

Extensive Pastoral Livestock Systems: Issues and options for the future

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SUMMARY

- 1 Extensive pastoral production used some 25% of the world's land and produces some 10% of the meat used for human consumption, while supporting some 20 million pastoral households. Pastoral production is split between the extensive enclosed systems typical of North America, Australia and parts of South America and the open range systems in Africa, the Andes, Asia and Siberia which are still largely the province of 'traditional' producers.
- 2 The rangelands used by pastoralists are often land that cannot be used by conventional agriculture, although as technical advances spread agriculture into new regions, pastoralists are forced into increasingly inhospitable terrain. Spontaneous settlement is quite common in areas on the fringes of the pastoral domain. Nonetheless, national governments are often hostile to pastoralists, and many countries have policies of sedentarisation that derive as much from political considerations as a concern for the welfare of those they wish to settle. However, compelling pastoral nomads to settle has a very unsatisfactory history and is unlikely to meet with long-term success.
- 3 Pastoralists make substantial contributions to the economy of developing countries, both in terms of supporting their households and in supplying protein to villages and towns. Their economic system is constantly threatened by the globalisation of the trade in livestock products and unstable import policies in many countries. Broadly speaking, the trend in this century has been for the terms of trade to increasingly turn against pastoralists.
- 4 The marginal lands that have previously been the province of pastoralists are increasingly coming into focus as reserves of biodiversity. Their very inaccessibility has permitted the survival of species eliminated in high-density agricultural areas. Consequently, there is pressure on governments to declare increasingly large regions as conservation areas, both because of the conservation lobby and the potential income from tourism. Uncertainties about pastoral tenure have made it difficult for pastoralists to lodge effective land claims.
- 5 The future of pastoralism will depend heavily on political decisions made by national governments with significant regions of grassland. Enclosed pastures are unlikely to see any significant extension, but conditions for existing pastoralists will become more difficult with land expropriation both from farmers and conservation lobbies. Working with pastoralists, based on a more sympathetic understanding of their production systems, could act both to protect their lifeways and to continue their capacity to produce protein on otherwise marginal land.
- 6 Experience to date suggests that technical inputs will only have a very limited impact on overall output. The key in the next millennium will be major policy re-orientation. Elements likely to become important are;
 - a. Production of niche products, either unusual species or breeds, or meat and milk free from contaminants
 - b. Crop-livestock integration, the effective use of pastoral outputs in mixed farming, particularly the extension of work animals
 - c. Co-conservation, the development of interlocking strategies to link conservation of wild fauna and flora with pastoral production
 - d. The expansion of ecologically-sensitive low-volume tourism, using pastoralists to provide services, particularly in the area of indigenous knowledge

Section I: SYSTEMS CONTEXT

1. Classification of pastoral systems worldwide

1.1 Overview

Pastoralist production, the use of extensive grazing in rangelands for livestock production, has had a vertiginous history in the realm of development agencies. The potential of the world's rangelands and the large numbers of livestock using them was for a long time seen as a major and underused resource and stimulated a vast body of research and development projects, both technical and social. The perceived failure of many of these projects and the linking of livestock to a spectrum of environmental damage caused a major retreat from support to pastoralism in the 1970s and 1980s. The 1990s saw the realisation that pastoralism remained in place, and moreover, the opening up of Central Asia, the largest pastoral region in the world stimulated a renewed interest, if not necessarily a wise application of lessons learnt in the previous decades. The new millennium therefore seems quite an appropriate time to review the status of pastoral production worldwide and particularly to focus on the insights gained by comparing Asian and African pastoralism, as well as to review policy in the light of recent concerns about poverty and vulnerability¹.

Pastoralism can be categorized in a number of ways. The most important of these are;

- a. by species
- b. by management strategy
- c. by geography
- d. by ecology

In addition to these there is a broad distinction between the developed and developing world. Extensive livestock production is practised in both Australia and North America, under very different conditions from elsewhere in the world, using fenced ranges and unambiguous tenure. This creates a level of investment in land and animals very different from 'traditional' systems.

Pastoralism evolved as a response to two factors, medium human population densities and the presence of extensive rangelands, usually in semi-arid regions, although reindeer pastoralism, found across the circumpolar regions of Eurasia is an exception to this. If human population densities were too low, i.e. hunting-gathering was relatively easy, then the impetus to herd animals was absent. Hence pastoralism was absent from the rangelands of the New World and Australia in the pre-European epoch. It is debated whether the absence of appropriate species also has an impact on the incidence of pastoralism; for example, the camelids, the alpaca and the llama, were domesticated as pastoral species in the Andes in the pre-Columbian era but no pastoralism developed in the New World plains, perhaps for lack of an appropriate species.

¹ The material in this paper reflects some two decades' research into pastoralism, but also the insights of many colleagues. I would particularly like to thank Piers Vitebsky and the staff at the Scott-Polar Institute in Cambridge for giving me access to the world of reindeer pastoralism, and also Carol Kerven, Ian Wright, Paul Starkey, Stephen Hall, David Bourn and William Wint for discussion and insights over the years. Florian Sommer, Zoë Marriage and Robert Chapman have acted as research assistants on pastoral projects over the years.

1.2 Pastoral species

Table 1 is a schematic representation of pastoral species worldwide, showing their approximate geographical distribution and the main management strategies used to keep them. 'Enclosed' covers fenced or demarcated rangelands operating within a Western economy.

Table 1. Main pastoral species and management systems, worldwide

Species	Scientific name	Main regions	Nomadic	Transhumant	Agropastoral	Enclosed
Alpaca	<i>Lama pacos</i>	Andes	-	+	+	-
Bactrian camel	<i>Camelus bactrianus</i>	East-central Asia	+	+	+	-
Buffalo	<i>Bubalus bubalis</i>	Iran, India	+	+	+	?
Cattle (taurine)	<i>Bos taurus</i>	Europe, West Asia, West Africa	-	+	+	+
Cattle (zebu)	<i>Bos indicus</i>	Africa, Central Asia	+	+	+	+
Donkey	<i>Equus asinus</i>	Africa, Asia	+	+	+	-
Dromedary	<i>Camelus dromedarius</i>	Africa, West Asia	+	+	+	-
Goat	<i>Capra hircus</i>	Africa, Europe, Asia	+	+	+	+
Horse	<i>Equus caballus</i>	Central Asia	+	+	+	-
Llama	<i>Lama lama</i>	Andes	-	+	+	-
Reindeer	<i>Rangifer tarandus</i>	Circumpolar Eurasia	+	+	-	?
Sheep	<i>Ovis aries</i>	Africa, Europe, Asia	+	+	+	+
Yak	<i>Poephagus grunniens</i>	Highland Central Asia	-	+	-	-

The inclusion of buffalo in pastoral herds is extremely rare and those in Iran are thought to derive from the migrations of the Zott Gypsies in the eighth century (see note in Digard 1981:30). Garwahl (1981) mentions the Gujjar, who practise vertical transhumance between the foothills of the Himalaya and the alpine meadows.

This discussion excludes birds, notably ducks and geese. Particularly in India, ducks and geese are herded by specialised pastoralists who move them from place to place to exploit changing feed resources. Given the very different parameters of such pastoralism from mainstream systems, they are not treated in the main text but a short discussion is given in Appendix II. Historically in Europe and the Middle East, pig-based pastoralism clearly existed, but there seem to be no clear modern cases of it, in part because the main areas where it was important have either switched to Islam or to enclosed production systems².

² The *dehesa* systems of Central Spain, based around cork-oak forests may well be the last survival of a major European swineherding tradition.

Another division of pastoralism that is less easy to model is the contrast between systems essentially based around a single species, and those based around the integrated production of several species. For example, although horses, donkeys, camels, goats, cattle and dogs are kept by nomads of Southwest Asia, sheep predominate and other animals are used for portage, riding, ploughing or herd management (e.g. Barfield 1981 for a description of the Arabs of northeast Afghanistan). By contrast, in Mongolia, and in the Northern Sudan, herders seem to manage 2-4 species of roughly equal importance simultaneously. Göbel (1997) shows that herders in the arid *puna* of northwest Argentina, herders keep a mixture of llamas, sheep and goats in roughly equal proportions.

1.3 Pastoral enterprises and movement

The most common categorisation of pastoralism is by the degree of movement, from highly nomadic through transhumant to agropastoral. Cultivators also keep livestock for work or marketable products but these are not usually regarded as pastoralists. Any classification of this type must be treated as a simplification; pastoralists are by their nature flexible and opportunistic and can rapidly switch management systems as well as operating multiple fragmented systems in one overall productive enterprise. For example, West African cattle-herders can practise a system of regular transhumance for a long period, building up patronage relationships with farmers on their routes. However, in a case of extreme drought or disease stress, they will switch to highly 'nomadic' patterns moving to new areas and breaking these relationships. When the crisis has passed they may revert to their former pattern or move into an entirely new management mode.

1.3.1 Nomadism

Exclusive pastoralists are livestock producers who grow no crops and simply depend on the sale or exchange of animals and their products to obtain foodstuffs. Such producers are most likely to be 'nomads' i.e. their movements are opportunistic and follow pasture resources in a pattern that varies from year to year. This type of nomadism reflects almost directly the availability of forage resources; the more patchy these are, the more likely an individual herder is to move in an irregular pattern.

Although in the popular imagination 'nomads' wander from place to place without any logic, their landscape is flecked with an invisible constellation of resources. Pastoralists have to balance their knowledge of pasture, rainfall, disease, political insecurity and national boundaries with access to markets and infrastructure. They prefer established migration routes and often develop long-standing exchange arrangements with farmers to make use of crop residues or to bring trade goods. Pastoralists usually only diverge from their existing patterns in the face of a drought, a pasture failure or the spread of an epizootic. Nonetheless, this flexibility is often the key to their survival. Highly mobile camel people such as the Rashaida retained a much greater proportion of their herds than the neighbouring Beja in the droughts of the early 1980s because of the Beja attachment to set routes and pastures (RIM 1989).

In some regions of the world, nomadism is an ancient and relatively static subsistence strategy; for example among the 'nomads of the nomads' in the Empty Quarter of Saudi Arabia (Cole 1975). However, along the ecotone between rangeland and arable land, movement between different strategies can be quite fluid. The tone of much of the literature suggests that the process of sedentarisation among nomads is irreversible, but as Glatzer (1997, 1982) shows clearly that limited opportunities for agriculturists in northwest Afghanistan have impelled some to turn to pastoral nomadism.

1.3.2 Transhumance

Transhumance is the regular movement of herds between fixed points to exploit seasonality of pastures. In montane regions such as Switzerland, North Africa, the Himalayas, Kyrgyzstan and the Andes, this is a vertical movement usually between established points and may have a regular and ancient pedigree. Transhumant pastoralists have a permanent homestead and base at which the older members of the community remain throughout the year. There is strong association with higher-rainfall zones; if the precipitation is such that the presence of forage is not a problem, then herders can afford to develop permanent relations with particular sites, for example building houses.

Transhumance is often associated with the production of some crops, although primarily for herders' own use rather than for the market. In many temperate regions, where snow is likely to block animals' access to pasture, haymaking is an important component of the system. 'Make hay while the sun shines' is very significant advice in such systems; if the grass is not cut, dried and bundled during the summer, it may rot while being stored. Hay production in tropical systems is less common because the movement of the herds is between higher and lower rainfall zones, in the expectation that there will be forage in both sites. In West Africa, for example, there is a broad pattern of movement south in the dry season, when grass is available and insect problems are minimised, and a return movement north in the wet, when humidity-related diseases increase and there is pasture in the regions further north.

A characteristic feature of transhumance is herd-splitting; the men take away the majority of the animals in search of grazing, but leave the resident community with a nucleus of lactating females. There are many variations on this procedure and moreover the development of modern transport has meant that in recent times, households are not split up as radically; members can travel easily between the two bases. Whether it is milking females, weak animals or work animals that are left behind differs substantially between one system and another and may even vary within an individual system on a year-by-year basis.

Transhumance has been transformed by the introduction of modern transport in many regions of Eurasia. For example, the transhumance of sheep in Britain between rough grazing on highland areas and lowlands is now conducted entirely by putting the sheep in trucks and carrying them between grazing points. Wealthier countries in the Gulf, such as Oman and Saudi Arabia have made vehicles available at subsidised rates to pastoralists to assist with animal transport and it seems likely this pattern will be more and more frequent, especially as the problem of controlling animals in increasingly densely settled environments can only get worse.

1.3.3 Agropastoralism

Agropastoralists may be described as settled pastoralists who cultivate sufficient areas to feed their families from their own crop production. Agropastoralists hold land rights, use their own or hired labour to cultivate land and grow staples. While livestock are still valued property, their herds are on average smaller than other pastoral systems, possibly because they no longer solely rely on livestock and depend on a finite grazing area around their village which can be reached within a day. Agropastoralists make greater investment in housing and other local infrastructure and if their herds become large, they often send them away with more nomadic pastoralists.

Agropastoralism is often also the key to interaction between the sedentary and mobile communities. Sharing the same ethnolinguistic identity with the pastoralists they often act as brokers in establishing cattle-tracks, negotiating the 'camping' of herds on farms, which potentially exchanges crop residues

for valuable manure, and arranging for the rearing of work animals which adds value to overall agricultural production.

1.3.4 Enclosed systems and ranching

Apart from the traditional pastoral systems described above, the fourth system of extensive livestock production may be described as enclosed systems or ranching, i.e. where the land is individually owned and usually fenced. The United States is an example of the gradual transition from common ownership systems prevalent in the nineteenth century to a fully enclosed system today. Ranching is the dominant system in North America, Australia and parts of South America, notably Argentina (Strickon 1965). Rivière (1972) describes these transitional systems for northern Brazil, where communal tenure is giving way to ranching. Some European systems could be described as ranching, although enclosures are often small and animals frequently supplemented in the field. As Ingold (1990) points out, there has been remarkably little description of ranching from points of view other than the technical and socio-economic descriptions tend to be uniformly hostile because the individual ownership of large tracts of land is seen as antisocial. Ranching, however, is an inevitable development in certain types of economy, where urban demand for protein makes the lax supply systems of conventional pastoralism unacceptable, and input supply can support the higher throughputs that justify ranches.

It represents a powerful ideology and the history of both colonial and post-colonial development and command economies is littered with failed attempts to introduce these systems both throughout the dry tropics and the temperate grasslands of Eurasia. In Nigeria, they have had a long and unsuccessful history dating from the early colonial era (e.g. Dunbar 1970); elsewhere in Africa, the late 1960s was the renewal of hopeful introductions and equally convincing failure (e.g. Galaty 1994:190). Livestock ranches have an interesting history in Southern Africa; in the colonial era these were established in Namibia, Botswana, Zimbabwe, Mozambique, and South Africa. Although a substantial proportion of these remain, in many places they have been gradually perceived as an unacceptable concentration of land in the hands of a single owner and are gradually reverting to more traditional tenure. In Zimbabwe, for example, large livestock enterprises are being invaded by smallholder settlers with the tacit approval of government.

The situation in North-Central Asia is a story of decollectivisation. Among Sakha and Even reindeer herders in Siberia, a system of managing wild reindeer seems to have operated in the pre-Soviet era (Vitebsky 1991, 1992; Van Veen 1995). After the imposition of Bolshevik rule, the land was divided into fenced enclaves and the herds collectivised and managed as very large ranches with centralised services. Although a suboptimal system of managing fodder resources, improved health of the animals and the ready market for their products acted as compensation in market terms. With decollectivisation after 1991, the fencing is gradually collapsing and veterinary services are in decline. The townships established to provide centralised social services are functioning less well and the product-buying systems have faltered. Herders are compelled to re-establish older management systems whilst trying to develop new markets for their products in a situation where inputs are no longer subsidised .

1.3.5 Pastoralism's links with trade and warfare

The flexibility so characteristic of pastoral nomadism, and the ability to transport goods and people have meant that pastoralism has long been associated with two other major livelihood strategies, trade and warfare. Prior to the evolution of modern transport, animals were the only method of moving large quantities of goods across land. Consequently, pastoralists often became heavily involved in

trade caravans, guiding, managing and supplying the appropriate livestock. In the Sahara and Arabia, this evolved into a quite sophisticated form of blackmail, whereby the nomads both guided the caravans and required monetary payments to prevent them from raiding those same caravans (Sweet 1965). Long-distance trade in the Andes was a key function of llama breeders, and elaborate multiple-point trade systems have been recorded, based on exchange relationships lasting many generations (Orlove 1982:104). Similar camel-based systems traverse the deserts between Eastern Turkey and Northwest India, while the movement of yaks and long-legged sheep is essentially to the distribution of trade goods in the Himalayan region (Downs & Ekvall 1965). A caravan trade still exists in the more inaccessible regions of the pastoral zone, but its economic importance has been much reduced by modern transport.

By no coincidence at all, pastoralism has also been associated with another type of trade, namely smuggling. The consolidation of national borders and the evolution of contradictory tariffs in neighbouring countries makes nomads the ideal group to smuggle contraband between these countries. This is particularly highly developed in the Near East, where extremely different economies border one another and long featureless frontiers are almost impossible to police. Abu-Rabia (1994) describes the important role the Negev Bedouin played in Israel in the 1950s, smuggling in both meat and scarce consumer goods with the tacit approval of the authorities.

The association between horse pastoralism and raiding is of great antiquity; since Herodotus reported on the Scythian horsemen 2500 years ago, raiders from Central Asia continued to threaten Europe until the end of the Middle Ages. Barfield (1989) is a history of the dynamic relationship between the Chinese Empire and its nomadic raiders from the steppes over 3000 years. Chatwin (1994) describes in some detail the association between pastoralism and military cultures across Asia. The Ful'e in West Africa launched a jihad in the early nineteenth century which transformed the political map the Sahelian region. Brotherston (1989:244) notes that the llama was essentially to Inca military operations, providing both transport and food on the hoof. It is probably no accident that the cyclical nature of the conflict between nomads and the state was first described with some acuity by the medieval North African historian, Ibn Khaldun, in his study of history, the *Muqadimah* (trans. Rosenthal 1967). It also helps explain why so much of the discourse of pastoral nomadism is framed in terms of 'crisis' and 'problem' (§1.7); the explosive nature of relations with the state and with the natural environment suggests to observers at any given time, that a catastrophic cusp has been breached. Although this type of warfare has largely ceased, the ability of nomads to move in hostile terrain continues to be perceived as a threat by national governments, witness the continuing hostilities between the Saharan nomads, the Tuareg and Teda, and the countries in whose territory they live.

1.4 Worldwide distribution of pastoralism

Pastoralism is strongly associated with the presence of grasslands, but there are numerous grasslands without pastoralists. This is partly a reflection of history; pastoralists tend to exist in complex relationships with hunter-gatherers, and in most of the New World and Australia, pastoralism never developed because population pressure on land remained limited. Table 2 shows a summary of the regions of the world where pastoralism is found and gives a simplified summary of its status.

