

Livestock losses and post-drought rehabilitation in sub-Saharan Africa

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Chapter 1 Introduction

1.01 This paper examines post-drought rehabilitation policies to aid recovery in livestock production and in crop production mainly insofar as this is related to livestock. The paper is aimed at decision makers in government and external agencies who wish to consider the rehabilitation options open to them. It starts by discussing what is meant by rehabilitation and the role played by reserves in affecting a population's vulnerability to drought. The second chapter examines the effects of drought on livestock and farming communities, stressing not only the direct effects, such as rising livestock death rates, but also those effects which operate through shifts in relative market prices and the income levels of affected groups. It goes on to discuss the macroeconomic implications of a drought-induced loss of livestock for the government budget, domestic markets and external trade. The following chapter investigates the likely speed of recovery in livestock and crop production in the absence of outside intervention. The range of policies open to governments and development agencies is considered in Chapter 4 and an assessment made of the likely impact and problems associated with each one. Chapter 5 presents material from a number of case-studies in order to show the nature of costs and returns involved and the particular issues associated with policy implementation in each case. Finally, Chapter 6 presents the main conclusions and suggests the priority areas for action for decision makers.

1.02 The paper focusses on policies which may be carried out in the short-to medium-term to mitigate drought-related losses, working on the assumption that losses of a certain magnitude have already taken place. The policies to be examined are those which will have a relatively rapid impact on reestablishing production and income levels among those affected by drought. This paper does not consider pre-drought measures, such as monitoring and early warning schemes, nor short-term relief measures, such as the provision of food for human and fodder for livestock populations. Nor will this paper investigate long-term policy questions, such as changes in the attribution and management of pastureland water resources in pastoral areas or re-settlement schemes. These are obviously subjects of enormous importance, affecting the management of future drought-induced crises and the overall vulnerability of production systems to rainfall shortages.

1.03 The paper has selected three countries upon which to focus its attention, although evidence from elsewhere is also used to support or challenge conclusions reached. The countries chosen are Botswana, Ethiopia and Mali. The choice of these three was made because livestock production represents an important sector of activity in each case, in both rangeland and farming areas. All three countries have suffered bad drought in the past two decades and some evidence is available on drought-induced losses and the subsequent period of recovery. These countries have pursued a variety of policies in the past to speed up the rate of recovery in drought-affected sectors of the economy and this case-material provides useful lessons for policy makers. In the last few years, all three countries have had to cope with a further period of very low rainfall which has adversely affected large numbers of people and major sectors of the economy. Consequently, at this moment the question of post drought rehabilitation policy is uppermost in the minds of many decision makers in government and in development agencies. Assuming that 1985 sees a return to more normal levels of rainfall, a major programme faces the development community in helping governments and producers to re-establish viable and less-vulnerable systems of production.

The meaning of rehabilitation

1.04 There are several possible definitions of rehabilitation depending on how one interprets the restoration of former levels of production and income. Rehabilitation could mean restoring particular systems of production practised by people to their former level of operation by, for example, replacing those factors of production (livestock, seed, equipment) that have been lost as a result of the drought. Alternatively, rehabilitation could imply the re-establishment of the peoples' concerned capacity to produce and earn an income, a definition which includes the first definition as only one among a number of other possibilities.

1.05 The question of what is meant by rehabilitation must also consider the aims of the different parties involved. Rehabilitation for the government will comprise several macro-economic objectives, such as restoring its tax revenue and the nation's earnings from livestock exports and ensuring a sufficient supply of meat on the domestic market' as well as the, regeneration of employment and income levels for producers hit by the drought. For individual producers directly affected by drought, the latter issue is likely to be of much greater importance than objectives at the macro-economic level. Thus, the government may consider the main goal of rehabilitation to have been achieved once total livestock numbers have regained their former levels. However, while national herd numbers may have been re-built, individual herders may not have re-established their pre-drought position and for them the need for rehabilitation remains.

1.06 Rehabilitation will mean different things to different people and the various measures taken to rehabilitate different aspects of production may occasionally be in conflict. Rehabilitation should not necessarily be taken to mean the restoration of the exact situation which existed before the drought took place. Rather, it can be more usefully interpreted to mean the reestablishment of general levels of production and incomes for drought-affected parties be they governments, herders or farmers, but along lines which may in detail differ significantly from those that existed before the drought took place.

Drought vulnerability and reserves

1.07 While it is not the purpose of this paper to identify the frequency of droughts of varying severity nor likely future trends, it should be noted that the intensity and consequences of a drought cannot be forecast simply on the basis of the percentage shortfall in rainfall. A 25% rainfall deficit does not necessarily cause a 25% fall in crop production or a 25% fall in pasture and associated livestock production. In assessing the consequences of a given rainfall deficit, account must be taken of the pressure of demand on the systems of production involved. For example, where livestock numbers are at the limit of what can be supported by natural grazing in a good year, a 25% drop in rainfall will cause heavier losses than where livestock numbers at the start of the drought were proportionately lower. Similarly, where farmers can only expect to satisfy basic subsistence needs in a normal year, a 15% fall in yields will have far more severe consequences than where farmers operate on a wider margin of surplus. Thus, the level of demand upon resources and the size of reserves within the system under study are important factors in determining the actual impact of a given rainfall deficit.

1.08 In general, the level of demand upon resources has been rising due to growth in human and animal numbers, so that even with no obvious downward trend in rainfall levels, one would nevertheless expect to see a greater incidence of drought-induced losses (Sandford, 1977). Where there are both adverse rainfall trends and rapid demographic growth, as has been the case in the Sahel over the last two decades, the frequency and severity of crises due to rainfall shortage will inevitably increase, unless more drought-resistant systems of production are established.

1.09 The existence of reserves is an important factor in affecting the way in which a drought-induced shortfall in some commodity affects the welfare of the individual household, community, region or nation-state. Farmers and herders hold reserves in the form of livestock, gold or other assets, such as a trading business. Reserves at the national level are composed of alternative sources of food, foreign exchange or government revenue. Droughts unfortunately only receive the attention of the world community after several years of rainfall deficit, by which time most people have exhausted their available reserves and approach complete destitution.

Chapter 2 The effects of drought

Effects of drought on the pastoral sector

2.01 Diagram 2.1 summarises the main effects of drought on pastoral groups, the importance of each item depending on the intensity of the drought and patterns of livestock production and marketing. A fall in fodder availability due to low rainfall is the first main effect of drought on livestock production systems; in some areas, low rainfall also causes a drop in the availability of drinking water, precluding the effective grazing of certain pastures. Fertility levels and the timing of conception are strongly related to the nutritional status of female animals. In normal years, cattle in the Sahel betray a highly seasonal calving pattern, most conceptions taking place in the mid to late rainy season (July to October) followed by calving in the late dry season leading up to the rains (April to June). In a drought year, animals suffer both a lower rate of conception, due to a tardy and incomplete return to peak bodyweight during the rains, and higher rates of miscarriage and stillbirth in the subsequent period of pregnancy and calving, due to the high level of stress experienced by animals as the dry season proceeds. Thus, drought in one year will lead to lower calving rates in the following year. This fall in the number of new calves entering the herd is further aggravated by high mortality rates among young stock.

2.02 Milk output falls as a female's access to fodder is reduced and, below a certain level of intake, lactation ceases completely. This fall in milk availability affects not only the calf's nutritional status but also the consumption level of the herder's family, which relies for part of its food requirements on offtake of milk from their animals. In normal years, humans are often in tight competition with calves for the small amount of milk available from females in the herd. A drought-induced milk shortage will intensify this rivalry.

2.03 Animal liveweight falls as grazing becomes scarce, reducing the value of stock as meat animals. This loss of condition also makes them less valuable for the transport of goods and pulling of loads, such as in ploughing, drawing water, etc.

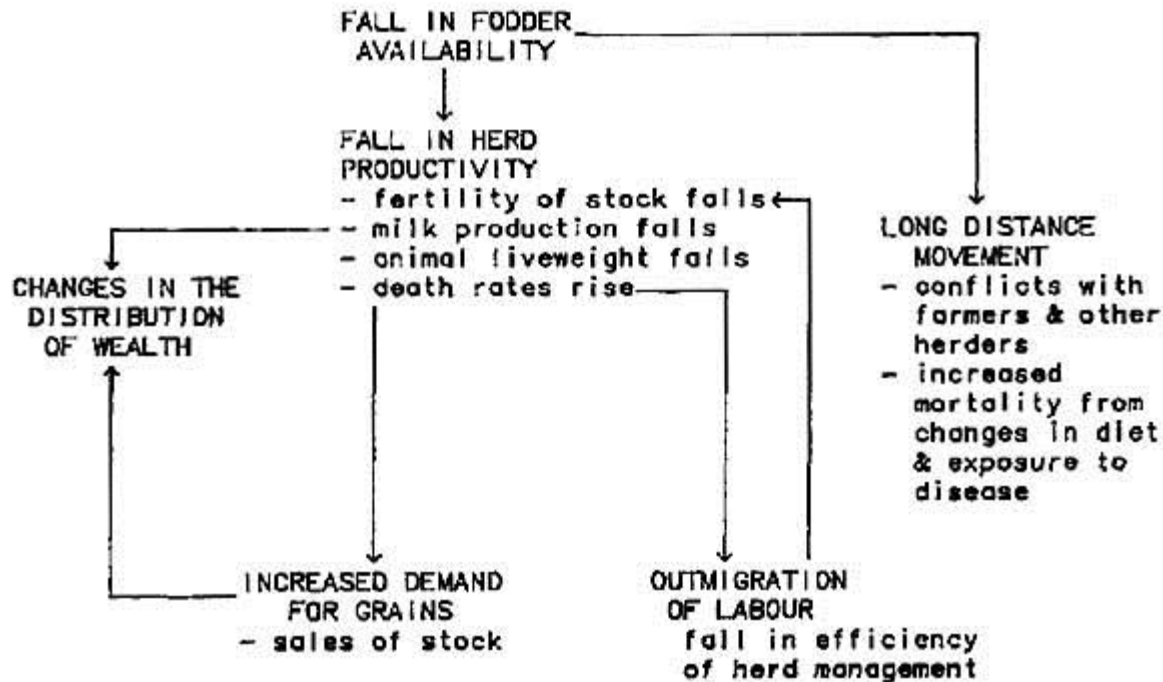


Diagram 2.1. Effects of drought on pastoral areas

2.04. Death rates increase with the fall in liveweight and increased susceptibility to disease. Death rates in times of drought are usually particularly high among certain species and classes of stock, cattle, horses and donkeys being in general less resistant than sheep, goats and camels. Young animals, elderly stock and pregnant females are the most vulnerable within any particular species. Death rates increase as the period of drought continues, as the period of nutritional stress lengthens and as the degree of stress intensifies. A number of surveys have been carried out on stock losses during times of droughts and data from these sources are summarised in Appendix A. As expected, rates vary widely from one species to another and from one drought situation to another.

2.05. Increased demand for grain for human consumption. In most pastoral systems, grains provide an important, though seasonally variable part of the diet. For example among the WodaaBe Fulani of Niger, it is estimated that cereals provide at least 50% of overall calorie requirements, this varying from 20–25% in the rains to more than 70% in the hot dry season (White, 1984). In times of drought, a pastoral household's dependence on grain intensifies, due to falling supplies of milk from having fewer calves born and lower milk offtake per cow. The increased need to buy grains during drought coincides with a fall in pastoralists' purchasing power, resulting from a fall in stock condition, stable or falling livestock prices and rapidly rising grain prices, caused by a drought-induced fall in farm output.

2.06. Sales from herds rise sharply as herders seek to salvage some value from their animals before they die and to buy food for their family. Initially, the least essential members of the herd are sold - male calves and adults, elderly females and those with a poor calving history. As the drought period lengthens, however, herd productivity falls further as does the number of non-essential stock available for sale. Herders will then be forced into sales of breeding females, a

strategy which indicates a situation of acute stress, since females represent herd capital, crucial to the continued maintenance and future growth of herd numbers. On the other hand, the herder is usually faced with little choice but to liquidate his livestock capital, given the immediate food needs of his family, in the context of a rapid fall in alternative sources of income and ability to purchase food. Several writers have documented this shift in relative prices of grain and livestock in times of drought. For example, Seaman et al (1978) found that the amount of grain which could be purchased with the proceeds from the sale of one adult camel had fallen from 1,700 kgs to 500 kgs over the period 1972-74 in Hararghe, Ethiopia. Similarly, in the case of Niger the value of a young ox was reported to have fallen from the equivalent of 832 kgs of millet in 1972 to 406 kgs in 1973 (SEDES, 1976). Sen (1981) combines data on losses due to livestock deaths with those from falling purchasing power and shows that the ability of pastoralists to feed themselves fell by a staggering 84 to 92% during the drought years of the early 1970s in the Ogaden and Wollo regions of Ethiopia (Table 7.7p. 108). The high proportion of animals sold made up by females in times of drought is shown by data from a survey done at Niamey abattoir in June 1973, where 70%-of slaughtered stock were females, in comparison with around 30% in more normal years (Boeckm et al., 1974). Germen (1975) notes the same high sales of females in the case of the drought in southeast Ethiopia, with a large number of such stock either being slaughtered in local towns or being sent to the meat market of Addis Ababa.

2.07. *Outmigration of labour from the pastoral sector.* One means by which the pastoral human population can temporarily adapt to the fall in herd productivity caused by drought is to send some of its members elsewhere, thereby reducing the number dependent on the herd for their support. At the same time, the emigrants may start to earn an income which can help the family left behind to buy some of its food needs. There are, however, likely to be negative effects on herd productivity from this outmigration of labour, which tends to consist of young adult males, the most productive workers in the pastoral economy and crucial to the efficient management of livestock in semi-arid conditions. Researchers in both East and West Africa have noted the drop in efficiency of herd management following the outflow of labor in Mauritania and northeast Mali where the pastoral sector has lost much of its servile labour force (Bonte, 1975; Marty, 1975); in Niger where many households must send part of their workforce on migration during the dry season when the labour demands of watering and herding stock are acute (White, 1984); and in Kenya, where the flow of migrants from the Boran economy has meant that more distant pastures can no longer be effectively used and protected, leading to bush encroachment or invasion by neighbouring pastoral groups and that areas close to Boran settlement sites are overused, leading to low herd productivity and localised pasture degradation (Dahl, 1979; Hogg, 1980).

2.08. Migration by herds to other grazing areas. In times of pasture shortage, a common strategy by herd-owners is to take their animals to other grazing areas where they hope to find better conditions. In the case of the Sahel, herds are Usually moved south in drought years, to higher rainfall zones or to areas of higher grazing potential such as flood retreat pastures and irrigation schemes. Conflicts are likely to arise where there is a large inflow of animals into an area occupied by other herders or by farming groups. Herd-owners will be competing among themselves for limited pasture and water resources. Farmers will fear the damage done to their crops when herds enter an area before the harvest is ended; additionally, the often substantial

livestock holdings of farming communities will face increased competition for grazing around the settlement as a result of the inflow of herds from elsewhere. The significance of these conflicts between herding and farming communities depends on the extent to which mutually beneficial relations can also be set up, based on the exchange of output from the farm (grain, crop residues) for livestock products (milk, manure, live animals).

