed animals permits to infer whether still untapped market resources exist in herds. Market data are useful for such an evaluation as they permit comparisons between the type, age and gender of stock marketed and the seasons in which is marketed. Only male stock is allowed to be exported. The number of animals of this class traded in markets may thus serve as an indicator for the existence or absence of such surplus stock in herds which from studies of herd structures (Zessin, 1986; Abdullahi, 1990) was not suggested. The supply of prime male animals is high prior to the main export period. During this period the proportion of males (*jer*)

on markets is higher than those of other classes like "*dhaqaleyn*" and "*dibaax*", while in other seasons the later stock classes are relatively more frequent. Pastoralists apparently exhaust their entire male surplus stock during periods of high demand and later are forced to draw on classes of lower market value, often female stock classes.

Figure 1 shows these seasonal differences in the market rate of different small ruminant classes at the *Beledweyne* livestock market for 1986/87. It is apparent that in both rainy seasons (*gu´* and *dayr*) the percentage of prime animal (*jer*) was low whereas the number of slaughter stock (*dibaax*) was overproportionally high. In the *xagaa*-season (export peak demand), in contrast, *jer* stock did dominate.

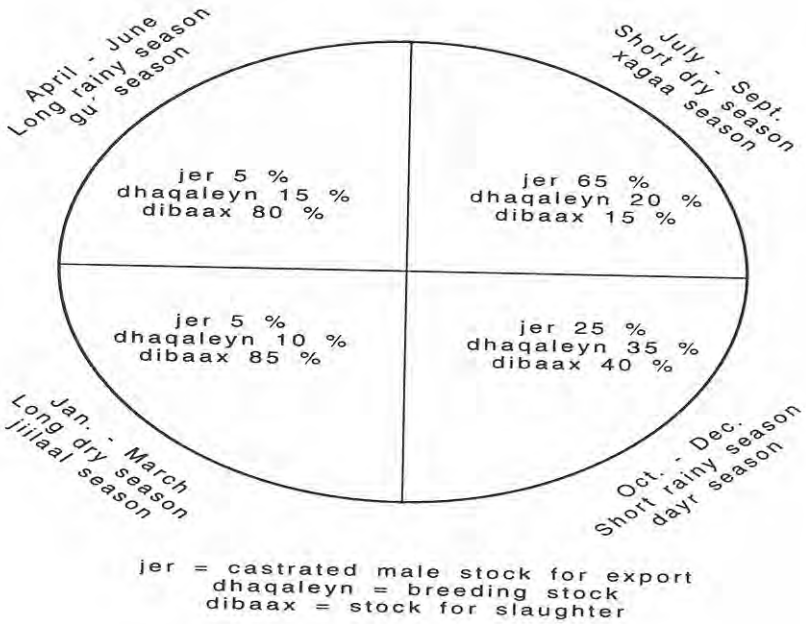

Figure 1: Estimated proportion of smallstock classes supplied per season to the *Beledweyne* livestock market (1986/87)

Source: Abdullahi, 1989

LIVESTOCK SUPPLY AND DEMAND

Seasonal variations in livestock slaughters and sales are considerable. Greater numbers of animals are slaughtered in *jiilaal* (long dry season) and during *gu´* (long rainy seasons). Forage is scarcest during the *jiilaal* period where milk production and the condition of livestock decline rapidly. To compensate, pastoral households slaughter more animals, consume more meat and use most of their cash receipt from some livestock sales to buy grains, grain products and sugar/tea.

Figure 2: Observed and assumed trends of livestock selling in central Somalia (1986/87)

Source: Abdullahi, 1989

Figure 2 summarizes the assumed and observed factors favouring or limiting livestock sales of pastoral households for the study years.

Supply and Demand of Sheep and Goats

Figure 3 shows the mean monthly numbers of sheep and goats sold at the *Beledweyne* market. The highest demand was during June until mid-August. This was the main export period for live animals to the Arabian Peninsula. Interestingly, this demand for sheep and goats corresponded exactly with peaks in the demand and price curves of camels and cattle. High demand levels in 1986/87 were in the period between May and July and in early August; low demand fell mainly in the dry season (late December to early April).

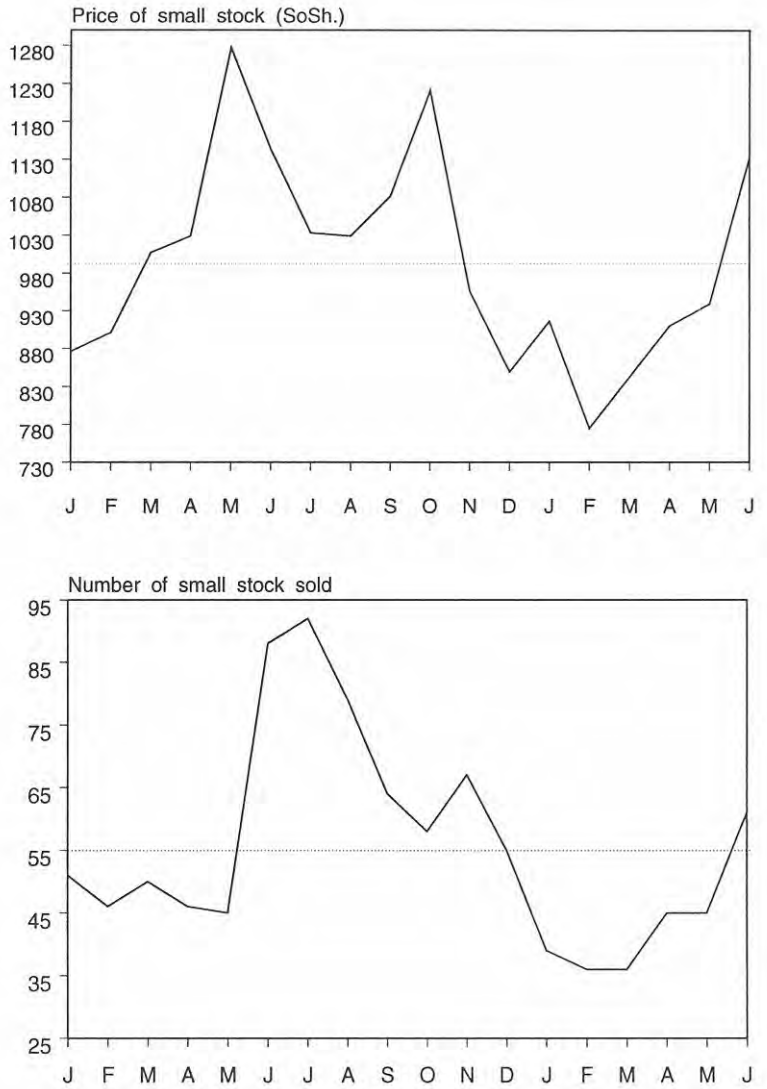

Figure 3: Average monthly prices and number of small ruminants sold at *Beledweyne* livestock market (1986/87)

Source: Abdullahi, 1989

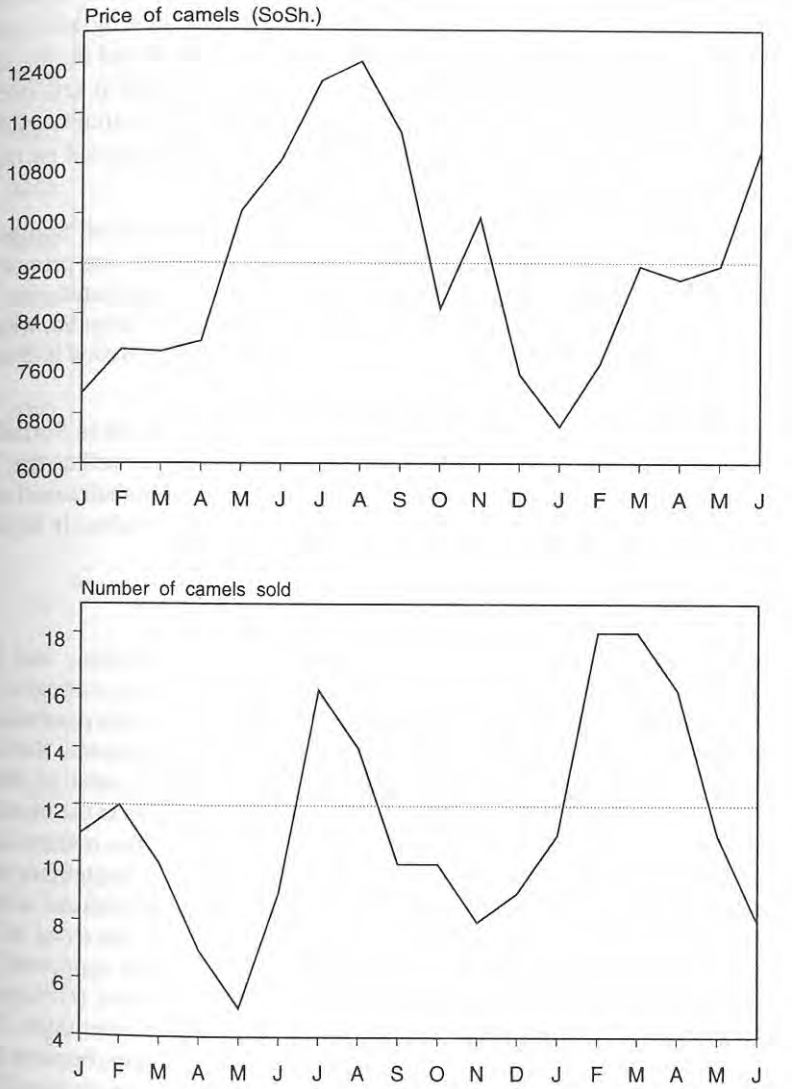

Figure 4: Average monthly prices and number of camels sold at *Beledweyne* livestock market (1986/87)

Source: Abdullahi, 1989

Supply of sheep and goats on the market was low from April through June (*gu´* season) when herder retain animals for breeding and milking and herds grow in size. Pastoral producers rely almost on milk as major food during this time; only very little meat is used. For herders there is no need to sell stock. Since many social gatherings (family congregations, marriages, circumcisions, etc.) occur during this season, pastoralists though may consider to sell animals for these feasts.

Dickie and Saygideger (1987) report for the Bay Region of Southern Somalia, report that fluctutations in volumes of sales and prices are primarliy due to religious holidays and due to the "Hadj" with its associated rise in demand for export animals. This phenmenon is a peculiarity for Somalia, where 80 - 90 percent of all goats and sheep exported are destined to Mecca in Saudi Arabia to be used in the Hadj season.

From figure 3, it can be concluded that major religious festivals in Somalia, such as the month of "Mawliid al Nabi" (October/November) as well as the "Id al-fitr" and the "Id al-adha" in the Hadj-season, had effects on both demand and price levels. Higher demand for small stock in these periods resulted in higher prices.

Supply and Demand of Camels

Camels play a dominant role both for socio-economic relations and for subsistence. Consequently, camel commercialization is very low compared to other species and is partially explained by the unwillingness of Somali pastoralists to sell camels. One may conclude that social rather than economic factors influence on pastoralists's camel selling behaviour. However, most of these factors are still poorly understood. Substantial seasonal variations in the number of camels offered and demanded at markets exist (Figure 4). The market data indicated a period of a maximum market activity from June to September and from January to March with a sharp drop at the start of the *jiilaal* season which lasted until the start of *xagaa* season around August. However, the trend of an increased demand for camels in the first months of 1987 was not supported by findings from the previous year. However, as in 1986 *dayr*-rains (October - December) failed compeletly and a drought was considered inevitable, the demand for camels increased during these months rather than later, because the nomads know from experience that from all livestock species camels stand the best chance of survival, once a drought strikes.

It is difficult to ascertain the extent to which camel pastoralists in Africa and Arabia have traditionally been oriented towards a meat market. Due to the long intervals it is hard to perceive that any camel production ever primarily aimed

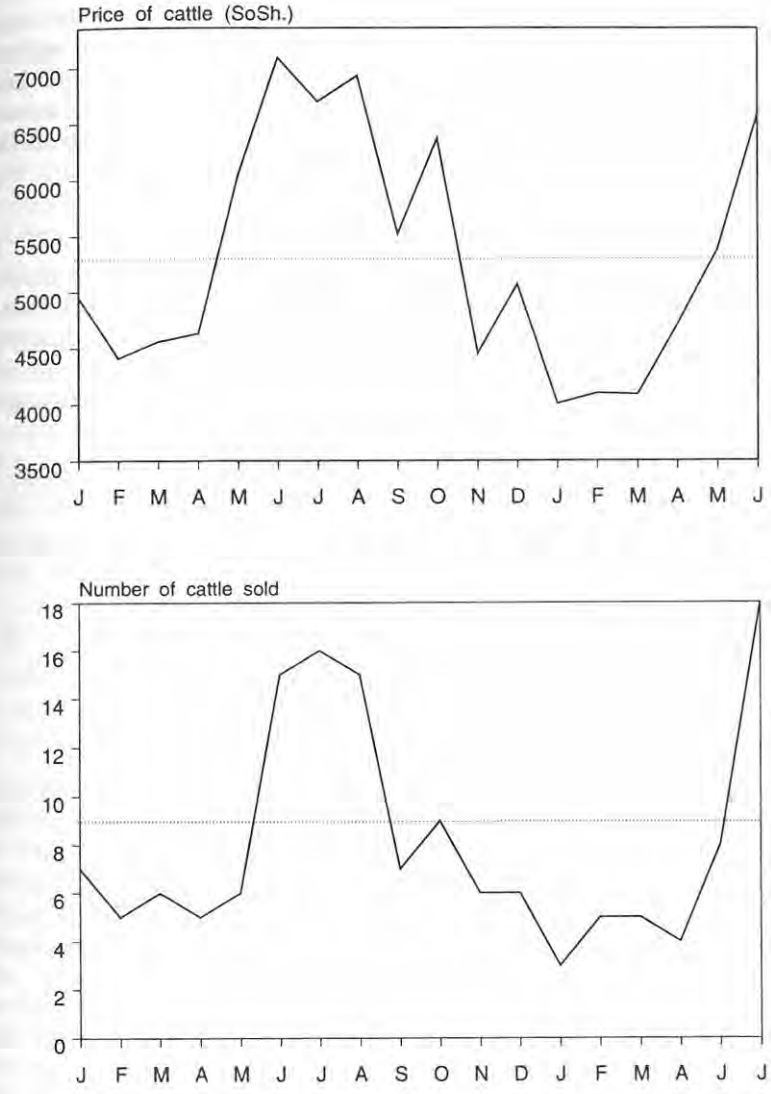

Figure 5: Average monthly prices and number of cattle sold at *Beledweyne* livestock market (1986/87)

Source: Abdullahi, 1989

at supplying meat for markets. Camel meat in the urban markets in Somalia comes exclusively from over-aged animals. Somali herders do not willingly dispose their of prime animals, thus fewer camels are brought to the markets than other types of livestock. These facts can be interpreted that camel herd sizes are maintained and extended not only for prestige but also as a precautionary measure against drought as discussed briefly by Samatar (1985) and Abdullahi, (1989).

Supply and Demand of Cattle

Like with smallstock, peak demand for cattle at the *Beledweyne* market closely followed the pattern of seasonal cattle exports(see figure 5). Demand peaked during the Hadj period and low demand was apparent for the *jiilaal* season. Cattle, in particular, are generally in poor condition during any dry season when range conditions deteriorate rapidly and little or no supplementary fodder is available.

It can be summarized that the supply of animals to livestock markets is determined by a combination of factors of which pastoral households cash needs, external driven demand for animals and environmental, particularly climatic conditions affecting the physical conditions of herds, are the most important.

LIVESTOCK PRICES

Price Seasonality

Strong demand in the 1970's and early 1980's for export animals resulted in rising prices in Somalia are marked. Although a detailed price analysis still has to be undertaken, first results demonstrate that livestock prices are subject to wide short-term and seasonal fluctuations. Prices are influenced by recurring periods of drought when pastoralists are forced to sell animals. Droughts are followed by a period of minimum sales when herds are re-built. Domestic livestock market prices particularly those in the central regions, further on, are driven by seasonal demand from Saudi Arabia and by major national religious feasts (Abdullahi and Jahnke, 1990). The price of an individual animal is not determined only by its weight, but by its condition, age, sex and apparent health. Domestic price fluctuations in seasons other than the export months, therefore, reflect actual conditions of animals during the different climatic seasons of a year. Animals in poor condition are of lower value than when in prime condition.

The strictly seasonal livestock export market has strong implications for domestic market prices. During the last years high price levels were common in the Ramadan-Hadj season when vast numbers of *jer* animals of prime condition fetched top prices. Low price levels occurred during the months of the *jiilaal* season which followed the Hadj, demand had dropped sharply and condition of all classes of stock was low. During the months of October to December 1986, when the *dayr* rains failed in many parts of Somalia, conditions and subsequently prices of animals dropped to the level of salvage value. The 1987 long dry *jiilaal* season did even further aggrevate the destruction of prices.

Table 3 sums up these relationships between prices and seasons. During the rainy seasons *gu'* and *dayr*, animals were in best condition but supply and demand was low, resulting in low livestock prices. Animal conditions declined during the dry seasons *jiilaal* and *xagaa*, further reducing prices. The fact that prices made an upswing in the *xagaa* season was not a virtue of this season but was entirely conditioned due the high demand for Somali livestock in Saudi Arabia. In response, pastoralists sold all available *jer* stock in still acceptable condition.

Table 3: Correlation coefficients between price of animals and seasons (1986/87)

Species	*jiilaal*	*gu'*	*xagaa*	*dayr*
Sheep and Goats	-0.540**	0.033	0.500**	0.110*
Cattle	-0.270**	-0.014	0.420**	-0.110*
Camels	0.021**	-0.100**	0.350**	-0.250**

* significant level at 90%, ** significant level at 99%.
Source: Abdullahi, 1989

Nevertheless, livestock prices (possibly with exception of camels) generally followed the supply and demand model. The majority of animals marketed in the *Beledweyne* market was sold at best achievable prices during the period of high demand, i.e. the period of Ramadan-Hadj.