Table 2. Regional zonation of pastoral systems

Zone	Main Species	Status
Sub-Saharan Africa	Cattle, camel, sheep, goats	Reducing due to advancing agriculture
Mediterranean	Small ruminants	Everywhere declining due to enclosure and advancing agriculture
Near East and South-Central Asia	Small ruminants	Locally declining due to enclosure and advancing agriculture
India	Camel, cattle, sheep, goats	Declining due to advancing agriculture but peri-urban livestock production expanding
Central Asia	Yak, camel, horse, sheep, goats	Expanding following decollectivisation
Circumpolar	Reindeer	Expanding following decollectivisation in Siberia, but under pressure in Scandinavia
North America	Sheep, cattle	Declining with increased enclosure of land and alternative economic opportunities
Andes	Llama, alpaca	Contracting llama production due to expansion of road systems and European-model livestock production but expansion of alpaca wool production

It is no accident that the high-capital land management approaches common in Australia and the New World are in areas where hunting-gathering populations lived prior to colonial intrusions. Historically, forager cultures have proved the most vulnerable to aggression from agricultural and technology-based cultures; ‘guns, germs and steel’ against dispersed low-technology populations (Diamond, 1997). Pastoralism developed in North America post the Spanish era with access by the Amerindian peoples to European ruminants. These have been adopted in very contrastive fashions, with such peoples as the Navaho developing what may be termed ‘true’ pastoralism, while others such as the Apache evolving highly-focused meat production through collective herds (Kunstadter 1965).

African pastoralists are very unevenly distributed; occupationally specialised pastoralists, principally dependent on camels, cattle and sheep, are virtually confined to the region north of the equator northwards in semi-arid regions (Blench 1998). Agropastoral communities, owning cattle, sheep and goats, are also found in the northern region, but predominate south of the equator.

Estimating numbers for pastoral households worldwide is very speculative. De Haan et al. (1997) quote an estimate of 20 million households worldwide for pastoral households. Pastoral and agropastoral communities account for 20 million and 240 million individuals respectively in sub-Saharan Africa (SSA) (Swallow, 1994 in Holden et al. 1997). Broadly speaking the economic importance of livestock within total household income rises as rainfall declines, and in desertic regions, dependence is near total.

1.5 Pastoralism and rangeland ecology

Pastoralism and extensive livestock production, with the exception of reindeer, is premised on the presence of rangelands. The literature uses several terms for the main world’s rangelands: African savanna, Eurasian steppe, South American savanna, North American prairies, Indian savanna, and Australian grasslands (Moore 1970; Groombridge 1992: 285; Solbrig, 1996). Estimates of their importance vary according to the regions included, but as figures given in the literature suggest, rangelands occupy between 18–23% of world land area, excluding Antarctica (Table 3).

Table 3 Estimates of the area of the world's rangelands

	Whittaker and Likens (1975)	Atlay, Dugvigneaud (1979)	Kettner, Olson, Watts and Allison (1983)
Savanna (million km ²)	15.0		24.6
Temperate grassland (million km ²)	9.0		6.7
Total (million km ²)	24.0		31.3
	%	%	%
Rangeland as % of world land area	16.1	23.7	20.7
Rangeland as % of world land area (excluding Antarctica)	17.9	26.5	23.1

Source: Groombridge (1992: 281)

Rangelands is a broader term than grasslands, including regions where woody vegetation is dominant; moreover, it is common in texts describing land from the viewpoint of livestock production. Grasslands are just that, and the term has a more biological emphasis³. Some of the ecological literature attempts to distinguish 'rangelands' and 'natural' grasslands (for example, the Elsevier 'Ecosystems of the World' premises different volumes on this dichotomy – see Bourlière (1983) and Coupland (1993a). But closer examination of the descriptions suggests that either the origin of many grasslands is contentious or else grasslands become 'natural' if they are ancient human creations (see, for example, Gillson (1993a) on the grasslands of New Guinea).

Grasslands are usually divided into four major types: tropical grasslands, prairie/steppe, temperate grasslands and tundra, determined either by the underlying soils or by climatic conditions. Table 4 shows the main categories of grasslands and their major zones of concentration:

Table 4 Classes of grasslands

Category	Where
tropical grasslands	Africa, South America, northern Australia, India
prairie/steppe	North America, Central Eurasia, South Africa
temperate grasslands	Europe, North America, Australia, New Zealand, Asia
tundra	All subarctic regions

The main floral component of rangelands, grass, exists to be grazed, and over time co-adapts to both the intensity and quality of grazing. The long-term evolutionary history of a grassland ecosystem as well as the history of the last few centuries are therefore essential to understanding its response both to management and to new pressures on it.

In parts of North Africa and Southwest Asia, rangelands have been reduced in size, in part because the widespread use of irrigation technologies, both in traditional and more recently in hi-tech forms, has allowed agriculture to colonise much larger regions of the rangelands. As a result, what rangelands remain are considerably more arid than those exploited by pastoralists in Sub-Saharan Africa. Indeed, 'drought' conditions may be said to obtain most of the year. Responses to this have long since been developed, both in terms of species and the movement of resources. Pastoralism has traditionally been oriented around camels and sheep, with sheep becoming predominant in recent times due to their greater marketability. The movement of water and feed resources to arid areas has been practised

³ There are two parallel series of international congresses, the International Rangelands Congress and the International Grasslands Society whose meetings alternate, but which are attended by largely the same constituency. So similar are these meetings that it has recently been proposed to merge the two societies, although this proposal remains controversial.

since before ethnographers began to describe pastoral nomads (notably through the carriage of large water-skins on camel-back). Today pastoralists throughout the North Africa and Southwest Asia have relatively sophisticated trucking systems (of water, feed resources and the animals themselves) that allow them to exploit areas that would be unavailable in Sub-Saharan Africa (Blench, 1998).

The situation in Australia is somewhat different; Australian arid and semi-arid rangelands occupy nearly 70% of the continental land mass, much of it used for extensive livestock production (Groves, 1981). Australia's rangelands have been transformed subsequent to European settlement by:

- provision of artificial sources of water
- introduction of cattle, sheep and rabbits
- introduction of exotic forage species (e.g. buffel grass, *Stylosanthes*)
- changes to traditional burning patterns
- elimination of the dingo from most sheep areas
- and clearing of overstorey trees

(James et al., 1998)

In many arid or semi-arid rangelands in Australia and in North America artificial sources of water are so widespread that lack of rainfall results in localised feed shortages (Bennet, 1997). Large herbivorous mammals are able to continue grazing in areas which they would usually have abandoned (James et al., 1996). Native wild animal populations, which previously relied on drinking from natural sources, increase because they are able to persist in areas that were previously most of the time not habitable. Such 'artificial' increases in some species may have negative effects on others. The effects on native fauna are: the displacement of ground-dwelling bird species; changes to the distribution and abundance of invertebrates (e.g. grasshoppers, ants and collembolans); possible recent extinction of some medium-sized native mammals; and indirect effect on wildlife populations through changing activities of predators (James et al., 1998:1). Another effect of artificial water sources is to maintain constant high levels of grazing pressure. Many native plant species are naturally not adapted to constant grazing and will tend to be eliminated in favour of exotics (Austin and Williams, 1988).

1.6 Sources of information on pastoralism

The worldwide literature on pastoralism is extremely uneven, and determined by politics and security issues as much as by the need for empirical data. Pastoralism studies have historically been dominated by anthropologists; and probably initially by East African pastoralists. Descriptions of a recognisably pastoral culture date back to Pliny (who described blood and milk drinking in the Horn of Africa) but it is generally assumed that pastoralism originated in West Asia and North-East Africa as early as 9000 bp.

At any rate, in many ways the accessibility of East African pastoralists combined with a perception of the importance of their herds in the eyes of the colonial authorities led to a flowering of monographs (Asad 1970). Sudan is well-known and Kenya (Bollig 1990); but for example, the non-colonial status of Ethiopia meant that its many pastoral peoples remained unstudied and even today are little known (Abbink 1993). In West Africa, the dominance of the Ful'e stimulated a series of monographs in French covering the different subgroups (Dupire 1970; Benoit 1979; Bougeot 1981; Awogbade 1983; Blench 1984, 1985, 1991a; 1994). By contrast, the Kanuri-speaking groups of Nigeria and Niger are barely described (though see Conte 1991).

Pastoralism was widespread in southern Africa at the period of first European contact, but the extermination of the Khoikhoi and the Herero has led to a near-elimination of true pastoralism

systems from the region (see Boonzaier 1987; Vivello 1977). Only in the extreme north of Namibia among the Himba does a recognisable pastoral system still exist (Bollig 1997).

Berber pastoralism in North Africa and the Sahara is relatively well described (Chapelle 1957; Bernus 1981; Baroin 1985) but in West Asia and Northeast Africa, the emphasis has historically been on the Bedu and romanticised descriptions of their herding data back to the mid-nineteenth century (Oppenheim 1939-1952; Lancaster 1981; Blench 1998). This tradition has been in the British social anthropological tradition and the relative wealth of many of these countries has rather discouraged pastoral projects of the type that has been dominant in Africa.

Between Eastern Turkey and northwest India lies a region very imperfectly known. The south of Iran is rich in pastoral groups usually specialised in sheep and these are described in a number of monographs from the epoch of the Shah (e.g. Barth 1961; Bates 1973; Irons 1975; Digard 1981; Barfield 1981; Black-Michaud 1986). Since the Iranian revolution, all scholarly field-study appears to have ceased. Similarly in Afghanistan and Pakistan, political insecurity in the pastoral regions has all but halted research. Indian pastoralism in the Rajasthan desert has been extensively covered (e.g. Agrawal 1992; Casimir 1996; Kavoori 1991, 1996; Sansthan & League for Pastoral Peoples 1999) but the Tibet-style transhumance typical of the Himalayan region less so (e.g. Downs and Ekvall 1965; Ekvall 1968; Garwahl 1981; Goldstein and Beall 1990).

In Central Asia, the Soviet period produced a large literature, seen through a rather specific ideological filter; little of this literature has been translated and much is inaccessible (though see Khazanov 1984). After the break-up of the Soviet Union there has been a major expansion of materials on pastoralists in both the CIS countries and Mongolia, although the potential for outside scholars to study has been limited by political insecurity (e.g. Temple, Swift & Payne 1993; Mearns 1991, 1993; Van Veen 1995). At the same time, the desire of development agencies to mount projects has led to a burgeoning of development literature and consultancy reports; much of this material is frankly very weak.

Chinese-dominated regions of Central Asia were off-limits for a long period, but have now begun to open up. Although Tibet remains problematic, Mongol and Kazakh herders in northwest China are gradually being placed on the pastoral map. Longworth and Williamson (1993) is a major source for these regions, concentrating principally on sheep and wool production.

In the Andes, indigenous pastoralism was virtually ignored until the 1960s and the herding of llama and alpaca (auchenids) was considered to be a borrowing from European traditions, similar to Navaho sheep herding. Andean pastoralism is now known to be extremely ancient (Rick 1980). Pastoralism is confined to the semi-arid regions of the Andes in a habitat known as *puna*, between 3700-5000 masl. This type of herding is found in South-Central Peru, Bolivia and in northern Chile. By comparison with other types of pastoralism, publications are few and scattered (see review in Orlove 1982 and also Flores 1964; Nachtigall 1966; Webster 1973; Browman, 1974, 1982; Orlove 1977; Novoa 1989; Göbel 1997).

The emphasis placed here on the sporadic and interrupted nature of pastoralist studies in many regions is important, because of the highly flexible and opportunistic nature of pastoral society. Descriptive monographs tend to fix a region or a people in time, but very often a restudy shows that major changes in species, breeding strategies and movement patterns has occurred. Basing development interventions on old data in the pastoral sector is a particularly inappropriate strategy.

For information to flow effectively, substantially more effort must go into translating and synthesising publications on pastoralism in languages other than English or French. Even monographs in German have a tendency to be ignored by the Anglo-American establishment; this is much more the case for

Chinese and Russian. Similarly, approaches from different disciplines tend to write in ignorance of one another; animal scientists don't read anthropology and development literature often seems to be written in blissful ignorance of any other discipline.

1.7 The discourse of pastoralism

The literature of pastoralism is not simply an ordered body of empirical descriptive literature; to read through this material is to become aware that it is written within a particular context. As much as nomadism is viewed negatively within many countries where it is practised so it is often viewed positively by outsiders. Writers are frequently impressed by the independence of nomads, their ability to survive in extremely harsh landscapes and their cosmopolitan outlook, compared with the neighbouring farmers. The other side of this, however, is the discourse of the 'crisis' or 'problem'. The literature is rich with articles and books analysing the crisis of nomadism or the problems nomads experience or are said to cause. Gloomy predictions as to the catastrophic decline of pastoralism are commonplace, although nomads surprisingly seem to survive these forebodings.

In part this reflects an inevitable aspect of the nomadic system of production, which frequently undergoes catastrophic collapses and recoveries. Climatic extremes and disease can cause apparently terminal livestock losses, while prosperity and stability in nation-states lead to agricultural encroachment on pastoral land. The presence of researchers while such situations are in progress almost inevitably leads to dire prognostications; however, history should make it clear that the flexibility and opportunism insisted upon in their monographs in fact allows pastoralism to be constantly resuscitated.

The other side of this is that individual countries see pastoralists as a 'problem' and it is hard not to take on this discourse. If it is part of national policy that pastoralists be sedentarised then the failure of projects or initiatives to settle them becomes a problem. If it is accepted that pastoralism is simply a part of the national tapestry of lifeways, then the 'problem' disappears. Much in the essay that follows describes attempts to provide solutions to these problems, but it is essential to remember that their existence and nature consists almost entirely of issues defined by outsiders. Pastoralists themselves often take considerable satisfaction in their lifestyle.

More recently, the literature of pastoralism has taken a more reflexive academic turn, with authors less concerned about ethnographic reality and more with the vast literature and archive material that has now accumulated. Anderson & Broch-Due's (1999) *The poor are not us* is a good example of this, with its contributors relying heavily on drawing out 'narratives' of rangeland degradation, pastoral fecklessness etc., while its theme draws on the fashionable concerns of the aid agencies that fund much of the work now undertaken. While this may be valuable in the seminar room it is of only limited interest to the comparative ethnography of pastoralism.

2. Pastoralism and the market

2.1 Selling pastoral products

The orientation of pastoralists towards the market has been extremely variable across the world, according to accessibility and ecology. Pastoralists have always had to exchange some products with outsiders for basic foodstuffs and minor household goods. Extreme weather pastoralists have generally reduced this to minimum because of the difficulties of such trade. However, West African pastoralists seem to have co-evolved with highly sophisticated long-distance trade networks, and

indeed make use of them to pass information about both market conditions and forage resources (Blench 1996).

Until recently, many pastoralists functioned essentially without cash, exchanging livestock products directly for external goods. In the command economies, prices were completely arbitrary, fixed at the centre and without regard to availability and access costs, and thus the inverse of a market system. In the shepherding systems of Central Asia, Russian demand for wool caused the replacement of the hardy breeds with Merino varieties, which could only be kept alive with high levels of external inputs (see Van Veen 1995 for Kyrgyzstan). But as monetarised systems and commoditisation have penetrated the region this has caused major adaptation problems. In Kyrgyzstan at least, the system is expected to revert to coarse wool and meat as more traditional breeds gradually replace the exotics.

The general problem of operating in a monetary economy is that pastoralism is essentially a 'slow-response' system; the reproductive cycle of livestock is not adapted to making major changes in strategy over a short period. Thus if the price of dairy products falls dramatically, a herd cannot be suddenly switched into meat production. It is no accident that livestock producers in the developed world are usually enmeshed in complex webs of subsidies and price-support mechanisms; they would otherwise soon go out of business in a world of rapidly changing market conditions.

Although agencies dominated by economists are prone to forget this, pastoralism is above all a cultural system and the close relationship between people and animals is essential to its persistence. The theoretical literature on pastoralism was dominated by an argument about the rationality of pastoral strategies. As far back as the 1920s, Herskovitz (1926) argued for the existence of 'cattle complex', in other words a skein of close cultural ties between herders and their animals that meant that their management practices were remote from rational economic strategies. In particular argument focused on the maximisation of herd size through the retention of 'useless' animals such as barren females. The rise of development economics meant that this anthropological view was regarded as unacceptable and much ink was expended trying to show that whatever pastoralists did was somehow 'rational'⁴. The debate itself now seems outmoded; pastoralists have their own culture and their management strategies develop within their cultural frame of reference. The result is often at cross purposes with outsiders' views; but then the recommendations of experts have a distressing habit of contradicting themselves over time, as changing attitudes to biodiversity and minor breeds demonstrate. Box 1 illustrates a case where customary management ideas seem very remote from modern ideas, but also underlines

Box 1. The Raika and their camels

The Raika/ Rebari people of Western Rajasthan are specialised camel-breeders who raise camels to sell as work animals to farmers and traders. However, they maintain a remarkable number of economic restrictions on the products of camels, which is not serving them well in the changing economy of India. Raika do not slaughter camels and will not eat camel meat. Female camels cannot be sold and it is against custom to make commercial gain from milk and wool. Moreover, camel milk cannot be processed in any way. One of the consequences of this is the existence of large herds of females with almost no adult males, which in turn is leading to low reproductive rates and less than optimal bloodlines. Moreover, the restrictions on making a profit from animals are leading young people to turn away from camel production and seek jobs in towns. These cultural constraints have been strongly maintained, leading both to falling camel production and economic fragmentation rather than responsive systemic change.

Source: Sansthan & League for Pastoral Peoples (1999).

⁴ Much of this argument was entirely circular; for example, if pastoralists maximised herd size this demonstrated their rationality as they would have a higher number of animals post-catastrophe. If they rid the herd of unproductive animals this was equally rational in terms of classical economics.

strongly the importance of a profound anthropological understanding of cultural constraints as a prerequisite to effective development.

2.2 Globalisation of the trade in livestock products

A major factor transforming the situation of pastoralists in the twentieth century has been the globalisation of the trade in livestock products. In the pre-modern era, pastoral products could be divided sharply between those that depended on rapid consumption such as fresh milk and meat and those that withstood relatively long-distance movement such as live animals, fibres and skins. The comparative advantages of extensive producers have meant that they have always had an advantage over agricultural regions which has stimulated a lively trade. Long-distance commercial networks are common in pastoral areas and pastoralists are frequently themselves involved.

However, enclosures in Europe and the gradual spread of both new transport, notably railways and steamships and subindustrial livestock production, especially in the area of fibres, created for pastoral producers both an opportunity and a threat. Roads opened up new markets for products such as wool and cashmere and brought increased numbers of potential buyers, but they also allowed the movement of products previously confined to local areas, such as milk and meat. As urban consumers became more demanding, especially in the area of hygiene, the balance of the market shifted against pastoralists and towards enclosed systems. This has reached its apogee in the 1990s where a sequence of health scares in intensive production systems has forced the imposition of hi-tech traceability so that all livestock products can be tracked from source to consumer. No pastoralist can compete in this market.