2.09 Long distance migration by pastoral groups into unfamiliar areas also poses risks to the herd from exhaustion and from the change in pasture species and diet for incoming stock. In addition, movement into higher rainfall zones often brings herds into contact with a new range of diseases and parasites. In the West African case, Sahelian herds are particularly vulnerable to infection from tsetse when entering southern pastures and experience high losses as a result.

2.10. Changes in the distribution of wealth. Drought brings about important changes in the distribution of wealth and access to income among those affected. This is due to the unequal incidence of drought and the differing capacities of producers to protect themselves and their assets in time of crisis. It is widely agreed that droughts tend to have a stratifying effect within communities, the weaker members becoming impoverished further while the rich are able to minimise their losses and may even increase their assets during such periods of stress (O'Leary, 1980; Sandford, 1977; Boeckm et al, 1974; van Apeldorn, 1981). Drought is often seen as a mechanism through which there is a periodic "sloughing off" of the poorest households from the traditional pastoral sector, this human population outflow serving to restore equilibrium between man, animals and pasture (Barth 1961; Johnson, 1973). This outmigration may be only temporary and as conditions improve so do the prospects for re-absorption of these people into the pastoral economy. Thus, Dupire's work (1972) among the Fulani of Niger details several case-studies of households which had been forced to leave the pastoral sector through stock losses but who were then able to re-establish themselves as cattle-owners over time by their involvement in farming, trading and the successful management of small stock holdings. Re-establishment after drought may not always be so easy and for many, drought losses of livestock capital will mean having to turn permanently to new ways of earning an income.

2.11. Drought affects herd-owners differently depending on their level of livestock wealth and their access to other resources. In general, the data supports the view that large herd-owners suffer proportionately fewer losses than small herd-owners (Tyc, 1976, Campbell, 1978; Tacher, 1983). Even when a similar proportional loss takes place among herds of all sizes, owners of larger herds are more likely to end the drought period with a herd big enough to form a breeding nucleus, while those with only a few animals at the start of the drought may see their holdings fall to zero, due especially to the need for stock sales to purchase food needs. Large stockholders will also be better able to minimise their losses by policies of herd dispersion and species diversification. Moreover, to the extent that wealthy herders also have assets in other sectors of the economy— such as a trading business or urban property —when drought hits their livestock assets they can fall back on incomes received from elsewhere. In large part, it is this capacity of the wealthy to transform animal assets into less drought-vulnerable capital which insures their greater viability in the face of drought.

Effects of drought on the farming sector.

2.12 Diagram 2.2 summarises the main effects of drought on the farming sector, each element of which is discussed below.

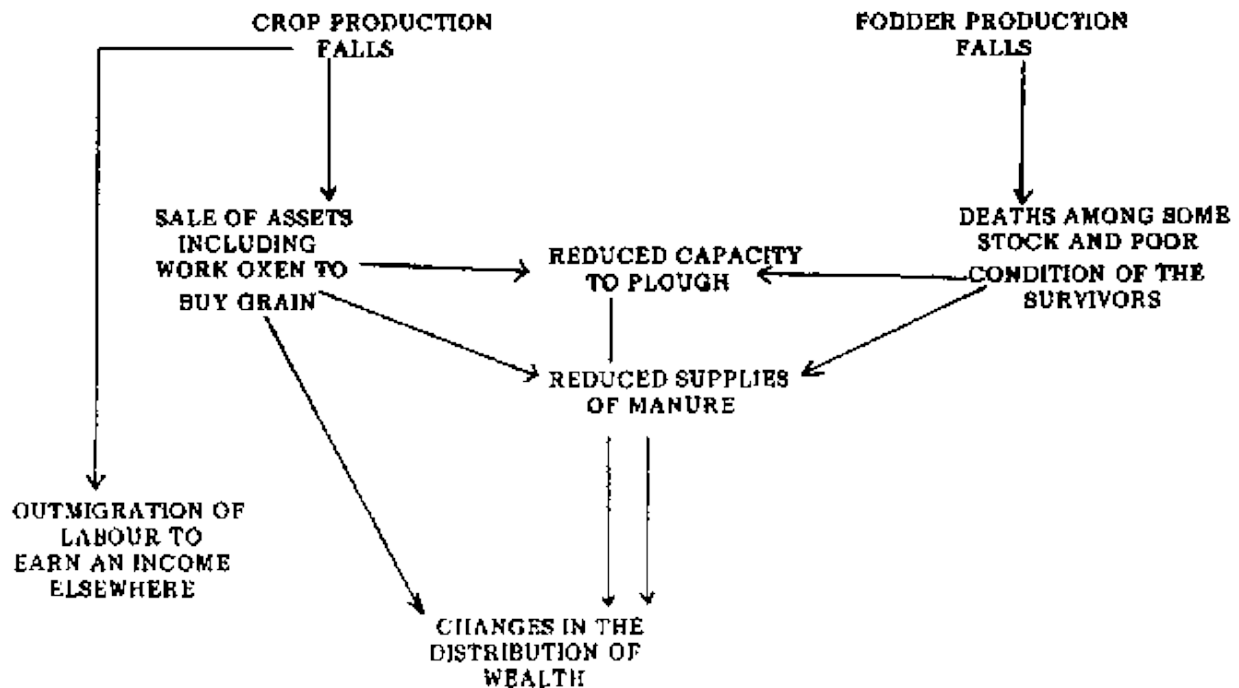


Diagram 2.2. Effects of Drought on Farming Areas

2.13 Fall in crop production. The most immediate effect of drought on the farming sector is a fall in crop production, due to inadequate and poorly distributed rainfall. Farmers are faced with an inadequate harvest to feed their families and to fulfill their other commitments. Livestock sales act as a buffer in times of hardship, farmers disinvesting in these assets to buy food. The first animals to be sold are usually those which make the least contribution as inputs to farm production, such as sheep and goats. However, as the period of drought-induced food deficit lengthens, farmers will have to start selling transport and draft animals, such as donkeys and work oxen—and breeding stock—which constitute the basis of the household's wealth. Thus, in the Ethiopian highland areas, stock are usually disposed of in the following order: sheep and goats, then younger cattle, with horses, donkeys and work oxen being sold as a last resort (Wood, A.P., 1976), oxen being of especial importance as they permit the timely preparation of land before sowing and thus maximise the chances of a good yield. Similarly, among Bambara millet farmers in central Mali, work oxen are only sold when all other avenues for getting cash have been exhausted (Fulton and Toulmin, 1982). In Botswana, while both work oxen and breeding stock are highly valued, Vierich provides evidence of farmers preferring to sell their oxen in order to keep their few breeding females from whom they can re-establish their oxen holdings in the post-drought period (Vierich and Sheppard, 1980).

2.14 Fodder production falls. Where crops have been badly affected by drought, fodder is also likely to have suffered, although output from natural pastures tends to be less vulnerable to drought than crop production. Low rainfall causes poor pasture growth and may also lead to a decline in fodder supplies from crop residues. However, the evidence on this latter point is mixed, with some writers suggesting that even in years of harvest failure crop residues may be an important source of forage for village and visiting herds, these residues often being the only output to be gained from fields (van Apeldorn 1981). Insufficient fodder around the village leads to a loss in weight and deaths among some stock, especially where immigrant herds put further pressure on limited local pastures. While the response of most pastoral groups to fodder shortage is to move themselves and their herds elsewhere, this is not an option so easily pursued by livestock-owning farmers, due to their lower herd number and less familiarity with regular transhumance. In addition, many farm households will have insufficient labour both to take their animals to other grazing areas and also to continue with necessary farming operations. Thus, sedentary herds can be particularly badly hit in times of drought. An example of this is found in the Niore area of north-west Mali, where a recent survey estimates deaths among draft animals (oxen, donkeys and horses) at between 50 and 70% over the period 1983-84 (FAO, 1984c). These losses are caused by pasture shortages, exacerbated by herds from the north on their way to southern pastures, the sedentary nature of these draft animals and the normal dependence of horses (and to some extent donkeys) on a regular grain ration to supplement natural grazing, a supplement which is no longer available given the very poor harvests of recent years.

2.15 The overall effect of the above two points is to reduce the draft capacity of the farming sector, leading to lower crop output in the subsequent cultivation season. Loss of livestock around the farming settlement also reduces the household's supply of dung, a product of considerable importance both as a fuel where wood is scarce and as a means to retain the fertility of regularly cropped soils.

2.16 The role and importance of dung. This varies across farming systems according to a number of factors. Shortage of fuelwood makes dung a highly valued commodity in many parts of the Ethiopian highlands where other sources of fuel are scarce. Dung is estimated to be the second most important product gained from livestock after draft power in such areas providing 80% of the households fuel needs (Gryseels and Anderson, 1983). In addition, sales of dung cakes make a contribution to the household's cash income. In many parts of West Africa, dung is a major element in the exchanges established between pastoral and farming communities. Transhumant herders agree to station their herds overnight on farmers' plots in return for grain, cash or water. This manuring of fields produces a considerable increase in crop yields and is of especial value in marginal farming zones in the Sahel as it enables a large area to be cultivated with rapid crop varieties, such as 60-to 80-day millets which are able to reach maturity within the very short growing period. Research in a Bambara farming village in central Mali reported a fivefold increase in millet yields as a result of manuring soils, giving an implied mean value to the dung produced by each cow equal to 20-40 kgs of grain, worth US\$8-10 (Toulmin, 1983a and forthcoming).

2.17 Drought affects the availability of dung to the farm household in two ways. Firstly, the number of animals owned by the farming population falls with deaths and sales among stock. Even where poorer households continue to own some animals, the extreme vulnerability of such

households in times of drought may force them to sell the dung from their stock rather than use it for raising their own crop yields (Hill 1972, van Apeldorn, 1981). Thus, drought is likely to increase the gap between poor and rich households in terms of their access to dung.

2.18 Secondly, drought affects the size and movements of pastoral herds. The quantity of dung potentially available from pastoralists' animals will fall in line with losses of stock during drought. In addition, the geographical distribution of dung supplies will change as a result of changes in patterns of transhumance. In the Sahelian context, drought conditions will force many herd-owners to move further south than normal out of the Sahel, in their search for fodder and water. Farmers in the southern Sahel, who regularly rely on visiting herds for their supplies of dung, will find their access to this commodity greatly reduced. By contrast yet further to the south, dung supplies will increase for those farming communities savannah areas which are hosts to immigrant pastoralists.

2.19 For many countries, with limited use of chemical fertilisers, dung is of great importance in maintaining crop yields as well as providing a renewable fuel source. A drought induced reduction in the availability of this input will have consequences for levels of farm output, for household incomes and for the pressure of demand on other sources of energy. However, little or no discussion was found in the literature surveyed of the relative value of dung in different uses nor of the consequences for different groups of a fall in the supply of this commodity.

2.20 Oxen losses from deaths vs. sales. The distribution of work oxen losses between deaths and sales will vary according to the circumstances in which drought has taken place and with the constraints faced by different producers. A report by the Relief and Rehabilitation Commission of Ethiopia for the province of Wollo for 1974 presents data showing almost all losses to have been due to deaths rather than sales, with 71% dead from starvation as opposed to 19% sold, leaving 2% disposed of by other means and 8% remaining (Wolde Mariam, 1984). By contrast, Wood's survey of farmers in the northern highlands of Ethiopia found that most livestock losses were the result of distress sales rather than deaths from inadequate fodder (Wood, 1976).

2.21 For Botswana, the number and proportion of work oxen in the national herd declined as a result of the 1978/79 drought, from 19.3% to 14.85% for herds surveyed in the hard veld and from 17.8% to 13.8% for those in the sand veld (Vierich and Sheppard, 1980). These figures indicate that there must have been considerably higher rates of offtake through sales of work oxen as opposed to other cattle during the drought, since oxen tend to have higher rates of survival than most other classes of stock. Little or no evidence is available on work oxen losses for the Sahelian drought of 1968-73, probably as a result of the fairly low losses involved. However, the recent survey in north-west Mali, quoted earlier, points to very heavy losses among draft animals due to deaths rather than sales (FAO, 1984c).

2.22. Outmigration of labour. As in the case of the pastoral sector, one means by which farm households try to make ends meet in times of crop failure is by releasing labour to earn income elsewhere; at the same time this reduces the burden on household food reserves. The net effect on farm productivity depends on whether this migration continues into the next cultivation season, thereby reducing the capacity of the household to farm on its former scale. This will be

the case where shortage of food is so acute that the household must depend on the earnings of some of its members to feed the rest of the family until the next harvest.

2.23. Changes in the distribution of wealth. The experience of different farm households in times of drought will be determined by their ownership of assets, access to incomes from other sources and the extent to which these assets and incomes are less affected by drought than are harvests. The most vulnerable amongst those hit by drought will be those with few assets of value to sell, those who most need to purchase grain due to an absence of their own household reserves, and those who cannot gain access to food through other means, like borrowing, coercion or theft. Wood (1976) shows in his study of farmers in northern Ethiopia over the drought years of the early 1970s that the speed with which farmers became seriously short of food varied very considerably, due to their differing access to income sources. The richest farmers were even in a position to benefit by acquiring land and other assets from distress sales by their poorer neighbours. Sen (1981) formalises the analysis of differential impacts on incomes and wealth in times of crisis in his essay on "Poverty and Famines". He introduces the idea of "food entitlement" an individual's overall access to food depending not only on his direct crop production but also on his access through the market - by sales of labour and other commodities - and through non-market channels such as social networks and re-distributive systems. Relative price movements change the entitlements of certain groups, making it more difficult for them to satisfy their food needs. This is seen in the case of pastoralists who face rising grain prices but falling prices of livestock as drought intensifies. Many farmers are in a similar situation, needing to sell livestock, labour or land in markets where an excess supply of these commodities has reduced their power to purchase foodstuffs.

The coincidence of livestock and arable droughts

2.24. A given rainfall shortage is likely to affect livestock and cropping sectors differently. In areas where crops and animals occupy the same ecological zone, farming is likely to be a more risky business, herds being able to compensate for localised rainfall shortages by movement to better favoured areas. Thus, droughts hitting crop production are reckoned to occur more frequently in Botswana than are those seriously affecting the livestock sector (Jones, 1979). Droughts in the livestock sector tend to be the product of a series of years with below average rainfall, causing a growing imbalance in the availability of grazing to animal needs. In the case of Sahelian countries, however, the farm sector occupies the higher rainfall zones to the south of the main grazing areas. Since variability in rainfall becomes more marked as rainfall totals decline, the pastoral sector is particularly prone to drought from the low level and erratic distribution of rainfall within and between years. Thus, in the drought years of 1968 to 1973, it was the pastoral zones of the northern Sahel which were especially badly hit, while many southern farming regions experienced very few drought-induced losses. As in the case of Botswana, it was the progressive effect of a number of years with low rainfall which caused the massive scale of losses felt by more northerly areas.