Prices for all four species thus are not constant over a year but are influenced by the following main factors:

- the market supply and demand;
- the weight, age and sex of the animals and
- the seasonal accessibility and movements of animals.

As might be assumed, most of the herdsmen claim to be aware of spatial price variations. They reported that prices rose from the late *dayr* season until the post *xagaa* export peak and then fell throughout the dry season, which was the accurate pattern of prices outlined in the previous sections. While few herdsmen were up-to-date on detailed and immediate changes in market conditions, they all seemed to have some information and awareness of the general changes in the market conditions that ultimately affect them. All of this information travels by word of mouth via merchants, traders, friends and relatives. Upon returning from a local market a pastoralist is obligated to share any information with others.

We can summarize that seasonal price fluctuations were substantial for different types of livestock. Peak price levels for live animals, particularly for small ruminants occurred for the Ramadan and Hadj seasons. Periods of higher prices are started some two to three weeks prior to the beginning of these seasons. Ramadan is one month long and is followed by a period of two months and ten days until Hadj. These Ramadan-Hadj seasons follow the lunar calender and annually move forward by about ten days. During the survey period the seasons fell between early April and early July. Inflated prices during this period therefore were directly due to a continues build-up of export stock for the Arabian markets. Prices dropped during the three to five weeks after Hadj, in the later part of the dry season *jiilaal* , i.e. February to April, and during the second quarter of the year. During the drought months of 1986/87, when rains failed during two preceeding "rainy" seasons (*gu´* and *dayr*), *jiilaal* prices in affected areas sank further to the level of salvage value.

Milk Prices

Milk, especially cow- and camel milk, plays an important role in the daily diet of the Somali population. Yet, information about milk marketing and production is scarce and widely scattered. Milk prices, like livestock prices display a seasonal pattern, as milk is plentiful during the rainy seasons and scarce in dry periods. This seasonality of milk production is reflected in the camel milk price pattern obtained from *Muqdisho* and *Baydhabo* markets (Figure 6).

During the two rainy seasons, being the calving seasons for all domestic animals with resultant high milk production, prices showed a downward trend. In between the rainy seasons, milk prices increased progressively, and indeed more dramatically during the long dry season between January and March (see Figure 6). It was reported that there was a 30% price increase from *Baydhabo* to

the *Muqdisho* market for camel milk, and a 20% price increase from cow milk. The margin increased dramatically during the seasons of high milk supply as prices in the producing areas dropped sharply (Dickie and Saygideger, 1987).

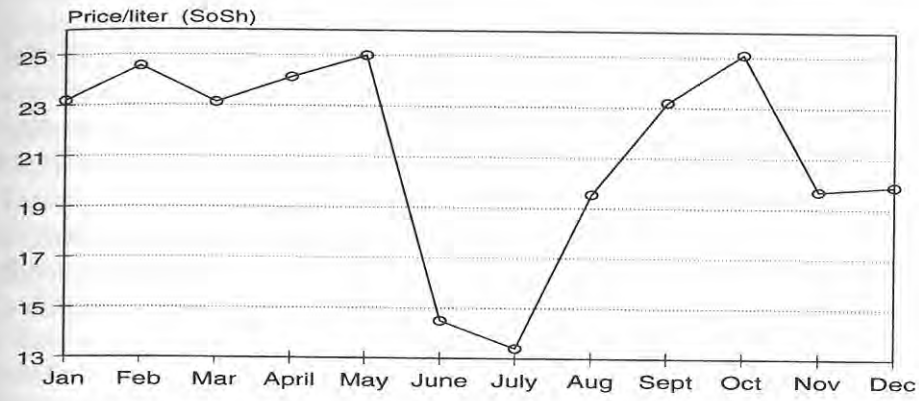

Figure 6: Average camel milk prices in *Baydhabo* (1984/86)
Source: Abdullahi, 1989

Price Structure and Efficiency

Livestock market systems, with the exception of those controlled by government or monopoly-pricing mechanisms, are subject to short-term seasonal shifts in supply and demand and, in the longer-term, to price cycles. Discussion with producers, traders and exporters showed how sensitive the overall system reacts to the shifts in supply and demand. Evidence in the survey clearly demonstrated how producer prices do rise very quickly when there is a sudden demand for export stock and when many traders converge to compete for stock. Commercial traders as profit makers therefore attempt to play a more active role. Whenever opportunities arise they will invest in times of low prices in purchase of livestock and will keep them until price rise. Commercial producers operate with the same strategy, particularly important in this respect, is the time of the Hadj export season to Saudi Arabia. Because it takes at least 1,5 to 2,5 months to obtain capital, organise traders/agents, assemble stock and move it from the central rangelands to the northern ports for shipment, everyone involved in the marketing chain has to adjust to the advancement of the Hadj market by about ten days every year (Mascott Ltd., 1986).

Given the current livestock husbandry system and the environment, in which production, marketing and consumption operate, the current pricing system does seem to be reasonably efficient and flexible. In some studies, it is reported that substantial price differentials for live animals between northern and southern Somalia has attracted traders who take animals from the south to the north for sales (Reusse, 1982). The higher cost of driving livestock over this distance is compensated by the better prices paid in the northern export triangle. This is a result of low seafreight rates and premium prices paid in export markets, and particularly in Jeddah, Saudi Arabia, for special shipments (Reusse, 1982).

The present organisation of rural markets in the central rangelands of Somalia would not appear to be an obstacle to future paths of livestock development. The supply of animals to the village markets is mainly influenced by demand from the Arabian Peninsula and is only in the second place a combination with other factors influenced by rangeland conditions. Marketing and market problems will likely arise when the peak demand period from Saudi Arabia coincides with the unfavourable *jiilaal* long dry season, with scarce feed and water for animals (Mascott Ltd., 1986).

MARKET PERFORMANCE

Having looked at livestock marketing from various angles, it is important to obtain some economic perspective of the whole system. How well does the current marketing system function? In general, the situation is very positive. The system has responded well to changes in supply and demand in the past decade. It has dealt with effects of droughts, an export embargo on cattle and with competition from other suppliers in the world. Through all this, trade has continued and has adapted. Considering the problems of communication and transportation, the proven ability of the system to purchase, transport, redistribute, export or slaughter close to 1.8 million animals every year is remarkable. This is, however, only one of the criteria on which the system should be judged. Economic efficiency also requires that redistribution is carried out at low cost. Observations made during the field study confirm the existence of such low cost and efficient private marketing systems with narrow trade margins. The differences between the rural buying price and the central urban slaughter or export-market price rarely exceed 6-10 percent or, if long distances are involved, 12-15 percent for all types of animals.

The traditional marketing system has also been efficient in its use of low cost of labour, something governments should seriously consider before opting for so-called modern methods of marketing which often involve heavy capital investments and significantly reduce employment in the sector.

Table 4: Mean costs and returns for sheep and goat traders at *Maxaas* and *Gaalkacyo* markets (SoSh)

Market of Origin	*Maxaas*	
Destination	*Gaalkacyo*	
Distance	ca. 800 km	
Transit Time	ca. 3 days	
Road type	Rough/Tarmac	
	Per Herd (200) sheep and goats	Per Head of sheep or goats
Mean purchase price from producer in *Maxaas* area	270,000	1,350
Producers marketing costs at *Maxaas*		
Dilaal fees	2,000	10,000
Self-help fee	2,000	10,000
Veterinary certificate	1,000	5,000
Trucking costs	16,000	80,000
Losses		
(Mortality Loss (12%)	16,000	162,000
Food and salary of 2 *sawaaqi*	10,000	50,000
Sale price at *Gaalkacyo*	443,000	1,875
Gaalkacyo market tax	1,000	-
Food and lodging	1,500	-
Miscellaneous	1,000	-
Total	446,500	
Trader's gross margin at *Gaalkacyo* livestock market	176,500	525 (28%)

Source: Abdullahi, 1989

An evaluation of the efficiency of a marketing system normally is based on the determination of the proportion of total marketing margins in final consumer prices of marketed goods. For this, in this section available data on prices paid to producers and those at the major collection centres are compared. Under ideal market conditions, with total market transparency and total market competition, differences in prices between markets would be limited to differences in transaction costs; without transaction costs prices in different markets would be parallel.

Differences in livestock prices between the export markets and the production areas in Somalia can be attributed primarily to transport costs. The price of 1,885 So.Sh. for a sheep in *Gaalkacyo*, enroute to the export ports, incorporates the *Maxaas* village producer price of 1,350 So.Sh. and transport and transactions costs. Table 4 provides some figures on local market taxes, marketing commissions, trekking/trucking costs and traders' profits.

SUMMARY AND CONCLUSION

The paper highlighted the main relationships between supply, demand and prices for livestock, and between prices and seasons. These individual factors contribute to the underlining economic principle which determines quantities and prices of marketed livestock. Interactions of the forces of supply and demand are the cornerstone of the neo-classical approach in economic analysis. These interactions, obtained from observations in households and markets, are presented in Figure 7.

The figure illustrates market equilibrium at three levels. In each case prices and quantities of livestock are determined by supply and demand. Changes in this balance occur as the quantities of animals demanded change. During the period of highest demand, top prices are realized and the maximum number of animals are marketed. Fewer animals are demanded and supplied during the "Mawliid al Nabi" month (Prophet Mohamed's birthday), resulting in lower average prices. Livestock prices are the lowest during the long dry season (*jiilaal*), when both demand and supply are low. In this period the condition of livestock is the poorest.

While seasonal fluctuations in the supply of animals from herds to markets are also influenced by the condition of the stock and the particular needs and aspirations of the herding household, the general market behaviour is the result of interdependencies between supply and demand, as in any other free market systems.

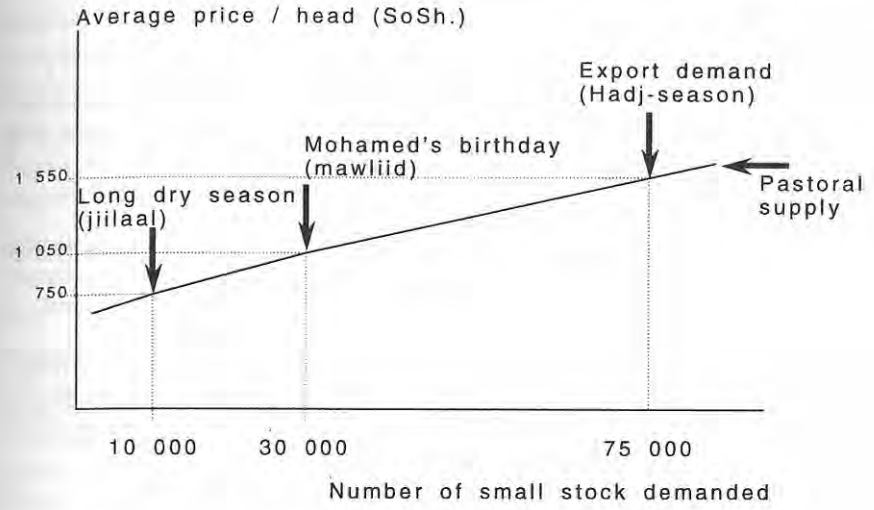

Figure 7: Supply and demand relationships determining prices and quantities of marketed pastoral livestock in central Somalia, 1986/87

Source: Abdullahi, 1989.

Pastoralists are generally quite conscious of livestock prices and the numbers of animals - by species- offered for sale at nearby markets. Word travels quickly in the closely-knit Somali society, where urban dwellers are apt to entrust livestock to kinsmen in the hinterland with whom they remain in close contact.

The market system determined by economic market forces of supply and demand, is also strongly influenced by social-religious behaviour, as can be seen during the religious feasts, when the response of the nomads to the upswing in demand is to sell more livestock. Not pastoral traditionalism (cattle complex) but price-cost considerations determine the market behaviour of these nomads.

Market partcipants, both producers and traders, thus act in a rational and economic manner. The market system is not determined by social or mystical attitudes but by basic economic market principles. Any unnecessary intervention into these freely balancing market forces of supply and demand is likely to distort the overall effective resource distribution.

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THE EFFECT OF STRATEGIC DEWORMING ON SMALL RUMINANT PRODUCTIVITY: A CLINICAL TRIAL

Cord Heuer, Ralf Patzelt, Mohamed Ahmad and Mohamed Ismail

INTRODUCTION

Several field investigations of livestock diseases in almost every district of central Somalia have shown 60-80% infestation rates with intestinal parasites for small ruminants. Because infected animals shed parasite eggs intermittently, faeces examinations of positive animals often have false negative results. It was therefore suspected that more or less every animal has in fact some type of worm in its intestines (Zessin et al., 1988; Heuer et al., 1990; Zessin, 1991). However, the number of parasites present in a particular animal - the 'worm burden' - was not determined nor has the detrimental effect of infestation on growth and reproductive performance been established. A statistical association was found, however, between the herd infection rate with coccidiosis and

young stock mortality at herd level. That association may have been confounded by poor herd management affecting both, mortality and the degree of coccidia infection. Among individual animals, body weights were not lower when eggs of several gastro-intestinal parasite species were found in the faeces as compared to faeces-negative animals (Heuer, 1991). This may have been due to low worm burdens. The qualitative faeces flotation method used is a poor indicator of the degree of infestation. Even fecal egg counts are poorly correlated with actual numbers of intestinal worms (Stampa and Linde, 1972; Baker, 1988). It was therefore the question whether removal of gastro-intestinal nematodes would improve weight gains and health of small ruminants.

Transmission of intestinal worms occurs when an infected animal deposits eggs or larvae into the environment. These develop into infectious larvae ('stage III') and are ingested orally by the definite host. The rate of infection depends on the type of parasite, environmental factors (temperature, humidity, soil moisture), the density of infectious larvae on the pasture or in the pen and on the susceptibility of individual animals (species, sex, age, state of health, genetic disposition, acquired immunity). From Central Somalia, little is known about prevalent parasite species, source of infecion and infection pressure from the environment, worm burden and the parasite susceptibility of sheep and goats.It is, however, hypothesized that a high parasite concentration exists in the night enclosures because these pens contain thick layers of faeces. Small ruminants are kept for 8-14 consecutive days in the same pen before the fence is shifted some 10-30 metres away (Schwenk, 1986). The pen is kept as small as possible in order to save fuel wood. The animals are therefore crowded within the fence during the night where they can take up faeces orally from the ground. Because animals have the habit of feeding on faeces when their diet does not contain sufficient minerals (and mineral deficiency is common in arid areas) it is likely that most infections take place at this time.

Of all the diseases in Central Somalia, parasitic infestations were most frequently found. Consequently, a clinical trial was designed to investigate the costs and benefits of randomly administered anthelmintic treatment at herd level rather than for individual animals.

Anthelminthic drugs were regularly available in regional capitals and occasionally in district towns and villages. The objective of the trial was to test the hypothesis that deworming at the beginning of the wet season with regrowth of vegetation leads to better weight gains and that returns from sales of heavier animals are greater than the costs of drugs.

TRIAL FLOCKS AND STUDY DESIGN

Fourteen mixed flocks of sheep and goats were selected in April 1989 from a pool of 25 flocks which had participated in a continuous survey since October 1987. Only those herd owners were allowed to join the trial who had consistently participated in the past and could be relied on not to drop out during the course of the investigation.

The flocks were from rangeland areas of the *Gaalkacyo* and *Dhuusamarreeb* districts of north- and south-western Central Somalia.

Instead of deworming whole herds for comparison with other herds that were not dewormed, the trial herds were divided in half. Each half-flock was similar to the other half with respect to species, sex age, lactation status and body condition of the animals. One half-flock received a single dose of Fenbendazol (5mg/kg body weight) approximately 14 days after the onset of rains in June 1989. Each animal was measured one month before the treatment, on the day of treatment and every month thereafter for the following factors: body weight, body condition score and packed cell volume (%). Four levels of condition scores were used: 1 for weak, thin animals and 4 for fat animals; the scores 2 and 3 rated intermediate conditions. Daily weight gains were calculated by dividing weight increases at subsequent visits through the number of days between visits. The presence of parasite eggs in the faeces was estimated from a representative sample of each flock. Additionally, 165 fecal samples were cultured in the laboratory to determine the various worm species present.

In the decision to treat half-flocks only and use the other half as control, preference was given to having two experimental groups with identical herd conditions. Management and other flock factors have an enormous impact on body weights (Heuer, 1991) and would confound the effect of treatment in a way that could not be compensated in the analysis. This design had therefore the advantage of excluding this distorting effect. The disadvantage with this method was that the drug would not have the chance to eliminate parasites from the whole herd, as half of the flock was left untreated. The remaining infected animals would continue to shed worm eggs and treated animals were likely to become re-infected immediately after treatment. In order to treat whole flocks and still limit the distorting effect of different herd conditions, probably over 100 flocks would have had to be included in the trial. Such a large trial would be unmanagable under the poor infrastructural conditions of Central Somalia.

Statistical procedures for testing the effect of treatment on productivity and parasitic disease included multivariance regression models and a one-way analysis of variance; these contained the variables sex, age and district.

RESULTS AND DISCUSSION

Tables 1 - 3 show that treated and untreated sheep and goats had similar frequencies of parasite-positive faeces examinations at the time of treatment, as well as one month after treatment. These frequencies were considerably lower in each experimental group one month after the drug application. Thus, the reduction of parasite infestation was obviously not due to the anthelminthic drug but rather attributable to the effect of "time". The time effect is interpreted as the result of better forage availability in the course of the rainy season (from June to July). This causes the clearance of nematodes from animals' systems either directly through increased intestinal activity or indirectly via higher resistence. The effect appeared equally in all age groups and genders of both species and in the two districts.

On the other hand, parasites of the *coccidia* type appeared to benefit from this time effect, as table 3 indicates. The prevalences increased by 15-20% during the 30 days between treatment and the first follow-up visit. This rise in coccidia prevalence was independent of the treatment and consistent over species, age groups and districts. Whether coccidia benefits from a competitive advantage as nematodes are cleared away or from a lower level of animal resistence against coccidia as opposed to nematodes or thrive for other reasons, could be the subject of further studies.