The other consequence has been that the large-scale livestock production characteristic of developed economies frequently produces unsaleable surpluses, often as a consequence of an intricate nexus of subsidies. Frozen meat and milk powder periodically glut world markets and eventually end up being sold in developing countries at unrealistic prices or being distributed as food aid. National governments usually accept this situation because it partially satisfies urban demand; cities are close at hand and pastoralists are usually far away. Dairy products imported into sub-Saharan Africa rose more than 300 per cent between 1972 and 1982 with the an increase of dairy consumption as a percentage of total consumption from 1-27 per cent (Von Massow 1989:7-9). But the inevitable impact is to depress production in the pastoral zone. Ironically, these processes are affecting European livestock producers in much the same way; hill farmers in Wales are going out of business because of a catastrophic decline in prices due to international competition.

In the case of fibres, the situation is more encouraging, as an international market for high-quality fibres remains quite buoyant. For Andean pastoralists, penetration of the international wool trade came relatively early, with wool being bought for export by the middle of the nineteenth century (Orlove 1977). Falling demand for the coarser llama fibres and increased demand for fine wools has had the consequence that alpaca production, previously of minor significance has become of much greater importance.

3. Meeting demand for protein: the role of pastoralism

3.1 Worldwide demand for protein

A series of recent analyses have shown the remarkable speed at which worldwide demand for animal protein is rising and project its likely increases over the next two decades (e.g. De Haan *et al.* n.d.;

Delgado et al. 1999). Table 5 shows projections for meat consumption based on FAO annual data since 1982;

Table 5. Actual and projected meat consumption by region

Region	Annual growth of total meat consumption		Total meat consumption		
	1982-1994	1993-2020	1983	1993	2020
	percent		million metric tonnes		
China	8.6	3.0	16	38	85
Other East Asia	5.8	2.4	1	3	8
SE Asia	5.6	3.0	4	7	16
India	3.6	2.9	3	4	8
Other South Asia	4.8	3.2	1	2	5
Latin America	3.3	2.3	15	21	39
West Asia & North Africa	2.4	2.8	5	6	15
Sub-Saharan Africa	2.2	3.5	4	5	12
Developing world	5.4	2.8	50	88	188
Developed World	1.0	0.6	88	97	115
World	2.9	1.8	139	184	303

Source: Delgado et al. (1999)

The suggestion is that it will be particularly in East Asia and Latin America that demand will rise, which squares with a more general understanding of the increasing wealth and growth of cities and market-driven economies in these regions. Projecting demand in the developed world is more problematic, since fashion and levels of confidence in the safety of intensively produced livestock products have an increasing influence on consumption. Changing societal patterns can often make new domesticates attractive; demand for stronger-tasting meat with a low fat content has accelerated the supply of antelope and ostrich.

Similar figures are given for milk; by 2020 projections suggest that developing countries will consume 100 million metric tonnes more meat and 223 million metric tonnes more milk than in 1993. At present, people in the developed world obtain 27% of calories and 56% of protein from animal food products, compared with 11% and 26% in the developing world; a well-known relationship between increasing income and meat consumption suggests that these percentages are set to rise in the developing world.

In terms of the sources of meat; the fastest growth areas are in pork and poultry; production costs fall more rapidly for monogastrics wherever land costs are high. Monogastric are also more efficient at converting feed and can typically be supplied with agro-industrial by-products from the cities. Sere & Steinfeld (1996) give the following rates for the increase of different livestock production systems in recent decades (Table 6);

Table 6. Source of increases in world meat supply

System	% increase
Industrial livestock production	4.3
Mixed farming	2.2
Extensive grazing	0.7

There is little doubt that these trends will continue; however, this is misleading in terms of determining the attention that should be paid to each system. Industrial production is monomorphic, it

has only a single output goal. Both mixed farming and extensive grazing are polymorphic; they provide work animals, supply rural households with protein, function as a store of wealth in areas where banks do not penetrate and often play a key role in ceremonial life. Moreover, they frequently make it possible to produce protein in terrain and eco-climatic conditions unusable in conditions of industrial production.

3.2 Evaluating productivity over time

One of the common arguments against extensive livestock production systems is framed in terms of low productivity; measuring offtake from pastoral herds or milk yields from ruminants and comparing them to industrial levels suggests to a certain type of economist that this is an ineffective use of land and resources. More attractive is the relative output argument; high-input, high-output exotics are usually measured over a short time-slice gives them attractive characteristics compared with landraces. However, over longer periods, when subjected to environmental stress, subclinical pathogens and unpredictable feed supplement costs often make them less economic, if only because mortality is almost inevitably higher. In the case of the economics of large ruminants, for smallholders even one dead animal can be a catastrophic loss, because accumulated profits from outputs are unlikely to allow another animal to be bought. Collecting data to show this is difficult, because project cycles are typically 3-5 years and this is barely time enough for exotics to be introduced and to reach their productive phase. The typical structure of evaluations does not allow sufficient time to elapse for a true comparison to be made, which would have to be over a period of a decade or more, in the case of slow reproducers such as cattle, camels and yaks. No absolute figure for such a period can be given as it follows the reproductive cycle of individual species, but it should allow a female to develop from birth to a maturity represented by several parturitions.

Box 2. Measuring output over time

Non-diverse livestock production systems are profitable because revenues are sufficient to cover the cost of the special attention needed to preserve a uniform and non-climax vegetation. Where such effort relies on planted pastures, it may also benefit from economies of scale. Outputs from such systems are usually higher when measured over short periods of time against 'complex', diversified production systems such as those involving an elaborate interface with woodland. The greater the simplification of the genetic base, the greater the risk from pathogens. The likelihood of a pathogen eliminating the resource base and thereby causing major food insecurity is hard to quantify. The political pressure for food in the present can often outweigh the potential for famine in the future.

4. The fate of pastoral populations and competing uses for rangelands

The economic importance of rangelands world-wide is extremely variable according to the socio-economic system in which they are embedded. In developed economies, such as Australia and America, rangelands are essentially marginal terrain suitable for low-intensity stock-rearing and hunting. In pluralistic economies such as Brazil, high-density vegetation such as rainforest, of crucial importance to hunter-gatherers and smallholder farmers, can be all too easily converted to low-fertility savanna of interest to wealthy ranchers. In Africa and Central Asia, rangelands are essential to the subsistence of pastoralists, foragers and farmers dependent on rainfed crops. Such groups are generally the most vulnerable groups in the region, both because they depend on a variable climate to support a necessarily patchy resource, and because tenurial regimes tend to be more ambiguous in regions often regarded as a common pool resource.

The consequence of this is that there is a gradient of competition for access to rangelands. In developed economies, rangelands are given over to low-intensity grazing or protected areas. Conflicts that arise, such as the desire of governments to increase the area of national parks, assert claims for mineral rights or predation from protected species on livestock, are relatively minor and easily settled. However, in South America, where rangeland can be created at the expense of the livelihoods of the occupants of the forest, conflict has been prolonged and violent. The principal means of habitat conversion, burning, is, for practical purposes, irreversible. Once cleared, neotropical rainforest takes centuries to regenerate.

In Sahelian Africa, India and west-central Asia, competition for rangelands is intense, but, by and large, it is not usually a case of the wealthy and powerful versus the poor and dispossessed. Increasing population pressure is tending to push arable farming into more and more marginal areas, especially with the introduction of modern transport and low-cost irrigation techniques. This in turn places further pressure on pastoralists and foragers and thus on rangeland vegetation. Although there have been serious doubts about the long-term impact of 'overgrazing' and more emphasis laid on the resilience of rangelands, continuing intensive pressure implies poor producers of biomass for both livestock and wildlife.

The consequence is very often that the poorest groups are competing with one another for a limited resource. Across semi-arid Africa and in parts of India, conflict between expanding farmers and pastoralists is an everyday occurrence; the numbers and political power of the farmers, as well as tenurial regimes more supportive of agriculture than livestock, ensure that the farmers are generally dominant. At the same time, foragers and livestock producers may come into conflict, especially in southern Africa. The consequence is often to drive pastoralists into zones so arid that farmers cannot follow them – placing more pressure on these fragile environments and exposing the herders to greater risks of climatic uncertainty.

Foragers and pastoralists often live in overlapping territories, especially in Africa and Siberia. Prior to the twentieth century, land competition was not of major significance and these two interlocking subsistence strategies could effectively co-exist. However, as human population densities have increased and pastoral habitats converted, pastoralists are under pressure to define their territories. In Siberia, the system of managing wild reindeer, was transformed under the Soviet regime into a system of herding within bounded and fenced territories, thereby excluding such hunting peoples as the Nenets. In Botswana and Namibia, cattle-keepers such as the Kgalagadi, Herero and Ovimbundu have themselves faced exclusion from white-owned fenced ranches and have been pushed into further incursions on the hunting territories of the Khoisan. The Hadza hunter-gatherers of northern Tanzania have seen their traditional hunting territories increasingly eroded by pastoralists with more access and influence at the level of the administration. At the same time, the establishment of game fences, intended to exclude migratory herds of wild animals and thereby keep livestock disease-free, reduced the ability of hunters to follow game, especially across national boundaries.

One of the options that foragers often take when faced with pressure from outside forces to cease hunting is to become pastoralists or work with livestock. The Navajo turned to sheep-herding and native Australians frequently work as stockmen. The Khoikhoi of southern Africa were partly herders at first European contact, but also engaged in extensive foraging. The impact of European settlement was grim and one of the few locations where their society survived in altered form was in Namaqualand, the arid region in the extreme northwest of South Africa and adjacent Namibia. Reserves were created and managed on a communal tenure system. However, in the early 1970s, a new proposal was made to create the Richtersveld National Park, effectively sequestering 80,000 hectares from the Nama (Boonzaier et al., 1996). This reflected as much the extreme political marginalisation of the Nama as any protection of the minimal wildlife resources of the region. However, in a reversal of the usual course of events, advocacy groups joined with the Nama to protest

the proposed exclusion. The effect was to halt the park creation until the end of the 1980s when grazing and foraging rights were conceded (or else compensation for their loss) and employment as rangers was offered as a priority to Nama.

Hunting and tourism in these regions remains a special case and of variable importance. The rangelands of west-central Africa, for example, are virtually devoid of large herbivores and infrastructure so unattractive as to make hunting and tourism insignificant. In eastern and southern Africa, however, wildlife constitutes a significant element of national income, notably in Kenya, Tanzania, Zimbabwe and South Africa. The system of national parks and a highly organised infrastructure means that the greatest proportion of income accrues directly to the state, rather than to nearby communities. As a result, poaching is rife and an adversarial relationship between park authorities and villagers is the norm. Although revenue-sharing systems have been put in place in some areas and heavily promoted by aid and development agencies, their contribution to livelihoods in these regions remains extremely small.

In Central Asia, the situation is somewhat different, since until recently, all protected areas were reserved by decree and certainly did not benefit from consultation with the local populations. The paradoxical consequence was an almost unparalleled level of habitat conservation. Similarly the system of collective farms was kept going with subsidised inputs, sometimes brought in at uneconomic costs. This had the effect of reducing pressure on the natural rangelands, as did the central control of animal numbers and relatively high levels of offtake. Tourism remains a nascent industry, and any income from it extremely volatile, reflecting the unstable politics of the region. However, the implosion of the collective farms has resulted in the regeneration of pre-Soviet patterns of pastoralism and grazing, increasing pressure on the rangelands and bringing herders into potential conflict with the management of poorly-resourced parks and protected areas. The lack of market infrastructure and the limited range of inputs means that Central Asian pastoralists are generally much poorer and more vulnerable than those in Africa.

Section II: TECHNOLOGY OPTIONS

1. Feeding and Nutrition

1.1 Rangelands: opportunistic use of patchy resources

1.2 Silvo-pastoral systems

Pastoralists almost everywhere make some use of woody vegetation in their annual grazing cycle; the most extreme systems are the reindeer systems of Siberia, which are entirely within forests. Throughout much of Africa, trees are the characteristic haunt of tsetse and other biting flies, which makes more than seasonal use problematic. In vertical transhumance in the Himalaya, the winters are spent in forested areas, the animals only moving to meadows during the summers.

1.3 Dry-season supplementation and non-conventional feeds

Compensatory gain, also known as 'catch-up growth', is the phenomenon of increased growth following a period of feed restriction. In other words, if an animal is unable to feed *ad libitum* for a period, it responds by putting on a spurt of growth when feed becomes available. This is used quite extensively in Euro-American production systems as a management tool; by reducing feed to yearling calves in the winter, farmers can benefit from growth once there is access to grass. Pastoralists, especially in semi-arid regions, involuntarily make use of compensatory gain, since their herds are almost inevitably starved for part of the year.

However, compensatory gain would seem to have very limited potential as a tool for increasing production from pastoral herds. It requires substantially more certainty about the availability of inputs than is usually available. Pastoralists usually have very restricted access to winter feeds and in regions where, for example, snowfalls are unpredictable, demands on stocked hay are equally difficult to foresee. In drylands, feed supplementation is much rarer, but pastoralists are more concerned about the date and quality of new-season grass growth; any extension of the dry season and animals will starve. Compensatory gain can really only be used in high-information systems and by definition, pastoralists are not in these systems.

2. Breeding and Reproduction

2.1 Breeding and reproduction in pastoral herds

2.1.1 Controlling bloodlines

Strategies in pastoral societies for controlling the breeding of livestock are extremely variable across the world. Pastoralism, by its very nature makes it difficult to control which animals breed, unless poor-quality males are excluded, either by mechanical means or by castration. Pastoralists are better at ensuring their herds do not mix with other herds than controlling breeding within their own herd. Nonetheless, different societies seem to have taken very different attitudes for reasons that are not always evident.

There is also a strong difference between species; camel pastoralists are much more likely to take a strong interest in breeding than sheep and goat producers. Musil (1928) describes the complex ideas about breeding of the Arabian Bedu. In contrast, Black-Michaud (1986) attributes extreme indifference to the Luri small ruminant herders of Iran. The Incas had a highly effective programme of recording the details of llama bloodlines, using *quipu* cords and a selection process to ensure that the strongest and fittest animals were used for breeding (Brotherston 1989:244). Mongolian herders make a very strong association between human and animal bloodlines; human ancestry is closely recorded and there is a sense that the same should be true for livestock, although this process was interrupted by the collectivisation of herds and the partial introduction of 'scientific' breeding practice. Many pastoral peoples in West Africa seem relatively indifferent about controlling breeding even among cattle, although they are well aware of the need to introduce new cattle races if their herds begins to exploit a different environmental niche (Blench 1999).

The notion that pastoralists should ensure they are breeding from high-quality males and that exotic stock would increase output has a long history in pastoral development. Horse pastoralism is replete with semi-mythological narratives of kings searching for stallions with near-magical attributes. In the real world, however, such introductions have not had the same success. In some ways, the reason is evident; pastoralists breed their animals to survive and produce under extremely harsh conditions and also to pass through climatic and environmental extremes. Animal breeders concentrate on marketable attributes and frequently focus on individual traits such as milk or meat production. Research stations are not ideal places to test livestock for extreme drought and disease stress. So the improved animals do not generally have the qualities that pastoralists really need, although of course they are pleased with the increased milk or meat output. As a consequence, the features of the introduced stock that make it attractive in the first place are rapidly eliminated and the overall herd output remains static.

Nonetheless, since pastoralists do engage in their own introductions, this must be possible; a more effective programme would work with animals genetically closer to those in the pastoral herds and under conditions more similar to those experienced by a real herd. Some progress in this direction has recently been made through 'open-nucleus' breeding schemes, where the pastoralist exchanges

animals with those in an improved herd. More success in this area will come with a greater understanding of the conflict between pastoralists' goals and animal breeders' goals.

2.1.2 Castration

The castration of male animals is a common strategy among pastoralists in many systems. It has the advantage that animals may become fatter and are very often less aggressive and thus easier to manage. The disadvantage is that wrong decisions about the genetic attributes of those left entire, or indeed accidents to male animals may leave a herd breeding from poor-quality animals. One counter-strategy is the use of mechanical means to prevent animals reproducing; genital covers are quite widespread in Western Asia with sheep and goats. Castration was probably little practised in sub-Saharan Africa in pre-modern times because of the risk to the stock of males; however, the gradual spread of better health care has made it more widespread as a strategy. In the Andes, castration seems to have been widespread and across all species (Göbel 1997:42). Castration also depends on social institutions for the effective circulation of males; in some ways it has structural similarities to the effects of droughts and blizzards. If the number of potent high-quality males is at a minimum and one dies, then it is only possible to recover by borrowing animals from beyond the household or community. This works more effectively as the community is more cohesive, but also can lead communities to taking substantial risks in reducing numbers of males.

2.2 Hi-tech *ex situ* strategies

Pastoralism is not well adapted for *ex situ* strategies because of the lack of infrastructure in pastoral areas and the difficulties of access. As was suggested in 2.1.1, some societies take great care over bloodlines and controlled mating while other allow unrestricted access to females. For the former, the concept of introducing unknown semen or embryos into their intricate breeding mosaic seems unlikely to be easily accepted. For the latter, it may be introduced, but the consequences will probably be the same as more conventional introductions of improved breeding stock; the elements in the introduced line that make it attractive will be rapidly eliminated by the harsh conditions of pastoralism.

Nonetheless, pastoralists are also the owners and managers of rare livestock breeds and there is now increasing concern that these could be lost or progressively eliminated by genetic introgression. With the loss of such breeds there would be a corresponding loss of genetic traits, in some cases built up over millennia, for example, the resistance to extreme cold of Yakut cattle, to extreme water heights, as Criollo and Kuri cattle and trypanotolerance. Recent scientific advances have made more intricate possibilities available for conservation and monitoring. Cloning is presently carried out in real time, since the goal is not breed conservation, but the same technology could be adapted to clone extremely rare breeds or individuals containing valuable genes. Nonetheless, cloning technology is subject to the same objections as conventional cryopreservation, that it does not reproduce the evolving responses of a live population.

The mitochondrial DNA of cattle is now routinely extracted through PCRs and can be used not only to establish the evolutionary history of breeds and species but also for routine monitoring of genetic variability within populations. DNA can be used to measure directly levels of homozygosity and thus the degree of inbreeding and thereby forming the basis for planning conservation programmes. ILRI, the International Livestock Research Institute, has taken the lead in this area and is presently engaged in DNA characterisation of African cattle breeds.

All these techniques are strictly concentrated in the developed world at present and within the scientific establishment of a few countries. Some are controlled by patents owned by large agricultural companies who will only license these technologies for their own profit. Nonetheless, as with transgenic crops, the technology will probably spread quickly to parts of the developing world with a

sophisticated science infrastructure and not at all to many other countries. The whole area is too new to make any secure predictions, but access to information, as in many other areas, may perpetuate inequity although not along conventional developed/developing world dichotomies.

3. Animal Health

3.1 Pastoralists and the health of their animals

One of the significant asymmetries between farmer and pastoralist is that the capital of the latter is tied up in living animals and these are subject to catastrophic declines through disease. An epizootic can rapidly wipe out an entire herd, well before the veterinary services reach the area. This has had two consequences, historically, that pastoral herds never became very large and herders developed elaborate systems of loans and animal exchange to reduce risk in case of this type of disaster. It seems fairly clear that there were no effective remedies against major epizootics such as rinderpest, anthrax, CBPP etc. in the pre-modern era. The rinderpest epidemics that swept through Africa in the 1890s devastated pastoral herds throughout the continent and brought whole herding systems to an end. Major epizootics that could wipe out whole herds and even debilitating diseases such as brucellosis were virtually untreatable. The principal response to trypanosomiasis was simply to avoid vast swathes of the continent, whilst rinderpest could only be combated by taking the entire herd into a remote area.