2.25 Account must be taken of the interaction between drought losses in the crop and livestock sectors for two reasons. Firstly, grain forms an important part of the pastoralist's diet even in normal times. In periods of drought, as herd productivity falls, herders come to rely even more heavily on grain for their food needs. Where both the livestock and farm sectors have been hit by

drought, the pastoralist's rising demand for grain is confronted by a drop in locally available supplies and by a rapid escalation of cereal prices as both farmers and herders must buy their food on the market, resulting in a sharp decline in herders' purchasing power. If drought has only hit the livestock sector, grain prices will be subject to much less upward pressure. Secondly, farmers commonly own a considerable number of livestock, both those used for cultivation such as work oxen and those kept as an investment, such as breeding stock. As was seen in an earlier section, these animals provide the farmer with a margin of security being sold in times of need to pay for food and other needs. Widespread drought thus worsens the position of both farmers and pastoralists. The only farmers to gain from widespread drought are those fortunate enough to have sufficient stocks of grain remaining from previous harvests to invest in livestock while relative grain to livestock prices are in their favour. Evidence from the 1968-73 drought in the Sahel shows that certain farmers were able to expand their animal holdings rapidly by the exchange of grain for stock on highly advantageous terms, as drought conditions intensified (Marty, 1975; Arnal and Garcia, 1974; Lewis, 1979).

The macro-economic impact of drought

2.26 Several countries have suffered a substantial drop in the size of the national herd following drought. For example, the Niger cattle herd was estimated to have fallen by 48% in 1972-3, from 4.5 million head to 2.3 million. Recent estimates put the losses in cattle herds over the period 1982-84 at 62%, from a population of 3.5 m head in 1982. Similarly, the cattle population of Botswana fell by 32% between 1962 and 1966 from a population of 1.35 m head in 1962 (Campbell, 1979). From 1981-84, the national herd is estimated to have decreased by 20% to 2.4 m head, following 3 years of drought (FAO, 1984a). These reductions in livestock numbers do not represent a total loss to the national income and wealth of the country, since some proportion of these losses will have been slaughtered for domestic consumption while others will have been exported. The reduction in the national herd does, however have implications for the country's ability to satisfy future demand from domestic and foreign markets in the short- to medium-term, as herd numbers will take time to re-build, the government is also likely to suffer a loss to its income from the tax it normally raises on livestock-related activities. A summary of the main effects of drought on macroeconomic variables is shown in Diagram 2.3.

Diagram 2.3. Effects of Drought on Macro Economic Variables

FALL IN OUTPUT FROM LIVESTOCK AND FARM SECTORS

GOVERNMENT BUDGET	DOMESTIC MARKETS	EXTERNAL TRADE
<ul style="list-style-type: none"> • fall in revenues from direct taxes and export duties • increased demand for government services, 	Livestock <ul style="list-style-type: none"> • short term fall 1 in prices with high offtake • longer term rise in prices as herds reconstitute 	<ul style="list-style-type: none"> • short-term rise in number of stock exported • medium-to long-term fall in exports as herds reconstitute

with shift to short-term relief.	<p>Grain</p> <ul style="list-style-type: none"> • short-term rise in prices with rising demand and fall in supply • medium-term fall in prices as harvests return to normal. 	<ul style="list-style-type: none"> • pressure on foreign trade balance from need to import grain and other relief supplies.
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2.27. The government budget. Drought causes a fall in government receipts from those areas and sectors affected by the shortfall in rain. Livestock and crop production represent a major proportion of GDP and 'provide many of the opportunities for employment in 'sub-Saharan' Africa. Governments gain revenue from these sectors either directly, in the form of taxes on livestock holdings and farmer populations or in the 'form of grain quotas, or indirectly, from taxes on the slaughter of stock and exports of livestock and grain. The direct taxation of livestock populations is estimated to provide between 5 and 10% of government revenue in states such as Chad, Burkina Faso and Mali '(Berg, 1975). This tax was lifted in several Sahelian countries over the period 1974-75, partly to reduce the stress on herding populations in the wake of heavy livestock losses and partly as a result of the very great problems posed by the levy of this tax, given large scale movements by herds across the region and the difficulties of conducting a new census of livestock numbers. Compensation was paid to those countries lifting the tax by the European Development Fund as part of the latter's programme of aid in the post-drought period. Export duties on livestock and their products provide government with additional revenue. However, as may be seen, this source of income is also vulnerable to drought losses. In the case of Mali, the percentage of government tax revenue derived from livestock and meat exports fell from 6.0% for the period 1968-73 to 3.3% for 1974-76, as a result of the decline in livestock exports after the drought (Delgado, 1980).

2.28 In the case of Botswana, taxes are levied on a wide range of livestock products: on domestic production and exports of meat, blood-, bone-and meat-meal, hides and skins (Anteneh, 1985). Revenue from the livestock sector has grown from 315,000 Pula in 1970/71 to 2.01 m Pula in; 1981/82, representing 1.02% and 0.8% of the government's overall revenue. While a fall in livestock exports, such as that experienced in 1978 and' 1980 following outbreaks of foot-and-moth disease, reduces government revenue, Botswana is in the relatively fortunate position of having substantial earnings from its diamond export industry which cushions the impact of this fall.

2.29 Domestic markets for livestock: Diagram 2.4 shows the relative price movements of livestock and grain typically found over the years spanning a drought and subsequent period of recovery. Stable or declining stock prices during the drought are caused by rapid increases in offtake as herders try to salvage some value from their stock and as they face rising prices for their staple food, grain. Marketing systems are usually unable to cope with the large increases in animals supplied, due to a lack of transport and storage facilities with which to spread this increase over space and time. As noted earlier, as the period of drought lengthens and as the purchasing power of herders is increasingly eroded, pastoralists will be forced to sell their productive stock, composed of young and breeding females. Only once grain supplies become

relatively more plentiful with the next harvest or with substantial food imports do relative livestock to grain prices reverse themselves. Price levels for all stock are likely to be high in the years following a drought as stable or rising domestic and foreign demand is faced by a low rate of offtake from herds depleted in the former period. Prices will be especially high for those species and classes in particular demand, such as small stock, valued for their rapid rates of reproduction, and female stock of all species (Sutter, 1982; Marty, 1975).

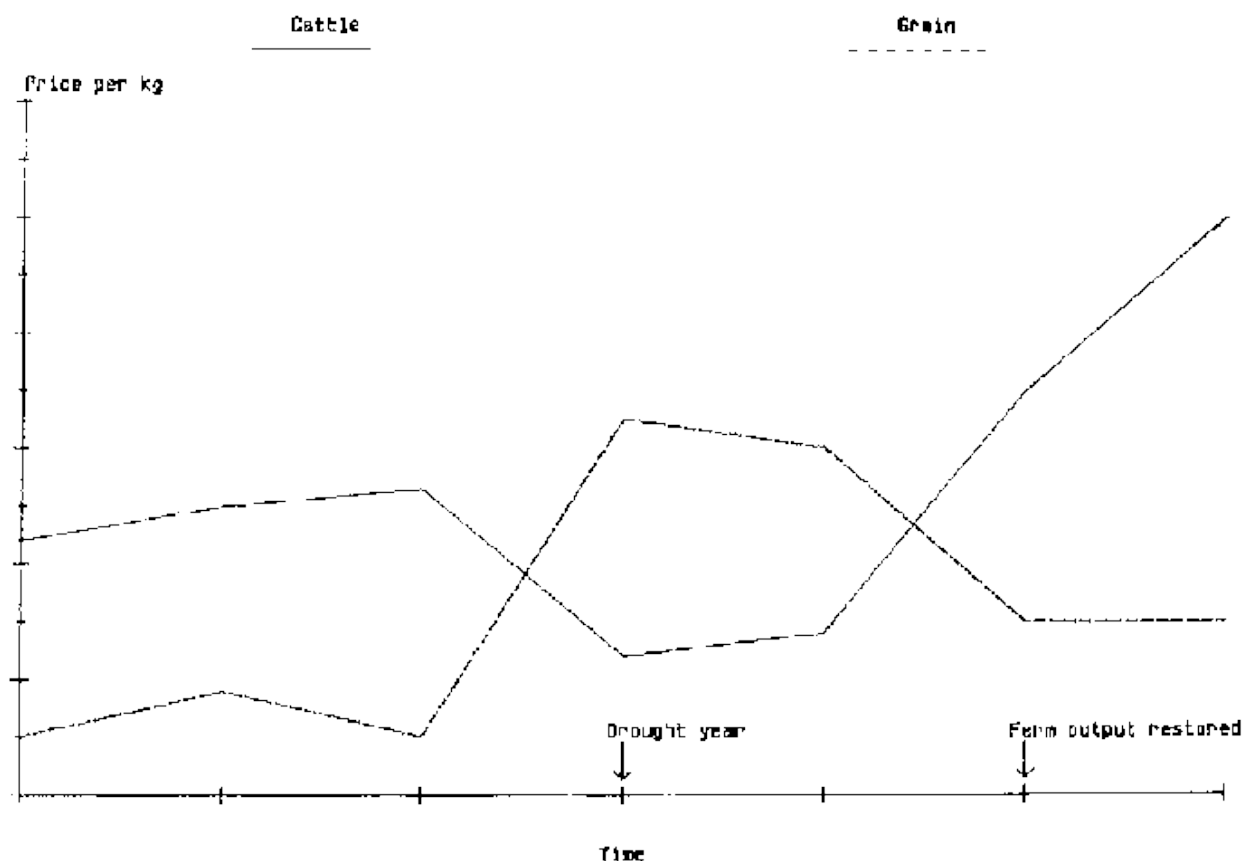


Diagram 2.4. Relative price movements of livestock and grain over a period of drought and subsequent recovery

2.30. In the case of Mali, urban meat prices doubled over the first half of 1975, following losses of stock estimated at 30–35% over the previous two years, due to a high level of urban demand coupled with high export prices for stock. This large rise in price occurred despite efforts by government to set a controlled price for meat and a short term ban on the export of livestock. Data presented by Sutter (1982) for Niger shows a rapid rise in the price received for an export bull, showing a tripling from 20,000 FCFA in 1974 to more than 60,000 FCFA in 1977. Meat prices in Ndjamena showed a parallel trend, quadrupling over the five years from 1970-75 (Tyc, 1976). These price increases for livestock and meat compare with a general increase in price levels of 20-30% per year over the period 1972–76 (ILCA, 1979).

2.31 *Domestic markets for grain:* The price movement of grain over a period of drought has been described above. The extent to which grain prices rise during drought obviously depends on the

size of drought-induced crop losses and how far these can be made good by imports of grain from elsewhere. The speed with which farm production returns to normal levels after the drought is determined by the level of loss in productive capacity - draft animals, seed, outflow of labour, damage to soils - which can only be reconstituted over a period of years. The question of speed of rehabilitation is looked at in more detail in a later section of this paper. In general, however, crop production will return to normal more rapidly than does output from the livestock sector, due to the slow rates of reproduction and herd reconstitution in the latter case.

2.32 Recent trends in the prices of grain and livestock in the Sahel show the development of a situation very similar to that witnessed in the early 1970s. Considerable price rises for grain as seen in Diagram 2.5 below have been coupled with an almost total collapse of livestock markets throughout the Sahel. Several observers have noted that by early 1985, livestock were trading at one-tenth of their value in previous years, a prime male export animal being sold for 10,000-15,000 FCFA whereas it would have fetched up to 150,000 FCFA a year or two earlier. While part of this large fall in market prices is attributable to high rates of herd offtake leading to excess supply, it is also partly due to changes in the demand for meat in coastal markets. Of particular importance has been the closure by Nigeria of her frontiers and increasingly tight controls over movements of foreign exchange. In addition, countries like Ivory Coast have continued to import large quantities of frozen meat from overseas, thereby reducing the level of demand for Sahelian livestock.

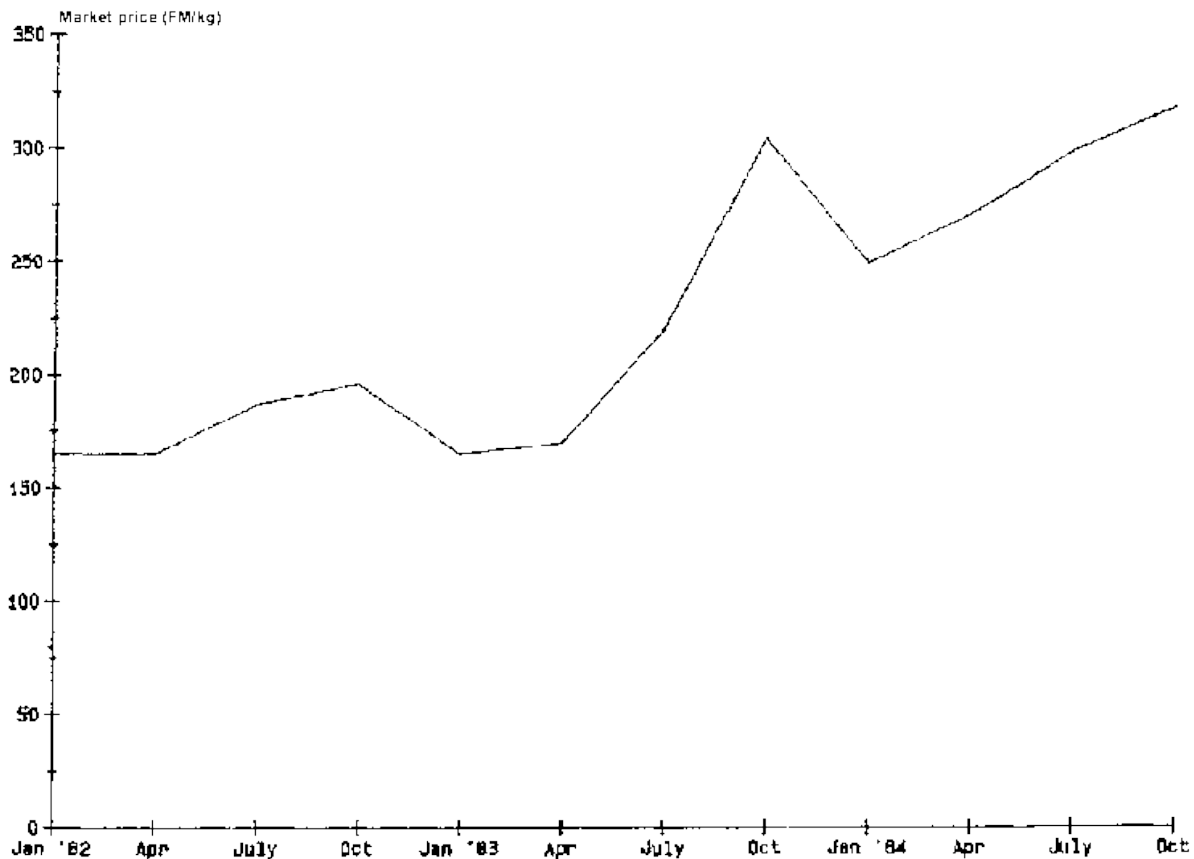


Diagram 2.5. Market prices for millet in Bamako, Mali, 1982-84

2.33 External trade. The external trade balance will also be affected by a drought induced fall in livestock production. A fall in the national herd reduces the number of animals available for satisfying domestic demand and for meeting export targets. In addition, disease problems may be aggravated by drought, because of the ensuing large scale movements of stock between areas. These disease problems may lead to the closure of certain export markets. The way in which the stock shortfall is distributed between the two markets (i.e. domestic and export) depends on a variety of factors which include income and price elasticities of demand in the two markets, changes in income levels, inflation rates, the degree of substitutability between animals destined primarily for the domestic as opposed to the external market and government interventions aimed at shifting stock in one or the other direction. Where a strong level of urban demand exists, this may absorb most of the available offtake from herds in the immediate post-drought period, so that livestock exports fall by an amount far greater than the percentage drought losses of stock (ILCA, 1979).