Table 1: The presence of the nematode family *strongylidae* before and one month after a single treatment with Fenbendazole (5mg/kg body weight) [differences between treated animals and control not significant at p=0.05]

	goats		sheep	
	untreated	treated	untreated	treated
on day of	71.4%	66.5%	72.5%	74.3%
treatment	(n = 259)	(n = 281)	(n = 109)	(n = 113)
one month after	28.2%	25.1%	49.5%	37.4%
day of treatment	(n = 216)	(n = 239)	(n = 109)	(n = 99)

Table 2: The presence of the nematode genus *strongyloides papillosus* before and one month after a single treatment with Fenbendazole (5mg/kg body weight) [differences between treated animals and control not significant at p=0.05]

	goats		sheep	
	untreated	treated	untreated	treated
on day of	60.5%	53.6%	59.6%	63.7%
treatment	(n = 258)	(n = 280)	(n = 109)	(n = 113)
one month	18.2%	19.3%	33.0%	29.3%
after treatment	(n = 214)	(n = 238)	(n = 109)	(n = 99)

Table 3: The presence of the protozoa order *coccidia* before and one month after a single treatment with Fenbendazole (5mg/kg body weight) [differences between treated animals and control not significant at p=0.05]

	goats		sheep	
	untreated	treated	untreated	treated
on day of	12.4%	9.6%	5.5%	7.1%
treatment	(n = 258)	(n = 280)	(n = 109)	(n = 113)
one month after	28.5%	26.1%	26.6%	23.2%
day of treatment	(n = 214)	(n = 238)	(n = 109)	(n = 99)

It is apparent that either the drug was ineffective -- a highly unlikely possibility -- or that nematodes were initially cleared from the treated animals but re-invaded immediately after the effect of the treatment was over. The ceasation of the drug effect, subsequent re-infection, the development of fertile adult worms and the shedding of eggs could well have occurred during one month. As opposed to the declining trend of nematode infestation with improving feed base, the frequency of coccidiosis increased substantially in both experimental groups. Thus, coccidia are more prevalent in humid periods. Because

most offsprings are also borne during humid periods, the above mentioned increase in young stock mortality, when flock infection rates with coccidia are higher, may be a seasonal phenomena independent of a causal effect of coccidiosis on mortality.

However, despite re-infection the animals could have gained a short advantage from the treatment, in terms of better weight gains and health, over the untreated group. Tables 4 - 7 show the differences in daily weight gains, body weight, packed cell volume, and body condition scores before and after treatment for the treated and untreated animal groups.

Table 4: Average daily weight gain (g/day) before and one month after a single treatment with Fenbendazole (5mg/kg body weight) [differences between treated animals and control not significant at p=0.05]*

	goats		sheep	
	untreated	treated	untreated	treated
on day of	49.8	39.5	88.7	86.3
treatment	(n = 544)	(n = 537)	(n = 232)	(n = 213)
one month after	92.3	85.1	124.4	151.7
day of treatment	(n = 485)	(n = 505)	(n = 184)	(n = 197)

* age, sex and district did not distort the association between treatment and weight gain or body weight.

Table 5: Average body weight (kg) before and one month after a single treatment with Fenbendazole (5mg/kg body weight) [differences between treated animals and control not significant at p=0.05]*

	goats		sheep	
	untreated	treated	untreated	treated
on day of	20.03	19.58	20.17	20.97
treatment	(n = 582)	(n = 584)	(n = 234)	(n = 229)
one month after	21.18	21.06	22.94	23.48
day of treatment	(n = 566)	(n = 543)	(n = 245)	(n = 220)

Table 6: Average packed cell volume (%) before and one month after a single treatment with Fenbendazole (5mg/kg body weight) [differences between treated animals and control not significant at p=0.05]*

	goats		sheep	
	untreated	treated	untreated	treated
on day of	27.2%	26.9%	29.5%	29.9%
treatment	(n = 422)	(n = 430)	(n = 182)	(n = 205)
one month after	28.3%	28.4%	31.9%	31.7%
day of treatment	(n = 439)	(n = 405)	(n = 179)	(n = 161)

Table 7: Average condition score (scale 1-4) before and one month after a single treatment with Fenbendazole (5mg/kg body weight) [differences between treated animals and control not significant at p=0.05]*

	goats		sheep	
	untreated	treated	untreated	treated
on day of	2.03	2.03	2.33	2.29
treatment	(n = 582)	(n = 587)	(n = 236)	(n = 232)
one month after	2.12	2.10	2.39	2.41
day of treatment	(n = 576)	(n = 551)	(n = 246)	(n = 220)

* age, sex and district did not distort the association between treatment and condition score.

Treatment and control groups gained weight at similar rates before and after the treatment day in June (Table 4). The weight gain measured between the onset of rains in May and the day of treatment was nearly twice as high for both species as during the experimental period. This shows how quickly small ruminants responded to the rapid transition from dry to humid periods of the year and from scarce to short term abundant forage. As gains were equal, body weights of the two animal groups were similar throughout the investigation

(Table 5). The state of health measured as body condition and packed cell volume was also similar. Both experimental groups had a slightly higher packed cell volume and better body condition ratings one month after treatment. At no time did the groups differ from each other significantly.

Table 8: Relative frequencies of worm species in cultures of 61 fecal samples of goats and 9 of sheep

Worm species	Sheep	Goats
Haemonchus contortus	67% (6)	62% (38)
Strongyloides papillosus	22% (2)	18% (11)
Other	11% (1)	20% (12)
(*Trichostrongylus spp., Cooperia spp., Bunostomum spp., Ostertagia spp.*)		

Culturing faeces samples to identify the species of worms present was succussful in 70 of 165 samples (42%). The most frequent nematode species was *Haemonchus contortus*, present in overall 63% of all positive cultures from sheep and goats. A similar rate (61.6%) was found by Cancovic (1984) who investigated sheep and goats at abattoirs in Somalia. But he found a much higher frequency (88%) of *Trichostrongylus-spp.* than in this study (5% in goats). In interpreting such findings it must be borne in mind that *Haemonchus contortus* lays 8-16 times more eggs than other nematodes in the same period of time. Hence, a higher concentration of eggs could have led to a higher chance of *Haemonchus contortus* being found in cultures than other parasites. *Haemonchus contortus* can therefore not necessarily be regarded as the most frequent type of parasite in small ruminants of Central Somalia.

Table 9: Relationship between the prevalences of *Strongylidae spp.* and the packed cell volume (PCV) in sheep and goats [differences within species significant at p<.001]

	faeces positive			faeces negative		
	no.	mean	SE	no.	mean	SE
PCV of goats	755	26.3%	.177	537	27.9%	.199
PCV of sheep	339	29.6%	.280	177	31.0%	.387

Table 9 shows that sheep and goats with faeces positive for *Strongylidae spp.* had significantly lower levels of packed cell volumes than negative animals. Reduction of the packed cell volume indicates loss of red blood cells. *Haemonchus contortus* and the hookworm species *Bunostomum* (also found in this study in a few faeces cultures) are known to feed on blood, in contrast to other parasites who live on intestinal secretions and epithelia cells. Because the infection status was associated with lower PCV levels there is a high probability that these two nematode species, particularly *Haemonchus contortus,* cause the greatest pathological effect on small ruminant flocks in Central Somalia.

In conclusion: the trial failed to provide evidence that deworming half the herd has a benificial effect without additional hygiene measures. The trial suffered from the necessity of not being able to carry out whole-flock treatment in order to make the investigation manageable. Presumably, the remaining untreated half of the flocks provided a source of re-infection for treated animals occurring as soon as the drug effect subsided (approximately 24 hours). The period from re-invasion to first egg production is 3 weeks for most nematode species. It is therefore not surprising that treated animals again had parasite eggs in their faeces by the time the first follow-up visit took place 30 days later.

It is moreover assumed that the thick layers of dung deposited in the night enclosure provide favourable conditions for larvae survival and constitute another important source of infection. Thus, unless the fence was cleaned or shifted, the treatment would probably have been ineffective anyway, even if all animals in the flock had been treated. On the other hand, the fact that infection rates decreased rapidly after the onset of rains raises the interesting question whether repeated cleaning or shifting of the fence alone would be sufficient to reduce the worm burden and the re-infection substantially. Such a cleaning operation in combination with the application of an anthelmintic drug might further enhance the elimination of parasites and result in better weight gains to an extent that is economically viable. The trial strongly indicates that a single anthelmintic treatment not supported by hygienic measures, i.e. eliminating sources of re-infection, is futile.

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ANIMAL HEALTH SERVICES IN SOMALIA: CAN CENTRALIZED STRUCTURES MEET DEMAND IN THE FIELD?

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THE GOVERNMENTAL VETERINARY INFRASTRUCTURE

The Historical Context

Although efforts have been made to heal domestic animals for as long as man has been dependent on livestock products, specific veterinary activities in the Horn of Africa were first launched with the coming of the colonial administration in former Italian Somaliland. Its earliest accomplishment was to set up a veterinary institute at *Marka*, 100 km south of *Muqdisho* in 1914. Inputs, however, were modest and staff numbers limited (Agricultural Sector Survey, ASS, 1986). In northern Somalia, the former Somaliland Protectorate, and now the Republic Somaliland, the first British veterinary officer arrived in 1924 in response to a severe outbreak of Rinderpest (Peck, 1962). At inde-pendence in 1960 the two former colonies were merged to form the Republic of Somalia and the two separate veterinary departments likewise merged. Yet the first Somali veterinarian to work for the new central veterinary service was not employed until 1964.

The Somali national animal health services focussed on the Rinderpest vaccination campaign from 1969 to 1975, known to livestock owners and senior veterinary service employees throughout the country as "JP15".

Structure

The organisational structure of the Ministry of Livestock, Forestry and Range (MLFR), which is responsible for the veterinary services, has changed both vertically and horizontally over the last decade. Figure 1 shows the structure of the Ministry in 1988.

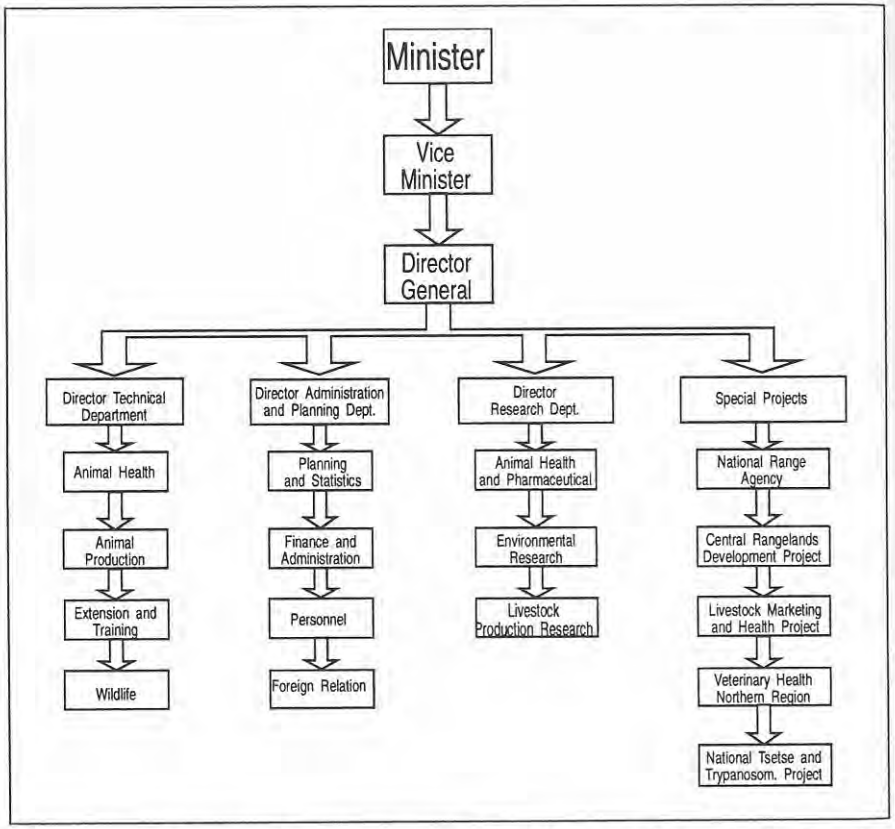

Figure 1: Organisational structure of the Ministry of Livestock, Forestry and Range (MLFR)
Source: after Hübl and Bechtel, 1988

It is important to note that "Animal Health" is separate from "Animal Production" and "Extension and Training", but that all three are part of one and the same directorate, along with all other technical services. The Animal Health Service, or Veterinary Department used to be part of a combined general directorate (ASS, 1986). The organization chart of this department, modified so that it corresponds to the de facto structures, is illustrated in Figure 2. At district and village level, the crucial animal health care delivery points in a pastoral production system, staff is hardly present and if, at all, ill-equipped with drugs, instruments and transport (not to mention fuel and spare parts).

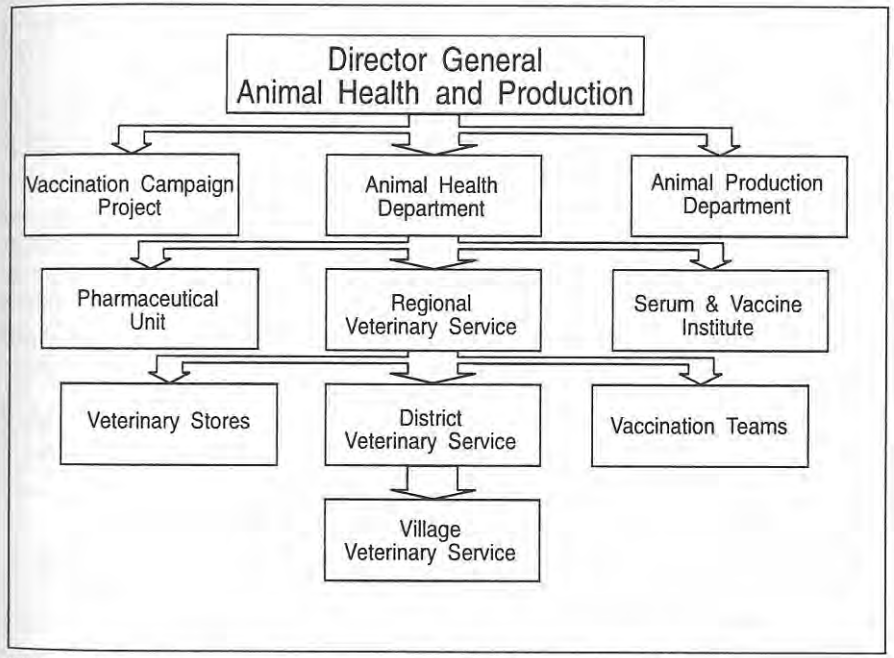

Figure 2: Organisational structure of the Animal Health Service
Source: after Hübl and Bechtel, 1988

Manpower, Budget and Financing

De Haan and Bekure (1991a) have devised indicators for estimating the efficiency of livestock services. The salary/non-salary budget ratio for Somalia was more or less constant at 40 : 60 (or 3.3 to 2.7) for the period 1983 - 1986, for which plausible figures were available (Table 1).

Table 1: Salary/Non-Salary Budget Ratio for the Somali Ministry of Livestock, Forestry and Range (MLFR), in million Somali Shillings

Year	1983	1984	1985	1986	1989
MLFR personnel	N/A	N/A	1695	1260 #	1284 @
MLFR budget (without projects)	57 x	60 *	N/A	80 x	195 +
Personnel emoluments	N/A	23.5 *	24 x	30 x	N/A
Ratio between salary emoluments and other charges	N/A N/A	39.3% * 60.7% *	42% x 58% x	37.5% x 62.5% x	N/A N/A
Salary/Non-Salary Budget Ratio	N/A	2.3	N/A	2.72	N/A
National budget	4,664 *	5,769 *	N/A	N/A	N/A
MLFR share of national budget (%)	1.17 x	1.04 *	0.6 x	0.7 x	1.1 x
As a comparison: Defence budget	1,325	1,751	N/A	N/A	N/A
Defence budget's share of national budget (%)	28.4%	30.4%	N/A	N/A	N/A

Sources:
x PARC Study "Somalia Rinderpest Control Project"; MLFR, EEC, Republic of Italy, 1987
* Masterplan for Animal Health, 1985, FAO, Rome
\+ Somali Livestock Statistics 1989/90, 1990
\# Agricultural Sector Survey, 1986
@ PARC Evaluation Report, 1991, Rural Development International, Dublin

The ratio, similar to those found in West Africa, but considerably better than that found in states such as neighbouring Kenya (70 : 30) would, at fist glance, appear to be close to the 50 : 50 ratio found in Southern Africa and considered as the optimum by the authors. The figures, however, disguise the overall

disastrous economic situation in Somalia, where staff salaries and travelling allowances have been frozen since the 1970s, while the consumer price index quadrupled between 1977 and 1982 (FAO, 1985). In 1989 alone the consumer price index rose by a factor of 2.4 (Somali Livestock Statistics, SLS, 1990). Even after the introduction of a 50% rise in salaries in 1989 the salary of a senior veterinarian was equivalent to the price of 6 lb spaghetti, the staple diet in both urban and rural areas.

The MLFR budget almost quadrupled in the 6 years from 1983 to 1989, but accounted consistently for around 1 percent of the national budget (Table 1) although the livestock sector produced 41.5% of the country's gross domestic product (GDP) in 1988 and generated 66% of the total value of Somalia's exports. If we compare this with the defence budget, no longer taboo as a yardstick for assessing government services, it is clear that the size of a budget is in inverse proportion to the socioeconomic relevance of the sector for which it is granted, in terms of the development priorities of the country.

Staffing density and professional/support staff ratio are further indicators of the operational capability of a livestock health service (Table 2). The low number of support staff in Somalia makes the national professional / support staff ratio seem fairly high in comparison to a ratio of 1 : 20 recommended for extensive systems (de Haan and Bekure, 1991a). There are more support staff in the Central Rangelands, but it must be asked whether the professional district staff can ensure proper management of this manpower in the field.