A consequence of this has been that, after an initial period of suspicion, pastoralists have generally engaged with modern veterinary medicine with enthusiasm. The consequence has been a major transformation that essentially sabotages the notion of a 'traditional' pastoralist. Vaccinations and drugs allow pastoralists to increase the size of their herds and to expand into regions previously closed to them (see Blench (1994) for documentation of the movement of herds into sub-humid regions of West Africa previously closed to cattle). By the 1930s, the Navaho had accumulated extremely large sheep herds because of the level of services available to them (Hoover 1931). Fixed veterinary services have reduced the flexibility of pastoralists to move their herds, placing greater stress on areas near where services are provided (Bovin and Manger, 1990). Unprecedented pressure was placed on feed and water resources, as well as keeping alive stock that would have died in previous conditions, creating large herds of poorly fed animals, often harbouring sub-clinical pathogens.

A major problem has been that after internationally-organised campaigns against epizootics, the normal veterinary infrastructure has been unable to cope with supplying a service of similar quality and pastoralists then become desperate for medicines. This usually stimulates the evolution of an extensive black market in drugs, many expired and some blatant fakes, which can cause havoc with pastoral herds. Nonetheless, recent years have seen considerable improvements in the techniques of reaching remote pastoral communities with veterinary services. The most important of these is the training of 'paravets' who can treat minor ailments and recognise epizootic conditions and major traumas and alert the veterinary authorities. Such programmes are in operation in Ethiopia, Kenya, Somalia, Uganda, Chad, CAR and Mali with varying degrees of success (Catley and Walker, 1997). In addition, traders and private vets (in some countries) are both making drugs available in remote areas and treating animals; this has the advantage of providing some service where the government may provide none, but the obvious drawback that there is no control over the quality and dosage of drugs. Pastoralists are increasingly taking control over the medication of their herds and are thus forced to make choices based on a very concrete appreciation of the economics of using drugs versus the value of an individual animal.

However, there is another, longer-term consideration. Just as the labour-intensive nature of traditional water-points limited the use that could be made of them and thus the potential for pasture degradation, so the low-level effectiveness of traditional veterinary systems kept down herd size and thus pressure on resources. Veterinary programmes are usually initiated without any consideration of the

consequences for overall animal-production systems (Konczacki 1978). The medical aspect simply takes precedence, as it does in human medicine, and programmes are often self-perpetuating. When the impact on environmental resources *is* considered, it is usually accompanied by the pious hope that pastoralists will voluntarily de-stock since their animals now have greater survival rates. The introduction of modern veterinary medicine demands a whole new management system, as the nature of a major threat, disease, is thereby radically changed (Bernus 1983). Herd maximisation is justified by the argument that if there are more animals to begin with, the impact of shock events will not be so devastating. However, when resource availability becomes the single most important factor limiting herd size, this argument breaks down: the more the animals, the greater the shock.

3.2 Traditional remedies

Pastoralists are usually highly knowledgeable about the behaviour and physiology of their animals and in many places have developed traditional remedies for some complaints, especially chronic pathogens, prior to their access to modern veterinary medicine. This is not always the case; for example, among the Luri of Iran there is marked disinterest in the health of animals and even a limited interest in modern remedies reflecting an underlying low investment in the health of individual animals (Black-Michaud 1986:50). The study of this 'ethnoveterinary' knowledge of animal health and indigenous remedies has now accumulated a considerable literature (see e.g. McCorkle 1986; Mathias-Mundy and McCorkle 1989).

Essentially there are two views about this type of ethnoveterinary practice; that it is of limited value and only a resort when modern remedies are not available, or that it is a grossly under-utilised resource that has been displaced as a result of the machinations of the drug companies. Prior to the colonial era, the ability of livestock producers to deal with viral diseases and pathogens other than ticks or worms was extremely limited. This is somewhat controversial; an alternative view is that ethnoveterinary techniques were widespread and more effective than they appear to be in hindsight. What is certainly true is that local remedies remain in use and pastoralists will continue to resort to them while the infrastructure to supply and the cost of modern veterinary drugs remains out of reach. It is also true that failures in the delivery of veterinary services have a very deleterious effect on both the trust placed by pastoralists in the state and is often responsible for iatrogenic diseases, when for example, animals gather for vaccinations that don't arrive and thus spread the pathogen they are trying to avoid.

4. Management and the mitigation of vulnerability

4.1 Migration

Johnson (1969) identifies the combination of animals herded and the role that agriculture assumes in a pastoral group's economy as being the most influential factors determining migration. The first and most obvious response to drought is to move the animals to areas where there is still pasture and water. This is probably the major motor for the expansion of pastoralism, especially in the case of the eastward expansion of the Ful^oe across the West African savannahs. In the pre-colonial era, pastoralists were limited principally by disease and more occasionally by insecurity. In the present century, these have taken second place to the occupation of land by cultivators and the presence of boundaries that impede free passage.

The migration of pastoralists to areas of higher productivity alleviates stress on less productive or exhausted land. Conversely, if the movement of pastoralists is restricted, already marginal land becomes more overused. Johnson (1975) observes that if pastoralists face a long journey stock deaths

increase, and they must weigh likely losses from the migration against comparable losses were they to stay on suboptimal land.

The creation and maintenance of corridors reinforces co-operation between the agricultural and pastoral sectors. However, corridors which are too long or too narrow tempt hungry animals to graze on the crops on either side; pastoralists have to use more labour to keep their herds under control, and the potential for aggravating the conflict between cultivators and pastoralists is apparent.

A major exception to this was Central Asia in the Soviet era where an extensive military infrastructure which controlled pastoral movement was based on unrealistic cost structures. Another curious exception was Israel post-1967, where extreme militarisation of the Negev led to major constraints on Bedouin ruminant production, through registration of herds, prohibitions on traditional migrations, and more surreally, campaigns against black goats (Abu-Rabia 1994).

4.2 Supplementary feeding

Supplementary feeding seems to have had little place in traditional pastoralism anywhere in the world, in part because herds were so small and pasture resources so vast in the pre-modern era. However, stocking winter hay was practised all across the temperate world, where snow or other climatic conditions made it impossible to provide the herds with adequate food. Grass is usually cut in autumn and bundled in stores and rationed to the herds during the winter months. Mechanised grass-cutters and transport have increased the efficiency of this process, and the helicopter has made it possible to drop hay on herds isolated by snow. However, this is expensive, and while typically subsidised from military budgets in Central Asia in the past, its use is now only sporadic.

In this century, changes in supplementary feeding have been extremely significant following the increasing availability of agro-industrial by-products and transport systems to deliver them to remote areas. In semi-arid Africa, products such as cottonseed and groundnut cakes and molasses are now regularly sold to pastoralists, together with mineral licks. Throughout semi-arid West-Central Africa, cotton production was introduced in the colonial era as a cash crop, and its cultivation has remained an integral part of the economy in some countries. The main by-product of ginning cotton locally is cottonseed cake: an oily compressed cake that acts as a nutritious livestock feed. In the 1960s, cottonseed cake was introduced as an experimental diet-supplement in Nigeria, and had to be given away to herders (Otchere 1986). After some time, pastoralists gradually realised the

Box 3. The desert in Jordan: a parking lot for herds?

It is generally considered that Bedu herds in Jordan in the pre-modern era were limited to some 150-200 animals, since this was all that could be managed by the labour available in a family unit. However, two changes have occurred that has radically changed this situation; the introduction of water trucks and the widespread availability of subsidised feeds. The buying of feeds has become the single most important household expenditure. *Every single livestock producer* interviewed in a survey of some 400 households spent some money on feeds. Feeds are purchased in bulk by the Government and sold according to allocations denoted by the 1991 livestock census. It is government policy not to allow purchase of subsidised feed for camels. Despite this, many of the camels, especially those kept for milk on the western edge of the rangelands are fed on purchased feed. The use of these feeds has spiralled in the last few years with the ever-declining rangeland resources. The system of allocating subsidised feeds on a per-head basis has created a major incentive to increase herd sizes and in the Badia, the rangelands covering most of eastern Jordan, herds of 1000-2000 sheep are common. The forage resources cannot support herds of this size and desert is increasingly a place to store animals while trucking in sacks of feed.

Source: Blench (1995).

value of these supplements; however, so did more intensive producers, especially those with stall-fed animals based around cut-and-carry. As a consequence, oil-seed cakes have become so highly valued that supplies are regularly bought up by wealthy urban entrepreneurs and rarely reach the markets or are available to ordinary cattle producers (Kaufmann and Blench 1989).

Increased globalisation of markets has also led to a highly significant international trade in animal feeds. Where herds have expanded far beyond carrying capacity as in most of the semi-arid steppeland of the Middle East, this is premised on supplementing herds with purchased feeds. The political significance of pastoralism in many countries in the region has had the consequence that national governments are tempted to subsidise these feeds thereby acting to swell herds to wholly unrealistic levels (Box 3).

4.3 Changing herd composition

A long-term recovery strategy and insurance against the impact of future droughts is changing the species in the herd. Although cattle are prestigious and highly valued in the market, they are vulnerable to drought in comparison to camels and goats. The relatively high rainfall in the 1960s encouraged pastoralists all across the Sahel to switch from camels to cattle, even populations such as the Tuareg (in Mali) who have been historically identified with camel-culture. The droughts of the 1970s demonstrated that this was an unwise strategy and their recurrence in the 1980s underlined this point.

These types of changes in herd composition can also apply within species. In West Africa, cattle breeds that specialise in grass are more prestigious than those that can digest a high proportion of browse. However, where low rainfall or high grazing pressure has changed the species composition of the landscape so as to favour shrubby vegetation, the herder with cattle that can tolerate a higher proportion of browse in their diet will survive better. In a concrete example, Ful'è herders in Nigeria, faced with rapidly vanishing grass in the semi-arid zone, have switched their herds from the Bunaji breed, which depends on grass, to the Sokoto Gudali, which can digest browse much more easily (Blench 1999).

Strategies relating to species diversification vary; there are advantages in owning a variety of species, so that whatever climatic events occur, there will be survivors. For example, the multi-species herd typical of Mongolia and the Andes may well be a reflection of the extreme climatic variability. However, maintaining such herds is a luxury that only the wealthier can afford. Herds of different species are generally split up, most commonly into browsers and grazers, so the available forage can be exploited most effectively.

Within species, herd diversification takes place during a drought. Productive animals, particularly females, receive priority treatment, whilst the bulk of the herd is sent to find pasture further afield. This allows milk to be obtained from the subsistence herd, or from relatives, while the rest of the herd does not exhaust the grazing (Dahl and Hjort, 1976). Larger animals, particularly camels, although resilient in a drought, will die in numbers after a critical point. After drought, smaller stock reproduce more rapidly, allowing the herd to recover, and acting as capital which can be exchanged for larger animals later on. Rebuilding a herd of camels by comparison is a slow process.

4.4 Predation

In the pre-modern era, predation on pastoral herds was a major concern of virtually all pastoralists and a constant demand on herding labour. The expansion of agriculture and the spread of modern weapons

in the early twentieth century has largely eliminated predators in whole ecosystems, for example, wolves, lynxes and leopards in circum-Mediterranean systems, hyenas and lions in West Africa. In the Soviet era, military-style collective hunts against predators in Central Asia and Siberia substantially reduced the impact of predation, although elimination was never practical. Predation remains a significant threat in the Andes, where pumas and foxes often take young animals (Göbel 1997).

However, external changes are affecting views of predation and thus attitudes towards the wholesale elimination of predators. Many species, such as wolves, bears and snow-leopards, are now seen as endangered and therefore as the object of conservation efforts rather than as a nuisance to be eliminated. Projects have been established in Mongolia, for example, to encourage herders to conserve snow-leopards by accepting the losses and providing alternative sources of income to compensate for them. In Namibia, where more traditional livestock ranches are increasingly interspersed with wildlife enclosures, predators such as leopards and cheetahs are on the increase, partly because a certain level of predation is accepted as necessary to the health of a wildlife stock. Similarly, in North America and Scandinavia, the re-introduction of wolves into National Parks has caused considerable controversy, as they inevitably pass beyond the boundaries of the park and kill livestock outside. Such losses are not acceptable to livestock producers and the rather mythic status of wolves has allowed them to articulate panic messages somewhat out of proportion to the wolves' actual depredations.

The consequence has been a policy war between these competing interests, played out in front of an interested media. There is little or no doubt that environmentalist and conservation concerns will win out; the strength of these lobbies across the developed world is constantly growing and they are well-funded and articulate. Wildlife, where picturesque, can often contribute more than pastoralists to national economies in hard currency, which is what counts with policymakers. Moreover, it has become clearer that there are ways to develop interlocking wildlife and pastoralist systems that allow both systems to flourish; such types of co-conservation are beginning to appear in East Africa (Bourn & Blench 1999).

4.5 Theft

A problem rarely addressed by livestock services, but which weighs heavily in the investment decisions of livestock owners, is the prevalence of theft. It is not worth investing in quality animals if the likelihood is that they will be stolen. Owners will not pay out for supplementary feeds if the only effect of fattening animals is to increase their attractiveness to thieves.

Livestock raiding has something of a romantic history and in parts of the world, such as the Kenya-Ethiopian borderlands or Madagascar the successful rustler gains prestige (e.g. Fukui and Turton 1977; Todd 1977; Bollig 1990; Turton 1991). There is, moreover, an argument that this chronic raiding acts to maintain an ecological balance (e.g. Sweet 1965). However, more commonly theft is practised by urbanised individuals linked into the market system who can sell their haul rapidly to butchers. Cattle and sheep are the animals most commonly stolen, because of their relatively high market value and because they can be driven away. Livestock theft is problematic in administrative terms; national authorities are often unsympathetic to pastoralists to begin with and perceive the expenditure of policing resources on lost sheep as futile. The consequence of this is that not only do herders need to allocate considerably more resources on guarding animals, but they tend to arm themselves and treat stock-raiders to summary justice. This in turn tends to aggravate the authorities still further as they then see pastoralists as forming unregulated militias.

5. Processing technologies

5.1 Dairy products

Pastoralists almost everywhere in the Old World depend heavily on livestock milk products for nutrition; both directly by consumption and through sales of dairy products to adjacent farmers to acquire grains or other foods. The exceptions to this pattern of exchange are where pastoralists are so remote from arable areas that this is not practical. The pastoral peoples in the centre of deserts, such as the Sahara, and in extremely cold areas such as Siberia, have no opportunity for such sales. Similarly, the evolution of processing technologies, such as cheese and yoghurt-making, are driven by climate; in extreme cold there may be limited value in elaborate preservation technologies. Processing technologies are also driven by breeding seasonality; for example, in most of sub-Saharan Africa, breeding is uncontrolled, with the consequence that animals can come into oestrus at any time, with some milk thus available all year round. In temperate zones, oestrus may be naturally highly seasonal or herders may control breeding through mechanical means or enclosure. Milk is thus seasonal and if herders depend on sales for carbohydrates then they must preserve the product and sell it when there is a market opportunity.

Dairy products thus exhibit a wide variety of storability. In an extreme herding economy such as Mongolia, where fresh milk is only available for part of the year, there is a strong requirement for a diversity of products to meet nutritional requirements throughout the year. Table 7 shows the principal dairy products made by Mongolian herders;

Table 7. Mongolian dairy products

Mongolian	English
<i>Aaruul</i>	Solidified dried curds
<i>Urum</i>	Clotted cream
<i>Shar Tos</i>	Reduced Butter
<i>Tsagaan Tos</i>	Fermented butter?
<i>Ezgi</i>	Caramelised curd
<i>Aartz</i>	Boiled yoghurt
<i>Tarag</i>	Yoghurt
<i>Byaslag</i>	Cheese
<i>Airag</i>	Fermented mares' milk
<i>Huruulsun suu</i>	Boiled milk
<i>Tsurum</i>	Dried yoghurt

Source: Blench (1995)

In Iran, a similarly wide range of products is made essentially from small ruminant milk (e.g. Martin 1980; Digard 1981). Generally speaking, dairy products in Eurasia seem to be much more complex and varied than those in Africa, which probably reflects greater exposure to climatic extremes and thus the need to devise products with differing degrees of storability. There is also considerable variation in attitudes to fresh milk; in Africa and Europe this has historically had a high cultural value among livestock producers, whilst in Iran it is rarely if ever drunk without processing (Digard 1981:198).

All species produce milk, but the culture of dairying varies between species. For example, although Cleopatra 'bathed in asses' milk' donkey milk seems no longer drunk anywhere in the world on a

regular basis though it is often an ingredient in magical remedies⁵. Table 8 shows a summary of a variety of dairy products produced from the milk of different species.

Table 8. Dairy products by species*

Product	Camel	Horse	Donkey	Cattle	Yak	Buffalo*	Sheep	Goat	Reindeer
Fresh Milk	+	+	-	+	+	+	+	+	+
Yoghurt	+	-	-	+	+	+	+	+	-
Butter	-	-	-	+	+	+	+	+	-
Ghee	-	-	-	+	+	+	+	+	-
Cheese	+	-	-	+	+	+	+	+	-
Fermented milk	-	+	-	-	-	-	-	-	-

Source: Collated from FAO (1990) and other sources

*Buffalo are very rarely herded by pastoralists (although see Digard 1981)

Reindeer milk yields are extremely low and thus reindeer are only occasionally milked and no products are made from the milk (Fondahl 1989).

Llama and alpaca were not traditionally milked and it seems that Andean populations were lactase-intolerant, pointing to a long history for this situation (Orlove 1982). Dairying in South America is thus entirely an introduced culture and probably the sale of dairy products such as cheeses originally developed because of a market among individuals of European descent. Nonetheless, where herds are mixed, combining llamas with small ruminants, cheese-making represents a significant economic activity (Göbel 1997).

A constant factor among pastoral populations is the assignation of milk and milking to women (Little 1994). Men usually only milk animals for their immediate consumption but almost everywhere, women are assigned the right to milk animals for feeding the family and for sale, where there are surpluses. This has been positive for women where the external market for milk has increased demand, for example in Sudan where the introduction of rural cheese factories pushed up prices (Michael 1987). However, where the comparative prices of milk and meat shift in favour of meat, men become more concerned about calf survival and thus pressure women to take less milk.

Milk yields of pastoral herds are almost everywhere very low compared to farmed species in modern intensive systems. West African cattle may give as little as one litre a day, compared with up to sixty in highly intensive stall-fed systems. The inevitable experiments on university and research station farms have shown that the capacity of 'traditional' breeds is much higher when their nutritional regime is changed. But pastoralists do not operate under these conditions, but have rather to contend with a range of subclinical pathogens, constant movement, and the need to balance calf survival against human nutritional needs. So, despite being the recipients of reams of good advice and the beneficiaries of countless projects intended to increase yields, this situation remains much the same.