2.34 The data available on both domestic slaughters and exports of live animals and meat is often very inadequate, so that the exact distribution of livestock losses between the two markets cannot be gauged with certainty. Diagram 2.6 below presents data for cattle on estimated total domestic consumption and exports for Mali and Botswana. In the case of Mali, it can be seen that the export trade was relatively static following the 1973 drought, not expanding until 1979, after which the numbers exported have risen rapidly. This increase in exports seems to have coincided with a fall in domestic consumption of beef, probably as a result of a shift in the relative prices of beef in domestic and export markets. The low level of cattle exports in the post-1973 period may be accounted for by several factors: (i) the drop in national herd size by an estimated 30-35%, reducing the number of animals available for meeting domestic and foreign demand; (ii) the priority given by the government in the immediate post-drought period to satisfying domestic demand, given the rapid inflation in meat prices noted earlier and the importance of urban consumers as a political force; and (iii) the turning by Ivory Coast to non-African supplies of meat - mainly frozen meat imports from Argentina - to make up for the temporary shortfall in meat supplies from its traditional Sahelian sources. As a consequence, Malian exports of meat now face a somewhat "softer" market in Ivory Coast than was formerly the case, consumers being ready to turn to cheaper supplies of frozen meat should imports of Sahelian stock become too expensive. However, it should be remembered that the figures must be treated with caution, since controlled* domestic slaughters of cattle probably account for only 50% of total slaughters while controlled* exports of cattle are thought to represent only 25% of the total actually exported (Delgado, 1980).

* "Controlled" exports and slaughters are those which take place through officially recognised channels and for which the relevant taxes have been paid. Thus, uncontrolled exports refer to those which cross international frontiers away from border posts and uncontrolled domestic slaughters are those which take place, for example, in herders' camps and farming villages. The proportions of controlled to uncontrolled activity are estimated by Delgado (1980) for the mid-1970s. However, he emphasizes that there is no reason to believe that controlled activity remains a constant proportion of total trade, given changes in government policy, customs duties, etc.

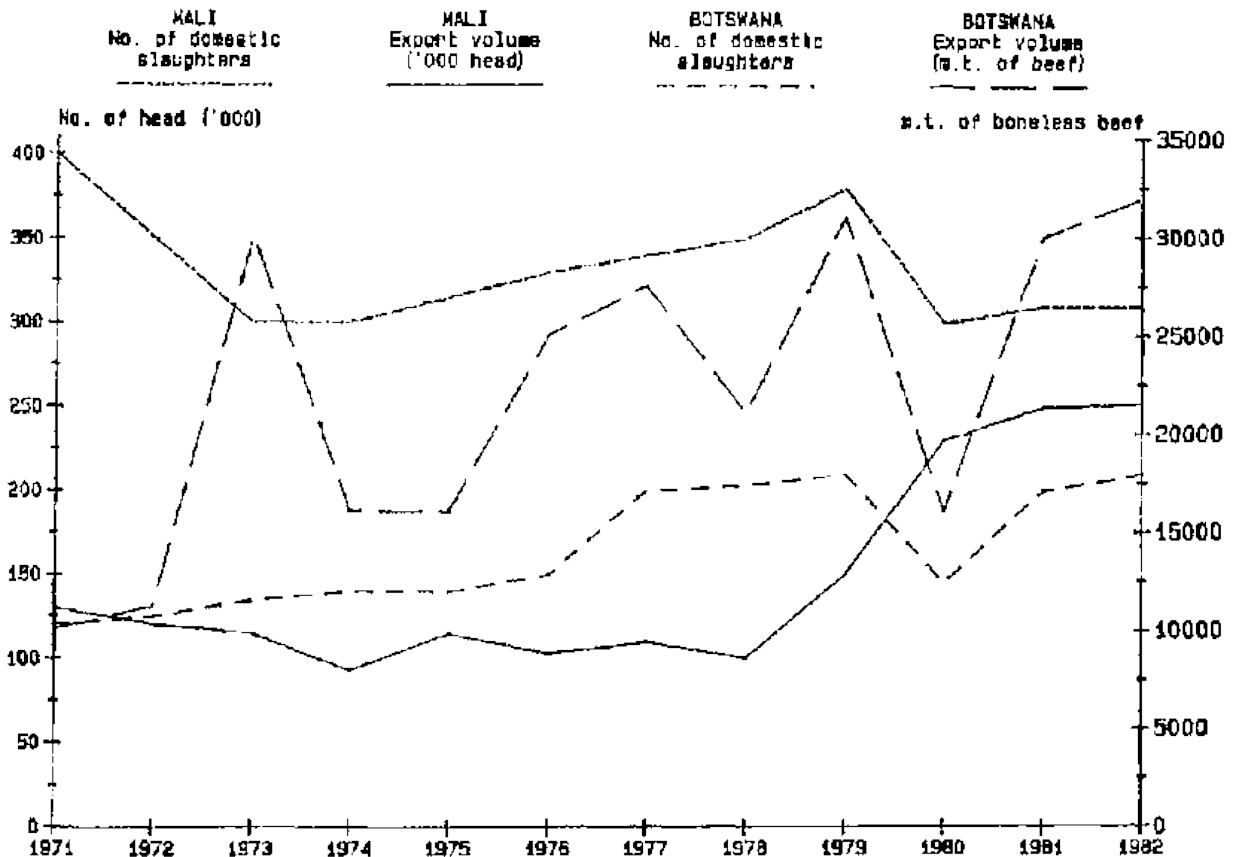


Diagram 2.6. Domestic slaughters and exports of cattle from Mali and Botswana, 1971–82.

2.35. In the case of Botswana, all cattle exports pass through the Botswana Meat Commission (BMC) and confidence can thus be placed on the export figures. However, domestic slaughters cannot be known with accuracy as many of these take place in rural areas. Export figures in Diagram 2.6 refer to metric tons of boneless beef while domestic slaughters are presented in thousands of head. The figures show the effect of certain drought years on increasing export volume, such as in 1973 and 1979. In addition, there is a marked effect on meat exports from outbreaks of foot-and-mouth disease, which occurred in 1978 and 1980. Not only are there lower volumes of meat exported in these years, but also the unit value of meat exports is reduced as particular high-price markets such as the EEC, forbid the importation of meat from areas infected with this disease. The figures for domestic slaughters show a generally rising trend with a sharp fall in the post-drought year of 1980, as expected.

Chapter 3 Reconstitution and rehabilitation

3.01. It is important to assess the capacity and speed of rehabilitation in crop and livestock production in the absence of intervention from sources external to the system or community involved for two reasons. Firstly, one must have some measure of expected rates of rehabilitation against which to evaluate the impact of various forms of intervention aimed at boosting the speed of recovery. For example, suppose that rates of herd reconstitution in the absence of intervention can be estimated at 2.5% per annum but that a programme of selective supplementation is expected to raise this to 3.5% per annum. The net gain in livestock productivity as a result of this intervention can then be compared against the cost of its implementation and its return assessed in relation to other possible policy measures.

3.02. Secondly, indigenous strategies in the post-drought period provide policy makers with guidelines as to processes of local adaptation which may be supported. Communities often display considerable resilience in the face of drought, enabling them to survive severe crises and to regain their ability to produce in the subsequent period. The policies of governments and development agencies can either re-enforce those strategies or render them less effective. For example, it is common in conditions of acute pasture shortage for herders from the Sahel to take their animals much further to the south of their usual circuits of transhumance, hoping by this means to get access to fodder in higher rainfall zones. Administrative control over the movement of herds from region to region and between nations curb the possibilities for migration and thus heighten the risks of heavy stock losses in times of drought. Similarly, temporary migration of labour from rural areas is pursued on a regular basis in many countries. For example, seasonal migration is an important source of off-farm income for many farmers in the savanna and sahelian zones of West Africa. In times of drought, this migration flow becomes crucially important, as it both reduces the number of people who must be fed by the household granary in the drought-affected area and it provides a supplementary source of income for buying food. Government policy can either aid or hamper this flow of labour from poor to better-off regions, by either minimising the paperwork and cost of movement, or conversely, by making it difficult for people to travel, cross regional or national frontiers or obtain temporary employment.

Rehabilitation of the pastoral sector in the absence of outside intervention

3.03. The reconstitution of herd numbers over time can be looked at, both at the level of the national herd and at the level of the individual herd-owner. The distinction must be made between the two cases of reconstitution because it can be assumed, in most cases, that imports of livestock will make little appreciable impact on the growth in total herd numbers at the national level, while much of the growth in an individual's holding may be due to acquisition of animals from various sources. In this latter case, there is no net gain in total national herd numbers, although a redistribution in livestock holdings will have occurred. The use of herd models to simulate reconstitution of livestock numbers after drought will be examined first before turning to strategies pursued by individual producers to restore their animal holdings.

3.04 Modelling the post-drought reconstitution of herds. Several writers have developed models aimed at simulating drought-induced losses and the subsequent period of herd reconstitution in the ensuing years (Dahl and Hjort, 1976; Tacher, 1975; Clark, 1984). The general format of such

models is to take a herd containing a certain proportion of animals belonging to different age-classes. Usually only the female breeding herd is taken as it is the number of breeding stock available which determines current and future herd growth rates. After subjecting a herd of normal structure to drought losses of a certain order, reconstitution is stimulated by attributing given values for fertility and mortality rates in each age-class.

3.05. The models proposed by different writers vary in terms of the different parameters chosen as typical of herds under normal conditions and in whether or not some compensatory increase in herd productivity is assumed to take place in the immediate post-drought period. It has been noted by some researchers' that herds typically experience abnormally high rates of fertility in the year or two following a drought, due to low rates of conception and birth during the drought period and to the favourable post-drought balance between livestock and pasture conditions. Thus, immediate post-drought growth rates may be very high, herds being largely composed of breeding females and many of these calving in the year after the drought. Dahl & Hjort (1976) give examples of herds growing by as much as 25% following a drought before falling back to more normal rates of increase of between 2 and 5% per annum. However, given the uneven impact of drought losses, the numbers, age composition and output of herds will undergo considerable fluctuation over the ensuing years as the herd gradually regains its former structure.

3.06. Table 3.1 gives the estimated number of years required for cattle herd reconstitution after losses varying from 10 to 90% and is taken from Tacher's model of Sahelian cattle herds. Diagram 3.1 presents this data in another form. There is a progressive flattening in the slope of the lines showing the time-path for reconstitution. This indicates that as mortality rates rise, the reconstitution period increases more than proportionately. For example, while losses of 20% will take 3 years to make good, losses of double this figure (i.e. 40%) will take far longer than double the time to reconstitute. Diagram 3.2 contrasts the speed of reconstitution for goats and cattle following different orders of loss. The rapid reproduction rates found among small stock allows them to reconstitute their number after drought relatively quickly. It can be seen from the diagram that after losses of 70% (or a survival rate of 30%), goat populations will be back to their former level in about 8 years. The slower growth of cattle herds means that they take much longer to reconstitute after losses of lesser significance.

Table 3.1. *Estimated time for cattle herd reconstitution after varying levels of drought loss.*

Percentage losses among herd	Number of years taken for herd reconstitution
20%	3
30%	10
40%	12
50%	21
60%	30
70%	43
80%	61

90%	85
Source: Tacher (1975).	

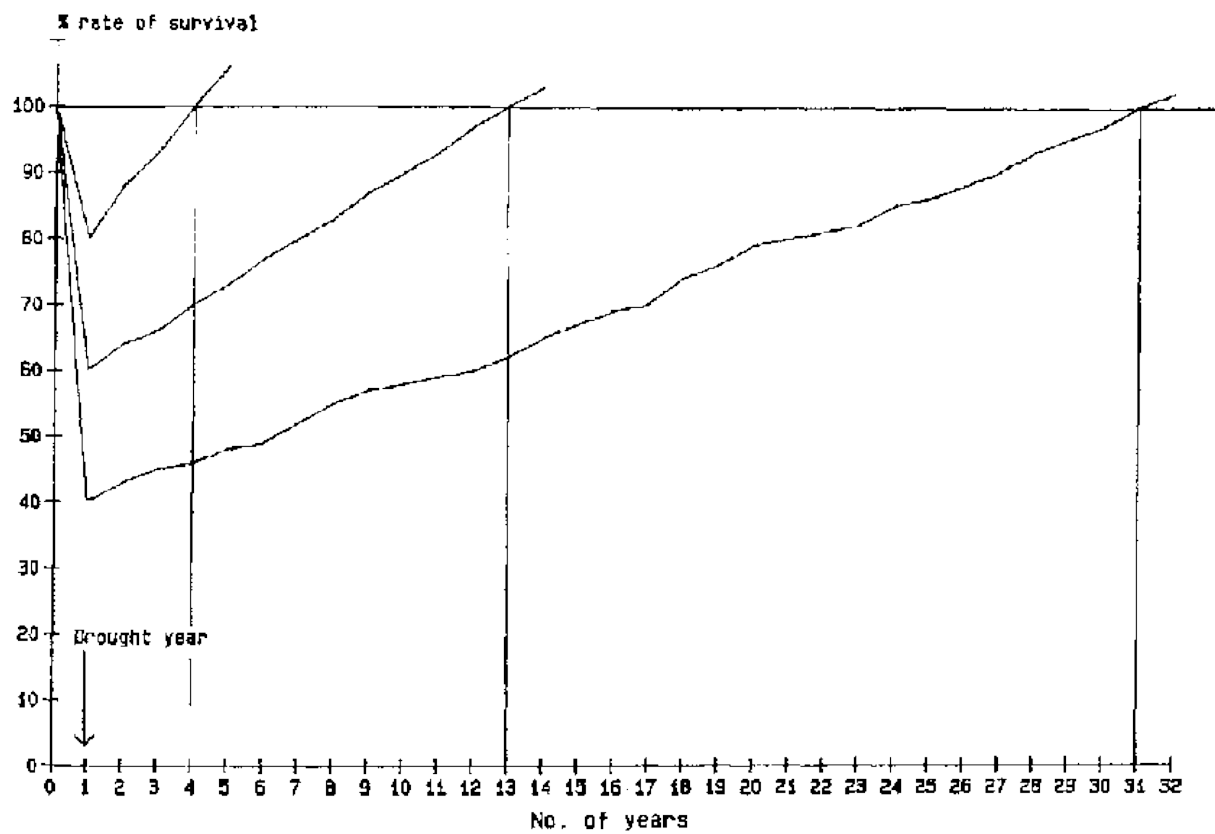


Diagram 3.1. Reconstitution of herd numbers after varying levels of livestock loss: The case of cattle