Table 2: Somali veterinary service staffing density and Professional/ Support Staff - Ratio

	Total	CENTRAL REGION *		
	SOMALIA x	*Hiraan*	*Galgaduud*	*Mudug*
MLFR staff				
veterinarians (VET)	1910	1	2	3
vet. assistants (VA)	856	30	23	20
vaccinators (VACC)	566	18	11	11
Staff Ratio				
VET/VA	1 : 4.5	1 : 30	1 : 12	1 : 7
VET/VA and VACC	1 : 7.4	1 : 48	1 : 17	1:10

Sources:
x PARC Study "Somalia Rinderpest Control Project"; MLFR, EEC, Rep. of Italy, 1987
* Masterplan for Animal Health, 1985, FAO, Rome

Table 3: Distribution of manpower in the animal health sector (Agriculture Sector Survey [ASS], 1986 and Masterplan for Animal Health, FAO, 1985)

	Masterplan 1985 absolute		ASS 1986 absolute	
Capital (*Muqdisho*)				
Ministry administration	14		25	
Faculty Vet. Science, SNU	-		30	
Animal Science School	11		92	
Serum and Vaccine Institute	27		25	
National Range Agency	5		1	
Others (Port, Projects, etc)	4		17	
Subtotal	61	46.6%	107	56.3%
Regions				
Regional Veterinary Service	57 *		37	
Regional Diagnostic Laboratories	-		10	
Ports	-		10	
Others (Meat Factory, etc.)	-		2	
Subtotal	57	43%	59	31.1%
Field Projects				
Tsetse Project	13		19	
Other Projects	-		2	
Subtotal	13	9.9%	21	11.1%
Overseas Training	-	-	3	1.6%
TOTAL	131	100.0%	190	100.0%
CAPITAL/FIELD RATIO				
including projects	.9		1.3	
without projects	1.1		1.8	

* including laboratories and ports

As regards high-level professional staff (veterinarians) manpower distribution within the animal health sector (Table 3) is another constraint facing the veterinary service. The capital/field ratio is extremely low, ranging from 0.6 to 1.1. Only about one third of all Somali veterinarians work in the field. The time veterinarians actually spend at their field post is also considerably lower than these figures suggest, in view of the fact that they are required to report in person to headquarters for all issues relating to drug and vaccine supply, operating funds etc., compounded by the magnetic attraction the capital appears to have. This, in turn has a drastic impact on animal health care delivery where it is most needed.

De Haan and Nissen (1985) advocate the livestock/staff ratio as one of the best indicators when assessing the staffing level and subsequent performance of veterinary services. The livestock/ staff ratio is expressed in veterinary livestock units (VLU) per veterinary staff member. Table 4 shows that there are marked differences between the various staff categories nationwide, and between the various parts of the Central Region. The Somali levels fall short of standard staffing levels for preventive disease control in nomadic and sedentary systems of one veterinarian per 240,000 VLUs and one veterinary assistant per 12,500 VLUs (GTZ/SEDES, 1977), and also of the level of one veterinarian per 30,000 VLUs for preventive and curative work in a traditional system as recommend by FAO. However, De Haan and Bekure (1991b) advocate a level of one professional staff member per 200,000 VLUs and one member of the support staff per 12,000 VLUs for disease prevention in extensive production systems. If all field veterinarian posts are included in the calculations (some District Veterinary Officer posts are actually staffed by senior veterinary assistants), the livestock / staff ratio in the Central Rangelands ranges between 170,000 and 300,000 VLUs per professional staff member - a distinctly better ratio than the national average. The figures look even better when support staff is included. When veterinary assistants and vaccinators are taken into account the average ratio comes to 35,000 VLUs per member of support staff, with figures for individual districts ranging from 22,000 to 57,000.

Table 4: Veterinary Livestock Units (VLU) in Somalia (based on De Haan and Nissen, 1985: 1 VLU equivalent to 1 cow or 1 camel or 10 small ruminants)

SOMALIA (TOTAL)		CENTRAL REGION			
		Hiraan	Galguduud	Mudug	Subtotal
Species	Livestock Numbers				
Camel	6,294,240	535,210	468,130	890,550	1,893,890
Cattle	4,636,230	203160	285,700	404,170	893,030
Sheep and Goats	31,297,440	1,867,600	2,926,660	4,990,740	9,785,000
VLU	14,060,214	925,130	1,046,496	1,793,794	3,765,420
No.veterinarians	191	1	2	3	6
VLU/Veterinarian	73,614	925,130	523,248	597,931	627,570
No.RVCs and DVOs	29	4	6	6	16
VLU/RVC and DVO	484,835	231,283	174,416	298,966	235,339
No. vet.assistants	856	24	23	20	67
VLU/vet.assistant	16,425	38,547	45,500	89,690	56,200
No. vaccinators	566	18	11	11	40
VLU/vaccinator	24,841	51,396	95,136	163,072	94,136
No.vet.ass. and vaccs.	1,422	42	34	31	107
VLU/supp. staff	9,888	22,027	30,779	57,864	35,191
All staff	3,035	85	70	65	220
VLU/all staff	4,633	10,884	14,950	27,597	17,116

Sources: Somali Livestock Statistics 1989/90, 1990; Agricultural Sector Survey, 1986

Education

Somalia's veterinary service can generally recruit junior staff from the Faculty of Animal Production and Veterinary Medicine at the Somali National University and the Institute for Animal Science in *Muqdisho*.

The first veterinarians graduated from the faculty in 1973, and by 1984 215 students had graduated (CTA/GTZ/ODA/CTVM, 1985). Dropout rates during the five-year course are high, however, principally because the language of instruction is Italian (one third of all teaching staff are Italians on short-term assignments) and too little attention is paid to practical skills in any discipline relevant for subsequent field work.

Formal training for mid-level technicians was launched in 1967 at the Institute for Animal Science. The initial two-year course was extended to a three-year one, and entry requirements were modified. Courses are run for animal health assistants, laboratory technicians and meat inspectors, as well as animal production assistants. It is estimated that some 1700 trainees had completed the courses by 1985 (ASS, 1986). Figures provided by the Director of the Animal Health Institute at the First National Veterinary Symposium (Hayles, 1986) point to a total of 521 animal health assistants, 74 laboratory technicians and 80 meat inspectors educated by 1986. Figures show that the majority of veterinary assistants [FAO, 1985: 478; PARC Study 1987: 856; Rural Development International, 1991: 466: Total personnel in Livestock Service: 1284 (220 veterinarians, 598 others)] and laboratory technicians (FAO, 1985: 33) working in the government veterinary service had been trained by the Institute, but that a number of those having successfully completed training turned to jobs outside the animal health sector.

To sum up briefly, figures on human resources in the governmental veterinary service clearly indicate a pressing need for additional and well qualified manpower in the field if the service is to have any impact on the needs of the pastoral livestock producer for preventive and curative animal health services. It is questionable whether the public sector alone can meet this demand, since renumeration must keep pace with the cost of living. Alternatively, other means of animal health delivery must be devised.

Services Offered and Activities

The main activities of the Veterinary Service comprise:

- therapeutic measures, i.e. animal treatment
- disease prevention, i.e. livestock vaccination
- sales of prophylactic drugs, i.e. acaricides.

A lack of even the most basic surgical instruments and husbandry equipment means that curative services are limited to treating minor wounds, where they are performed at all. Diagnostic services are available, but deal only with samples submitted to the Regional Diagnostic Laboratories in *Hargeysa* (World Bank-supported), *Burco*, *Baidoa* and *Kismaayo* (GTZ-supported), *Beledweyne* (GTZ Veterinary Component) with sub-laboratories in *Dhuusamarreeb*, *Gaalkacyo*.

The Central Veterinary Laboratory - Serum and Vaccination Institute (SVI) in *Muqdisho* has two main functions (FAO, 1985): "(1) production of all commonly used animal vaccines for the country, and (2) provision of a sophisticated diagnostic service for the whole country, particularly for the field service and a back-up for the regional laboratories". Although support in terms of finance and manpower was provided by the UNDP / FAO, the SVI's main thrust is vaccine production. Rinderpest, sheep pox, contagious caprine pleuropneumonia (CCPP; *Mycoplasma mycoides capri)* and contagious bovine pleuropneumonia (CBPP) are some of the vaccines produced.

Table 5: Vaccine production, vaccination figures and Rinderpest vaccination coverage, 1980-1989, Somalia

RINDERPEST

Year	vaccine produced (1,000)	cattle vaccinated	cattle population (1,000)	vaccination coverage
1980	5,187	712	4,358	16.3%
1981	N/A	706	4,473	15.8%
1982	1,498	492	4,578	10.7%
1983	600	1,483	4,201	35.3%
1984	1,500	787	4,296	18.3%
1985	N/A	324	4,360x	7.4%
1986	N/A	491	4,426x	11.1%
1987	N/A	616	4,492x	13.7%
1988	N/A	186	4,560x	4.1%
1989	N/A	N/A	4,628	N/A

Sources: - Masterplan for Animal Health, 1985, FAO, Rome;
Somali Livestock Statistics 1989/90, 1990; Hübl, 1986
x Calculated after Hübl with 2% annual increase

Table 6: Vaccine production, vaccination figures and vaccination coverage for contagious caprine pleuropneumonia (CCPP), 1980-1989, Somalia

CCPP

Year	vaccine produced (1,000)	goats vaccinated	goat population (1,000)	vaccination coverage
1980	2,233	427	17,000	2.5%
1981	1,701	N/A	18,000	N/A
1982	961	729	19,000	3.8%
1983	1,720	185	18,000	1.0%
1984	1,199	606	18,300	3.3%
1985	N/A	783	19,400x	4.0%
1986	N/A	558	19,400x	2.9%
1987	N/A	301	19,400x	1.6%
1988	N/A	200	19,400x	1.0%
1989	400	N/A	19,400	N/A

Sources: - Masterplan for Animal Health, 1985, FAO, Rome;
Somali Livestock Statistics 1989/90, 1990; Hübl, 1986
x No figures available, thus, figures for 1989 have been used

Tables 5 and 6 illustrate vaccine production and vaccination figures for selected diseases. It is quite clear that the vaccination coverage (number of animals vaccinated and thus protected as a percentage of the total number of animals - a vaccination coverage of at least 80% if not 90% must be achieved for effective control of Rinderpest for instance (IAEA, 1991) - bears no relation to the production potential of the SVI for rinderpest and CCPP, two major livestock plagues. Although no details of vaccination coverage are available for individual regions and districts, it can be safely assumed that not even small-scale area coverage was achieved. Vaccination activities were sporadic and untargeted, determined not by sound understanding of disease patterns or immune status of the population, but by fuel supply and the availability of allowances.

Apart from disease prevention activities, animal treatment figures are useful indicators when analysing the working performance and capacity of an organized animal health service. Figures for treatment of trypanosomiasis, ecto- and endoparasites and "non-specific" diseases (everything else, according to the

MLFR classification) are given in Table 7. The relatively high number of ectoparasite treatments are not based on actual treatments administered by veterinary staff, but are calculated to fit the ministerial balance sheets for acaracides. The low number of animals treated for endoparasites (with anthelmintics) and for so-called "non-specific" diseases, including infectious diseases, (treated mainly with antibiotics) in no way reflects the extent of incidence and the impact these diseases have on livestock production. The treatment figures reflect more the amount of drugs and stocks available which, in turn, is linked to the amount of foreign exchange provided by the treasury.

Table 7: Percentages livestock treated for trypanosomiasis, ecto- and endo-parasites, and "non-specific" diseases, 1980-1989 in Somalia, and 1989 in the Central Rangelands

Total Somalia:		Trypano-somiasis	Ecto-	Endo- parasites	Non-specific diseases
Year	no. of animals (1,000)	% treated *	% treated	% treated	% treated
1980	37,458	17.1%	28.4%	1.9%	7.0%
1981	39,287	11.0%	24.6%	7.2%	3.0%
1982	41,397	10.2%	28.1%	3.6%	2.4%
1983	39,532	17.9%	35.4%	5.6%	4.5%
1984	40,558	12.2%	45.6%	9.5%	3.6%
1985	42,227	6.7%	37.8%	2.3%	1.8%
1986	42,227	15.8%	35.2%	7.9%	3.4%
1987	42,227	12.2%	29.7%	4.3%	3.3%
1988	42,227	21.2%	30.3%	2.2%	2.8%
1989	42,227	18.0%	32.3%	6.6%	6.5%
Central Rangelands:					
1989	12,570	9.1%	19.2%	5.4%	4.7%

Sources: - Masterplan for Animal Health, 1985, FAO, Rome;
Somali Livestock Statistics 1989/90, 1990; Hübl, 1986
* calculated from no. cattle and camel (1980: 10,158; 1981: 10,487; 1982: 10,817; 1983: 10,332; 1984: 10,458; 1985 - 1989: 10,930)

The figures for trypanosomiasis are difficult to evaluate since no distinction is made between camel trypanosomiasis (*Trypanosoma evansi*), which is mechanically transmitted by biting flies and is thus not limited to a certain geographical area, and cattle trypanosomiasis (*Trypanosoma spp.*), which is cyclically transmitted by tsetse flies and is limited to the tsetse belt. These therapeutic measures do, however, account for a major part of all animal health delivery activities of the government service, which shows the constant demand for curative treatment.

To sum up briefly, services performed by the government veterinary structure are subject to budget constraints and priorities in livestock disease control, if identified at all, are poorly defined. The result is that scarce resources in terms of manpower, logistics and finance are not assigned in line with sound animal health control strategies, and the relevant action taken to the benefit of pastoralists.

A COMPLEMENTARY APPROACH: THE NOMADIC ANIMAL HEALTH AUXILIARY SYSTEM (NAHA SYSTEM)

Background

In most of sub-Saharan Africa veterinary care has been deteriorating progressively over the last decade in terms of quantity and quality (CTA/GTZ/ODA/CTVM, 1985). In some parts of Africa not even a marginally sufficient delivery level from the stance of the livestock producer has ever been achieved, either during the colonial period or since. Somalia is one country, but not the only one, where even this level of care has never been reached throughout the country in general and in the Central Rangelands in particular from where about 60 - 80% of the country's goat exports and 30 - 40% of its sheep exports originate (Mascott Ltd., 1986). As described above, the government veterinary service is operating at the limit of its financial, infrastructure and manpower resources. Thus, immediate and appropriate steps must be taken to meet the pressing demands of nomadic and transhumant livestock producers for appropriate, practical, prompt and efficient animal health care. Innovative approaches and strategies must be developed and put into practice.

Primary animal health care programmes which attempt to reach individual producers and meet some of their most felt needs can be useful adjuncts to effective disease control and livestock production improvement at national

level and at herd / flock level, particularly as a way of gaining the confidence and cooperation of herders in remote pastoral areas (Baumann, 1990). In concert with most of the sub-Saharan African states the idea of primary animal health care in Africa was propagated in conferences in Bujumbura (CTA/GTZ/IEMVT, 1984), in Blantyre (CTA/GTZ/ODA/CTVM, 1985) and in Bangui (GTZ/IEMVT, 1988), and it was agreed to incorporate the concept into national livestock policies. The basic concept is based on recommendations of field researchers (Schwabe, 1980; Halpin, 1981; Sandford, 1983) and international development agencies such as the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH (Brückle, 1983) and the Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux (IEMVT).

The "Somali answer" to primary animal health care delivery is the Nomadic Animal Health Auxiliary System (NAHA System), first designed and introduced by the GTZ/CRDP veterinary component.

Impact of the NAHA System on Animal Health Delivery in the Field

The principles involved in the concept or in the practical implementation are renounced here, since this topic is dealt with in chapter 6 by Zessin et al. This section will focus at the technical evaluation of the NAHA system from the viewpoint of supporting Somalia's veterinary structure in general, and complementing the government veterinary service in particular.

Figure 3 shows the linkage at grass-roots level, i.e. the *degaan* (communal grazing area) and the "villages", and the branching out of animal health delivery to pastoral producers in the Central Rangelands. In areas which boasted nothing more than a few black market drugs, well past the expiry data or inappropriate, and a handful of old, barely serviceable syringes before the NAHA programme was launched in 1986, the herdsmen could not fail to be struck by the difference. It can also be seen that trainee selection is community based, and that one integral task of the village committees and associations is to monitor the performance of "their" NAHA.

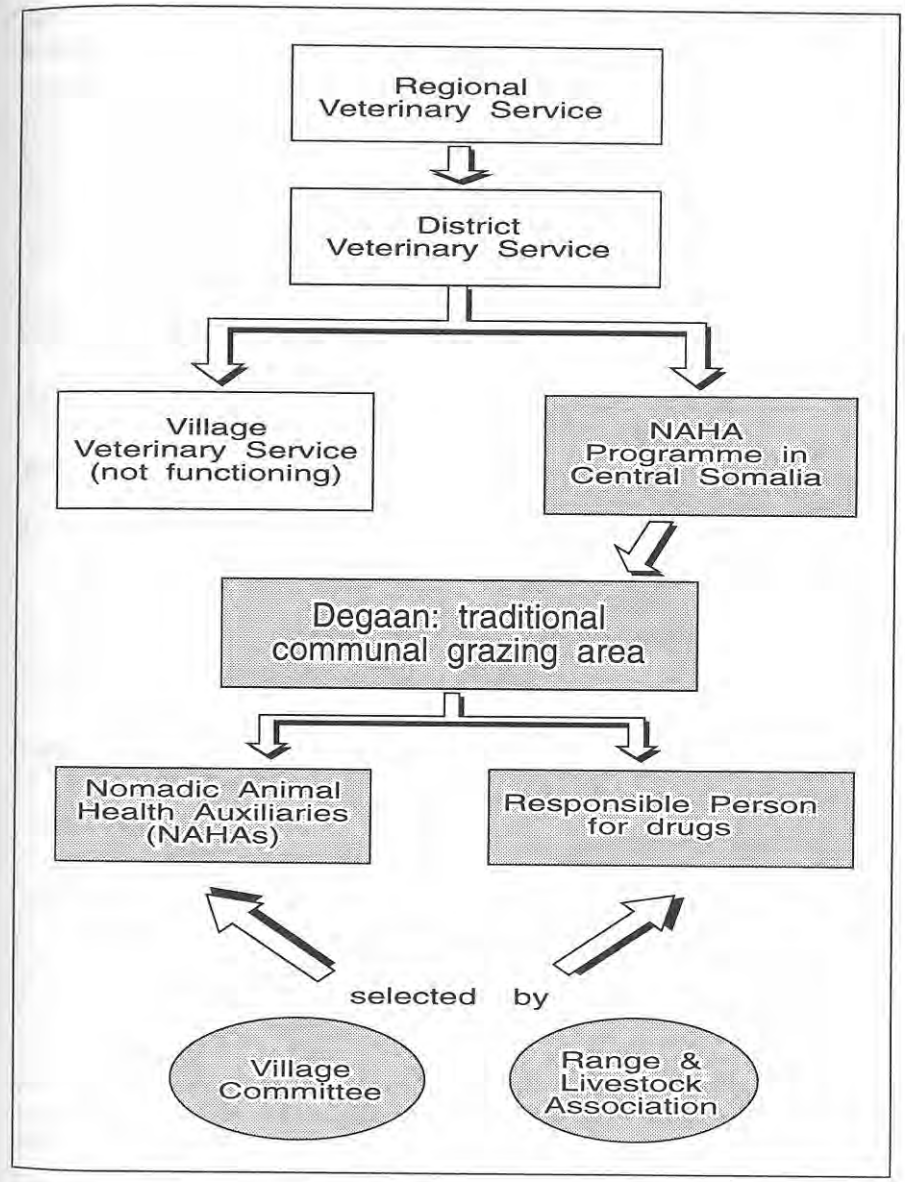

Figure 3: Diagram of the NAHA-System
Source: after Baumann, 1990

The impact on animal health manpower and on the livestock/staff ratio is striking (Table 8). With the NAHA programme raising manpower by between 50% and 550% , the VLU to supportive staff (veterinary assistants) ratio also fell by between 20% and 50%. Figures for the Central Regions are now approaching recommended levels. This programme involves no additional financial burden on the MLFR budget, while an indirect (quantifiable though not yet quantified) contribution is made to the household income of the pastoralist thanks to improved livestock health and, subsequently, improved productivity.