Another aspect of pastoral dairying that has frequently been the source of near moral panic among developers is hygiene. Although hygiene in dairy production represents a major cost to intensive milk producers, pastoral societies have virtually no outgoings, since they generally take no special precautions. Since the principal consumers and purchasers of their products attach no importance to this they can compete effectively with packaged products from intensive systems and see no need to adopt additional technologies that increase costs without also increasing market price. If, however, pastoralists operated in countries with onerous regulations concerning dairy hygiene that were actually enforced, their production systems would be threatened; but almost by definition pastoralists are remote from such regimes.

⁵ Apparently, fresh donkey milk was widely available in nineteenth century London as an alternative to the highly adulterated cow milk sold by dairies.

It has been observed in various regions of the world that the terms of trade are slowly but inexorably moving against pastoral producers. In other words, the value of their milk, either exchanged directly against grain or sold to buy grain, is gradually declining. The reasons for this are manifold but can be reduced probably to a single underlying cause, the spread of competing products in a market once dominated by milk. For example, in semi-arid West Africa, milk was once the gift of preference to visitors and the status of an individual confirmed by the amount of milk they drank. The availability and prestige of beer and soft drinks has largely displaced milk and it has become something of a poor person's drink, thus forcing down the price. In addition, the tendency of Western economies to produce surplus milk has the consequence that there are frequently surpluses of dried milk powder which are either dumped in countries with a pastoral sector or sent as development assistance. The sporadic and aseasonal availability of such a competing product makes it problematic for pastoralists to predict the market value of their own product.

Apart from milk, live animals can also yield blood and this has been historically exploited in Eastern Africa and the horn of Africa, although it is a practice looked on with distaste by pastoralists elsewhere. Pastoralists such as the Maasai bleed cattle with a special hollow arrow and mix the blood with milk. The Dodoth and perhaps other pastoralists also bleed small ruminants, making a cut above the eye. Yields are not high as individual adult animals give about a litre a month during the wet season and less in the dry, while small ruminants give only about 0.25l (Deshler 1965). Although nutritious and apparently safe, it seems unlikely this practice will have potential to spread to other pastoral regions.

5.2 Meat preservation

The preservation of meat is extremely variable among pastoralists and reflects both the seasonality of slaughter and market access. For example, where the majority of animals are slaughtered at one time of year, notably in cold-weather sites such as Mongolia and Siberia, meat must be preserved, but can often be kept fresh by simply freezing it. In the arid tropics, there is less impetus to slaughter at a particular time of year because of aseasonal oestrus and thus significantly less interannual weight variation. Meat is occasionally smoked, especially for market, but pastoralists usually match the species slaughtered to the occasion and consume all the meat before it goes bad.

5.3 Hides, skins and other products

Apart from meat and milk, livestock fibres and hides can also be of substantial economic importance. Woolled sheep tend to be found in temperate zones; for example there were hardly any wool sheep in Sub-Saharan African pastoral systems or in South-Central India. Wool is one of the high-value products that is not facing significant competition from an equivalent external product; the evidence is that globalisation of trade has caused wool and cashmere production to expand. Alpacas, for example, are tending to expand at the expense of llamas because their wool commands a better price on the international market. The exact definition of 'wool' versus 'hair' is somewhat variable; products from camelids are listed under hair in some statistics and wool elsewhere. Orlove (1977:205 ff.) has a useful discussion of this problem in relation to the Andean wool trade. Table 9 shows the main fibre and hide products traded by pastoralists by species.

Table 9. Livestock products other than dairy by species

Livestock products	Camel	Horse	Donkey	Cattle	Yak	Sheep	Goat	Reindeer	Llama	Alpaca
Hair	+	+	+	+	+	+	+	+	-	-
Wool	-	-	-	-	-	+	-	-	+	+
Hide	+	-	-	-	-	+	+	+	+	+
Tail	-	+	-	-	-	-	-	-	-	-
Antlers	-	-	-	-	-	-	-	+	-	-

Camelids are defined as having wool along with sheep. However, the cashmere produced by goats, yaks and Bactrian camels is very close to a wool. Reindeer antlers can be harvested both mature, when they are used for handles and other implements that require bone, and immature when they are prized for medicine, especially in Korea and other SE Asian countries.

All the products except hides can be harvested sustainably but hides come only post-slaughter. Pastoralists are usually more concerned about animal survival than the quality of hides, so these are often of limited market value. Enterprises requiring quality skins very often prefer to work with specialised sedentary producers. For example, the Sokoto Red goats of the Sahel used to produce morocco bindings are never drawn from pastoral herds. In West Africa, however, there is a substantial market in hides for human consumption, so much so that leather for shoe production has to be imported. In large economies such as Nigeria, this can lead to quite startling frauds such as the passing off of donkey or camel skins as cattle hides in remote markets.

In the traditional sector, almost all post-abattoir products are of some economic value; blood is dried and sold as fertiliser, horns and bones are clean and ground up as animal feed. However, animals are sold live and this disposition of minor products is in the hands of traders leaving little room for improving the added value of pastoral products.

6. Work animals

One way of gaining added value from pastoral species is through their use as work animals. Working animals are more likely to be found among agropastoralists or farmers, but the boundary between the two is highly permeable. In West Africa, for example, it is not uncommon for farmers in semi-arid regions to use cattle for ploughing or carting produce during the rainy season and then hand the animals to occupationally specialised pastoralists for the remainder of the year. This enables them to exploit the economies of scale that come with the management of large herds, or alternatively to avoid the labour outlay associated with cut-and-carry management.

Extensive Pastoral Livestock Systems

Table 10 shows the same species of animal as the other tables and the types of work performed by animals. An additional column notes the importance of the dog which is a key species used for herding throughout much of semi-arid Eurasia.

Table 10. Working animals by species

Uses	Dromedary	Bactrian	Horse	Donkey	Cattle	Yak	Sheep	Goat	Reindeer	Llama	Alpaca	Dog
Riding	+	+	+	+	+	+	-	-	+	+	-	-
Portage	+	+	+	+	+	+	+	+	+	+	+	-
Cartage ^o	+	?	+	+	+	+	-	-	-	-	-	-
Tillage ⁺	+	+	+	+	+	-	-	-	-	-	-	-
Threshing	-	-	+	+	+	-	-	-	-	-	-	-
Rotational machines*	+	-	+	+	+	-	-	-	-	-	-	-
Drawing water	+	?	+	+	+	-	-	-	-	-	-	-
Herding	-	-	-	-	-	-	+	+	+	+	-	+

^oIncludes pulling sledges, both for human and agricultural products transport

⁺Includes, planting, ploughing, harrowing, weeding and lifting

*Sugar-cane mills, oil-mills and clay brick making mortars

Buffalo are crucial work animals, especially in Egypt, parts of Western Asia, India and SE Asia, but there is no evidence for their use as a pastoral species, hence they are excluded from this table.

Sheep and goats are not usually used as pack animals, but they are essential to the system of vertical transhumance in part of the Himalayas (Downs & Ekvall 1965). Similarly, goat-carts are used on a small scale in Honduras, although but could not be described as a significant widespread technology. The use of reindeer for herding is a key element in the entire production system; reindeer brought up in the household can be trained to round up and lead the semi-wild herds. Much the same is true of goats, for example among the Bedu, where a trained goat will manage a flock of goats and sheep.

7. Environmental

7.1 The overgrazing debate

Pastoralism may begin in Africa as early as 7000 BC, but its major impact is probably felt by about 3000 BC in both East and West Africa. Cattle and sheep do not reach the rangelands of southern Africa until about 300 AD. The widespread presence of tsetse would have constituted a major constraint to livestock in many regions, at least until trypanotolerant breeds were developed. Destroying tsetse habitat in woody vegetation and gallery forest would have provided an additional incentive for pastoralists to burn off forest cover. The twentieth century brought trypanocides, enhanced veterinary care and eliminated much tsetse habitat, providing an incentive to substantially increase herd sizes and thus grazing pressure (Blench 1995b). Hence the growth of a large and often problematic literature on range degradation and overgrazing.

Other literature has focused on range degradation and vegetation change due to overgrazing or to climatic variability (Adams, 1996; Behnke, 1994; Doughill & Cox 1995; Blench and Marriage, 1999). Nonetheless, heavy grazing does change the composition of the vegetation (Hiernaux, 1996). The density of palatable perennial species falls as they are replaced by less palatable ones, because their competitive ability declines.

Another consequence of heavy grazing can be the spread of woody vegetation and the eradication of grassy areas (Arntzen, 1990). Adams (1996: 6), discussing the Kalahari in Botswana, reports that in 'low tree and shrub savanna' the combination of heavy grazing and the absence of hot grassfires causes the spread of dense, woody vegetation (bush encroachment). The spread of pure and persistent stands of species – such as blackthorn – means long-lasting and irreversible decline in species diversity (De Queiroz, 1993b; Dougill and Cox, 1995). This kind of bush encroachment means a decline in the productivity of the grazing for both cattle and goats, as well as wild herbivores. Adams (op. cit.) points out that bush encroachment in the Kalahari is distinct from other forms of vegetation change, both in terms of persistence and its exclusion of other species.

Apart from the semi-arid and subhumid savannas, Africa has a smaller number of high-altitude grasslands. The Ethiopian Plateau constitutes the most extended area, but the highlands of Uganda and Rwanda represent a similar ecology. In West Africa, the Fouta Djallon in Guinea and the Adamawa grasslands in Cameroun and Nigeria are comparable grasslands. Unlike the Sahel, the West African grasslands have historically had relatively low grazing pressure from wild herbivores and none from domestic animals because the foothills around these plateaux are humid forest that acted until recently to exclude cattle. The colonisation of these grasslands by pastoralists took place in the mid-to-late nineteenth century when the expansion of population cleared sufficient areas of tsetse to make it possible to reach them without unacceptable levels of mortality from trypanosomes. They represented almost ideal conditions for pastoralists, with lush grass, little competition with farmers and reduced disease problems. As a result, cattle herds came in increasing numbers, gradually changing the pattern of vegetation until they became almost unusable as a habitat for livestock (Blench 1998b). The Mambila Plateau in SE Nigeria represents a good case history of this type of cycle (See !).

In silvo-pastoral systems, notably the reindeer-based systems of Siberia, the potential for overgrazing of mosses and lichens is both very real and long-recognised by herders. Moreover, the speed at which reindeer can reproduce means that without epizootics and blizzards they can soon strip their habitat. As a consequence, herders such as the Chukchi have developed culturally-sanctioned systems of destocking (Box 4).

Pastoralists do not usually manage pastures and generally do not plant them. Attempts to encourage the planting of pastures, such as through ‘fodder banks’ have not met with significant success. However, in the Andes, herders create irrigation channels to encourage the growth of *bofedales*, bunch grasses that are particularly for llama nutrition (Orlove 1982:100). This is not reported elsewhere in the world, although it would seem to have potential for cold-weather pastoralism.

7.2 Drought and drought management

Livestock can fall victim to two main types of climatic anomaly, droughts and blizzards. These are very different in their impact on herders, since in blizzards, animals are cut off by snow and often unable to break through the

sheet of ice that forms over the grass to feed. In this situation, a large number of animals are likely to die simultaneously, irrespective of herders’ strategies and the condition of the stock. Droughts, however, are cumulative, and the gradual realisation of a drought causes pastoralists to move their animals rapidly in search of more favourable conditions. As a consequence, animals die slowly, with the weaker animals first, and are often sold in advance of likely death to realise some profit.

Droughts, or periods of unusually low rainfall, are part of the expected pattern of precipitation in semi-arid Africa, and the common response of pastoralists in the past was to move to areas with higher rainfall where the vegetation persisted. This was no more than an extension of typical intra-annual seasonal movement, with pastoralists clustered in more humid regions in the dry season and moving to drier zones when the rains begin to take advantage of the new grass. Pastoralists exist along a gradient of willingness and capacity to move, and those that shift rapidly in response to a coming drought are more likely to conserve their herds. Contributors to Gallais (1977) show that in the Sahelian droughts of the early 1970s, nomadic pastoralists survived better than their agropastoralist neighbours by moving their herds long distances.

Recent high-profile media coverage of El Niño and similar climatic anomalies has tended to present an image of unprecedented climatic crises. In reality, however, there is no unambiguous evidence that the climate is worsening although distributions are changing, as indeed they have always changed (Blench 1999; Blench and Marriage 1998, 1999). However, a series of rapid and external changes in the present century have led to pastoralists being under unprecedented pressures and thus unable to respond appropriately. A bundle of factors are making long-distance opportunistic movement increasingly impractical, notably through the establishment of national frontiers, the expansion of cultivation even in very dry areas, and continuing increases in total livestock numbers. The consequence is that droughts now cause significant humanitarian problems and localised degradation, since large numbers of animals converge on certain pastures, especially around wells. This in turn is

Box 4. Keeping Chukchi reindeer herds in check

The Chukchi people herd reindeer throughout much of Siberia, east of the Kolyma river. Because of the importance of matching herd sizes with moss resources, they have developed a number of mechanisms of controlling herd size, somewhat surprising in terms of other pastoral societies. Herds are regularly split between family members and the new herds take off for pastures elsewhere. ‘Assistants’, i.e. hired herders are paid with stock and can often gather enough animals to form the nucleus of their own herd. ‘Herd capture’, the intentional mixing of a small herd with a large and the consequent disappearance of some animals from the large herd is tolerated. However, the Chukchi also kill pregnant does in order to prevent them from reproducing. At the annual sacrifices, when male fawns and bucks are killed each must be accompanied by a ‘wife’ thereby removing further females from the system.

Bogoraz (1902-9) and Leeds (1965)

responsible for long-term impoverishment among pastoralists, since they must sell animals cheaply and cannot afford to re-buy them when the drought ends. At the same time it places extra stress on already ineffectual veterinary services, since weakened animals are more susceptible to pathogens.

In one sense, these cycles are increasingly understood by national governments, international agencies and NGOs, with the consequence that effective mechanisms are generally in place to deliver relief supplies to affected pastoralists. This however, has led to the perception that drought is essentially a humanitarian problem. As a result, policies to deal with the long-term consequences of drought and to try to prevent the cycle from simply repeating itself are best described as inadequate. There is considerable historical evidence that pastoralists who could not succeed in difficult climatic conditions or who lost their herds through disease simply left the agro-ecological zone and became settled farmers or traders. This was a brutal but effective mechanism of reducing pressure on resources. However, the provision of food aid has the effect of keeping in place populations who would otherwise move and initiate a new subsistence strategy.

The present responses and policies of governments, agencies and NGOs to drought cluster around restocking and sedentarisation. Restocking can work on a local scale, although it is expensive in terms of management and seems to provide no evident insurance against further droughts, which on average seem to occur every 10 years. Although it is generally agreed that pastoralists are not responsible for 'overgrazing' in the way this was pictured in earlier literature, the inexorable increase of both herds and cultivation *has* placed unparalleled pressure on resources. Pastoralists themselves tend to insure against individual risk by dispersing animals in other herds; this is effective for individual herders especially as protection against epizootics but does not remove animals from the system. Unless there is more effective strategic thinking about the long-term consequences of present drought response strategies the cycle of crises is likely to continue.

Section III: POLICIES AND ISSUES

1. How can the livelihoods of pastoralist families and communities be improved?

1.1 Sedentarisation and land tenure

The conflict between nomad and the settled farmer goes back to the earliest written records and is mythically symbolised in many cultures. Cain slew Abel, the Chinese emperors built the Great Wall to keep out the marauding hordes, the rulers of Egypt were constantly at war with nomads from the deserts west of the Nile⁶. The association of highly mobile pastoralists with raiding and warfare has been crucial in establishing negative stereotypes throughout history, whether the Twareg of the Sahara, the Mongols in Central Asia, the cattle-raids poeticised in the Tain or the present-day Somali *shifita* raiding into northeastern Kenya.

Typically the state sees only the threat and ignores the fact that pastoralists frequently exist on land that is too fragile or too variable to be intensively used and is moreover a significant supplier of pastoral products to farmers and urban populations. Government policy tends to favour the agriculturalist and faith in technical assistance given to farmers is reinforced by ethnic prejudices, since administrators come predominantly from agricultural backgrounds (Horowitz and Little 1987).

⁶ There are references to pastoralists in the deserts west of the Nile Valley in Egyptian records. Ramses III defeated a Libyan tribe called the I-S-B-T-U usually identified with the Asbytes of Herodotos. The 'Tehenu' appear in Vth Dynasty sources (3200 BC) as livestock keepers of the Western Desert and later numerous other tribes are mentioned (Vernet and Onrubia-Pintado 1994:56).

There is therefore a long history of the state attempting to settle pastoral nomads, often with very limited success. In Iran, for example, during the epoch of Rezâ Shâh (1925-1941) there was a concerted campaign not only to settle the pastoral nomads but also to eliminate their distinctive culture in terms of language, dress and authority structures (Digard 1990). During the administrative chaos in the Second World War, the nomads rapidly reverted to their former migratory patterns, and up to 1960, there was long series of councils restituting much that was appropriated during the 1920s and 1930s. However, during the rule of Mohamed Rezâ Shâh, persecution of nomads began anew and leaders of many groups such as the Qashqa'i fled into exile (Beck 1986). Following the departure of the Shah and the period of uncertainty, many returned to reform their authority structures. However, within a couple of years, Revolutionary guards were attacking with Qashqa'i with the same helicopter gunships used by the Shah.

Attempts to settle the pastoralists in the Middle East go back as far as 1910, when King Abdul Aziz moved Bedouin into Hijra schemes in Saudi Arabia. These centres grew until 1929, when a revolt destroyed them and by the 1950s they have completely reverted to herding settlements (Chatty 1996:19). Such schemes, far from being a discouragement, were replicated throughout the region, often under very different political regimes with very similar results.

However the conflict between these two groups does not justify one sector being sacrificed to the other, particularly given their symbiotic relationship between the two. The growing number of pastoralists and settled farmers who are diversifying into agropastoralism demonstrates the potential complementarity between herding and farming. Furthermore the scope for further collaboration is evident: inputs such as fodder, apart from simply crop residues, provide the possibility of greater diversification of herd-management techniques.

Even spontaneous sedentarisation does not necessarily entail any increase in production or food security and may, on the contrary, have the effect of shifting underemployment and hunger to other regions. Economic and military pressure on the Negev Bedouin has forced many to settle with often disastrous consequences for their society (Meir 1977). The growing urban population gives rise to greater demand for livestock and agricultural produce, whilst the labour force in rural areas dwindles, and depopulation of areas suitable for pastoralism only wastes natural and human resources. Niamir (1991) notes a drain of expertise as young people move out of the pastoral sector.

The encroachment of cultivation onto land traditionally held and grazed by pastoralists has forced them into increasingly marginal and unproductive land. Despite this, some interest groups argue that pastoralists are inherently inefficient and self-destructive, and should be settled, as is the official line in Nigeria, for example (Awogbade 1981). Besides the cultural damage involved in forcibly settling pastoralists, small-scale agriculture or urban unemployment does not necessarily offer a lifeline out of poverty.