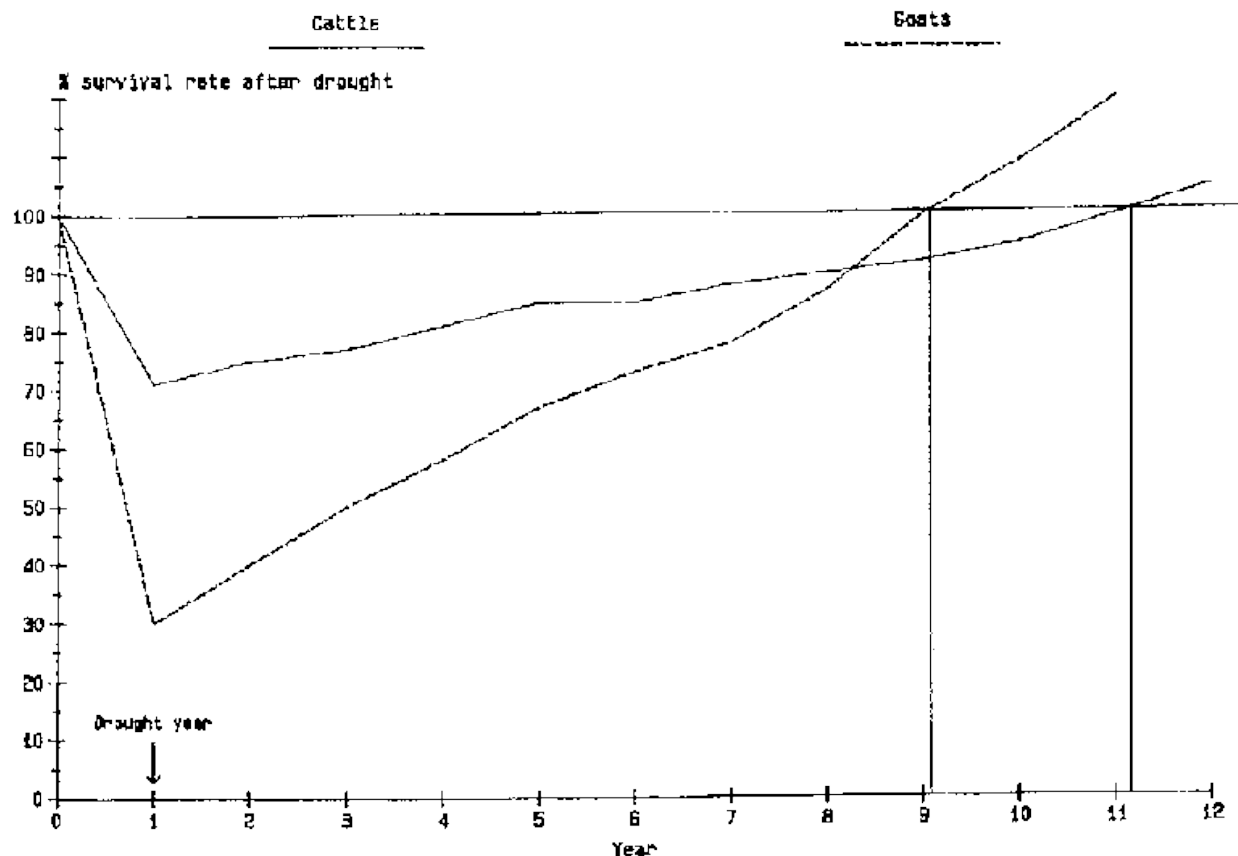


Diagram 3.2. A comparison of cattle and goat herd reconstitution after differing levels of drought loss

3.07 The higher survival rates of small stock in times of drought as compared with cattle and the faster rate of growth among the former explains changes in the composition of livestock populations in the post-drought period and in particular the dominance of goats as reconstitution takes place. This shift in the species composition of herds is seen in the following section

The reconstitution of the Sahelian livestock sector after the 1968-73 drought

3.08 The general conclusion of the herd models discussed above and the derived rates of growth may be compared with the evolution of animal numbers in the Sahel, following the losses of the prolonged drought period of 1968-73. As may be seen from Table 3.2 most Sahelian states had by 1983 seen a restoration of the national herd, although a shift had taken place in the relative importance of different species and in their geographic distribution. The evolution of livestock numbers since 1973 provides support for the conclusion that overall drought losses were around 30% for cattle in most countries, with somewhat lower rates among sheep and goats, although the incidence of loss varied considerably between regions within any single country. Only in the more northerly zones did cattle losses exceed 25 to 30%, so that cattle numbers were approximately restored over the ten-year period, as would be predicted by the model described above. Very high losses among cattle of 80 to 100% for herds in northeast Mali (Marty, 1975), while of critical importance to the herders concerned, were probably of low national or

international significance. These losses were composed not only of livestock deaths but also of distress sales of stock, some of which were subsequently slaughtered for meat while some were bought by other herd-owners.

Table 3.2. *Reconstitution of livestock numbers in the Sahel after the drought of 1968–73 (millions of head).*

Country	1972	1974	1982/83
Burkina Faso			
Cattle	2.40	1.60	2.95
Small stock	4.05	3.00	4.50
Mali			
Cattle	5.40	3.70	5.40
Small stock	11.18	7.70	3.95
Senegal			
Cattle	2.51	2.32	2.33
Small stock	2.70	2.53	3.36
Source: FAO (1985 a, b, c).			

In the latter case, while the sales of an animal to another represents a net loss to the individual producer, at the national level this transaction represents a redistribution of available livestock rather than a net loss of herd capital. In addition, some animals which had been thought lost to the national herd by their migration to states further south are likely to have returned to the Sahelian countries with the better rainfall and pasture conditions of the mid-70s.

Herders' options for herd reconstitution

3.09 Earlier, reference was made to several herd models used to estimate the speed of herd reconstitution in the absence of outside intervention, after losses of varying intensity. It was seen for example that for losses of 30%, it will take about 10 years for a herd to regain its former numbers. Individual herders, however, can pursue a number of strategies in the event of loss in order to reduce the length of time taken for their own herd numbers to re-build on the basis of natural reproduction alone. These include: supplementing livestock output with income earned elsewhere, concentration of resources on rapid reproducers, like sheep and goats, the acquisition of stock from other households or attempts to raise the productivity of remaining livestock

holdings. Most of these strategies involve the re-distribution of existing livestock and thus do not exert an overall impact on the overall rate of growth of the national herd. If however stock are available from elsewhere (for example if Malian herders can buy breeding stock in Burkina Faso), individual herders' strategies for herd-rebuilding can add to total number of animals owned at the national level.

3.10 The pastoralist is faced with a major problem in the post-drought period, that of having reduced herd numbers producing a lower income in the form of milk supplies and saleable stock. Herd size may have fallen below a level capable of supporting the human group formerly dependent on it. As a result, the herder has several options:

3.11 Firstly, to increase the rate of herd exploitation by increasing milk offtake or selling more stock. This policy will lead to the disappearance of the herder's capital sooner or later.

3.12. Secondly, to supplement income from the herd with that obtained elsewhere, for example by the outmigration of some household members or by the pursuit of a number of supplementary activities carried out in association with care of the herd. The success of such a strategy depends on the extent to which herd management patterns change as a consequence. As discussed earlier, the outflow of adult male labour from the pastoral household can have adverse effects on the way the herd is managed. Where herders must combine farming with the care of their animals, the heavy labour demands of cultivation will reduce the possibilities for efficient herd management. Transhumance over long distances during the rainy season may have to be abandoned because labour is tied up in farming. However, in some cases, the combination of farming with herding may be relatively easy. For example, several households can group their animals together and send one or two of their members with the 'Joint herd' thereby minimising the labour demands on individual households. Alternatively, agricultural production can be fitted into transhumance circuits in such a way as to minimise disruption in grazing patterns (as described by Cunnison (1966) for Baggara nomads of the Sudan).

3.13. The third option is to convert remaining holdings into small stock, whose rates of reproduction are considerably higher than those for cattle and which can supply a more even supply of milk throughout the year. Having built up a large holding of sheep and goats over a period of years, the animals can then be sold in order to buy cattle. The viability of this option depends on the relative price ratios of small to large stock in the period immediately following the drought and in subsequent years. The success of this strategy is hampered by the tendency for small stock prices to be fairly high after a drought' due to strong demand among herders for these species as many producers try to reconstitute their holdings in this way. In addition, as noted by Dahl and Hjort (1979), this strategy is very risky, as small stock tend to be more susceptible to disease.

3.14 Fourthly, herders can acquire animals from other herd-owners, through legal or illicit means. The pastoral literature presents many examples of livestock "loans" between different producers and details the variety of terms and contexts within which these exchanges occur (see Toulmin 1983b, pp 12-18, for a summary of these animal loans). Some of these loans are re-distributive in function and motive, involving the transfer of rights to offspring of loaned animals to the borrower, enabling the latter to build up his own livestock capital over time. An example

of this is exhibited by the *habbanaae* system of loans among the pastoral WodaaBe of the Sahel, whereby a cow is loaned to another herder, the latter receiving the first three calves born before returning the cow to her owner (Dupire, 1962). Other livestock transfers do not offer the same prospect for gaining an independent herd, the temporary allocation of animals to another being made on less favourable terms, such as granting access to a quantity of milk, or payment in grain or cash. The latter examples are essentially herding contracts, involving the exchange of a herder's labour for a wage denominated in cash or in kind. It is generally held that the frequency of loans will decline in the period following a drought, given the fall in total numbers of livestock available and the lack of surplus animals at the level of the individual household. However, Marty (1975) finds that they remained the most important means by which herders gained access to animals after the 1973 drought for the group of pastoralists surveyed in north-east Mali.

3.15 Theft or raiding of stock is an alternative means by which an individual herder or group of pastoralists can make good their losses relatively quickly. In the past, this was probably a much more frequent means by which people could expand their herd numbers, but is of much less importance today' except perhaps in remote border areas where control by the government is weak.

3.16 The fifth option open to herders is to try to raise productivity levels of existing stock, so that herd numbers increase more rapidly and/or a higher level of offtake can be maintained without running down herd capital. For example, herders can acquire access to inputs - medicines, supplementary fodder with which to reduce mortality rates, increase milk production or raise fertility. However these inputs are often expensive and in very short supply. Herders who have recently suffered heavy stock losses are unlikely to be able to finance the purchase of such inputs on a significant scale. Alternatively, herders can change management practices to raise herd performance, for example by reducing milk offtake to raise calf growth and survival rates, by adapting circuits of transhumance and by devoting more time and attention to their livestock. However, as noted above, herders face pressures in the opposite direction following a drought. With few breeding cows left, the herder may have to raise milk offtake to feed his family. With the outflow of labour, a shortage of herding labour acts as a constraint on the pursuit of more efficient herd management practices, such as herd division and transhumance to salt deposits.

The effectiveness of herders' options

3.17. It is debatable how effective are the strategies pursued by herders in the post-drought period in significantly increasing the speed at which the individual herder can regain his former herd numbers. Individual case-studies are presented by a number of researchers but little can be concluded from these except at the anecdotal level. However, a comparison of two studies among the pastoral Fulani of Niger in the 1980s and twenty years earlier does suggest certain factors which have reduced the effectiveness of herders' strategies over the past few decades.

3.18 White's study (1984) notes that WodaaBe herders have faced severe constraints since the drought of 1973 because their herd size has fallen below the minimum for household viability. As a result of this, herders are forced to sell many of their animals at a very young age and must sometimes sell breeding stock in order to finance grain purchases. Herders also take on entrusted

cattle from sedentary livestock-owners to supplement their incomes. However, the presence of these animals in their herd constrains the pattern of transhumance they can follow, as the owners of entrusted stock do not want their animals to be taken far from their control and supervision. This constrained transhumance limits herd productivity.

In addition to these factors, the outflow of migrant labour in the dry season further reduces the efficiency of herd management techniques and contributes to the persistence of the household in a vicious circle, in which it is unable to reestablish a herd of sufficient size to become fully self-supporting,

3.19 Dupire's work (1872) among the Fulani of Niger in the 1950 and 60s presents a picture of greater flexibility, with many households following a cycle of loss and subsequent rehabilitation' by their temporary settlement in agriculture and the gradual re-building of herds using small stock. The difference between the situation described by the two writers is probably attributable to several factors: (i) the relatively favourable climatic conditions over much of West Africa in the 1950s and 60s, in contrast to the period after 1970; (ii) the exceptional severity of the 1968–73 drought in terms of livestock losses in contrast to less devastating droughts of previous decades; (iii) the growth in human and livestock populations over the past twenty years which has put heavy pressure on available pasture resources; and (iv) the growing involvement of non-pastoral producers in the livestock sector which has led to rising livestock prices and increased competition for the use of grazing and water resources.

3.20 Post-drought recovery by herders will be accelerated where the fall in livestock numbers allows a favourable balance to be restored between available grazing and animal fodder needs. However, while very heavy animal losses provide good conditions for those with some surviving stock, they make rehabilitation more difficult for those who have lost their entire herd. Herders in the latter situation will face high livestock prices, especially for breeding stock, relative to the other commodities available to them, such as their labour power, grain, etc. The pursuit of supplementary incomes by pastoral household with some surviving stock can have both positive and negative effects on the speed of herd reconstitution. On the one hand, diversion of labour from managing the herd reduces the level of herd productivity. On the other hand, the receipt of income from elsewhere reduces the pressure of demand from the pastoral household on available milk supplies and on animals to be sold to finance cereal purchases. With calves receiving more milk, calf mortality will be lower and calf growth to maturity faster, leading to a higher overall level of herd growth and productivity.

Rehabilitation of the farm sector in the absence of outside intervention

3.21 An earlier section summarised the likely effects of drought on livestock productivity and holdings within farming areas. It focussed on the consequences of draft animal losses for crop production in the years following drought, due to the weakness or death of some animals and to the distress sales of others by farmers needing to get cash to buy grain. Diagram 3.3 presents a schematic picture of the different lengths of time required for rehabilitation of farming areas, according to the level of draft animal loss experienced. The modelling of the farming sector's rehabilitation after drought is of greater complexity than that of herd development over time. This is because the significance of draft losses will depend on the nature of the farming system

and the effectiveness of different options pursued by farmers in order to maintain crop output. In order to assess the likely fall in crop output due to work oxen losses, questions such as the following must be answered:

- i. What proportion of land is normally ploughed and weeded by oxen?
- ii. how much time is available for land preparation before sowing?
- iii. what effect is there on yields from late sowing, from sowing on unploughed land or from weeding by hand rather than by plough?
- iv. can land be prepared by hand and, if so, what is the area that can be dealt with?
- v. what proportion of households have the necessary animals and equipment for their own ploughteam and thus what slack is there in the system for ploughing using borrowed or shared animals?