Table 8: Impact of the Nomadic Animal Health Auxiliary Programme (NAHA Programme) on animal health manpower and Livestock/ Staff Ratio in central Somalia

	Hiraan Region	Buulobarde District	Galguduud Region	CeelDheere District	Mudug Region	*Hobyo* District
PERSONNEL						
Veterinary Assistants	30	7	23	4	20	4
Nomadic Animal Health Auxiliaries (NAHAs)		19		12		22
INCREASE IN MANPOWER	63%	271%	52%	300%	110%	550%
EFFECT ON WORKING CAPACITY						
VLU/Veterinarian Assistant	18,880	N/A	29,900	N/A	42,709	N/A
VLU/Veterinarian Assistant ratio reduced thanks to NAHA by	51%	N/A	34%	N/A	24%	N/A

Auxiliaries were trained in the field to overcome the shortcomings already mentioned in terms of practical knowledge transfer within the formal structures. Training needs had already been identified on the basis of an epidemiologically sound baseline survey on disease and production, and on empirical findings in the course of field work. The opportunity for continuous problem-oriented training was much appreciated by the NAHA.

Services Delivered to Nomadic-Pastoral Livestock Producers through the NAHA System

Table 9 shows remarkable figures for curative services performed by NAHAs. In two districts - in 1986, the Central Regions comprised 12 districts (Mascott Ltd., 1986) - where the programme was already fully operational in 1987, up to one eighth of all antibiotic treatments in Central Somalia were administered by these trained auxiliaries. This corresponds to an average of seven injections against infectious diseases per day, generally administered to small ruminants. This is a result worthy of acknowledgment when we compare it with the average of 12 treatments per day performed by full-time professional staff in the government service.

Table 9: Examples for drug supply and subsequent treatments in two selected NAHA districts in 1987 and 1988 in Central Somalia

1987

Drug	Quantity	Monetary value in SoSh *	Treatments (tx) total (% of all tx in Central Regions)	per NAHA total	per NAHA per day
Trypanocides					
for camel	4,400 dosages	601,150			
for cattle	2,920 dosages	116,800	7,320(02.8)	236	0.8
Oxytetracyclin +	1,560 bottles	372,000	78,000(13.2)	2,515	6.9
Anthelmintics +	8,000 dosages	63,360	20,000(02.9)	645	1.8%
1988 (first six months)					
Trypanocides					
for camel	950 dosages	122,000			
for cattle	1,150 dosages	46,000	2,100	68	0.4
Oxytetracyclin +	1,560 bottles	58,800	14,000	451	2.5
Anthelmintics +	17,000 dosages	302,600	44,500	1,436	7.9

\+ dosages and treatments calculated for adult small ruminants

* exchange rate: 1 US $ = 100 SoSh

One call a day to a camel or cow with *dukan* or *gosha* (the vernacular terms for trypanosomiasis) became part of the daily routine of a NAHA.

The main focus of the NAHAs' work was treatment with anthelmintics often as a curative measure against worms and diarrhea, but also used in a prophylactic way for all gastro-intestinal parasites. While not every single dose was administered by the auxiliary himself he was the one to give advice to the livestock owner as to proper dosage and use. This, combined with the swiftly visible effect of the drug - shiny coat, weight gain, and better performance of the treated animal - led owners to pursue a "strategic deworming policy". Rams and bucks to be sold for export to the Arabian Peninsula were dewormed and then separated from the rest of the flock for finishing.

Table 9 also gives both the annual figures and shows the seasonal variation in drug demand, partly as a result of the disease situation. Particularly for anthelmintics (8 treatments per NAHA per day in the first half of 1988 as compared with 2 treatments per day in 1987 as a whole) it also reflects the stocks available in the country and those allocated to the NAHA programme.

After the NAHAs provided evidence of their skills in castrating male animals using the Burdizzo emasculator this zootechnical service was much in demand by pastoralists. The figures are impressive: a total of 8889 animals were castrated between February 1987 and November 1988, which amounted to one castration performed every two days by each NAHA.

Potential of Primary Animal Health Care Programme Implemented

A human resource survey carried out among the NAHAs themselves revealed that their capacity is not yet fully exhausted (Table 10). NAHAs activities are determined primarily, indeed almost exclusively, by the prevailing disease situation in their *degaan* and "villages". For more details see Baumann (1990) and Zessin, Nuux and Baumann (1988). While bearing in mind the auxiliaries year-round involvement in livestock raising their working capacity for veterinary activities is naturally subject to major seasonal variations. Other differences from one district to another can be explained by looking at factors such as livestock density, range conditions, infrastructure and management practices. In *Hobyo* long distances must be covered (on foot) between livestock "camps" even within a common grazing area, but the herd/flock size is larger than in other districts. At *Nooleeye*, for example, there is a motor pump-driven well, which is used by many herders, which means that large numbers of livestock can be treated at the well site without spending time travelling. The trend towards sedentarization around the well, with emphasis on agropastoralism seems to point to a further potential expansion in the work for NAHAs.

Table 10: Actual performance and future potential of NAHAs in central Somalia

NAHA working areas:		*Hobyo*	*Buulo-barde*	*Ceel Dheere*	*Nooleeye/ Maxas*
Treatments (tx) per day based on NAHAs own estimates of working capacity					
		2 x more	3 x more	5 x more	6 x more
Trypanocidal Tx	1987	1.2	1.8	3.0	3.6
	1988	.8	1.2	2.0	2.4
Antibiotic Tx	1987	13.8	20.7	34.52	41.4
	1988	5.0	7.5	12.5	15.0
Anthelmintic Tx	1987	3.6	5.4	9.0	10.8
	1988	15.8	23.7	39.5	47.4

Though caution should always be exercised when interpreting an individual's own perception of his or her workload, the "maximum" calculated - 4 trypanocide treatments, 41 antibiotic treatments and 47 anthelmintics applications per day - is achievable, and could well be stepped up by more than as expressed by the applied factor of six given an uninterrupted, adequate supply of appropriate drugs. However, two conditions must be met: there must be a functioning revolving drug fund and an operational disease intelligence system. Both have already been set up, but within the context of this study we will look in more detail at the latter.

Disease intelligence was always closely linked to supervision of manpower and drug management, in terms of information retrieval in the field. As experience with the NAHA programme has shown, primary animal health care delivery in nomadic-pastoral areas can form a solid basis for identifying disease patterns, monitoring the endemic situation (with particular regard to the endemic stability of tick-borne diseases), and recognising likely constraints to production.

Should an epidemic break out (an epidemic is defined as the unexpected increase in disease or death, reaching a level which exceeds two standard deviations above the mean) a powerful task force is already deployed in the field and can take prompt action.

FUTURE PROSPECTS

As demonstrated the implementation of this primary animal health care programme, the NAHA system, has made a significant contribution to the benefit of nomadic-pastoral livestock producers in Central Somalia. This programme has gained increasingly in popularity and has served as a model for a similar programme initiated by the French project, "Development of Oasis in Northern Somalia". The concept presented here stimulated a discussion process among other donors and non-governmental organisations (NGOs) working in rural self-help programmes.

Since NAHA services are not subject to rigid regulations, other disease prevention activities can be incorporated in their work as required, such as support in vaccination campaigns. The disease intelligence system already established at herd/flock level is to be expanded and stepped up to make a national livestock health surveillance system. In this way the government veterinary service will benefit from the potential and the flexibility of the system in a cost-effective way. By complementing the governments veterinary service, rather than competing with it, the NAHA system will continue to meet demand in the field, and possibly open up new avenues to the private sector for innovative animal health delivery.

As soon as civil disturbances cease, which it is hoped will be in the very near future, the Nomadic Animal Health Auxiliary Programme can be resumed rapidly if essential support in terms of equipment, training and logistics is provided by external sources.

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SIMULATION MODELS FOR THE IMPACT OF DROUGHT ON SMALL RUMINANT FLOCKS IN CENTRAL SOMALIA

Karl-Hans Zessin and Horst Jürgen Schwartz

INTRODUCTION

Animal agriculture projects, having a lower success rate than crop projects, have often disappointed governments and external sponsors in sub-Saharan Africa (World Bank, 1985). Among animal agriculture projects, those to improve nomadic pastoralism in particular have been the least successful. There were two key reasons for these failures. Firstly, attempts to replace traditional systems with new production forms underestimated the efficiency of the traditional range-livestock systems. In the second place, the complexity of the systems was also underestimated and information was lacking on indigenous pastoralism as a system, particularly with regard to interactions and interdependencies of eco-climatic factors, rangeland conditions, husbandry practices and the biological performance of herds and how they adjust to changes in external factors such as drought.

Development planners, researchers and project implementors therefore lacked quantitative data to make informed decisions as to what type of interventions to implement and at what level these interventions should be applied.

Some ways of providing such needed data are extended field observations and live animal experiments. Often, however, such data tend to be disparate and because they are taken at fixed points in time, do not provide a representative picture. Point estimates distort the true dynamic nature of the system and can result in a misinterpretation of the potential response of herds to measures. For example, it is often assumed that forage quality is some static value year round. Although known to be incorrect, such simplifying assumptions are constantly applied in efforts to gain an insight into ways of altering a production system.

The fact of the matter is that animal production systems are not simple, and as long as we treat them as such our projects will continue to have limited impact. As we now begin to consider small ruminants and the role they play in sustainable agricultural systems, the complexity of the systems will completely overwhelm the traditional way of investigating and implementing livestock projects.

Instead of protracted and expensive field investigations, systems analysis by computer simulation offers a solution for planners and implementors towards achieving their goals. Such a method permits a systematic consideration of the entire production system. Systems analysis takes into account the various components of a system and the interaction between them. Furthermore, because the system is linked to external influences, e.g. fluctuation in forage quality, the dynamics of the entire production system can be observed with much greater accuracy than approaches which assume constant year-round values.

In Somalia, recurrent droughts are a problem confronting all livestock species. With small ruminants having particular importance, a large part of the difficulty is in assessing how flocks of sheep and goats should be handled in case of these droughts not knowing what the impact of drought will be but also how long it takes the flocks to recover from drought. To make the issue even more complex, the effect of flock size and how that impacts the rebuilding capacity needs consideration.

In order to provide some assessments of the short term effects of a localized drought upon entire flocks and upon individual animal classes in them a series of computer simulations was carried out. A particular question addressed was how flocks of varying sizes rebuild themselves in post-drought years, when weather and forage conditions have improved. Attention also was given to longer-term readjustments in years following recovery from a local drought. Of particular interest were the magnitudes and time series sequences of events

pertaining to classes of animals in flocks under a scenario where the environments shifts from years with average rangeland condition, to a drought spell, and then recovery years back to predrought rangeland conditions.

Models were used to simulate the physiological mechanisms and variables of fertility, mortality and population growth or decline among animal classes during these successive years. Differences between small and larger flocks provided information on their offtake, hence development potentials in terms of income for their owners.

MATERIALS AND METHODS

The Texas A&M University (TAMU) sheep and goats simulation models (Blackburn et al., 1987; Blackburn and Cartwright, 1987) were used. These models perform analyses of small ruminant systems under particular environmental, husbandry and offtake conditions. These conditions include the absence of epidemic diseases.

The TAMU models simulate the performance of individual female and male stock in 5 classes (lambs/kids, weaning stock, replacement stock, breeding stock) in their nutritional and management environments. Animal weight, reproduction, milk production, forage intake, mortality and offtake are simulated for each animal across time. The models use time steps of 15 days.

Model parameters for flock structures were based on data from 125 small ruminant flocks, collected between 1984 and 1988 (Zessin et al., 1988). Initially, four preparatory model runs were made to establish the proportion of goats and sheep in a "small" and a "large" model starting flock. The sizes and population structures of the model flocks approximated flock composition experienced in the field. Small and large flocks contained the same species, age and sex compositions, and thus differed only in the number of animals in model classes (Table 1).

Model specifications for flock management were representative of those used in Central Somalia where goats and sheep are herded together and used for various commercial and non-commercial purposes (Table 2). Only goats are milked and predominantly male surplus stock, of both species, are sold to generate cash income, slaughtered for household consumption, or used to fulfill social and religious obligations. Except for replacement breeding males, all male stock between one and three years old, of which about 30% are castrated (Bourzat et al., 1991), are sold to traders or at markets.

Table 1: Absolute numbers and relative frequencies () of male and female sheep and goats age group in small and large model start flocks (from headcounts of flocks)

	Age group					
Category	< 1Y	1-2Y	2-3Y	3-4Y	4-5Y	> 5Y
Small Flock						
Sheep:						
Females	7 (19.3)	4 (10.7)	5 (12.5)	7 (15.7)	5 (13.4)	4 (10.1)
Males	4 (10.3)	1 (3.0)	1 (2.2)	1 (1.5)	0	0
Total Sheep: 39						
Goats:						
Females	12 (18.9)	6 (9.9)	7 (12.1)	10 (16.2)	8 (13.5)	11 (16.1)
Males	4 (7.0)	1 (1.8)	1 (1.4)	1 (1.2)	0	0
Total Goats: 61						
Large Flock						
Sheep:						
Females	19	10	12	15	13	8
Males	10	3	2	1	1	0
Total Sheep: 94						
Goats:						
Females	29	14	17	24	20	22
Males	10	3	2	2	2	1
Total Goats: 146						

Table 2: Annual mean number and classes of animals used for productive offtake (established from herder interviews and long-term observation of flocks)

	kids/ lambs lost	young males sacrificed	home-slaughter	religious-	Sakko*	Gifts	Sales	Adults lost	Added
Small flock									
Goats (%)	**1.3**	**2.8**	**4.4**	**3.7**	**1.2**	**1.5**	**7.5**	**1.7**	**3.4**
Males (%)			51	43			58		
avg. age (Mo)			24	32			45		
Females (%)			49	57			42		
avg. age (Mo)			36	35			46		
Either sex (%)									
avg. age (Mo)					35				
Sheep (%)			**6.3**	**9.0**	**1.8**	**0.9**	**8.3**		
Males (%)			57	48			53		
avg. age (Mo)			25	29			40		
Females (%)			43	52			47		
avg. age (Mo)			43	33			50		
Either sex (%)									
avg. age (Mo)					35				
Large flock									
Goats (%)	**1.3**	**2.8**	**3.1**	**1.5**	**1.2**	**3.3**	**7.7**	**1.7**	**3.4**
Males (%)			64	25			50		
avg. age (Mo)			27	35	35		48		
Females (%)			36	65			50		
avg. age (Mo)			64	45			56		
Either sex (%)									
avg. age (Mo)					41				
Sheep (%)	**1.3**	**2.8**	**4.2**	**11.8**	**1.7**	**5.5**	**16.4**		
Males (%)			72	54			55		
avg. age (Mo)			32	28			41		
Females (%)			28	46			45		
avg. age (Mo)			56	34			61		
Either sex (%)									
avg. age (Mo)					38				

* Sakko = help for the poor, amount according to the Koran.

Older and often barren female stock is culled for meat when older than 7 years. Young females are rarely slaughtered.

During the worst of the long dry season *jiilaal*, herders kill young male kids when conflict over milk arises between them and the subsistence needs of the family.

"Management" in the models, i.e. the transfer of animals from one class to the other reflected husbandry methods observed in the field. For example, lambs and kids are weaned at about 5 months; breeding, particularly of goats, is uncontrolled and continuous year-round, female and male replacement stock start breeding with earliest sexual activity before reaching mature age or weight. Therefore, parameters for transferring male and female replacements into breeding classes in the models were set at an early age (5 months for females and 12 months for males or minimum weights of 18 kg for both sexes).

Simulation scenario

A scenario was simulated of five base years (BYs) with "average" range conditions, then one drought year (DY), followed by one recovery year (RY1) with favourable rangeland conditions after rainfall, a second recovery year (RY2) with conditions intermittent between BYs and RY1, and finally five follow-up years (FY) with again "average" conditions. In the drought year (DY), the *gu'* spring rains were less than normal and *dayr* fall rains failed completely, a typical circumstance for Somali local droughts. The dry spell extended into the first 3 months of RY1 until *gu'* rains exceeding the normal amount arrived. *dayr* rains in RY1 were normal. In RY2, *gu'* rains again were good but less than those of RY1 and *dayr* rains were again normal. In the subsequent 5 follow-up years, seasonal climates were those of the base years.