The fact that nomads are often unwilling to settle suggests (particularly given the role of opportunism and adaptability in the decision-making process) that it is generally deleterious, except after some near-starvation critical point. Adverse conditions generally encourage pastoralists to wander more and further afield. If it were beneficial for pastoralists to settle, this is what they would do and until such time as this, the rationality of nomadism is evident.

Blame for the impoverishment of pastoralists has been laid at the door of the weather, 'pastoralist irrationality', sedentary farmers, and governments. However, to apportion blame is not to solve the problem, and a political problem lies as much in the relationships between the parties concerned as in the nature of the agents themselves. Cullis (1992) has suggested that future work for development lies in advocacy. Conflict between sedentary and nomadic groups has escalated in recent years in spite of

the relationship of symbiosis and bartering which has been, and remains, essential to both sectors. An analysis which concludes that there are too many mouths and too little water does not explain the political alliances or address the need for diversity in order to maintain any part of the system. The temptation to see the world in terms of opposites rests on the assumption that clear distinctions can be made between sedentary and nomadic people, and consequently between pastoralists and agriculturists, but this is not borne out by the fluid and adaptable existences of many groups. The semi-nomadic pastoral populations of the Lahawin in the Sudan, for example, divide the year into migration and settlement phases, and the mobility of group members is dependent on the rainfall as well as other factors such as herd size (Gorman and Boosh, 1990). Other nomadic groups are known to choose an increasingly or decreasingly mobile existence depending on environmental conditions. Nomadic peoples often live on the land surrounding rainfed agriculture; in wet years agricultural practices are expanded, and during drier years, people return to pastoralism (Johnson, 1969).

Past external intervention has been informed by northern specialists, but the lessons of the integration of the pastoral system with other sectors points very forcefully towards the conclusion that future advice and thinking, whether from within the pastoral sector or without, should take a holistic view of the situation. Settlement does not reduce the consumption needs of pastoral groups, and the issues of food security and pressure on resources are not addressed by a policy of sedentarisation.

Issues of land tenure in the pastoral sector remain a fraught topic. Broadly speaking, prior to the modern era, traditional tenure in pastoral areas was either loosely framed or non-existent. Where a resource was patchy, and the pastoralist an opportunistic grazer it made little sense to establish elaborate tenurial regimes. The exceptions to this were where a valuable and fairly reliable resource was being competed for by a variety of players. For example, in the inland Niger Delta in Mali, a vast wetlands used for livestock, fisheries and rice-growing, a complex regime existed in the pre-colonial era to regulate access to pasture. The Beja, living along the Red Sea Coast of Sudan, seem to have 'owned' patches of rangeland for a very long time, reflecting the antiquity of their settlement in the region. In pastures subject to heavy snow, frameworks grew up to control access to meadows in the lee of hills where snow depths were the least.

The twentieth century, with the growth of the nation state and widespread demands to codify land ownership, has compelled pastoralists and others to think more coherently about tenure. In many regions, the absence of written documents has simply allowed farming and timber interests to take over pastoral land with any hindrance. This should not be thought of as a problem confined to the developing world; cases in court at present in Sweden are being brought by timber interests who are gradually eating away at Saami land and their success is based on the absence of written documents confirming Saami proprietorship. The irony in this case, of course, is that Scandinavian countries have a reputation for pastoral studies and projects, and these, conveniently located far away, take an entirely different approach to customary tenure.

1.2 Rethinking pastoral organisation

Pastoralists are not very prone to develop complex social institutions to defend their interests as a group, in part because their mobility and flexibility makes it hard for such institutions to maintain their coherence over long periods. The exception to this is when pastoralism is allied with military organisation as in the case of the Mongols and other horse-mounted raiders of Central Asia or in the states established by the Ful'e in West Africa. However, when conquest leads to empire, the necessity for a functioning administration effectively excludes actual pastoralists. Traditional social organisation thus focuses on the household and kin group with more nebulous clan entities providing social identity but not necessarily organisational capacity.

This has seemed highly unsatisfactory to outsiders encountering pastoral society, for various types of co-operation would seem to be a precondition for development. Pastoralists moving through arable areas are frequently in conflict with farmers; it seemed logical to form agreements with farmers, to prevent this. The purchase of drugs, access to water and pasture would seem to be better regulated by local and regional associations. Moreover, the prejudice against pastoralists in many nation-states might be better combated by organisations that could effectively articulate their case to government.

In the command economies, the solution to this was relatively simple; through collectivisation, co-operation and association was simply forced upon people. This had both a good and bad side; it made the delivery of inputs simple and the organisation of necessarily collective operations such as predator hunts functional. It evened out the production of winter hay and ensured that the economic burden of herd loss would not fall on single households. The disadvantage was that the system was heavily subsidised from outside and subject to arbitrary pricing. As a result, there was no discrimination for competence and unsustainable production strategies were the rule. Despite the benefits, these systems are gradually collapsing following the fall of Communism and much more traditional social patterns are re-asserting themselves.

Outside the command economies, principally in Africa and the Middle East, the main tool in the armoury of developers has been the Pastoral Association (PA). By one means or another, pastoralists were encouraged to associate and to negotiate collectively with outside bodies for veterinary services, water development etc. Both the World Bank and regional NGOs such as SOS-Sahel have been involved in the promotion of PAs all across the Sahel since the 1970s. In East Africa, the system of 'group ranches' was developed, principally for the Maasai, to encourage a more comprehensive system of land ownership and thus investment as well as to provide centralised systems of livestock dipping. Elsewhere in Africa, Pastoral Associations were more fluid as governments have not generally had the resources to mount such a large-scale operation as the group ranches.

Whether PAs have really been successful and indeed how success is to be measured remains moot. Pastoralists were hit very hard by the droughts of the 1970s and 1980s and the rinderpest epizootic of the 1990s. As a consequence, what fragile social capital had been built up tended to dissipate as individual herdowners scattered. This may well be the problem with any sort of voluntary association of this type; where promoted by committed individuals it can be successful for some time. However, the logic of pastoralism is such that in a period of crisis, herds scatter and with them the associations.

Nonetheless, if pastoralism is to make any effective defence of itself in the coming millennium, it will have to develop new structures; existing social institutions have not served it well in a new era. It seems likely that new technology may change the equation in interesting ways. Proposals to use radio to communicate useful information pastoralists have been on the table for some time but they have generally been blocked by state control of the airwaves in almost all pastoral areas. Recent times have seen a significant relaxation of radio licensing in many countries and deregulation may well drive the provision of information services to pastoralists. Even more important is the evolution of affordable satellite phones probably also supplying internet access. These may allow pastoralists to link together and to learn about resources and inputs in remote places. Mobile phones have already transformed communications in many countries dogged by unreliable landlines and this process has every potential to drive even more far-reaching changes.

1.3 Restocking

Restocking, whether initiated by herders or organised by an external agent, attempts to rehabilitate herders within their environment rather than suggesting they settle and take up, for example, fish

production⁷. Rehabilitation relies, though, on there having been a significant change in the environment or in herder management of it. Returning to the *status quo ante* serves little purpose and contravenes the principle of constant readjustment in conditions of disequilibrium. Simply providing pastoralists with animals to replace those lost during drought does not take account of the fact that the available land, environment and management has not sustained the level of stocking. Restocking risks providing another hecatomb for the next drought. The loss of weight from animals during drought is of much less importance than the loss of animals through starvation, especially if rehabilitation through restocking will replace lost animals. Selling animals at appropriate points in the drought cycle maintains the possibility of autonomously rebuilding herds in better times. It is beneficial as a means of management, but is still geared towards maximising herd numbers.

Restocking is usually thought of as something perpetrated by agencies, but pastoralists have their own systems of insurance against drought. Herders prepare for drought and epizootics by 'lending' their animals to relatives or friends in exchange for looking after some of their animals in return. If a herd is caught up in a crisis and suffers high mortality, then the herder calls in these animals to form the nucleus of a new herd. Even where such an insurance mechanism is not in place, it is quite usual for relatives to lend animals, until they have produced sufficient offspring for the affected herder to rebuild a viable enterprise. Even so, such mechanisms were not always successful; hence the suicides of West African pastoralists who lose all their herds. Restocking by outsiders tends to result in distress sales or slaughtering. When implemented inappropriately, restocking risks achieving little more than postponing disaster and the decline of pastoralism, whilst interfering with indigenous recovery systems (Heffernan, 1995).

The need for a viable herd determines the nature of restocking programmes, and a herd which is large and diverse enough to support a family, providing a taxable surplus for purchasing necessities, is considered optimal. Despite the obvious weakness that such standards of sustainability are subjectively determined, this concept informs the level of restocking (Bernus, 1987). In some projects, pastoralists were given money in place of animals to have more autonomy in restocking. Mace (1989) records some successes with restocking, while stressing that even following restocking, families with fewer than one hundred goats will need some additional form of income. Moris (1988) goes further, and from work by Oxfam in Kenya, draws attention to the need to work within pastoral administrative mechanisms when interventions are made. Many NGO interventions rely on the provision of smallstock which do not provide food security, as pastoralists are dependent on the diversity of produce from their herds (Oba, 1992). Toulmin (1987, 1995) has considered both the drought cycle and restocking responses and concluded that restocking should only take place within a bundle of drought interventions and that these should be targeted at specific points in the drought/reconstitution cycle.

In some parts of the world, livestock raiding is a highly developed culture which not only constituted a threat to viable herds but also was one method of restocking a herd after a drought. Sweet (1965) argued that camel-raiding in Arabia was part of a larger system that maintained the ecological balance within the region. In East Africa and Madagascar, cattle-raiding was much more developed than in West Africa (Fukui and Turton 1977). Needless to say, this is one 'traditional' recovery mechanism not usually advocated by aid agencies, although it remains fairly widespread in the Horn of Africa. In southern Sudan, much of the conflict has found expression in cattle raiding, undermining food security in the region, and destabilising the population. The potential for livestock production as well as agriculture is significantly underused, and the situation is one of a cycle of threats to food security, leading to social upheaval, which in turn results in further food-security problems.

⁷ This sounds satirical, but reflects the conclusion of more than one report on pastoralists in the Lake Turkana area of Northern Kenya.

1.4 Livestock banking

Livestock banking has been proposed on the analogy of cereal banks, to assist producers to carry stock across the difficult seasons. Livestock banking proposes that the expense of restocking can be spared if, during parts of the year, animals can be traded in to an independently owned 'bank' in return for a token. The animals are then tended until such time as the pastoralist decides to redeem the tokens. There is, however, a fundamental asymmetry between grains and animals, in that only the latter require feeding. This in turn demands a responsible, disinterested, well-established organisation to function as a holding operation for the stock, which seems, at the least, politically unfeasible. A system by which animals are fed at the expense of the government during the hardest parts of the year when grain is scarce and expensive seems improbable. It is not evident how such schemes would be able to fund the feeding of livestock when the pastoral system has proved incapable. Goldschmidt (1975) proposed a National Livestock Bank for Kenya, which would make sense if livestock planning were conducted according to very strict economic criteria. Such ideas have never been put into practice.

Other alternatives might include simply turning the animals into cash and then rebuying when prices are low. This would undoubtedly be effective for individuals who see a drought coming, but would cease to work, were it adopted by more than a small fraction of the pastoral community. This, of course is what livestock traders do all the time, speculating in animals as well as simply directing slaughter stock to the abattoir, and livestock producers generally despise them for it instead of imitating their model. Livestock insurance is yet another common proposal, which, despite its apparent attractions, has never been put into practice. The transaction costs of both registering animals and ensuring against fraud seem to be too high to make the scheme workable, even assuming pastoralists were willing to pay money up front for an eventuality that might not occur.

1.5 Early warning systems: Idea and reality

The basic idea of early warning systems is extremely attractive. Droughts occur in fragile rangeland areas quite frequently, and the result is a humanitarian disaster—plainly seen on television images. If we could know in advance that a drought was about to occur, this would allow us to do two things;

- ❖ warn the pastoralists to take appropriate action
- ❖ allow governments or relief agencies to put in place remedial strategies before the disaster occurs

Early warning systems seem to have been driven powerfully by technology, especially from the late 1970s. As rich, multi- (false)-coloured satellite images of desert areas began to appear, the illusion of omniscience appeared with them. The National Oceanographic and Atmospheric Administration (NOAA, 1999) and the Spot satellite earth observation system (Spot Image, 1999) could tell pastoralists that vegetation was going to be in short supply through the mysterious agency of the 'normalised difference vegetation index' (Infocarto 1999).

The value of such prediction engines remains controversial but disillusionment also set in from the opposite end of the equation. It became apparent that;

- ❖ Pastoralists were ahead of developers and could respond rapidly to subtle shifts in patterns of rainfall and vegetation. The problems that arose were often political and could not be addressed by development agencies; their responses included crossing national borders, especially when insecurity made their usual grazing inaccessible
- ❖ Governments and most agencies had procedures far too slow and cumbersome to respond in an effective way to climatological information and deliver it to those who might need it.

It may be, in addition, that there was problem of visibility. There is less exposure and credit to be gained from preventing something happening than from 'saving' people when it does. Early warning predictions put people in a position of greater knowledge, but does not necessarily equip them with the tools to use such knowledge. The 1980s phase of disaster response saw something of a dip in the popularity of early warning, although technical advances in climate modelling have led to some restoration of its credibility (Blench and Marriage, 1998). There are now numerous websites devoted to providing up-to-date information on such climatic anomalies as the El Niño Southern Oscillation, and monitoring catastrophic events relevant to food security. They include, on a global basis, the USAID-funded Famine Early Warning System (FEWS, 1999), and on a regional level, one for South Africa (South Africa, 1999). Agencies now have somewhat less hubris about their capacity to respond, but the emphasis has now changed to influencing governments to building in an awareness of the impact of climatic anomalies in their long-term planning. Variability of climatic conditions is a reality that needs to be acknowledged and incorporated into government policy, as well as into individual- or group-level contingency plans.

Although the 1990s saw considerable advances in meteorology, problems remain, both on the technical side and in terms of packaging and presenting the product. Regional forecasts, such as those made for West and Southern Africa, provide probabilities about the average rainfall for the coming season which may help inform choices over seed selection, but as yet say nothing about the timing or distribution of rains. The relevance to pastoralists is, in any case, dubious. Pastoralism is essentially a *reactive* subsistence strategy, by which herds are taken to the areas of greatest productivity in a given year. Pasture depends on factors such as soil quality and water retention; for the foreseeable future, pastoralists will determine their movements either by what they observe, or by traditional transhumance routes. At the present, weather forecasting based on sea surface temperatures and satellite imagery is often too general and zonal to be of any value in a restricted field of operations. The alternative is thus to look for ground-based indicators, most notably livestock prices and herd movements, as well as talking to pastoralists (Hesse, 1987; Swift and Umar, 1991). One of the most well-known of these systems is the Turkana early warning system in Northern Kenya (Buchanan-Smith, 1992).

1.6 Economic diversification

A key strategy promoted by governments to address the crisis perceived to be afflicting rural areas of Europe is economic diversification. As the terms of trade move ever further against livestock producers, they are increasingly urged to diversify to ensure against further declines in the market. Carr (1977) after analysing the threats to Dasanetch society in Southwest Ethiopia, sets out an entire programme of economic diversification based on locally available resources. This is an old story with traditional pastoralists; catastrophe, whether climatic or epizootic enforces economic and often social change. However, for pastoralists within their ecozonal niche this is often not easy, because they are there precisely because of the remoteness of the region and the problematic climate. Projects to encourage diversification have thus often met with a rather stony response. Bollig (1997:82) discussing the Himba of northern Namibia, notes they conduct almost no outside activities and even their gardens are meant more as market buffers than as risk-aversion strategies.

The diversification of income, or engagement in temporary paid labour is an indirect means of restocking. Money gained in other sectors can be channelled into pastoralism, particularly after a drought when animal numbers are low and prices high (Horowitz and Little 1987). The integration of pastoralism with other sectors thus benefits the pastoralists' own restocking agenda; this, argue the authors, should be supported as alternatives to herding available to pastoralists are not likely to be as socially, ecologically or economically effective in the short to medium term. Large fluctuations in herd numbers can create 'green desertification' which occurs when livestock numbers are no longer capable of keeping back woody bush encroachments (Heffernan 1995).

Among the Bedouin of the Near East, however, economic diversification has become so extreme that dependence on sheep production is more symbolic than actual in many cases. Lancaster (1981) and Abu-Rabia (1994) describe how the Jordanian and Negev Bedouin have increasingly taken up a variety of seasonal and permanent employment outside the pastoral sector and are investing in permanent housing, maintaining and perhaps even cementing their social structure while effectively discarding herding. This process is slower in remoter areas but in Oman, for example, Chatty found a relationship among the Harasiis pastoralists between smaller flocks and degree of dependence on wage labour.

2. Can rangelands land use and livestock offtake be sustainable?

2.1 Competing uses of the world's rangelands

Until recently, pastoralists were to a certain extent protected by the remoteness of their habitat. Its inaccessibility meant that it was written off by national governments. However, the evolution of modern transport and remote-sensing has changed this equation rather dramatically. Remote drylands, mountains and tundra are often the sites of valuable mineral deposits and new telemetric devices means that their presence can be detected. Similarly, the rise of the conservation lobby, and the fact that in remote areas, terrestrial fauna is likely to be better preserved, has created accelerating pressure to declare wildlife or biodiversity reserves, thereby taking land out of the pastoral orbit.

2.2.1 Pastoralists and the exploitation of mineral resources

Although mineral and oil extraction in the developed world are frequently subject to controversy, the presence of regulatory frameworks and highly-developed advocacy groups ensure public debate and eventually pressure to adopt sustainable and environmentally sound practice. This is very much less the case in the developing world, partly because of the relative economic importance of mineral revenues, with the consequence that governments are generally not keen to publicise details of either potential income or environmental impact.

Most developing countries have weak communications and transport infrastructure. The low populations in arid and semi-arid zones tend to make the opportunity-cost of developing these relatively high. Mining and oil enterprises therefore set up highly sophisticated telecoms and logistics supply systems which are independent of local structures. These are effective within the limited context of extraction but their isolation from the national system can be problematic in the case of community-awareness programmes, or indeed disasters. Poor communications and weak CBOs in arid and northern semi-arid zones mean that government is rarely called to account for deficiencies in the monitoring of mineral extraction enterprises. The importance of mineral revenues is such that governments often have no regulatory framework in place, or else do not enforce one that has been enacted.

This is most evident in the former command economies where anxieties over the declining economy have pressured government to increase mineral extraction rates. Vitebsky (1990) discusses the impact on reindeer herders of the gas deposits in the Yamal Peninsula in the Soviet Arctic, and similar problems have arisen in relation to oil extraction in Siberia, for example among the Khanty of the Pim River (Stewart 1994/5). Reindeer have also been the principal pastoral species affected by escaping radiation. After the Chernobyl incident of 1986, reindeer and caribou all across the circumpolar regions accumulated such high levels of radioactivity in their tissues that the meat was unsaleable on the world market. This led to increased levels of hardship for pastoral peoples across the region, especially as no compensation was forthcoming. In addition, much unsafe meat was probably locally consumed and health issues relating to Chernobyl will continue to be of concern for many years to come.