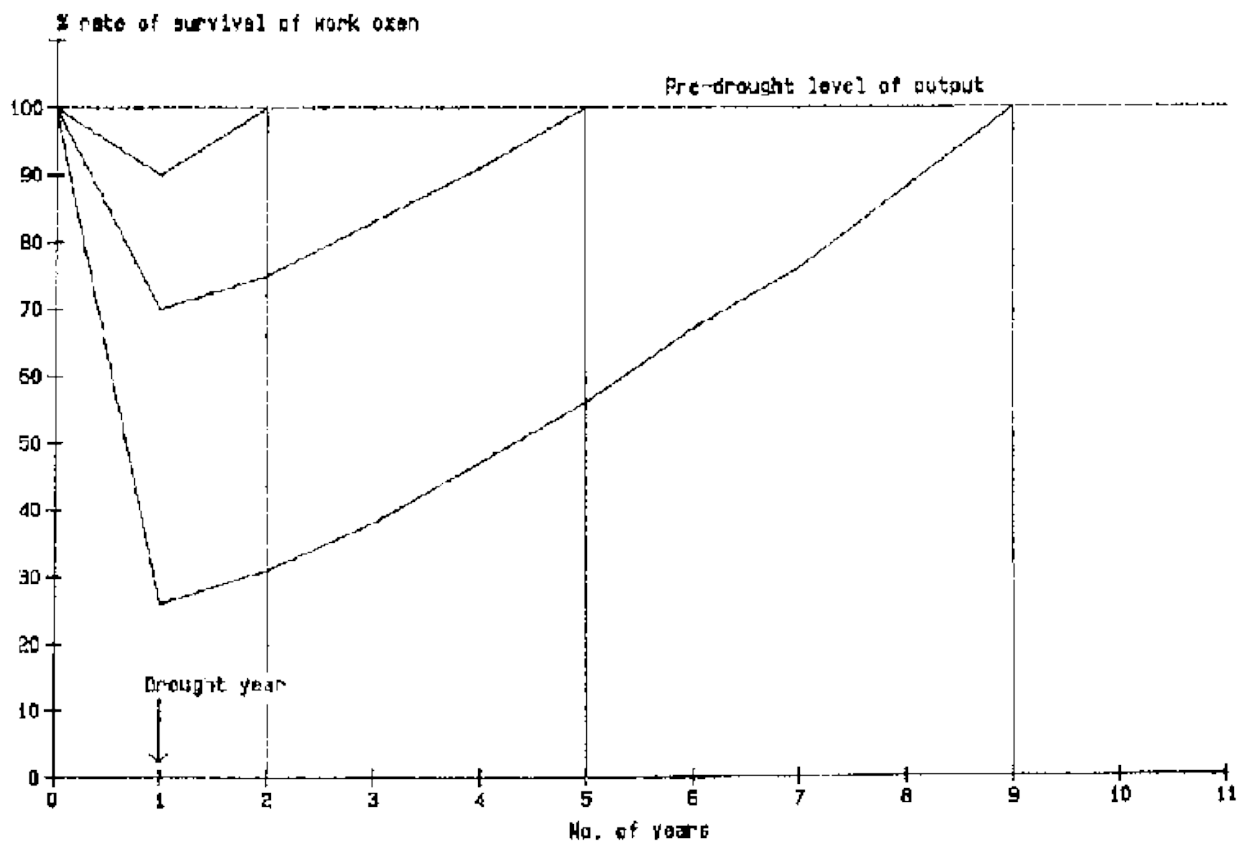


Diagram 3.3. rehabilitation of farm output after drought losses of work oxen: the time pattern for recovery after varying levels of loss

Table 3.3. Draft animal population: Ethiopia, Botswana and Mali, (thousands of head).

Country	Work oxen	Horses and donkeys	Total cattle
Ethiopia	5,670	5,465	26,300

Botswana	420	167	2,818
Mali	400	575	5,400
Sources: Ethiopia (FAO Production Yearbook, 1983) Botswana (FAO, 1984a) Mali (FAO, 1985b)			

3.22 The three countries looked at in this paper - Ethiopia, Botswana and Mali - all depend to a greater or lesser extent on work oxen for their draft power requirements. The draft animal populations of each country are shown below in Table 3.3. Ethiopia has an ancient heritage of plough cultivation going back for more than 1,000 years; in the case of Botswana, plough technology was brought in during the late nineteenth century, for Mali, ploughs have only become of importance in the last 20 to 30 years, the number of farmers using this technology increasing by an estimated 9 to 10% per annum over the last decade (Delgado, 1980).

3.23 Soils vary considerably between the three countries, the Sahelian and savanna soils of Mali being far lighter than those of highland Ethiopia and of Botswana, where heavier clays and vertisols are found. In the case of Ethiopia, soils must often be worked 4 to 6 times to achieve a fine enough seedbed for the traditional crop of teff, in contrast to the rapid ridging of sand soils done by many farmers in Mali. The total volume and timing of rainfall also vary very considerably within and between each country. For highland areas of Ethiopia the short rains of February to April provide the opportunity for much land preparation to take place before fields are sown in June when the main rains begin. In arable areas of Botswana and in the more northerly farming zones of Mali, time available for land preparation before sowing is much more limited and working of the soil is often minimal as a result. Part of the millet crop may even be sown on unploughed land in order to maximise the plant's growing period, although the subsequent weeding problems are severe.

3.24 Given the above factors and their varying importance between farming regions, one would expect the consequences of work oxen losses to vary considerably according to the characteristics of the farming system involved.

Farmers options

3.25 There are a number of options which farmers can pursue to restore levels of crop production and holdings of draft animals: the share or loan of draft animals between households, use of other stock for pulling the plough, hand cultivation of soils, hire of tractor services, changes in crop composition, purchases of fertiliser, supplementation of remaining stock, turning to income earned elsewhere or waiting for livestock holdings to re-grow. Each of these is discussed below.

3.26. Sharing or loans of work oxen from other households. Where oxen losses have been relatively slight, farmers may be able to borrow a single animal or plough team from another household. Such loans are common in many farming systems, loans being repaid on a variety of terms often involving the exchange of several days hand labour against each plough team day

borrowed (see Vierich and Sheppard, 1980 for Botswana; Fulton and Toulmin, 1982 for Mali). Alternatively, two households with A single ox each can arrange to take turns in using the oxen pair, as described by Gryseels and Anderson (1983) for Ethiopia. With very heavy work oxen losses in a particular region, loans are likely to be less easy to arrange for those having lost their own animals. For the case of Botswana, a recent survey notes that there may be considerable reserve capacity in the availability of draft animal power in normal times, so that minor losses, of say 20%, have little effect on the overall area cultivated. More extensive sharing of draft power takes place and animals can be worked more intensively in order to maintain total output at expected levels.

3.27 Use of other animals for draft. If losses of oxen have been high, a farmer can continue to cultivate his land using other animals for the ploughteam, such as milk cows, horses, donkeys or camels. These animals will have a lower productivity in work but will partially compensate for the loss of trained oxen. In extreme cases, even human labour has been known to be used for pulling the plough for example in the period following the great rinderpest epidemic in Ethiopia in the 1890s when an estimated 90% of the country's draft oxen were lost (Wolde Mariam, 1984). However, if work oxen holdings have been badly affected by drought, it is likely that other stock will also have either suffered high mortality or have been sold to purchase food grains.

3.28 Hand cultivation. In the absence of draft power, farmers may be able to cultivate part of their land by means of hand tools. However, this will be at the cost of lower crop output, due to the smaller area cultivated and the less effective tillage that can be achieved by hand as against plough techniques. Estimates of the land area which can be cultivated by hand vary from 10 to 50% of that which can be managed by a plough team, depending on the nature of soils and time available for land preparation. Where weeding is usually done with a plough, resort to hand techniques will lead to lower yields from the less optimal timing of this operation.

3.29. Hire tractor services. This option is open only to those farmers with access to this service at a reasonable cost. Hiring a tractor tends to be more expensive than hire of a ploughteam for the same work and usually requires a cash outlay rather than repayment in labour or other services (Vierich and Sheppard, 1980). For this reason, farmers who find themselves without work oxen may also be without the funds to finance ploughing by tractor. Data from Botswana would suggest however that a considerable number of farmers resort to hire of tractors both in normal years and in times of drought, a survey done after the 1979 drought finding that while 1.7% of households in a given region owned tractors, 11% of households had ploughed their land by this means (Jones, 1980). Migrants' earnings were especially important in financing the hire of tractors by poor households.

3.30. Change in crop composition. Different crops vary in their tillage requirements. For example, in the case of Ethiopia, teff needs a finely-worked seedbed; in Mali, much of the millet crop may be sown on unploughed land whereas groundnuts require a prepared seedbed. Farmers can moderate the effects of work oxen loss by switching to less tillage-intensive crops, the possibilities for doing this depending on their access to seed, their family's consumption requirements and their marketing possibilities.

3.31. Fertiliser purchases. Farmers can reduce their shortfall in output arising from a decline in area cultivated by higher levels of fertiliser use leading to higher yields. The effectiveness of this option in maintaining total crop production depends on crop response to fertiliser use and the relative costs of purchase, transport and application of fertiliser. The adoption of a short term policy of heavy fertiliser use in the years immediately following drought may be a reasonable policy for governments to promote, as will be investigated later. Lack of cash available to the farmer in the post-drought period is the main constraint on this option being widely pursued in the absence of extensive government subsidies on the purchase and distribution of this input.

3.32. Supplement remaining animals. Where some livestock are still left to a farmer, their work capacity can be increased by giving them supplementary fodder. This fodder could come from crop by-products or natural pasture and browse—both likely to be in short supply following drought—or from purchases of locally available agro-industrial by-products, such as cotton-seed, molasses and bran. However, the latter are also likely to be heavily in demand in the last few months of the dry season, when oxen most need supplementation, as many livestock owners will be trying to carry their stock through to the next rainy season. Exports of these commodities will further raise their prices and restrict supplies. Work is currently in progress in Ethiopia and in several Sahelian states to develop supplementation programmes based on blocks made from a mixture of molasses and urea (FAO 1985 a,b,c). While urea must usually be imported, molasses are in abundant supply in many countries as a by-product of the sugar processing industry. These molasses blocks have the advantage of being relatively easy to transport and store, in contrast to molasses in their liquid form. However, the molasses-urea mix is not meant to be a substitute for other sources of fodder but rather to stimulate consumption of low quality roughages like natural hays and crop straw. Preliminary estimates within the Sahelian context put production and sales costs at 35-40 FCFA per kg, equivalent to US\$0.07-0.08 per kg (FAO 1985 a,b,c).

3.33. Earn income elsewhere to buy replacement oxen. Farm households may be able to finance the purchase of new stock by income earned from other sources. For example, migration earnings are a major source of income to many farming areas of southern Africa and the Sahel. Migration may either be seasonal or take the form of a male household member being away for a number of years, during which time cash remittances are sent back to the agricultural sector to purchase both food and farm inputs. The ease with which these earnings can be used to finance the purchase of new work animals depends on the relative value of remittances, the price of work oxen and the urgency of other calls upon cash income. In times of drought, urban labour markets experience a large number of job-seekers and real wage levels tend to be lower than at normal times. For this reason, the availability of migration earnings will be lower in the post-drought period and possibilities for acquiring the funds for oxen purchase more limited than in normal times. It also will be harder for farmers to reconstitute their holdings where both the arable and the livestock sectors of the economy have been simultaneously hit by drought losses. In this case, there will be heavy demand from both the farming community and the meat market for a limited supply of young male animals and prices will rise accordingly. Delgado (1980) noted in the case of Mali that farmers provide strong competition for young oxen with those involved in meat-fattening schemes, substantially constraining the availability of animals and the profits to be made from meat enterprises.

3.34. Wait for herd to regrow: For those households with their own breeding herd, the offspring of these animals can provide future working animals. In this case, the speed of recovery in work oxen numbers depends on the number of oxen required for ploughing, the size of the breeding herd and its rate of increase. Usually one would expect both work oxen and breeding herds to have been adversely affected by drought, although there may be circumstances in which households prefer to sell their oxen rather than lose their breeding herd. In such an event, the household must wait for a sufficient number of male calves to be born and brought to an age when they are ready to work, although in the intervening years some arrangement must be made to either plough by other means or to purchase food from elsewhere. Where some cattle must be sold to buy food on a regular basis, the household may never be able to reestablish itself as a viable farming unit and it will be faced by the prospect of increasing impoverishment (Vierich and Sheppard, 1980).

How long does it take the farming sector to recover?

3.35. Table 3.4 gives rough estimates of the likely length of time taken for the farming sector to recover from a range of drought-induced losses in the absence of outside intervention. The spread in the number of years given for each case results from the dependence of reconstitution speeds on a variety of factors discussed earlier. Reconstitution will be more rapid in the following circumstances:

- where sharing of animals provides a temporary means by which those without draft power can continue to cultivate their land;
- where the agricultural sector is sufficiently productive for farmers to have access to a regular surplus for investment and where the relative price of crops to oxen is in favour of the former, so that a good harvest may enable the farmer to replace his lost animals in a single year;
- where there are external sources of income available to members of the household which can be used to buy new animals and equipment and which can provide for the household's food needs in the intervening

Table 3.4 *Estimated time taken for recovery of farming sector after drought in the absence of outside intervention.*

Work oxen losses	Number of years
< 20%	0– 2
20 –40%	2 – 5
> 50%	5 –10

3.36 Conversely, rehabilitation speeds will be longer, the heavier are oxen losses, the greater the area affected by crop losses and livestock deaths and sales' and the higher the price of oxen relative to crop output and migration earnings.

3.37 Post-drought surveys provide some data on the evolution of harvests over subsequent years and on the time taken for crop production to get back to normal levels. However, there are often a number of factors affecting total harvest size in the post-drought period which makes it hard to assess the relative importance of work oxen losses as compared with other variables, such as lack of seed, rainfall levels, social and political dislocation, etc.

3.38 In the case of Ethiopia, data on crop output and areas cultivated is scarce for both the pre- and the post-1973 period. One source estimates a fall of 60% in arable land planted in the worst year of the drought in the regions of Wollo and Tigre (IBRD, 1979) due to shortages of work oxen and seed. Wolde Mariam (1984) cites a report showing that previous losses of work oxen accounted for between 44% and 87% of the cases in which land was not cultivated in 1973, seed shortages being mentioned as being of only secondary importance. Crop production figures suggest that 1974 saw a return to more normal levels of output at the national levels with the total crop harvest up by 14% over the previous year (IBRD, 1980). However, these figures must be treated with care because they are based on a slender sampling frame and apply to national production rather than being limited to the most drought-affected provinces. In subsequent years' additional factors such as land reform and political instability have themselves contributed substantially to the difficulties faced in assessing changes in farm output in the drought-prone areas of Wollo and Tigre.

3.39. For Botswana, harvests in the post-drought years of the late 1960s show very high variability, attributable to continued fluctuations in rainfall. While figures on total areas cultivated are not available, those on total output suggest that the farm sector was not operating at normal levels of output until 1971 (Jones, 1979). The drought year of 1978/79 in Botswana saw an estimated 60% fall in area cultivated in one region surveyed, caused by the poor condition of work oxen and the poor timing of rainfall at the start of the farming season. However, the following farming season appears to have seen an increase in area cultivated above normal levels, farmers having an incentive to increase their field size, given shortages in food supplies (Jones, 1980). This increase in area was made possible by the relatively low losses (10–15%) suffered among draft animals and the extensive systems for loaning draft power between households.