In the models, the management of animal classes reflected herders customs in these years. As herders attempt to maintain as large and productive a female breeding nucleus as possible, the decrease of female breeding stock during DY and RY1 was kept at a minimum, i.e. no female stock was sold and the culling age of old females was extended from 7 to 9 years.

With the recovery of the flocks beginning in RY1, the culling age was set back to 7 years. However, the use of animals for social and home purposes still remained half of that in the base years. In FYs, when the female flocks had nearly reached their pre-drought numbers again, transfers of females was

brought back to BY levels. As from follow-up year 3, all management parameters returned to those of the base years. Sales of surplus male stock continued throughout all years, as long as the animals fulfilled the requirements for sale, i.e. a minimum age of 20 months or minimum weight of 20 kg.

Varied forage parameters were set according to rainfall patterns in seasons and years. As no actual field data were available, forage parameters had to be estimated. Reports and estimates of experts who had worked in the area and data from comparable areas in northern Kenya (Herlocker and Dolan, 1980; Schwartz et al., 1986) served as starting estimates for the base years, used as reference years. These data were then fine-tuned until model results for bodyweights of mature does and ewes and other pertinent flock parameters (fertility and mortality rates) approximated the results obtained in the field investigations as closely as possible, within validation limits.

Simulation procedure

The goat and sheep portion of the flocks were simulated in separate models. Simulation results were determined separately for each species and then combined to assess the flocks as a whole. Results for individual female classes, essential for the reproductive success of flocks, were reported in detail while male classes were included in total flock size results.

RESULTS

Model validation

To validate the models, the actual and simulated average body weights of mature female goats and sheep were compared for the baseline years (Figure 1). During the entire year there was close and consistent agreement between simulated and actual weights. The average differences between observed and simulated weights, with the exception of July, were low, i.e. 0.9 kg for does and 1.3 kg for ewes.

Flock development

Total flock sizes and numbers of female sheep and goats in age categories of small and large flocks over the entire 13-year simulation period are illustrated in Figures 2a and 2b.

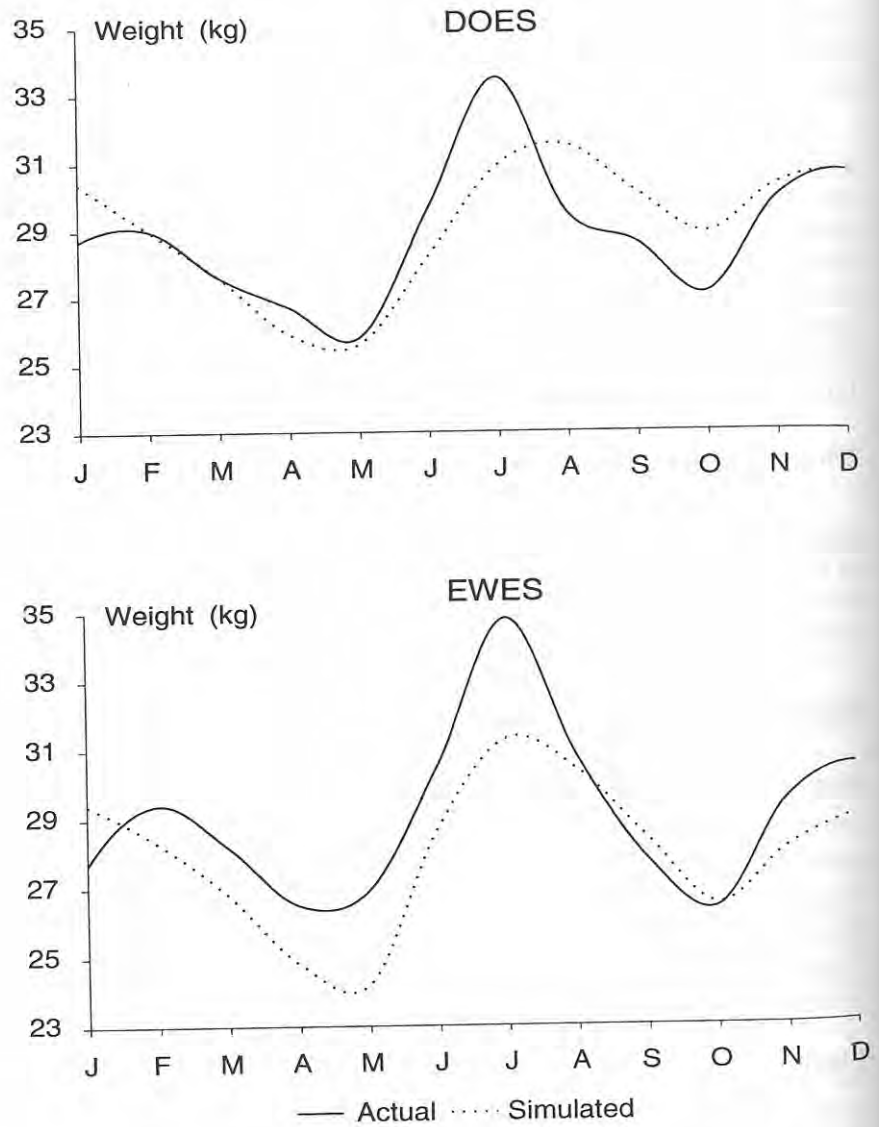

Figure 1: Monthly actual and simulated bodyweights (kgs) of breeding does and ewes

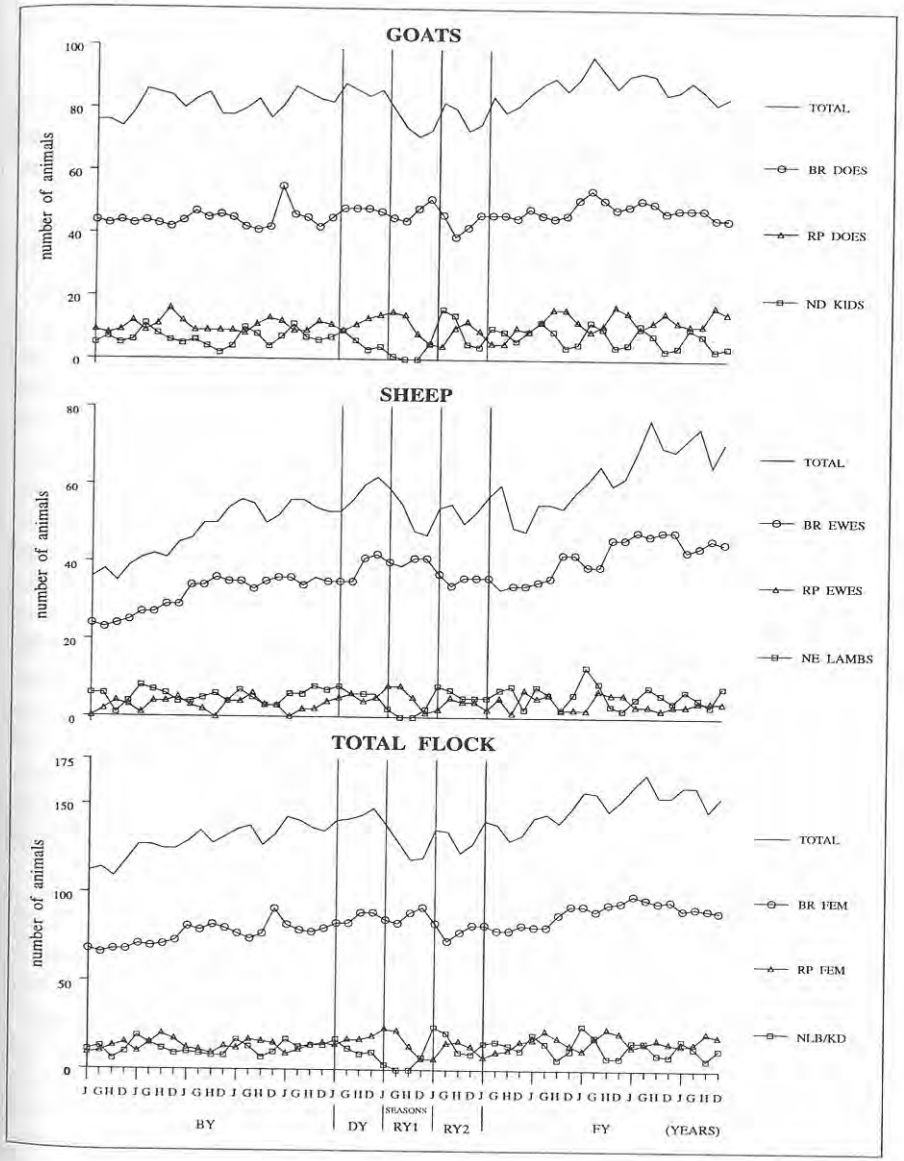

Figure 2a: Numerical development of goat and sheep portions, female animal classes and total flock sizes of **small** simulation flocks

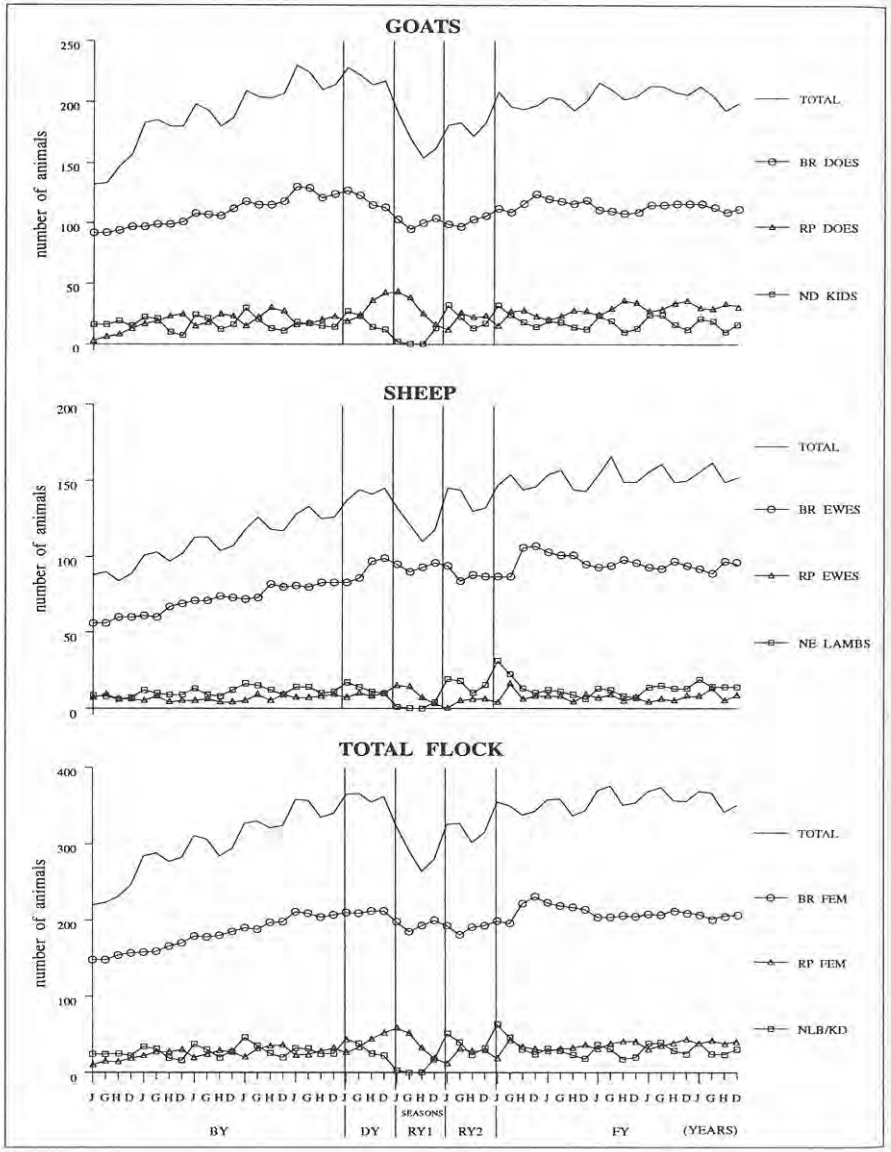

Figure 2b: Numerical development of goat and sheep portions, female animal classes and total flock sizes of **large** simulation flocks

Base Years

Over the 5 base years (BY) the proportion of goats in large and small flocks increased by 62 % (annual cumulative growth rate: 10.1%) and 7.9% (1.5% annually), respectively; sheep growth was 43% (7.4% annually) and 47% (8.0% annually) for large and small flocks.

In total, large flocks grew by 51.4% and small flocks by 20.5% over the 5 years.

The predominant lambing/kidding seasons are in *gu'* and *dayr*. The numbers of kids and lambs increase during these seasons until they are transferred into the replacement classes after weaning at 5 months. Numbers of replacement stock increase accordingly during the *gu'* and early *dayr* seasons and replacement females usually reach sufficient body size to be transferred into the breeding class during the second half of *dayr* or the beginning of *jiilaal*, or else in the second half of *gu'*. Because kids (lambs) and replacement females are transitory in their classes and move from one class up to the next in accordance with their age and condition, their numbers apart from seasonal fluctuations stayed fairly constant over the BY simulation period. In contrast, breeding does during this period increased by 35% and 2% in large and small flocks and ewes by 43 and 50 percent, respectively. As female breeding classes are the largest in a flock the total growth rate of a flock is chiefly due to increases in breeding females, while regular interannual fluctuations in flock size are due to varying proportions of male stock. Male stock numbers gradually increase during *jiilaal* and *gu'* following the lambing/kidding seasons; surplus males mature and reach sufficient weight for sale in the subsequent *xagaa* and *dayr* seasons and their numbers in flocks decreases accordingly.

Replacement does are less heavy than replacement ewes in both flocks. Replacement ewes, regardless of differences in climate and year, were between 2 and 6 kg heavier than replacement does. More importantly, over the 5 base years the age structure of replacement does in the large flock began to diverge from that of the small flock. At the end of the 5 baseline years replacement does in the small flock were on the average markedly older than those in the large flock. Model listings of measurements of individual animals revealed that both flocks contained a number of replacement does that did not meet the model requirements for transfer into the breeding group. These animals were overaged but of too low body size for transfer. Because the small flock had a low total number of replacement does, this portion of stunted replacements increased the

average age of their class. In the large flock, on the other hand, the larger total number of animals of normal age/weight in this class compensated for the proportion of stunted animals.

In the small flock between 9 and 15 replacement does were transferred into the breeding group annually. An equal number of breeding does left the flock as productive and unproductive offtake (mortality, other losses). In consequence, the breeding group of goats in the small flock did not change significantly in size. There were too few prolific replacement does to adequately replenish and increase the breeding doe class in this flock.

In the large flock, in contrast, the larger number of replacement does compensated for the relative proportion of retarded young females. With a larger number of young does entering into the breeding class than leaving the flock, there was a considerable net growth in flock size.

The number of stunted replacement ewes, in contrast to replacement does, was low in both flocks. Higher body weights of ewes were indicative of an overall better body condition of this class.

Drought year

Drought conditions started in *gu'* with less than average rainfall. A sequence of events followed, affecting flock classes in different ways and at different times.

The first class to be affected was the replacement stock (does and ewes). Their number increased as animals lost weight, became stunted and could not be transferred into the breeding group. The breeding class was therefore not replenished. However, as breeding females during the drought were withheld from any productive offtake, this class stayed fairly constant in size or even in the case of breeding ewes increased slightly. Replacement ewes, as mentioned, were heavier than replacement does: the stunting effect beginning later in them than in the lighter replacement does and the breeding ewe class, at least initially, was replenished.

Seasonal lambing (kidding) patterns were unaffected during DY. They were comparable to patterns during BYs but at a lower rate. The General Fertility Rate (GFR) from BY to DY dropped from 77.3% to 62.8%. However, lambs (kids) born in the *dayr* fall lambing season of the drought year were less likely to survive. *dayr* seasonal lamb mortality increased considerably and the annual Young Stock Death Rate (YDR) rose from 10.7% in BY to 23.1% in DY. The adult stock mortality rate remained at the level of BY.

Towards *dayr*, the daily milk production of does (ewes) dropped to below 100 ml from between 300 to 400 ml in BY.

Recovery years (RY)

With the drought extending into the first months (*jiilaal*) of the first recovery year (RY1), all remaining nursing stock of sheep and goats died, due to a complete cessation of milk production. By this time drought conditions had depleted female body stores and they were no longer able to produce milk. Also, weights of adult stock had decreased considerably leading to increased mortality. Replenishment stock lost weight and the average age of this stock class increased because they did not meet requirements for transfer into the breeding classes.

By the end of *xagaa* of RY1, both flocks were depleted of any nursing stock. Total flock sizes reached their lowest levels during this time, reflecting the inability of the flocks to produce lambs (kids) during the previous 12 months and due to some adult mortality. From *dayr* of DY to *xagaa* of RY1, flock sizes dropped by about 25 percent, settling slightly above those at the start of the simulation 6 1/2 years before.

The recovery of flocks began with the arrival of above-normal rainfall above normal values in late *gu'*/early *xagaa* of RY1. Different classes responded at different speeds. Improved forage immediately increased the body size of replacement stock. The transfer of replacement does and ewes into the breeding classes subsequently increased. The number of breeding females increased in RY2, parallel to a decrease in the number of replacement stock. By RY2, most of the replacement stock that had built up during DY and early RY1 had been transferred onward.

Some of the breeding females returned to breeding condition with the rains, leading to conceptions beginning in *gu'* of RY1. Subsequent first lambings (kiddings) began in *dayr*, signalling the recovery on flock sizes. Milk production increased with the beginning of kidding (lambing).

Regrowth of the flocks continued as favorable forage conditions improved in the first half of RY2. Flock fertility in RY2 was above 100 percent while mortalities were reduced. After two years (DY and RY1) with no productive offtake (culling age was extended from 7 to 9 years), productive offtake of adult females was resumed. Overaged females were culled from the flocks in the first half of RY2. The subsequent transitory drop in the number of breeding females was quickly replenished by new, post-drought replacement stock.

Follow Up Years (FY)

The immediate recovery of flocks in RY1 and RY2, years with improved forage conditions, did not continue in the follow-up years when forage reached base year availability levels again and when productive offtake also returned to pre-drought norms.