2.2.2 Wildlife and conservation issues

The marginal lands that were previously the province of pastoralists are increasingly coming into focus as reserves of biodiversity. Their very inaccessibility has permitted the survival of species eliminated in high-density agricultural areas. Consequently, there is pressure on governments to declare increasingly large regions as reserved areas, both because of the conservation lobby and the potential income from tourism (Bourn & Blench 1999). This has probably gone furthest in East Africa where large mammals are still most abundant and the tourist industry most highly developed.

The immediate consequence is conflict between pastoralists, government and conservation lobbies. Uncertainties about pastoral tenure have made it difficult for pastoralists to lodge effective land claims and very often potential grazing land is simply appropriated. Pastoralists then enter conservation areas which they consider traditional grazing areas and encounter game or forest guards with predictable results.

Two opposing views have evolved in response to this; that it is correct to assign a high priority to wildlife both because of the income from tourism and the global importance of the conservation of biodiversity or that pastoralists have rights and that these should be protected. A widespread position is that pressure for establishing reserved areas is strong and well-funded and it would be better to make agreements with both pastoralists and villagers to compensate them for their loss of access to resources through revenue-sharing. Such agreements with villagers have been extensively tested in Zimbabwe through the CAMPFIRE programme, but developing similar programmes with occupationally specialised pastoralists is altogether more difficult and although this is in development in East Africa there are no clear examples of success. Unlike villagers, establishing pastoral access rights in a fluid landuse situation is problematic and a fruitful source of disputes. Similarly the lack of a central organisation makes effective revenue-sharing more complex and open to manipulation.

Whatever ethical stance is taken, in management terms, the present situation is rather unsatisfactory. Kenya is one of the few countries where long-term monitoring of both wildlife and livestock populations allows us to assess change over time. Table 11 shows the change in these population over a period of some twenty years.

Table 11 Kenya Rangeland Livestock and Wildlife Population Estimates: 1970–1990s

	Est 70s	SE 70s	Est 90s	SE90s	70s-90s	%70-90	Stat. Sig. (p=0.9)
Buffalo	35,453	6,060	30,187	4,197	-5,266	-15%	
Camels	551,462	24,636	651,254	33,209	99,792	18%	+ve
Cattle All	3,319,749	157,958	2,911,496	83,333	-408,254	-12%	-ve
Donkey	95,059	10,884	85,350	5,021	-9,710	-10%	
Eland	25,775	3,376	19,123	1,242	-6,652	-26%	-ve
Elephant	39,108	6,008	14,923	1,808	-24,185	-62%	-ve
Gazelle Grant's	247,491	12,407	103,208	3,915	-144,283	-58%	-ve
Gazelle Thomson's	87,086	14,766	31,259	4,269	-55,827	-64%	-ve
Gerenuk	42,918	1,820	21,418	1,282	-21,500	-50%	-ve
Giraffe	62,255	2,808	50,080	2,337	-12,175	-20%	-ve
Greater Kudu	233	99	45	25	-188	-81%	-ve
Impala	116,177	8,930	67,934	3,194	-48,243	-42%	-ve
Kongoni	29,606	2,533	18,521	1,054	-11,085	-37%	-ve
Lesser Kudu	17,468	1,214	7,751	710	-9,716	-56%	-ve
Oryx	53,653	3,571	25,824	1,950	-27,829	-52%	-ve
Ostrich	25,716	1,772	33,871	2,798	8,154	32%	+ve
Topi	93,822	10,977	92,934	18,139	-888	-1%	
Sheep & Goats	6,473,519	263,793	5,696,021	173,426	-777,498	-12%	-ve
Waterbuck	12,309	1,476	5,260	733	-7,049	-57%	-ve
Wildebeest	224,404	49,582	173,354	38,918	-51,050	-23%	
Zebra Burchell	138,448	12,643	146,093	9,549	7,645	6%	
Zebra Grevy	10,364	1,355	4,868	871	-5,496	-53%	-ve
Total Wildlife	1,262,227		846,652		-415,634	-33%	-ve
Total Livestock	10,439,789		9,344,121		-1,095,600	-10%	-ve

Including: Baringo, Garissa, Isiolo, Kajiado, Kilifi, Ktui, Kwale, Laikipia, Lamu, Mandera, Marsabit, Narok, Samburu, Taita Taveta, Tana River Turkana and Wajir Districts (Source: GoK, 1996).

Source: Bourn & Blench (1999)

As the table shows, the only two species showing increases are camels and ostriches, both characteristic of highly arid environments. In other words, even considerable growth in conservation areas has not slowed the overall decline of wildlife populations and the pressure on rangelands exerted by cattle, sheep and goats has also led to a fall in their numbers.

In Central Asia, the situation is somewhat different, since until recently, all protected areas were reserved by decree and certainly did not benefit from consultation with the local populations. The paradoxical consequence was an almost unparalleled level of habitat conservation. Similarly the system of collective farms was kept going with subsidised inputs, sometimes brought in at uneconomic costs. This had the effect of reducing pressure on the natural rangelands, as did the central control of animal numbers and relatively high levels of offtake. Tourism remains a nascent industry, and any income from it extremely volatile, reflecting the unstable politics of the region. However, the implosion of the collective farms has resulted in the regeneration of pre-Soviet patterns of pastoralism and grazing, increasing pressure on the rangelands and bringing herders into potential conflict with the management of poorly-resourced parks and protected areas. The lack of market infrastructure and the limited range of inputs means that Central Asian pastoralists are generally much poorer and more vulnerable than those in Africa.

The other aspect of Central Asia is the tradition of shooting predators, notably wolves and snow-leopards, species rather regarded as conservation targets elsewhere. Wildlife organisations have

recently begun operations to try and both develop alternative income generation strategies and develop compensation schedules for communities to prevent them from killing snow-leopards, accepting the cost of predation. How well these will work is too early to say, but the strategy depends on considerable external input. Ultimately, the cost of predation should be balanced by the revenues from conservation if community protection of species is to take root.

2.3 Controlling grazing pressure

Artificial water sources are now widespread in many arid and semi-arid rangelands. For example, in pastoral areas of Australia today there is at least one artificial waterpoint every 10km (Bennet, 1997: 11). Originally, establishing closely spaced water sources was intended to avoid the localised degradation that follows the concentration of many animals at few sites. Creating this dense network induced similar grazing patterns over large areas. The impact on biodiversity was negative because native species in Australia's arid and semi-arid rangelands are adapted to very light or no grazing pressure. Once biodiversity becomes a consideration, management should promote grazing patterns that are spatially heterogeneous rather than uniform. Fencing tends to be expensive for extensive areas, whereas water is a powerful and cheap tool for this purpose. If artificial water points were shut down in areas with a high conservation priority, grazing pressure would be reduced. Obviously, such a strategy is only applicable where artificial water sources are numerous and would not apply in Africa or much of South America.

3. Maintaining livestock biodiversity

The breeds most relevant to biodiversity concerns are those that have co-evolved with a particular environment and farming system and represent an accumulation of both genetic stock and management strategies in relation to a particular environment. These have usually taken a long time to evolve and have characters, such as humidity-resistance, that cannot be easily developed. Breed, however, is a broad church, covering ornamental breeds of dog and rabbit and also what may be called 'research station constructs'. For example, many catalogues of breeds include recently developed crosses between, for example, a local breed and an exotic. This is particularly the case in the former Soviet Union where many existing 'breeds' have no natural habitat but only persist in fields outside research stations (see Dmitriev & Ernst 1989). The Second FAO Worldwatch List (Scherf 1995) includes a large number of breeds of turkey and goose in Sub-Saharan Africa. These are not indigenous species and reading the text, it appears that all are twentieth century introductions, some of which have never left the research station. There appears to be no significant case for the conservation of such breeds except at the level of individual country priorities.

Local races and breeds of livestock disappear for a variety of reasons, some representing rational responses to changing economic, ecological or social conditions, others pressure from government bodies, development agencies or simply an inappropriate understanding of short-term gains against long-term viability. Where communities voluntarily replace one breed with another or cease keeping livestock in order to concentrate on other activities such as tree-crops, it would be inappropriate to pressurise these communities into conserving breeds; this should be the role of national institutions. Livestock breed conservation is a public good, both nationally and internationally, and is a long-term investment in future genetic resources. In many areas in Southern Nigeria, rising prices of tree-crops such as cocoa and palm-oil have caused the communities to dispense with their traditional dwarf cattle and goats to concentrate on these profitable crops. This is a perfectly rational medium-term strategy of their part; but it would be short-sighted of the national government to lose the genetic resource these livestock represent simply because of a temporary pattern in world trade. As to whether such a strategy is sustainable on the part of government, the analogy is not with an economic enterprise but an investment against unpredictable future developments. New antibiotics are expensive to discover

and produce, and when discovered they may have been reserved against future, still unknown epidemics. So it is with genetic resources.

Existing baseline data remains too imprecise to hazard an estimate of the rate of loss, although this is possible in some developed countries. New breeds are always being created, especially by large livestock companies and on research stations, but this points to a fundamental asymmetry. A breed that has evolved over centuries in a particular socio-economic and pathogen niche cannot be 'replaced' by a modern breed, any more than a wild plant or animal that becomes extinct can be recreated in the laboratory.

Table 12. Factors accelerating erosion of livestock biodiversity

Factor	Description
Development interventions	Preference given to high-input, high-output breeds developed for benign environments. Commercial interests in donor countries promote use of relatively temperate-adapted breeds and create unrealistic expectations in developing countries
Specialisation	Emphasis on a single productive trait, e.g. dairying, leading to exclusion of multi-purpose animals
Genetic introgression	Crossbreeding and accidental introgression leading to loss of indigenous breeds
Technology	Machinery replaces work animals
Biotechnology	Cryopreservation equipment inadequate to store germplasm of threatened breeds. Artificial insemination and embryo transfer rapidly displace indigenous breeds.
Political instability	Can eliminate local breeds owned by vulnerable populations
Natural disaster	Floods, drought and epizootics preferentially affect remote or isolated human and livestock populations

Adapted from Hammond & Leitch (1996)

Projects and development aid for livestock have historically focused on large ruminants, and tend not to focus on work animals or small species, 'micro-livestock' (to adopt Vietmeyer's felicitous term). The only significant exception to this is occasional chicken projects, and even these have been dominated by attempts to establish large-scale intensive poultry production. These agendas have been wholly set by the priorities and economies of developed countries, reflecting both their research structures and commercial interests. The most notorious example of this is probably ILCA (the so-called 'International Livestock Centre for Africa') a CGIAR centre which refused to countenance research on animals other than cattle, sheep and goats, ignoring key African domesticates and work animals such as donkeys, camels and all types of poultry.

If poverty and sustainable livelihoods are the key agenda, and even if they are not but the priority is to work with species important to the majority of rural farmers, then the evidence is extremely strong to suggest that these priorities are very skewed. Most rural households depend on a scatter of small species for protein, with the slaughter of cattle or sheep as a very occasional festival meal. Micro-livestock often do not have to be fed, do not require substantial labour inputs and do not require access to land beyond the backyard. Sale of individual animals can provide small cash sums without threatening household capital in the same way as the sales of larger animals.

In many regions of the world where livestock are an important element in overall subsistence, the large ruminants are in the hands of professional pastoralists or ranchers. Such systems make an important overall contribution to national meat and dairy supplies, but often the majority of their output feeds the cities. Pastoralists in both tropical Africa and Central Asia have historically made significant investments in breeding races of domestic animal appropriate to the environment they exploit and are constantly exchanging and adapting bloodlines to meet changing external conditions. Typically, animals are bred for their ability to survive subclinical pathogens and to digest poor and variable pasture with yields of meat and milk only a secondary consideration. Local breeds are thus a key element in trying to ensure food security.

Although traditionally, New World indigenous species were used for a type of transhumant pastoralism, this has been largely replaced by ranching systems based on Eurasian ruminants. In the New World, much of the output from South America goes to supply the 'fast-food' market of North America. This may be important in terms of the priorities of the civil servants with whom developers often have to deal but not necessarily central to the concerns of those at whom their interventions are purportedly aimed.

There is a strong correlation between poverty and a high degree of genetic diversity, both for livestock and crop plants. This has been subject to two differing interpretations;

- a) poor people keep a biodiverse range of species⁸ because they do not have access to high-output breeds and would like to switch to these if resources are available
- b) or because a range of species and breeds enables them to continue producing in uncertain environments and thus to manage risk effectively, as well as using a diverse range of outputs and permitting flexible allocation of labour

Interpretation a) is clearly favoured by development agencies who wish to promote exotics, crossbreeds and high-input systems. It also has the advantage of appearing to increase food security. However, interpretation b) seems to be emerging from several decades of ethnographic study of rural

⁸ This does not contradict the previous observation that the highest density of *breeds* is found in the developed world. rural households can map a range of low-input species against diverse capital and labour availability.

subsistence systems, suggesting that poor rural households trying to ensure their food security are above all interested in minimising risk. The risks induced by natural phenomena such as weather anomalies and insect or disease surges have now been compounded by an increasingly unstable socio-economic environment, where sudden changes in policy can make their produce uncompetitive. Development agencies have added to risk by rapid changes in policy and failure to provide long-term support to introduced species or inputs. An analogous situation is found in the health sector where Western medicine does not replace a diversity of local remedies but is simply added to them, sometimes with unfortunate effects.

Current approaches to livestock issues in the context of biodiversity are still uncommon, and often ill co-ordinated. Even the FAO, which is leading on the DADIS initiative, continues to send out free semen from Friesian cattle under the auspices of another programme, with no clear control on the use to which it will be put. Large livestock companies have significant political influence, especially in the United States, and approaches which run counter to their commercial philosophies often get short shrift in international decision-making. This is particularly striking in the Americas, where American aid and the purchase of 'modern' livestock breeds in development projects is still very prevalent. Even in SE Asia, where work is beginning in earnest on the evaluation of local breeds, development projects involving crossbreeding remain commonplace. The recent financial collapse in SE Asia and Brazil is likely to demonstrate rather bluntly just how unsustainable these strategies are, as householders who accepted the blandishments of these projects will no longer be able to afford the inputs necessary to keep their stock alive.

4. Who should address these policies and issues?

4.1 Pastoralists in national, regional and global perspective

Pastoralists pose a number of problems for policymakers in respect of their transnational status. Unlike farmers, who largely are tied to the boundaries of the nation-state, pastoralists tend to cross borders freely in their quest for forage, whatever the wishes and policy of individual countries (Blench 1996). Pastoralists in Arabia have switched from being romantic figures of the desert representing tradition and freedom to a 'national problem' (Chatty 1996:15). Most countries with an extensive pastoral sector are likely to have both limited resources both to service the pastoralists and to police their frontiers. Individual countries inevitably want to see pastoralists as 'their' citizens, an enthusiasm which pastoralists exploit willingly, often by holding identity cards for several countries at once.

It is logical, therefore, to treat pastoralism on a regional basis, to draw up common policies in relation to health, forage and water resources, subsidies on feed etc. However, such an approach runs exactly counter to the burgeoning ideology of the nation-state and it has rarely been possible to develop such regional policy initiatives, let alone implement them effectively. Health provides a good example of this; with the JP-15 campaigns in the 1960s, it was possible to effectively eliminate rinderpest from Sub-Saharan Africa. However, to prevent a return it was necessary to keep up a co-ordinated programme of vaccination of young stock. This was never feasible, with the result that 1984-5 saw a West Africa-wide rinderpest epizootic that killed up to one-third of the animals (see e.g. Nwosu 1987).

The primary task, then is to co-ordinate approaches, to try and persuade research and development agencies to not try and subvert each others' policies with ill-considered projects. Beyond that is propagating and understanding of the significance of long-term sustainability in livestock projects, why it is that preliminary results after two years cannot apparently show impressive increases in productivity, while after ten years, the rural householders may be more impoverished than at the start

of the project. As so often, the main thing standing in the way of effective development is other development projects.

4.2 Key re-orientation of policy towards pastoralists

4.2.1 Constructing policy: new paradigms or old lies?

No agency dealing with pastoralists does not now pay lip-service to the concept of participation; gone are the former top-down mandarins and bureaucrats to be replaced by the listening fieldworker. Pastoralists gather, express their problems, preferably by drawing conceptual maps in the dust, and solutions emerge, preferably based on the indigenous knowledge they have been hoarding these last few millennia. Agency or NGO then joins with pastoralist –happy cows and their owners appear in the annual report. At the inevitable workshop another victory for the participatory approach is announced; luckily no ‘top-down’ advocates appear or they might be fed to the pigs.

Without some key realworld input the gentle reader might be forgiven for thinking that things were never better for pastoralists. But as the evidence suggests, things are far otherwise. War and famine preferentially displace and impoverish pastoralists as their herds are obvious targets for hungry soldiers. Agricultural expansion increasingly cuts into pastoral land and cultivators extract the water feeding pastoral wells. Collapses in the command economies have created widespread impoverishment of pastoralists because no corresponding infrastructure was established as a safety-net. Examples of governments shifting to pastoralist-friendly policies are few and far between⁹.

The reason for this is that it is not in the interest of agencies concerned with pastoral development to identify national trends and policies as the source of pastoralists’ woes. A neat project with no loose ends ideally involves a defined region or subset of population and includes elements of co-operation and improved social cohesion in addition to technical inputs. For this reason, various types of association all too frequently feature on the menu of options.

Unpalatable as it is, it may be time to skewer these lies. Pastoralists, by the nature of their occupation, form loose and flexible social groupings. The closer they come to sedentarisation on a cline, the more likely they are to form cohesive social structures. But pastoralists are also opportunists and whenever a visitor arrives to suggest a project they listen in case something useful may emerge. But inevitably, no matter what they say to a passing development expert, they will do whatever seems expedient for their herds in the light of the current situation.

Relations between pastoralists, governments and developers thus come close to institutionalised dishonesty, a state of affairs that is no use to anyone; many governments depend on the milk and meat from their pastoral sector to feed urban populations, although they are often unwilling to acknowledge this. Pastoralists have an inbred distrust of national governments and a dismaying unwillingness to pay more than lip-service to the values of the nation-state. Governments all too often repay them by violence and coercion, a consequence of their incomprehension. Such phenomena are not confined to the developing world; the treatment of gypsies in Europe suggest that highly developed societies feel equally threatened by mobile populations who do not subscribe to their values.

⁹ One exception to this might be the oil-rich states of the Gulf who have given considerable financial assistance to their remaining pastoral populations. However, the result is not only unviable production systems that exist only within a bubble of subsidies but with the additional irony that the countries in question do not need the meat and milk produced by the pastoralists and give this assistance essentially from sentiment.

What must be recognised is that any sort of rational policy process involves some element of top-down imposition and some element of consultation and participation. Governments have access to regional information on climate, disease, feed supplies and water resources while pastoralists can provide a dense account of local conditions. It is obviously in the interest of governments to make as much of this information as possible available to pastoralists and to collate and synthesise their comments and suggestions. But there will always be practical barriers since pastoral areas tend to be remote and inaccessible. Governments must make policy and resource decisions on less than perfect information and almost certainly some sector will be disadvantaged. This is inevitable in the real world; the key task is to make information flow between sectors as effectively as possible to try and minimise the impact on individual groups.