3.40 In the case of the Sahel, no material is available on the speed with which areas cultivated returned to normal after the drought of 1968–73. However, grain production figures would suggest that harvests were back to pre-drought levels in 1974 which would imply no significant adverse impact on farm productive capacity as a result of the drought. This may be explained by the relatively low losses of harvests and livestock in most farming areas, so that area farmed and output could return rapidly to normal once rainfall conditions improved. It may also be the case that producers were able to minimise the consequences of drought-induced crop losses with the help of migration earnings and systems for help and redistribution within peasant society thus avoiding sales of work oxen. By contrast, recent material from north west Mali would suggest a fall in area cultivated of between 30 and 50% in 1984, due to heavy losses among draught animals the previous year (FAO, 1984c).

Chapter 4 Comparing the impact of policy measures

4.01. Tables 4.1 to 4.7 present a comparison of alternative policy instruments aimed at restoring various aspects of livestock production and use. They analyse policy measures applicable in each area of concern and show their relative impact on different sectors of the economy in the short term.

4.02 The government budget: refers to changes in government revenue and expenditure as a result of implementing a particular change in policy. Most changes involve expenditure in one form or another, through, for example, provision of subsidies or financing credit to producers. Against this increase in expenditure should be set (a) the possible receipt of finance for some of these policies from external agencies (b) the cost to government budgets from not acting, e.g. the continued provision of relief supplies to affected populations unable to reconstitute their capital and income, (c) the longer term benefits in the form of increased revenue-from reestablishing the viability of livestock and farming sectors.

4.03. Producers are divided into those of livestock and of grain. This is in order to identify the effects of changes in relative prices and levels of demand for the two products. There is evidently considerable heterogeneity within each group of producers which this distinction overlooks, for example in terms of herd size, herd management objectives and access to resources. Similarly, grain producers are not a homogenous body, some farmers producing a regular surplus while others must buy a part of their grain needs in most years. In addition, many producers are involved in both areas of activity, pastoralists growing some grain and farmers holding livestock assets.

4.04. Consumers: High income consumers are predominantly urban, purchasing above-average quantities of meat, predominantly beef. They are usually politically powerful group on whom governments depend for their support. This implies that governments will aim to avoid adverse changes in their welfare. Low income consumers are composed of the urban poor and the vast majority of the rural population. Their consumption of beef is relatively low and they depend instead on cheaper sources of meat - small stock, poultry - and other forms of protein - eg dried fish. Grains form a major part of their diet and of their expenditure; consequently, a large rise in the price of cereals will adversely affect the welfare of their group of consumers. While they represent a politically less powerful group, less influential and with poorer organisation and contacts than the high income group, the urban poor can occasionally wield great political power. Several governments have avoided or reversed cereal price rises following the threat of urban riots over the escalating price of food. Considerations of equity would imply the pursuit of policies in the interests of low as opposed to high income consumers.

4.05. External trade: This item measures the net expected changes in the flow of imports and exports as a result of each policy being carried out. Some measures will have a substantial foreign exchange cost, such as the diversion of animal feed from export to domestic use, imports

of grain and meat, etc. As in the case of the government budget, external funding may be available to carry out some of these activities, thereby reducing the overall foreign exchange cost.

4.06. Discussion of Tables 4.1–4.7: These tables present the short term impact of various policy instruments on different sectors of the economy, the nature of the impact noted as being positive (+), negative (–) or neutral (0). The tables consider only the likely effects in the short term and thus ignore the longer term repercussions of different measures. For example, a ban on the export of female stock will reduce foreign exchange earnings in the short run. Over a period of years, however, this ban may promote faster reconstitution of herds and a more rapid return to pre-drought levels of livestock exports.

4.07. The impact of a particular policy instrument will be strongly affected by the structure of marketing and prices. For example, the effect on external trade from raising farm prices will depend on whether these farm products are exported, whether price increases paid to farmers are passed on in higher export prices (or absorbed by marketing boards) and, if the former, on the elasticity of demand in world markets for this export commodity. The overall size of the impact will often depend on the relative sizes of gains and losses. For example, some policies such as the lifting of direct taxes on livestock will involve a loss of revenue to governments on the one hand. On the other hand, there may be some fall in administrative costs as a result of the tax being lifted.

Table 4.1. *Assessing the impact of alternative policy instruments on the economy. Aim of policy—to reconstitute livestock capital.*

Affected sectors	Policy instruments used				
	Credit for herders to buy stock	Agency buys animals for redistribution	Ban export of females	Ban slaughter of females	Raise livestock prices paid by government
Government budget	–	–	–	–	–
Producers:					
Livestock	++	++	–	–	–
Grain	+/0	+/0	0	0	0
Consumers:					
High income	–	–	+	–	–
Low income	–	–	+	–	–
External trade	–	–	–	+	–

Table 4.2. *Assessing the impact of alternative policy instruments on the economy. Aim of policy—to reduce pressure on herder incomes.*

Affected sectors	Policy instruments used			
	Reduce livestock taxes	Subsidise grain to herders	Subsidise dried milk distribution to herders	Develop non-pastoral income sources
Government budget	–	--	--	--
Producers:				
Livestock	++	++	++	++
Grain	+/0	–	0	0/–
Consumers:				
High income	–	–	–	0
Low income	–	–	–	0
External trade	–	–	–	0/–

Table 4.3. *Assessing the impact of alternative policy instruments on the economy. Aim of policy—to raise the productivity of the livestock sector.*

Affected sectors	Policy instruments used		
	Subsidise distribution of supplementary feed to pastoral areas	Subsidise distribution of supplementary feed to fattening schemes	Animal health programme
Government budget	--	--	--
Producers:			
Livestock	++	++	++
Grain	0/-	0/-	+/0
Consumers:			
High income	0	+	0
Low income	0	+	0
External trade	--	--	--

Table 4.4. *Assessing the impact of alternative policy instruments on the economy. Aim of policy—to reconstitute farmer's ploughing capacity.*

Affected sectors:	Policy instruments used					
	Farmer loans for oxen purchase	Purchase oxen, feed and distribute	Tractor pool run by government	Farming loans for tractor hire	Subsidise fodder for oxen	Subsidise fertiliser and hand tools
Government budget	--	--	--	--	--	--
Producers:						
Livestock	+	+	0	0	0/-	0
Grain	++	++	++	++	++	++
Consumers:						

High income	0-	0/-	0	0	0	0
Low income	+	+	+	+	+	+
External trade	-	-	--	-	--	--

Table 4.5. *Assessing the impact of alternative policy instruments on the economy. Aim of policy—to reduce pressure on farmer's incomes.*

Affected sectors	Policy Instruments Used		
	Reduce land tax and poll tax	Raise farm prices paid by government	Minimise constraints on wage-employment, flows of migrant labour, etc.
Government budget	--	--	+/0
Producers:			
Livestock	+/0	-	+/0
Grain	++	++	++
Consumers:			
High income	0	-	0
Low income	0/-	--	0
External trade	0/-	+/-	+

Table 4.6. *Assessing the impact of alternative policy instruments on the economy. Aim of policy—to promote the export of livestock.*

Affected sectors	Policy instruments used			
	Subsidise exports of livestock	Reduce taxes and other export costs	Increase taxes on domestic meat consumption	Impose direct controls sectors on domestic consumption rationing, etc.
Government budget	--	--	++	--
Producers:				
Livestock	++	++	--	--
Grain	0	0	0	0
Consumers:				
High income	-	-	-	-
Low income	-	-	-	-
External trade	++	++	-++	++

Table 4.7. *Assessing the impact of alternative policy instruments on the economy. Aim of policy—to favour the domestic meat market.*

Affected sectors	Policy instruments used				
	Lower taxes on domestic slaughters and market	Subsidise domestic consumers prices	Ban the export of stock	Raise export taxes	Subsidise imports of meat
Government Budget	--	--	--	++	--
Producers:					
Livestock	++	++	--	--	--
Grain	0	0	0	0	0
Consumers:					
High income	++	++	++	+	++
Low income	+	+	+	+	-
External trade	--	--	--	--	--

4.08. A number of conclusions can be drawn from Tables 4.1–4.7 with respect to the cost and effectiveness of the different policies considered.

4.09. *There is usually a variety of policy measures open to governments to achieve a desired aim or objective.* These are not necessarily alternatives to each other but may be used in combination. For example, pressure on herders' incomes can be reduced by a mixture of policies including the abolition of livestock taxes, provision of cheap grain supplies and the development of supplementary income sources.

4.10. *Policies aiming at a single objective differ considerably in their distributional impact,* depending on the policy instrument used and the course by which it achieves its effect. For example, the promotion of livestock exports may be achieved either by offering relative higher returns to producers and traders in export markets, or by imposing a mixture of taxes and controls on domestic sales and slaughters. In the latter case, producers will suffer a net income loss, since the flow of livestock through markets is directed by fiat rather than by providing price incentives.

4.11. *Policies vary in the size of their spill-over effects into other parts of the economy.* Some policies achieve their objectives fairly precisely, with the minimum of side-effects, while others cause a range of changes in other factor and product markets.

Spill-over should be kept to a minimum, since they cause unintended changes in relative price levels and incentives affecting the efficiency of resource use in other areas. However, in some cases the government may have little choice but to adopt a broad-based policy with considerable spill overs where it lacks the administrative infrastructure to pursue a more precisely focussed policy. Table 4.8 shows, for the achievement of particular objectives, how policies can vary in their specificity and degree of spill-over.

Table 4.8. Targeting of Policies and Size of Spill-over Effects.

	Example 1) Promotion of Livestock Exports.	Example 2) Help to Reconstitute Holdings of Particular Herders
Well-targeted policies	Specific subsidies on livestock exports.	Distribute livestock to particular herders, on credit, subsidised prices or free.
	Reduce taxes and costs of exporting livestock, such as-improvements to transport.	Promote small stock, such as specific health programmes for reducing high mortality among kids.
Increasing spill-over effects	Control number of domestic slaughters' meat rationing. Increase tax on domestic consumption of meat leading to consumer price rises and a fall in demand.	Provide subsidised inputs to certain class of herder, for example by reducing pressure on incomes of smallest herd-owners by differential taxes' subsidised grain, milk powder. Ban on export and slaughter of females. Maintain high government buying price for stock.
		General livestock health measures. Develop non-pastoral income sources in most seriously affected areas.
Less specific policies	General subsidies on the exports of all commodities. Exchange rate measures to increase earnings from exports.	Reduce livestock tax on all herd owners. Reduce pressure on the incomes of all herd-owners by subsidies on inputs, grain, fodder.
	General tax increase for domestic consumers, reduction in government paid salaries.	Ban on the export of all stock.

4.12. There is a wide range in the administrative costs of policy implementation, there being in general a trade-off between the precision attainable and the cost of achieving this. For example, it could be argued that livestock tax relief should go to herders with the smallest number of stock, tax being levied once herd numbers rise above a certain level, this graduated schedule providing relief only to those most in need. However, the assessment and collection of livestock tax is sufficiently problematic in many countries already, without additional demands being made on administrative staff to verify actual ownership of livestock in the close detail which

would be required for the introduction of such a policy measure. Similarly, in designing a credit programme to aid farmers who have lost their work oxen, a decision must be made about how much time to spend, on the selection and screening of applicants for loans. While a tighter procedure might ensure a lower degree of fraud, it also places a greater strain on limited administrative resources and hampers the speed at which reconstitution of holdings can take place. Some degree of fraud may be acceptable in order to achieve a rapid disbursement of funds where speed is a crucial actor in the success of a policy. This would be particularly the case where, for example, work oxen must be distributed before the start of the farming season in order to ensure a timely preparation and sowing of fields.

4.13. The probability of receiving external funding will differ between policy measures. Many donors will be more willing to fund direct interventions in farm and livestock production than in provision of general financial support to the government's budget.

4.14. Policies differ in terms of their timing, the speed with which they can be implemented and the time period over which their impact is intended. Certain actions can be taken immediately, such as the abolition of taxes on livestock, land, slaughters, etc. Others will take much longer to implement, requiring the setting in place of administrative structure, for example to control the movement and prices of livestock or to establish a system for the distribution of subsidised animal feed. Policies which build up productive capacity on a permanent basis are to be preferred to those which provide inputs over a limited period. For example, when helping farmers to reconstitute their work oxen holdings, funds may be used to enable them to purchase new animals or to hire draft power (work oxen or tractors) from elsewhere. The latter policy evidently does not provide the farmer with permanent access to draft power; it may however be a useful complement to a work oxen credit programme where, due to limited numbers of oxen available for distribution immediately, considerable demand for draft power remains unsatisfied. Over time, as an increasing supply of oxen becomes available, the tractor hire scheme can be phased out.

4.15. A comparison of policy options should include an explicit assessment of the cost of not taking action in a particular field. In the cases looked at here, the costs of inaction are composed of an extension of the period with below average production in livestock and farming sectors, leading to reduced opportunities for income and employment for part of the population who must as a result depend on others for support (from the state, famine relief agencies, kinship links, etc), a reduced taxable base, lower export earnings and higher domestic prices for output from drought-affected sectors of the economy. The financial, economic and social costs- of inaction are high. However, as recent experience in several drought-affected African countries has shown, it may be relatively easier for the government to get funding for the provision of food relief than it is for longer term development programmes.

4.16 The above points illustrate the different characteristics of policy measures aimed at restoring the performance of drought-affected sectors of production, in terms of their costs, spill-overs and distributional impact. Particular governments will be faced by additional constraints on the choices to be made among possible policies; these constraints are imposed by limited resources, poor marketing and administrative infrastructures leading to weak control by government of trade flows within the country and to foreign markets, weak institutional

development at the level of producer organizations and political constraints imposed by the need to act in the interests of certain groups.

4.17. Resource constraints, almost all policies require the direct allocation of funds for their implementation and many of the policies investigated in Tables 4.1 - 4.7 are costly in administrative and material resources. By contrast, inaction makes no immediate demands on the government budget; however, its long term cost may be much greater in terms of foregone output, incomes and foreign earnings. In all poor countries, there will be a high opportunity cost to the use of most resources. Foreign exchange is usually in especially short supply. Thus, policy measures which rely on using exportable commodities (such as agro-industrial by-products) or on importing inputs (such as machinery, fuel and spare parts for a tractor hire scheme) must be looked at with particular care. Foreign exchange limitations are relaxed where part of the finance required is available through grants in aid from external agencies.