Vital flock statistics (GFR, CDR, YDR) readjusted from upswing levels during RY to BY levels. However, the rate of flock growth in the 5 FY was lower than during the five BY. Only marginal flock growth occurred for sheep. The advantage of a larger number of normally growing offspring in the recovery years - which had resulted in more and better replacement stock entering the breeding class - ceased during the subsequent FY years. Flocks in FY contained a larger proportion of overaged and undersized replacement stock, some of which were left over from the build-up during drought. Others were the results of readjustment of animal growth to another decrease in forage conditions during the FY. In consequence, the breeding classes were not replenished enough to continue flock growth. Rejuvenation of the replacement class by the influx of lambs/kids during a year only temporarily masked the fact that a sizeable group of overaged and undersized replacement females, unfit for breeding, had accumulated in the flocks.

The readjustment of flocks to normal forage conditions after the first post-drought upsurge thus eventually led to a different age structure in flocks, which included a replacement class less likely to mature into breeding stock. The momentum of immediate flock recovery after the local drought was neither maintained nor were pre-drought growth rates of flocks repeated when the range returned to normal levels after the short-term recovery upsurge.

Body condition and reproduction

The underlying interrelationship between the environment (rangeland forage), and the physiological (reproductive) status of females determine the reproductive capability of flocks and vary according to season and simulation year. These interrelationships are illustrated in detail in Figure 3.

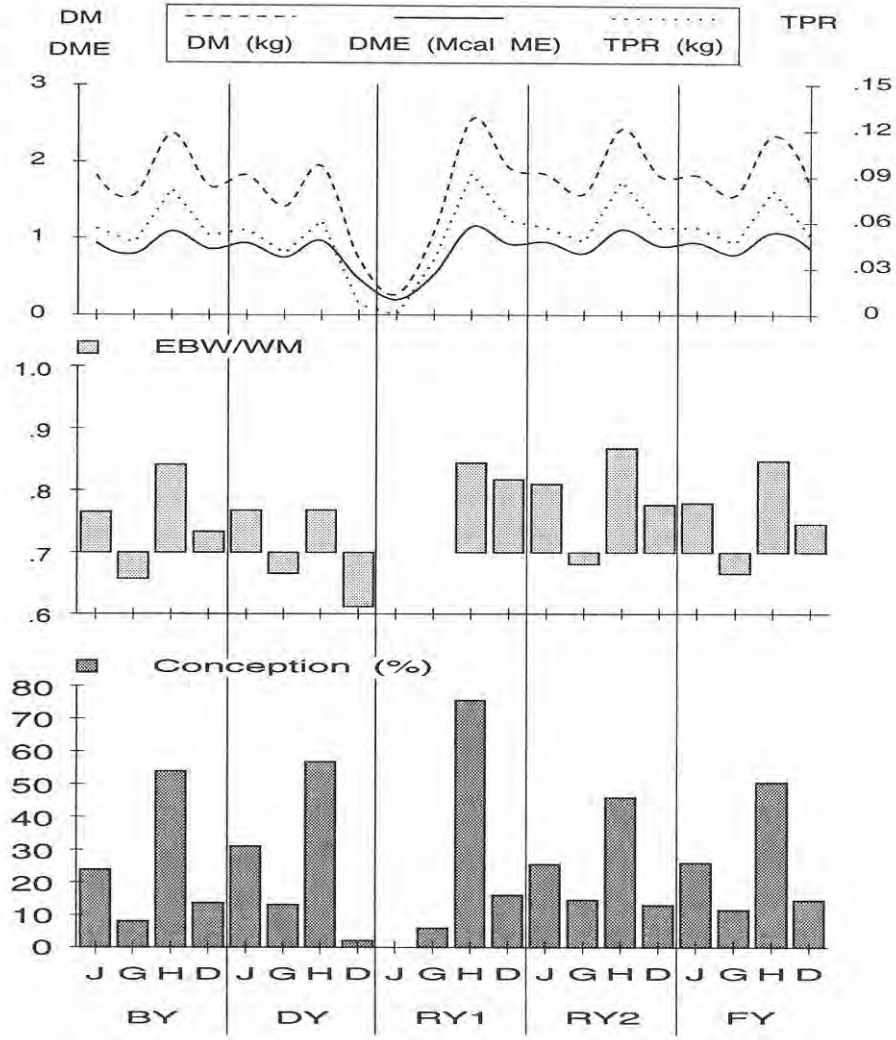

Figure 3: Relationships between model results for seasonal values of forage (DM, DME, TPR), body condition (EBM/WM) of does and relative frequencies of seasonal conceptions over the 13-year simulation. [BY = base years (average years); DY = drought year; RY1 = 1st recovery year; RY2 = 2nd recovery year; FY = follow-up years]

Conception was synchronized with body condition (EBW/WM) of females and body condition was linked to forage. Although Somali pastoralists seek to breed their flocks continuously throughout a year, environmental conditions limit reproductive activity to periods of improved forage. Forage is thus the limiting factor for year-round breeding and hence for lamb/kid production.

DISCUSSION

The study demonstrates that viable parameters collected from field investigations of flocks could be used in the TAMU models to characterize flock performance.

Although forage parameters in particular had to be approximated, the model output reflected flock parameters close to those observed. This suggests that the model structure, function and input parameters were appropiate.

Although the weather patterns for the various simulation years, represented by forage parameters, were fixed and hypothetical (whereas they may be more variable in nature), and offtake numbers used mean and fixed values (whereas offtake is likely to be more dynamic), the models nevertheless permitted an evaluation of the response of flocks under a fixed set of environmental and husbandry conditions. The models helped to formalize our understanding of the Somali small ruminant system and to generate and explore hypotheses on the reaction of flocks to regularly occuring droughts.

In particular, the models provided detail and insight on the direct and indirect effects of a local drought and how and when these affect the total flock, as well as the individual classes of sheep and goat as a proportion of the flocks.

Environmental effects were direct and indirect. Flock size was directly affected by reproduction and mortality while the indirect effects were through perturbations in the age-weight structure of the replacement classes of flocks.

Changes in reproduction and mortality rates under drought conditions were directly measurable in terms of animal numbers. This effect of drought on flock size and the magnitude of the effect is not new. But what is important is the assessment of which groups are more at risk and what time sequences are involved. Direct effects occurred with some time lag and created shorter-term intermittent gaps in the age structure of flocks. Flock performance gradually returned to normal values, given a sufficiently long period of forage conditions to assure a good plane of nutrition.

Disturbances in the precocity of replacement stock were more insidious. The effects were cumulative, with poor-quality stock being carried over from year to year. In the longer term they slowed flock growth after the intial recovery during the first good forage years. Both effects in combination had a strong impact on the offtake from flocks for subsistence and markets, not only during the later stages of the drought, but also for a long time afterwards.

Under prevalent husbandry conditions, the strong relationship between the animal's nutritional intake, the physiological status of females and flock growth is clearly a close one. Mating and conception stand in direct relation to the season, and hence to forage availability. Fluctuations in reproduction (including milk production) were as large as the variability of rainfall throughout the simulation periods. Nutritional deprivation already during the dry seasons of "normal" years decreases body conditions drastically, as females catabolize fat or muscle for maintenance and/or lactation. This finding provides circumstantial evidence for a nutritional anoestrus during the dry season. During the drought period the physiological mechanism of female reproduction was severely affected, to the extreme point where no conceptions took place, and lambs did not survive because milk production ceased.

Immediately with the recovery of the range, mature females regained or improved their body condition, suggesting little or no residual effects due to the drought on this class. Growing, immature females, in contrast, showed signs of stunting. The maturing process was arrested, the animals apparently having no body reserves to buffer initial drought effects. Their condition deteriorated immediately with the onset of the drought.

In Somalia, goats are used more intensively than sheep, in that they provide milk for both their own kids and for people. In a sense, kids are undersupplied from birth. This sometimes results in early stunting that may be carried over into older age groups.

In this situation random events in a flock greatly influence the flock's ability to accomodate to environmental setbacks such as a seasonal forage shortage or drought. With small numbers of offspring, the flocks's chance of having a sufficient number of normally growing kids to replace ageing breeding does is reduced. As a result, there is little or no increase in goat productivity. Both the number of replacement does and their age-weight structure have a major impact on the rate of flock growth in the particular Somalia environment. Owners of small flocks should be alerted to this limitation.

Marginal rangeland with poor forage quantity and quality are limiting factors for improving and intensifying animal production. Herders in Somalia have been moving from subsistence towards commercial production. This shift has been accompanied by a change in food consumption patterns towards market foods (Behnke, 1983, Abdullahi, 1990). This change, however, limits herders' options to sell or keep animals. Animals have to be sold regularly in sufficient numbers to pay for families' increasing dependence on market foods.

On the basis of this study, small herders have little chance at present to increase their sales of animal products given the ecological marginality of the central rangelands, the current technical status of production and the limited resource base. Either some other strategies for their market participation must be developed or they will eventually be forced out of the sector.

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PERSPECTIVES AND RECOMMENDATIONS FOR PASTORAL DEVELOPMENT IN SOMALIA

Jörg Janzen, Horst Jürgen Schwartz and Maximilian P.O. Baumann

PERSPECTIVES FOR DEVELOPMENT OF THE PASTORAL SECTOR: AN OVERVIEW

There is no doubt that traditional pastoral production systems had reached a very high degree of adaptation to marginal environments which they were utilising. The driving motive behind the species diversity and the high mobility that are characteristics of these systems is risk aversion. This strategy has worked exceedingly well for many centuries, otherwise the system would have disappeared many years ago. However, faced with rapidly changing conditions, such as increasing population pressure, land losses to other competing economic activities, accelerated breakdown of traditional social assurance systems, reduced mobility due to political and administrative restrictions and widespread political and ethnic strife, this adaptation does no longer suffice to protect the pastoralist from hunger and destitution.

Over three decades technical assistance and development aid efforts attempted to stabilize the old systems with two approaches:

- improving livestock productivity, and
- conserving, rehabilitating and improving the feed base by better pasture management.

Basically two avenues were tried in both approaches: strengthening of potentials and removal of constraints. Strengthening the productive potential of livestock usually entails genetic upgrading of indigenous breeds with high yielding exotic stock. This has failed so far, both biologically and economically, in almost all cases where it has been tried under pastoral production conditions. Removing constraints, on the other hand, has worked quite well in the case of animal health programmes, at least in biological terms. Economic feasibility of animal health programmes in pastoral systems still needs to be determined. Certain tasks in the field of animal health, such as communicable diseases and public health risks, will remain a government responsibility, whereas other veterinary activities which do not present a public risk but rather an economic risk to the producer alone, will have to be covered by the producer. Here one has to mention the control of internal and external parasites and the reduction of rearing losses. Gains in animal productivity might be considerable if the relevant measures can be applied, whether the increased productivity is sufficient to support the necessary inputs financially, remains doubtful in many incidences.

The second approach, which has been tried over and over again since the early colonial times everywhere in Eastern Africa, was the attempt to conserve and/or rehabilitate the open range by controlling livestock numbers and regulating livestock movements through government interventions. This has not only been a story of total and dismal failure, but has been counterproductive in all those instances where and when it was done in conjunction with enforced sedentarisation.

Arid and semi-arid pastures are and will remain a marginal resource. Light, sporadic and opportunistic exploitation, like the traditional migratory pastoralism, is the only sustainable land use system. Reseeding, controlled burning, fertilizing, irrigation and other techniques of range improvement, which are well tried for the sub-humid tropics, are inefficient where variation of annual rainfall and the related biomass production is 30 to 45 % of the long term annual mean. The only conservation technique applicable is the carefully considered use of such lands. This implies that the pastoral economy cannot be able to sustain an indefinitely growing number on a finite resource base.

Fratkin (1991) in his book "Surviving Drought and Development" states:

"Given the developments in urban migration, sedentarization, and population growth, it is unlikely that the pastoral economy can sustain all its people. New job opportunities related to the economic growth of the pastoral sector need to be encouraged. It is particularly important to train health, veterinary, extension and marketing officers directly recruited from the pastoralists themselves. Institutions empowering the rural pastoralists need to be strengthened, both in political and economic arenas. But more than political office, pastoralists need to control their own resources."

Very few solid proposals can be made as to how the pastoral production system can be stabilized. Improvement of livestock productivity is most likely achieved promoting low-cost animal health programmes. Range improvement on the other hand will only be possible by reducing grazing pressure, which ultimately means a reduction of the number of people which remain dependent on livestock. A promising perspective in reducing this dependence seems to offer itself in the careful development of agro-pastoral land use systems, wherever the natural potential allows cultivation. A semi-extensive and market-oriented system of milk production with camels in reasonable distances from an urban centre is conceivable, to name one example. There may be others. But the overall need to find employment opportunities outside the pastoral sector will remain a constant challenge.

SPECIFIC ISSUES BASED ON THE SOMALI EXPERIENCE

The following issues derive from the chapters of this book dealing with livestock productivity, health, and development, and, as such, with the economic and social well-being of the Somali pastoralists.

Development planners are well advised to take these recommendations into account when designing short-term programmes and long-term strategies. The structure and development of mobile pastoralism in Somalia being the subject of this volume, has elucidated the ongoing fundamental change in all its complexity, and underlined the numerous problems resulting from these alterations.

The authors have clearly shown that in a country with a natural resource basis and physical circumstances such as that of Somalia, mobile livestock keeping based on an extensive utilization of the rangelands and a high degree of spatial mobility can be considered the most efficient economic source of subsistence and cash income.

However it has also been made clear that ecologically maladapted forms of landuse have led to a severe degradation of the natural resource base in parts of the nomadic living space during the past two decades. This is due to mistakes in development policy, the direct and indirect promotion of sedentarization of nomads, the one-sided preference of development measures in crop production, and the lack of a lobby representing the interests of the nomads in the state bureaucracy.

As a result of this policy, a process of massive displacement of pastoralists from ecologically favorable locations to less advantageous marginal areas can be observed. The negative impacts of high concentrations of livestock combined with reduced spatial mobility which can arise for the natural environment as well as for the quality and the state of health of the animals are well known.

Consequently, the main challenge for development policy has to be the elaboration of a development strategy for the nomadic habitat which should focus on the rapid attainment of sustainability in all fields, and the consistent consideration of regional variations of the political, judical, social, economic, and ecological circumstances. The pastoral economy cannot be treated as an isolated subject, but has to be considered as an integrated part of a comprehensive regional development strategy based on basic needs and a self-help oriented approach. In this regard the end of the civil war also represents a chance for a new beginning for development policy. From past experience, e.g. those of the CRDP, should be evaluated, positive results may be taken over or changed according to specific requirements.

The purpose of this article is not to compile a detailed catalogue of criteria for a development strategy for nomadic pastoralism and its living-space. Therefore, only a few important aspects shall be summed up.

The primary aim should be the preservation of the resource base of existence above all and here the conservation and rehabilitation of the vegetative cover, soils and water resources. Only through this it will be possible to combat the latent process of desertification and to maintain the basis for existence for present and future generations.

For this purpose the negative circumstances for living and the constraints to production have to be eliminated, or reduced in order to reach risk minimisation for the pastoral sector. This can be attained by fast improvement of the living standards and through efficient livestock production. As far as the political and judical circumstances are concerned, existing laws and the judical insecurity of

range utilization and possibilities for migration resulting for a large part from the expropriation of all clan-owned grazing land should be examined. If necessary, they should be in accordance with spatial needs of the nomads. This would facilitate the preservation or reintroduction of ecologically adapted landuse systems. Such systems exist mainly within the traditional range units (*degaan*) of the clans, and are utilized according to communal law.

Another important prerequisite for a development policy would be a change in the political and administrative order. Not centralization but decentralization would better facilitate nomadic interests and needs. As long as all important decisions concerning rural development policy will be made in *Muqdisho*, there will be no real chance of participation by pastoralists. It would be much more suitable to introduce a federal system in Somalia, that transfers a large part of the decision making to the regional and district level. Moreover, trust worthy traditional clan institutions must be included into the decision making process. Such measures would contribute considerably to reestablishment of confidence in the state by nomads.

Although there is no doubt that state intervention should be kept to a minimum, there are cases where the involvement of the government and/or development agencies might be useful in order to carry out development activities. Infrastructural development projects are of particular importance for the remote areas of the country. To a certain extent they can also be considered as an indicator for progress and honest interest in the development of the nomads' habitat. As far as the improvement of the technical infrastructure is concerned, the construction of roads, power stations, and - above all - water facilities are of special interest. Although the improvement of water availability is an important issue, any extension of water supply points should be strictly carried out in conjunction with an assessment of range condition. Large surface basins for water collection and high-capacity deep-wells have proved to be inappropriate water supplies in many cases.

The improvement of social infrastructure is of major concern as well. The construction of sports and leisure facilities may contribute to slowing the exodus of especially young people to the urban areas. However, major efforts should be undertaken to build up educational and health services. Not only school education and vocational training should be strengthened, but also mobile medical and veterinary services should be provided in order to improve the harsh living conditions.

Apart from medical care the provision of veterinary services has high priority for the nomads. The experiences of the veterinary supply for central Somalia shall therefore be briefly summarized.

The lesson learned from the rather ambitious approach of the large-scale Central Rangeland Development Project (CRDP) shows that small-scale, community-based activities organized in a participatory fashion are most promising. Assigning a more geographically circumscribed area to such development activities the systems approach, without doubt the method of choice, will allow the logical and consequent shift from investigative /pilot activities to the implementation of field-tested interventions from which, in the end, not only livestock productivity and health will benefit.

Aside from the formation of the CRDP Range and Livestock Associations (RLA), the community health worker concept of the Italian Medical Team as well as various other activities of non-governmental organisations in Central Somalia point into that right direction.

All activities of the GTZ Veterinary Component in the Central Rangelands were centered in the field from the very beginning. The rationale followed a stepwise approach: after setting up infrastructure and the necessary logistics in the districts baseline health and production parameter were recorded in the field and subsequently analysed. This led to the formulation and implementation of the Nomadic Animal Health Auxiliary System (NAHA-System, see Map 4) on the *degaan* level (sub-district level). Through the successful adoption of this community-based programme most of the demand for animal health care delivery in the field could be covered, however, on a limited while pilot scale. Here, at the micro-veterinary delivery level, the pastoral livestock producer appreciates any professional support resulting in better utilisation of the rangeland and, as such, in improved productivity of his animals.