4.2.2 Rethinking policy clusters

Apart from key questions of who should be making policy and what mechanisms should be used to support it, policies towards pastoralists are themselves in dire need of reform. This is in part because key players in a position to influence the policy reform process are usually both highly conservative and commonly problematically close to the agendas of large modern livestock companies. Some clusters of policy reform revolve around;

- ❖ The general perception that livestock production is a poor gamble in development terms compared with increased crop production
- ❖ That animal protein is best supplied by monogastrics because extensive production is wasteful
- ❖ The idea that pastoralists, as vulnerable people in fragile environments, are better consigned to relief agencies than dealt with as a significant economic proposition.
- ❖ The common notion that unfamiliar land tenure systems are not tenure at all and that national governments have the right to expropriate land for conservation, mineral extraction or marginal farming

More specifically, however, policy re-orientation should tackle the following;

- ❖ The tendency to ignore ‘minor’ species, camels, yaks, reindeer, llama, in favour of cattle, sheep and pigs.
- ❖ The tendency to calculate the economic viability of projects in terms of single trait characteristics rather than total household support characteristics
- ❖ The tendency to look at the viability of production systems over short periods of time, which inevitably advantages introduced breeds.
- ❖ Ignorance of the value and significance of livestock and rangeland biodiversity and its role in increasing productivity in uncertain environments

The future of pastoralism will depend heavily on political decisions made by national governments managing significant grassland zones. Enclosed pastures are unlikely to see any significant extension, but conditions for existing pastoralists will become more difficult with land expropriation by both farmers and conservation lobbies. Working with pastoralists, based on a more sympathetic understanding of their production systems, could act both to protect their lifeways and to continue their capacity to produce protein on otherwise marginal land.

Experience to date suggests that technical inputs will only have a very limited impact on overall output. The key in the next millennium will be major policy re-orientation. Elements likely to become important are;

- ❖ Production of niche products, either unusual species or breeds, or meat and milk free from contaminants
- ❖ Crop-livestock integration, the effective use of pastoral outputs in mixed farming, particularly the extension of work animals
- ❖ Co-conservation, the development of interlocking strategies to link conservation of wild fauna and flora with pastoral production
- ❖ The expansion of ecologically-sensitive low-volume tourism, using pastoralists to provide services, particularly in the area of indigenous knowledge

4.3 Who should be doing what?

4.3.1 Intervention versus information dissemination

Traditionally at this point it is usual to conclude that developing countries need policy assistance and there are a wealth of international agencies, think-tanks and consultants ready to jump in and off this advice. It is worth remembering, however, that much of the policy already in place is the result of this same process and one legitimate response would be to ask whether another proposed paradigm shift would be any more ephemeral than previous re-engineering. It is also clear that many countries have benefited from *not* taking international advice on pastoralism, livestock biodiversity, dairy production, traditional remedies and the like and have conserved a store of indigenous skills and knowledge

4.3.2 Remediating uneven research

It should be clear from the above accounts that research and policy developments in pastoralism are extremely uneven. Pastoralists benefit from accessibility, picturesqueness and the dominant language of the country in which they happen to reside. A bibliography of the Turkana or the Saami would probably fill several fat volumes, whereas it is hard to track down a single substantive reference to some Indian or Ethiopian pastoral peoples. A pastoral programme should try for global comprehensiveness, ensuring that at least some information is available for pastoral peoples throughout the world and that valuable but antique monographs are updated.

4.3.3 Agencies and individuals

It may seem perverse to be recommending yet more information flow when there seems already to be an overload in this area. Indeed the problem is often choosing between a variety of sources whose quality is difficult to assess. But this is very much the perspective of the wired individual with the internet at their disposal. Most pastoralists and many who make policy decisions at the local level have extremely weak access to information, especially in electronic forms. Such information as might be useful is often contained in lengthy reports written in tortured English and is consigned to the back shelf along with all the other worthy documents (including, presumably, this one). Better policies for pastoralism can flow from more accessible, better-presented information. The consequence of this is;

- a. Wider translation and synthesis of existing materials
- b. Consideration given to all types of media, notably radio, internet, CD-ROM, video and DVD.
- c. Much greater attention paid to style, and quality of visual material
- d. Development both of meta-resources and quality filters
- e. Improved feedback mechanisms between

4.3.4 Practical support

This section has begun by suggesting the how and who of support of the pastoral, sector, but it is also useful to know what support would be most valuable. The following are suggestions emerging from the body of this report.

- ❖ Support to the conservation, use and international exchange of animal genetic resources
- ❖ Support to the re-orientation of National Research institutes towards research on indigenous livestock
- ❖ Support a re-orientation of research from a focus on individual traits to lifetime and herd productivity
- ❖ Support a re-orientation of research and extension towards species and uses relevant to poor people, i.e. micro-livestock and work animals
- ❖ Support a switch to more responsive (?participatory) methods of determining selection goals
- ❖ Support to innovative initiatives such as co-conservation, co-exploitation, exploration of new domesticates, and improved management of existing semi-domesticates
- ❖ Support to new marketing initiatives to add value to unusual livestock products
- ❖ Support to inventory projects that add value through cross-border and regional co-operation through economies of scale
- ❖ Support to the implementation of the CBD and its COP extensions
- ❖ production systems.

The promotion of pastoral production will undoubtedly remain controversial, but the argument that it is an effective use of land that cannot otherwise be used for agriculture, suggest that governments and others will continue to invest in it. If this is to be a productive enterprise, as opposed to a simply humanitarian project, then linking understanding with action will have to become more effective. This in turn means trying to root out entrenched attitudes, which probably do more harm than anything large herds of herbivores can achieve.

Suggestions for initiating this process:

- The process of changing the policy and attitudes of governments towards pastoralists through education, publicity, studies, etc., must continue.
- Drought-response mechanisms, as with other policies towards pastoralists, must be discussed and set at a regional level. The most crucial elements in this are co-ordination in protection against epizootics and the siting of water points.
- Regional decisions should determine the quality and type of services available to livestock producers and ensure that these have some comparability.
- The relevance of levels of insecurity and the effect these have on the decisions of livestock producers must be recognised—no matter how politically unpalatable these may be.
- Forced sedentarisation is both ethically dubious and unlikely to succeed. However, neither government nor NGOs need respond to a mythical ethical imperative to restore some fictional status quo.
- International agencies have a significant role both in combating misinformation and diffusing accurate information as it becomes available. This is relevant both in terms of countries with semi-arid regions and in donor countries.
- Technological developments will substantially improve the modelling of climatic events in the coming years, and international agencies should have a major role in making the results available rapidly and effectively, as well as in convincing governments of their relevance.

- The collapse of notions of land degradation and carrying capacity should not be used to justify simply increasing pressure on resources. Further research should generate models that can be used to monitor access and predict likely bottlenecks in resource availability.

Pastoralism, almost by definition, is an ecozonal phenomenon that is not bounded by the nation-state. Unless we begin to see it as a regional problem, both technically and in terms of its institutions, it may be a significant casualty of the early twenty-first century.

5. Conclusion and recommendations

5.1 Why has pastoralism survived?

Given the forces ranged against it, it is perhaps surprising that pastoralism has survived at all. However, pastoralists do have some features in their favour.

- Flexibility
- Low costs
- Freedom of movement
- Light regulatory environment

Pastoralists have a long-term flexibility derived from their ability to exploit patchy resources. It has often been observed that the more 'nomadic' pastoralists are, the better they are able to survive climatic catastrophes such as blizzards and droughts (see for example, the accounts in Gallais (1985) of the Sahelian drought of the early 1970s). However, they are also able to switch species (as Jordanian Bedu have switched almost entirely from camels to sheep in the period 1970-1995), main saleable output (as Ful°e in the Igbo areas of Nigeria have switched from dairying to meat production) or even entirely out of pastoralism for a period.

When pastoralists come up against highly efficient modern era livestock industries they face major price competition for their products especially as these may often be dumped, sometimes by the same bodies offering pastoralists emergency assistance with another arm. However, pastoralists do not have to meet sometimes onerous hygiene costs, packaging, transport and tariffs. Moreover, the single most important cost to all intensive systems is investment in land itself, both enclosing it and maintaining its productivity, a cost that pastoralists do not bear, except on the rare occasions when they destock to conserve forage.

5.2 Key trends in twentieth century pastoralism

Whatever the future of pastoralism, its present shape has evolved under pressure from very distinctive twentieth century influences, making impossible any return to some prior imagined golden era. These factors are summarised in Table 13;

Table 13. Key factors shaping twentieth century pastoralism

Factor	Impact
Modern veterinary medicine	Increases in productivity and greatly enlarged herds
Modern weapons	Major decline in predator threats
Enclaving	Collapse of traditional 'safety-nets' in terms of long-distance migration in periods of climatic extremes
International pressure for hygiene in slaughtering and dairying	Declining market for pastoralist products
Declining prestige of dairy products	Terms of trade running constantly against pastoral livelihoods
World market in livestock products	Governments import cheap meat, milk etc. to satisfy urban demand at expense of pastoral sector
Ideological interference by the state	Inappropriate social and management strategies adopted and maintained by combination of subsidised inputs and implied violence
Alternative calls on pastoral labour	Pressure for children to go to school and younger people to earn cash outside the pastoral economy
Modern transportation structures	Affects systems where transport is a major element of economic production (llamas, horses)
Introduction of high-input, high-output exotic breeds	Makes pastoralists dependent on effective infrastructure where in fact the system cannot supply inputs regularly thereby creating periodic crises
Emergency relief, restocking and rehabilitation programmes	Keeps non-viable households in pastoral areas, thereby accelerating the cycle of deficits
Conservation lobby	Pressure to turn previously pastoral land over to reserved wildlife/ biodiversity regions with corresponding hard currency income from tourism
Encroachment on rangeland	Rangeland is being eliminated through the use of politically attractive but often uneconomic irrigation systems

5.3 Where is pastoralism headed?

Evidence as to the future of pastoralism is generally discouraging; throughout Africa and the Near East pastoralists are being driven into ever more marginal areas through the gradual expansion of arable terrain. Transport and enclosed livestock production are forcing out the remaining pastoralists in the Americas and the circum-Mediterranean region. The marginal lands that were previously the province of pastoralists are increasingly coming into focus as reserves of biodiversity. In Central Asia, decollectivisation and the consequent loss of subsidised infrastructure provided by the former Soviet regime has paradoxically brought about a return of more traditional systems. At the same time, however, the veterinary services are declining, and market prices for livestock products now reflect the access problems of much of the region. The consequence has been accelerating impoverishment in many countries; a situation intermittently remedied by mineral revenues but not through the development of pastoral systems.

Pastoralism is likely to simply disappear in any region where it competes with agriculture. Nonetheless, it is increasingly being realised that politically popular but unsustainable development of rangelands, often dependent on the mining of fossil water, is not a long-term development strategy and in some decades pastoralists may reclaim such land. The ancient North African development of much of the northern Sahara through large irrigation channels is today only an archaeological curiosity in a pastoral zone. Pastoralists remain a resource, a system of producing meat and milk cheaply in otherwise hard to exploit land and as such will still persist in some form. This resource can be protected and managed effectively or ignored and allowed to decline. Government policies are very unlikely to be uniform in this respect and pastoralists are thus likely to gravitate to regions where conditions are most favourable. The key is thus to disseminate improved understanding of pastoral

society as broadly as possible, making both policy and the effective management of natural resources as widespread as possible.

APPENDIX I: The origin of pastoral species
Appendix Table 1. Domestic animals and their wild counterparts

DOMESTIC FORM		WILD PROGENITOR		DATE AND REGION OF FIRST DOMESTICATION		DISTRIBUTION OF WILD PROGENITOR	
Common	Scientific	Common	Scientific	DATE	PLACE		
MAMMALS							
CARNIVORA							
Dog	<i>Canis familiaris</i>	Wolf	<i>Canis lupus</i>	12 000BC	Iraq		N Hemisphere
PERISSODACTYLA							
Horse	<i>Equus caballus</i>	Wild horse	<i>Equus ferus</i>	3500BC	S Ukraine		Russia, Central Asia
Donkey	<i>Equus asinus</i>	African ass	<i>Equus Africanus</i>	4000BC	Egypt		N Africa, possibly W Asia
ARTIODACTYLA							
Pig	<i>Sus domesticus</i>	Wild boar	<i>Sus scrofa</i>	7000BC	Turkey		Europe, Asia and N Africa
Llama	<i>Lama lama</i>	Guanaco ?	Possibly <i>lama guanicoe</i>	4000BC	Andes: Lake Junin and ? Lake Titicaca regions		S. America: Andes
Alpaca	<i>Lama pacos</i>	Guanaco ?	<i>Lama sp.</i>	4000BC	Andes: Lake Junin region		S. America: Andes
Dromedary	<i>Camelus dromedarius</i>	Dromedary	<i>Camelus sp.</i>	3000BC	W Asia		Asia, possibly N Africa
Bactrian camel	<i>Camelus bactrianus</i>	Bactrian camel	<i>Camelus ferus</i>	3000BC	Central Asia		Russia, Central Asia
Reindeer	<i>Rangifer tarandus</i>	Caribou	<i>Rangifer tarandus</i>	? ?			Arctic, sub-Arctic
Water buffalo	<i>Bubalus bubalis</i>	Wild buffalo	<i>Bubalus arnee</i>	Not known	China/ SE Asia		India, SE Asia
Cattle (taurine)	<i>Bos taurus</i>	Aurochs	<i>Bos primigenius</i>	6200BC	Turkey		Europe, Asia, N Africa
Cattle (zebu)	<i>Bos indicus</i>	—	<i>Bos primigenius namadicus</i>	<4000 BC	India ?		India/ SE Asia
Yak	<i>Poephagus grunniens</i>	Yak	<i>Poephagus mutus</i>	Not known	Not known		Tibet, Himalayas
Goat	<i>Capra hircus</i>	Wild goat	<i>Capra aegagrus</i>	7-8000BC	W Asia		W Asia
Sheep	<i>Ovis aries</i>	Mouflon	<i>Ovis orientalis</i>	7-8000BC	W Asia		W Asia

Extensive Pastoral Livestock Systems

DOMESTIC FORM		WILD PROGENITOR		DATE AND REGION OF FIRST DOMESTICATION		DISTRIBUTION OF WILD PROGENITOR
BIRDS						
<i>ANSERIFORMES</i>						
Goose	<i>Anser anser</i>	Greylag goose	<i>Anser anser</i>	<500BC	Europe, Central Asia	N Europe, N Asia to NW Africa
Chinese goose	<i>Anser cygnoides</i>	Swan goose	<i>Anser cygnoides</i>	<500BC	? China	Europe, Asia, N America, N Africa
Muscovy duck	<i>Cairina moschata</i>					Mexico to Peru and Uruguay
Mallard duck	<i>Anas platyrhynchos</i>			500BC		Europe, Asia, N America, N Africa

Sources: Groombridge (1992:390), Browman (1989:265)

APPENDIX II: Pastoralism with monogastric species

1. Ducks and geese

Duck herding is quite widespread in Tamil Nadu, South India. Duck producers are so lacking in capital that they purchase ducklings from traders in return for a contract to sell the eggs produced back to the traders. Ducks feed mainly on freshly harvested rice paddies, which benefits farmers, as they loosen the soil, eat weeds and insects and drop manure. The ducks are nowadays moved between farms on trucks, although formerly they were herded. Traders pass to buy the crop of eggs once a week and the ducks can be sold for meat after two or three years. With careful management, these sharecroppers can become independent producers after several years.

(Adapted from Nambi 1999)

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Electronic resources

Links to international organisations:

UNEP

<http://www.ipcc.ch/> - UNEP's International Panel on Climate Change has a number of links to other UN and related sites.

<http://www.ipcc.ch/pub/gloss.pdf> - A glossary of terms used in the literature on climate change.

UNDP

http://www.sas.upenn.edu/African_Studies/Hornet/past0698.html - Describes the system of Somali water points and the consequences of uncontrolled borehole digging.

FAO

<http://www.fao.org/sd/epdirect/epan0005.htm> - more background information on desertification as a global problem, from FAO's Sustainable Development web pages.

<http://www.fao.org/sd/epdirect/epre0031.htm> - Agenda 21 progress report. FAO update (1997).

USAID

<http://www.info.usaid.gov/fews/fews.html> - FEWS: Famine Early Warning System.

<http://www.info.usaid.gov/HORN/GHAI/cycle/nextstep.html> - GHAI (Feb 1999). Next steps for the Inter-Governmental Authority on Drought and Desertification including regional integration, early warning and local capacity building. The Greater Horn of Africa Initiative, United States Agency for International Development.

US Government

<http://www.ars.usda.gov> - website for the Agricultural Research Service of the US Dept. of Agriculture

<http://www.earth.nasa.gov/> - the website of Nasas Earth Sciences. NASA and its inter-agency and international partners are striving to discover patterns in climate which will allow us to predict and respond to environmental events - such as floods and severe winters - well in advance of their occurrence.

Links to Universities and Research Centres

<http://www.shef.ac.uk/uni/academic/I-M/idry/Escreport.html> -SCIDR (Feb 1999). 'Environmental change and poverty in Kalahari pastoral systems.' Full report of research activities and results. Sheffield Centre for International Drylands Research.

<http://www.unu.edu/unupress/unupbooks/80458e/80458E08.htm#11> -As part of a summary of a book on ecology in general, two sections describe pastoralism on the Iranian plateau and in Afghanistan.

<http://www.doc.mmu.ac.uk/aric/arichome.html> -GCCIP (Feb 1999). 'Global Climate Change Information Programme. Climate Change and its Impact on World Agriculture'. Manchester Metropolitan University.

<http://www.infocarto.es/mvc.htm> -Infocarto (Feb 1999). Normalised Difference Vegetation Index.

<http://www.noaa.gov> -NOAA (Feb 1999). National Oceanographic and Atmospheric Administration.

<http://www.parent.qub.ac.uk/geosci/teaching/modules/geog/ggy203/lect6/environment.html> -QUB (Feb 1999). Environments in transition: Aridification and desertification. Geography teaching modules, Queen's University of Belfast.

<http://www.southafrica.net/economy/forest-agri/ews.html> -South Africa (Feb 1999). Southern Africa regional early warning systems to monitor people's access to food and water. Embassy of South Africa, Washington, DC.

Links to other organisations

<http://cnrit.tamu.edu/SRM> - website for the US-based Society for Range Management

<http://www.forages.css.orst.edu> - website for the Forage Information System maintained by Oregon State University

<http://www.agnic.org> - website for the Agricultural Network Information Centre

Satellite Images

<http://www.spotimage.fr> -Spot Image (Feb 1999). Spot satellite earth observation system.

Rangelands

http://www.icimod.org.sg/focus/rangelands/range_toc.htm -A very comprehensive site describing Himalayan pastoralism with particular attention to rangelands and biodiversity conservation.

<http://agronomy.ucdavis.edu/calrng/pub.htm> -A newsletter called, "Rangeland Communities" a newsletter about rangeland ecosystems, people and management put out by the University of California Cooperative Extension.