The liberalisation policy for veterinary drug import and distribution, which was about to gain momentum before the civil unrest began, seems to be a major issue for getting self-administered structures like the NAHA-System working and in place again in the near future. Furthermore, this will open up a broad avenue for privatisation of animal health services delivery at the producer level as well as other supporting services to pastoral and rural development.

With respect to livestock health and production government authorities ought to concentrate its limited resources on its genuine and souvereign tasks of national disease control. Through the (re)establishment of the NAHAs a basic

structure for reporting animal health and production constraints is in place in the pastoral production areas. This first-hand information from the field will form the foundation for an adapted and reliable national disease surveillance and monitoring system. Then, selective action can be taken to combat emerging diseases and other production constraints.

From a macro-economic point of view government support for livestock export is only justified in the field of regulatory veterinary medicine; this is to acertain that the requested sanitary regulations for international livestock trade are met to full extend. The sector ministry should prepare its services (and seeking assistance) for the somewhat disregarded field of veterinary public health, beside national livestock disease control the other major task at the macro-veterinary delivery level. The increasing demand, particularly in urban centres, for safe and wholesome food of animal origin, in sufficent quantity and quality, has to be covered.

In addition to infrastructural improvements, the creation of nonpastoral job opportunities should be a main goal of rural development policy. The construction of small industries for manufacturing of local products in district and regional centres may reduce unemployment among young people. Only through diversification can the economic future at rural areas be attained.

Furthermore, mixed livestock-crop-production systems, which occur along rivers and the coast of southern and central Somalia should be supported financially and by the introduction of an extension service. A precondition for assistance has to be an ecologically and socially adapted land use pattern.

Fundamental to development is the strengthening of pastoral self responsibility for the conservation and the rehabilitation of degradated ecosystems. That is utilization and guarding of range reserves should for example be the exclusive responsibility of local people.

As far as the structure and the future of Somali livestock trade is concerned the following factors should be kept in mind.

Livestock trade, and livestock export in particular, has always been a private entrepreneurs' business. Its dynamic is driven by market forces and not dictated by or largely dependent on government authorities. Livestock trading is not a perfectly organized branch of national economy but, at least, it is until now, although presently on a small scale, a functioning and profitable business for the parties involved. Thus, supporting this system in terms of development

should be not so much an issue of opening up new markets but rather of safeguarding existing ones. Any statal interference in the trading itself will jeopardize a well established scheme.

Although minimal state interference is preferable, the support of government institutions is a necessity. This is especially true for combating the effects of droughts. Any improvement in animal productivity will be impaired if practical and infrastructurally adapted contingency plans against droughts do not exist.

Although a large number of scientific publications on pastoral nomadism/ mobile livestock keeping is available (Scholz, 1992), it should be mentioned that interdisciplinary research has to be extended. Only through intensive research in the fields of natural resource management, human resources, social structure, economics, political and judical circumstances, health etc. may mistakes in development planning be avoided. The extensive capability of nomadic herdsmen with respect to breeding, keeping and caring for livestock, as well as their knowledge of the natural environment, should be utilized in the planning and implementation of projects.

It should be a major task of scientists and development planners to convince politicians of the necessity for sustainable development strategies in particular also for remote areas.

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Talle, Aud, is an associate professor in social anthropology at the University of Stockholm. She has carried out field research among pastoral groups in Tanzania (Barabaig and Massai), Kenya (Massai) and Somalia (Hawiye) and has mainly focused on changing relations of production and gender systems. Her research interests also include applied and medical anthropology. Talle has done several consultancies related to Eastern Africa. She also has a long experience in research collaboration with developing countries. Between 1983 and 1989 Talle was a consultant to SAREC (Swedish Agency for Research Collaboration with Developing Countries) for designing and establishing a unit of gender research at the Somali Academy of Sciences and Arts.

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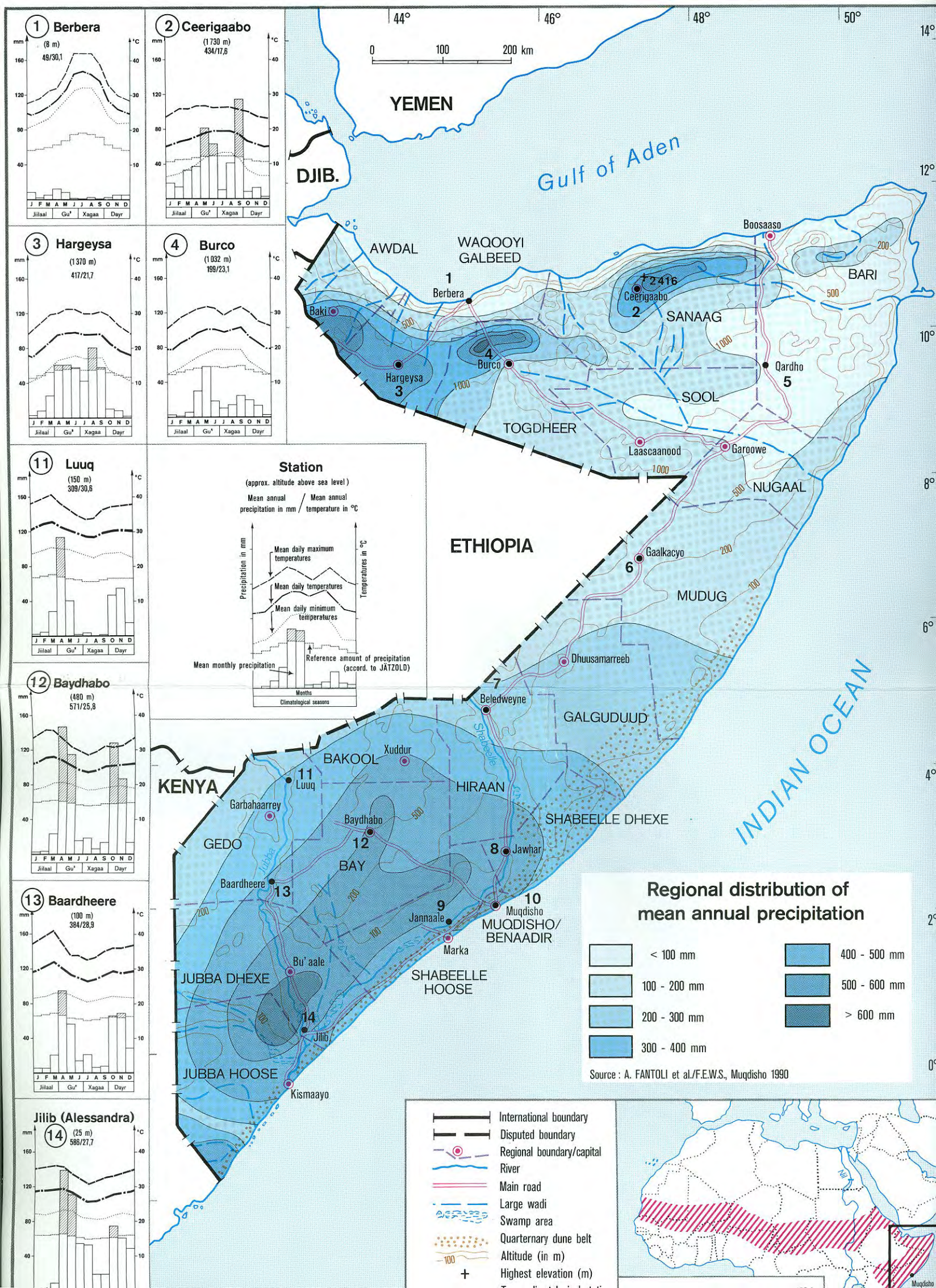
LIST OF ATTACHED MAPS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(1 032 m)
199/23,1
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(150 m)
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571/25,8
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(100 m)
384/28,9
Jilib (Alessandra)
14 (25 m)
586/27,7
J F M A M J J A S O N D
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mm
°C
Station
(approx. altitude above sea level)
Mean annual precipitation in mm / Mean annual temperature in °C
Precipitation in mm
Temperatures in °C
Mean daily maximum temperatures
Mean daily temperatures
Mean daily minimum temperatures
Mean monthly precipitation
Reference amount of precipitation (accord. to JÄTZOLD)
Months
Climatological seasons
44°
46°
48°
50°
14°
12°
10°
8°
6°
4°
2°
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0 100 200 km
YEMEN
DJIB.
Gulf of Aden
AWDAL
WAQOOYI GALBEED
BARI
SANAAG
SOOL
TOGDHEER
NUGAAL
MUDUG
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Baardheere
Jannaale
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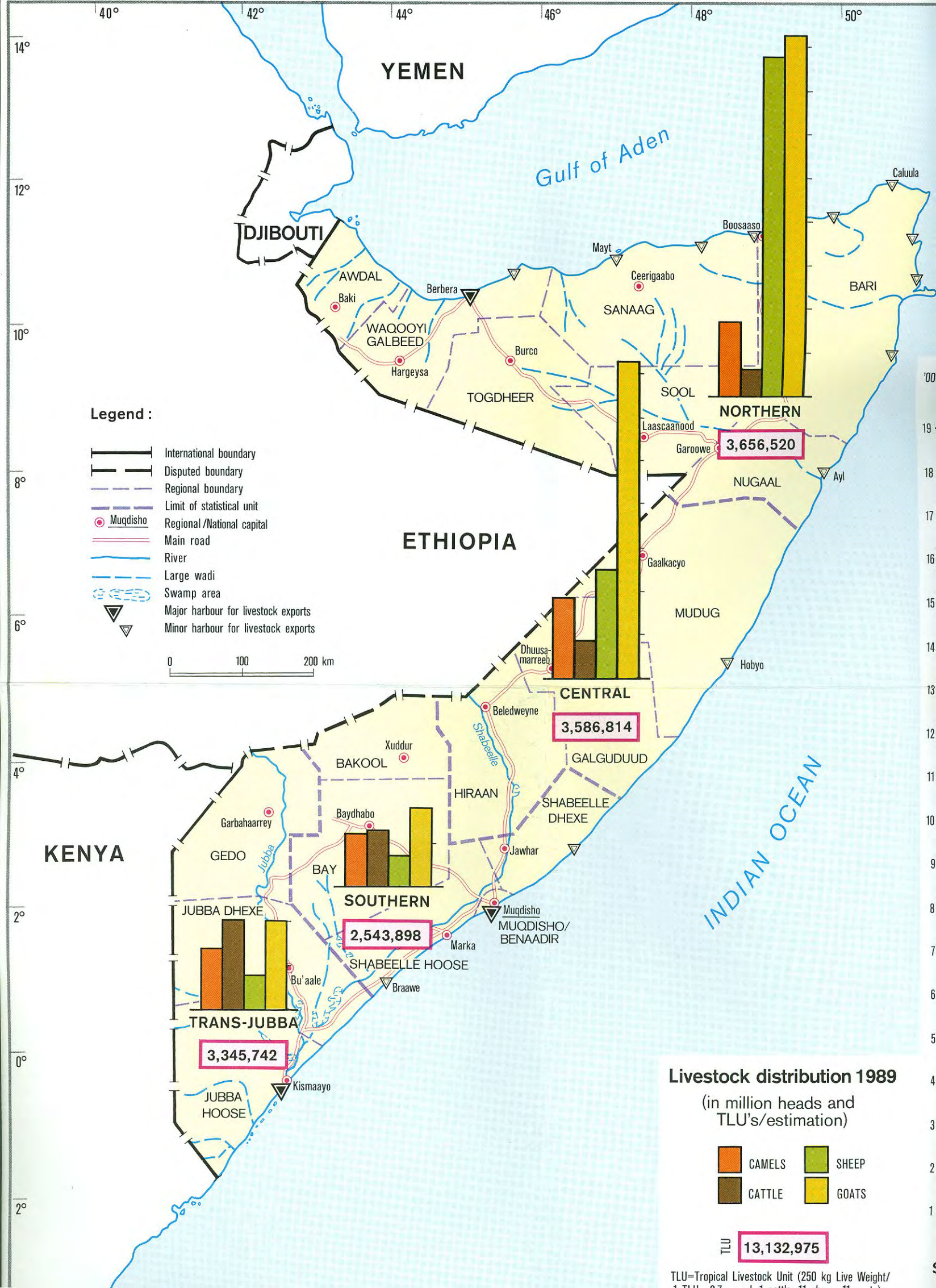
Marka
Bu' aale
Jilib
Kismaayo
Shabeelle
Jubba
100
200
500
1000
Regional distribution of mean annual precipitation
< 100 mm
100 - 200 mm
200 - 300 mm
300 - 400 mm
400 - 500 mm
500 - 600 mm
> 600 mm
Source : A. FANTOLI et al./F.E.W.S., Muqdisho 1990
International boundary
Disputed boundary
Regional boundary/capital
River
Main road
Large wadi
Swamp area
Quarternary dune belt
Altitude (in m)
Highest elevation (m)
Muqdisho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Gulf of Aden
DJIBOUTI
ETHIOPIA
KENYA
INDIAN OCEAN
AWDAL
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Berbera
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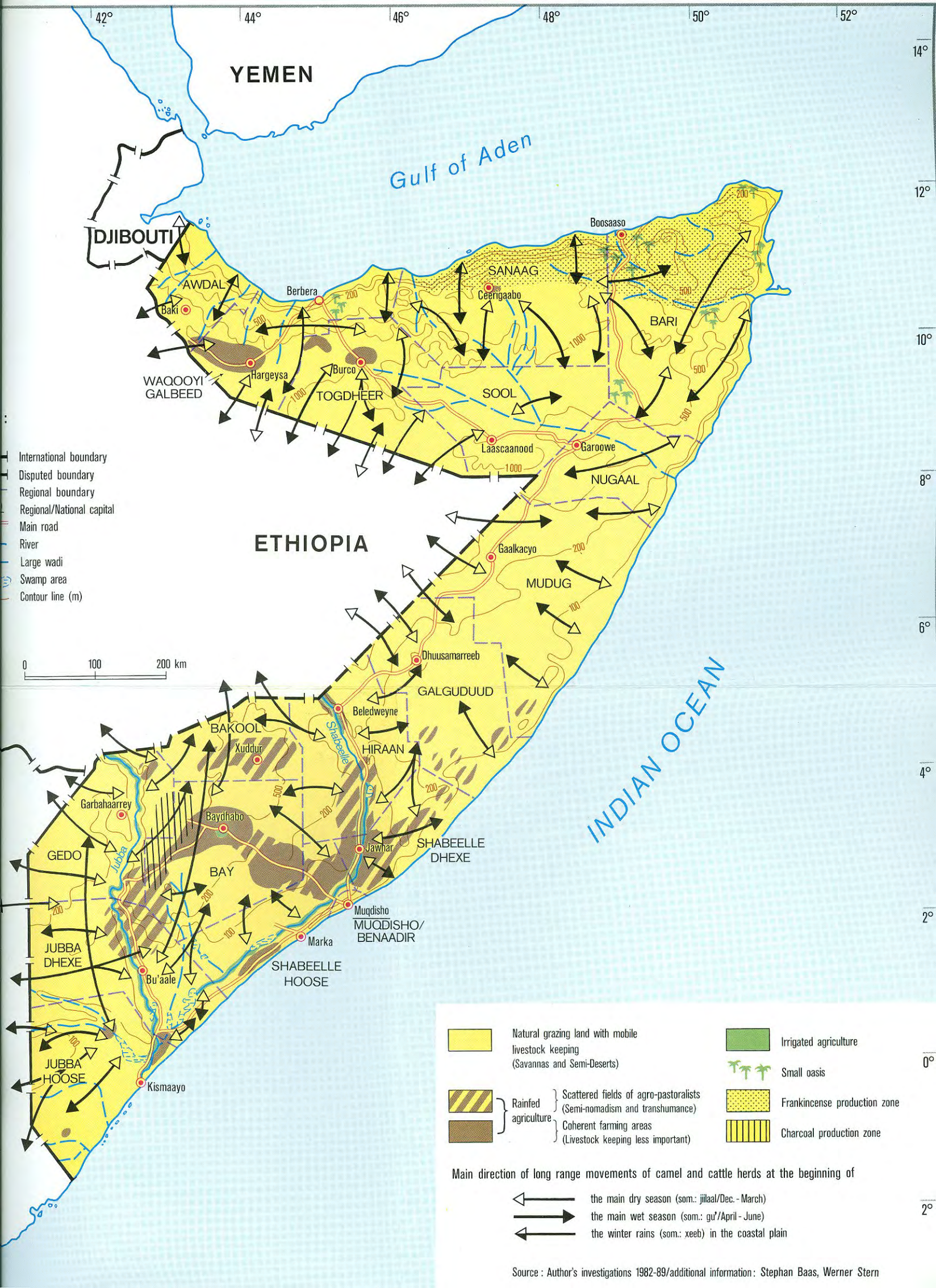
Beledweyne
Shabeelle
Xuddur
BAKOOL
GALGUDUUD
HIRAAN
SHABEELLE DHEXE
Garbahaarrey
Baydhabo
Jawhar
GEDO
Jubba
BAY
SOUTHERN
2,543,898
JUBBA DHEXE
Muqdisho
MUQDISHO/ BENAADIR
Marka
SHABEELLE HOOSE
Braawe
Bu'aale
TRANS-JUBBA
3,345,742
Kismaayo
JUBBA HOOSE
Legend :
International boundary
Disputed boundary
Regional boundary
Limit of statistical unit
Muqdisho
Regional /National capital
Main road
River
Large wadi
Swamp area
Major harbour for livestock exports
Minor harbour for livestock exports
0
100
200 km
Livestock distribution 1989
(in million heads and TLU's/estimation)
CAMELS
SHEEP
CATTLE
GOATS
TLU
13,132,975
TLU=Tropical Livestock Unit (250 kg Live Weight/



Source : Author's investigations 1982-89/additional information: Stephan Baas, Werner Stern

The Central Rangelands