4.18. Marketing and administrative structures. Several of the policy options outlined in Tables 4.1- 4.7 involve government intervention in controlling trade, prices and the imposition of taxes and subsidies. This presupposes a structure through which governments are able to act effectively at little extra cost. In practice, in few countries do governments have the required degree of control in these fields to carry out such policies. Thus, for example, it is estimated that controlled exports make up only a small proportion of total livestock exports both from Ethiopia and from many Sahelian countries. This is due to long frontiers which are impossible to police effectively except at very great cost. By contrast, Botswana meat exports - are channelled entirely through the Botswana Meat Commission official exporting body and this is made possible by the high prices paid to producers by the BMC. On the hoof exports of stock across the frontier to neighbouring states are of negligible importance. Control over domestic slaughters is less complete as many of these take place in rural areas. Prospects for policies aimed at redirecting livestock flows between export and domestic markets are far greater for a country like Botswana, where movement within the country is also tightly controlled, due to the need for careful monitoring of livestock quarantine regulations to comply with the import standards of the European Community. Some countries have tried to set up parastatal bodies to enable governments to have more control over livestock marketing but attempts by government to impose tighter controls on domestic slaughters or exports of stock have often had little or no effect. Instead such policies tend to drive a higher share of the market into the uncontrolled sector. Thus, Stryker (1974) reckons that attempts to intervene in the Malian livestock market, over the period 1960-68, were largely nullified by the ability of merchants to displace their activity to other locations. Similarly, the short-term export ban on various categories of stock from many Sahelian states after the drought of 1973, while it led to a dramatic fall in controlled exports, probably caused a substantial increase in the number of exports passing through illegal channels.

4.19. Level of institutional development at the producer level. The structure of livestock production differs between countries, in the case of Botswana, 15% of the cattle are held by large commercial farmers and 85% by smaller herd owners in the communal areas. In Ethiopia, the traditional farming sector accounts for about 70% of the country's cattle population, most of the rest being held in rangeland areas while State Farms are of significance in some areas. In most Sahelian states, livestock are in the hands both of pastoralists and farmers' although an increasing

proportion of animals are thought to be held by non-traditional producers (traders, civil servants, etc.) who invest in cattle as one asset within a wider portfolio of investments. Different patterns of ownership imply differing herd management objectives and supply responses to changing market conditions. The structure of production, mean herd size and the extent of producer organisation affect both the options open to government to intervene successfully in this sector and the extent to which producers can themselves lobby for their own interests. A network of herder co-operatives, for example, provides a framework within which credit and other inputs can be channelled to herd owners. In their absence, active intervention in the livestock sector becomes much more administratively costly as systems for selection, allocation and distribution of resources must be established. For this reason, several development agencies working in the Sahel have made it an explicit component of their project work to set up some institutional structure that can act not only as the vehicle for current intervention, but also for evolving systems of communal resource management.

4.20. Political constraints. All governments depend on particular groups for their support, for example the army, the middle classes or producers of commodities critically important to the performance of the economy. Almost all policies are likely to affect the distribution of welfare within society' whether it be by changes in relative prices or by changes in employment and income prospects for certain groups of workers. On the whole, the power of the urban professional class has tended to ensure that priority is given to the level of food prices in urban markets. For this reason, governments have been unwilling to adopt policies which might lead to domestic shortages of key commodities, such as grains and meat.

Chapter 5 Examples of policy interventions

5.01 This chapter takes three examples of rehabilitation policies pursued by governments and development agencies in order to examine in more detail questions of cost and return and the particular implementation problems involved in each case. The three policies examined here are: the reconstitution of pastoral herds, rehabilitation of farmers' draft power; and livestock supplementation- aimed at raising levels of productivity. There is a certain amount of project experience in each of these fields and material will be taken from a variety of sources in order to discuss the main issues involved.

Herd reconstitution

5.02. The 9 schemes looked at here, and summarised in Table 5.1 all involve the distribution of loans or animals to herders to partially restore their livestock capital and to provide them with' income. In almost all cases, the credit scheme has followed a period of heavy losses among stock, badly affecting certain areas and groups within a country. Several projects were specifically designed for former pastoralists who had become totally destitute and remained in famine relief camps once other people had departed. In all but one case, that of Oxfam-Kenya, livestock were intended to be distributed on credit rather than being a gift but repayment performance has often been poor, aggravated in many cases by continuing drought. For all but Oxfam-Kenya, relatively few animals were distributed per household, the stock being intended to supplement other sources of income and to provide a nucleus for herd growth rather than to be the primary source of support for the household.

5.03. Several important points emerge from a comparison of these schemes which relate to (i) the scale of the operation, (ii) the institutional framework within which it is carried out and (iii) the alternatives available to governments, agencies and populations if a herd reconstitution programme is not carried out.

5.04. Choice of scale: This must involve consideration of the number of people a scheme is aimed to help and the number of animals to be distributed per household. The aim of reconstitution schemes can be either to give an additional source of income to those in need or to provide for the total reestablishment of a certain number of households.

Table 5.1. Herd reconstitution: A comparison of alternatives.

Scheme	Number of animals allocated/household and species mix	Average cost/household and no of households	Framework of scheme
Tin Aicha, NE Mali	1-3 cows, 1-3 sheep, depending on size of household	US\$165 for around 200 households	Part of settlement scheme involving destitute nomads: farming, schools health, etc.
Relance du mouvement Cooperati NE Mali	5-10 small stock, largely goats	US\$75 for 5,000 house-holds	Part of programme to re-establish co-operative movement among herders, setting Up grain reserves, irrigated gardening etc.
Oxfam, Gourma,	20-30 small stock plus small cash reserve for grain purchases	US\$450 for. 45 households	Part of wider project to establish herders' associations
Government of Niger	Average of 1 cow, 1 sheep, 2 goats	Average of US\$140 per household	Herd reconstitution scheme funded through Caisse Nationale de Credit Agricole
Oxfam-Habbanaae, Niger	2-3 cattle plus some smallstock and transport animals	US\$150-160 for 300 households	Project for destitute herders
USAID, Niger	1-2 cattle per household	US\$75-150 per household for 200 pilot	Part of Niger Range and livestock Project, including setting up co-operatives general credit fund, etc.
UNHCR, SE Ethiopia	1 cow, 1 donkey, 2-3 sheep and goats	No data	Re-settle refugee Somalis
LMB, NE Ethiopia	2 cows, 2 camels, 12 sheep and 15 goats proposed	US\$300 for 5,000 households	Re-distribute post-drought livestock population between regions, help destitute
Oxfam Kenya	50-80 small stock' pack animals and domestic equipment and grain	US\$1200-1300 per household	Pilot project for more extensive project 1985/86

Sources: Tin Aicha, NE Mali- AFSC, 1982; Relance du Mouvement Cooperatif NE Mali - Marty, 1975; Nieuwekerk et al, 1983; Oxfam, Gourma, Mali - Mike Winter, personal communication of initial developments; Oxfam, Habbanaae, Niger - Oxfam, n.d.; Harmaworth, 1984; Scott and Gormley, 1980; USAID, Niger - Swift and Maliki, 1984; UNHCR, SE Ethiopia; LMB, NE Ethiopia—LMB, 1974; Oxfam, Kenya— Hogg 1985; Government of Niger- Rep. du Niger. 1985.

5.05. One constraint on choice of scale is imposed by the total number of affected persons. Where a very large number of herders have been badly hit by drought, a choice must be made between distributing a small number of stock over a large area and the complete reconstitution of herds for a few households. Most projects have opted for the former policy basing their decision on the desire to have an impact, albeit low, on a large population. Those households receiving a few animals must continue to pursue a wide range of income-earning activities' a strategy which will be easier for larger extended family groups than for smaller households. Thus, a survey of Tin Aicha village, in north east Mali several years after the initial distribution of livestock to households found that those who had built up a successful mixture of activities were those with sufficient labour, so that some members could be allocated to pasturing animals, some to cultivating the family's fields and some to engage in trade. Small households with very few members were not able to easily combine the demands of managing a few animals in addition to looking after their fields and as a result the animals they had received in the initial distribution had not flourished so well (AFSC, 1982).

5.06. The continued pursuit of a variety of activities by the household may be the best means by which to protect overall income from the risks attached to a particular sector. There may be a certain price to be paid in terms of lower productivity in each sector when these activities are combined in the same household enterprise than were they to be pursued individually. For examples herders who combine farming with looking after their herds experience lower levels of productivity in both livestock and crop production than if either had been pursued as a single activity, unconstrained by the labour demands of the other. However, the benefit of combining these different sources of income may be considerable in terms of reducing the risk to household income from dependence on one source of income alone.

5.07. Thus, in planning a herd reconstitution project, account needs to be taken firstly of the extent to which other income-earning activities are available and could be encouraged to provide the household with a mixed livestock farming-trade based enterprise. Where such mixed strategies are not possible, or only at great cost due to environmental conditions, it may be better to provide a viable herd for a limited number of households and to aid the rest of the population to move and re-establish themselves elsewhere. Secondly, in those areas where herding is one among a number of possible options, a variety of distribution strategies could be considered, although these would present certain problems for the selection of recipients. For example, the largest households could be given a small number of stock, since these domestic units are best able to deploy their labour among a variety of different income-earning activities while small households would receive a herd large enough to provide a viable source of subsistence and income so that the family's management of the herd need not be constrained by the pursuit of incomes from other sectors.

5.08. Another constraint on the choice of scale is imposed by the local availability of livestock for distribution and pasture conditions. Where all herds have been gravely affected by drought losses, few animals will remain in the local region which are available for purchase and redistribution. However, stock may be available after a lesser drought in the hands of both herders and of livestock investors (farmers, traders) who were able to acquire animals during the drought, due to relative price movements of livestock and grain. Where livestock are bought locally, there is no increase in overall stocking rates, the existing animal population being redistributed among producers. If stock are bought from distressed herders, forced to sell animals due to an unviable herd size, the project could consider purchasing animals for loaning back to their former owners, as was done in the Habbanaae scheme in Niger (Oxfam-America, n.d). The alternative is to buy stock from better-off livestock-owners, who benefit from the high post-drought prices of livestock in general and of breeding females in particular. While the spread of benefits to the better-off is of questionable merit in a post-drought rehabilitation scheme, there may be few alternative means to acquire the stock needed to carry out the programme. The number of stock available locally will determine the level of prices which must be paid. If there are few animals for purchase within a given area, the project must consider the possibility of buying significant numbers from less-affected regions where prices will be lower.

5.09. The advisability of bringing in livestock from outside the region depends greatly on the speed of pasture recovery after drought and on the suitability of livestock coming from a different area and possibly a different ecological zone. If livestock losses have been very heavy and rainfall returns to normal levels in the post-drought period, some pastoral areas will find themselves with insufficient stock to make use of available grazing. This represents a waste of resources and a loss in potential milk, meat and herd growth of particular significance if livestock are kept under less favourable grazing conditions in other parts of the country. There are strong arguments in favour of herd reconstitution programmes in such circumstances that involve the movement of livestock from more to less crowded areas through a restocking scheme, such as that pursued by the Livestock and Meat Board in Ethiopia in the post-1974 period (LMB, 1974). Moving livestock from one region to another will not be advisable where (a) such stock are not suited to the ecological conditions in the area to be re-stocked; for example, the Tin Aicha scheme in north-east Mali found that many of the sheep and cattle bought in markets further to the south could not survive the extremely arid conditions found at the project site (AFSC, 1982); and (b) where the effects of a prolonged drought on pastures has been so severe that a few years should be allowed to elapse before encouraging a substantial growth in herd numbers.

5.10. The costs per household of alternative schemes are compared in column 3 of Table 5.1. From this may be seen the great variation between projects, ranging from a low of US\$ 75–100 per household to over US\$1,200 for the Oxfam-Kenya project. The schemes with a low cost per household involve the transfer of relatively few stock, such as 1 or 2 cattle and/or several small stock. These are obviously insufficient to enable households to become fully self-sufficient and the future of such small holdings depends on whether households can gain sufficient income from elsewhere to allow livestock numbers to grow into a viable herd. The alternative policy of providing a herd sufficiently large to satisfy basic consumption requirements would be very expensive and, given the limited funds available to the smaller agencies, would prohibit the pursuit of a programme affecting a large number of impoverished households. Marty (1975)

contrasts the livestock package asked for by herders in north-east Mali, containing 8 large and ten small stock and costing 342,000 Malian francs, with the policy actually carried out, involving a loan of 50,000 MF, capable of buying 8 to 10 small stock. Apart from the constraint on resources, a large scale project involving the reconstitution of herds for a large number of households is also likely to run up against the shortage of stock for sale, as noted earlier.

5.11. *The institutional framework.* Several issues need to be raised about the optimal institutional structure within which to carry out a herd reconstitution programme. Firstly, several writers have emphasized the importance of a close knowledge of the community which it is intended to aid, arguing that projects should aim to support local "adaptive strategies and traditional mechanisms for coping with harsh climatic conditions and periodic drought" (Harmsworth, 1984). Turton and Turton present a similar view in relation to formulating successful programmes of rehabilitation, using their observations among the Mursi of south-west Ethiopia as a guide; even "to speak of the 'rehabilitation' of a people such as the Mursi is to run the risk of overlooking precisely those qualities of resilience, technical sophistication, inventiveness and sheer human determination to survive which must be tapped, rather than ignored, if outside intervention in their affairs is to be anything but counterproductive" (Turton and Turton, 1984, p. 178). The experience of past projects thus suggests that it would be useful to devote some resources at the start of a herd reconstitution project to gaining knowledge about the recipient community and discussing with them the species of stock best suited, the preferred method for buying stock and a workable system for the reimbursement of loans.

5.12. Secondly, the overall structure within which producers operate needs to be considered and the extent to which there are existing groups or social institutions through which to channel funds to recipients. This second point, in part related to the previous issue raised, has been recognised as of increasing importance by many researchers who have come to see how critical it is to establish an institutional framework for producer groups. Thus four of the schemes in the West African Sahel shown in Table 5.1 form part of a wider project aimed at building up co-operative structures in pastoral areas. These will not only provide a channel for current development work but, more importantly, a framework within which producers can generate initiatives and guide future interventions by governments and external agencies.

5.13 Thirdly, the advantages of giving credit in the form of cash or in livestock should be investigated. Cash has the advantage that the herder can then choose the stock he wants, rather than having to accept those bought by others. As is noted for the Tin Aicha scheme in north-east Mali, project staff made several mistakes in the choice of animal species bought (sheep and cattle rather than hardier goats) and in the particular beasts purchased, some of which were sterile females and some of which were so young that they could not be expected to calve for two or three years. These mistakes would have been reduced had the recipients themselves been allowed to choose the stock to be brought as herders will be more experienced than project staff in recognising the qualities of stock well-suited to their ecological zone (AFSC, 1982). The disadvantage about giving cash is the possible fraud involved, with recipients using the money for some other purpose. However, the risk of this can probably be kept fairly low by requiring all stock to be brought for inspection and marking after purchase.

5.14. Fourthly, herd reconstitution projects face the problem of which households to select as recipients of stock. The target group is likely to be those households who have lost most if not all of their stock but who have access to sufficient labour and skills to be able to care for animals received. In two of the Sahelian schemes, the recipients were composed of totally destitute herders who had remained in famine relief camps at the end of the drought and had no resources with which to re-establish themselves except their own labour. Members of the community may themselves be best-able to choose those in greatest need. However, this will not always be the case and it is probable that in some circumstances, those with economic and political power will try to direct project resources to their own benefit. For example, Rochette (1981) in his evaluation of the 'Relance des Co-operatives' of the 6th and 7th Regions of Mali, found that there was considerable variation in the development of co-operatives and their activities over the project area. While some functioned very successfully, with much member participation, others barely functioned or had been taken over by traditional elite groups as a new source of power and wealth. Thus, in a few cases, poor pastoral households no longer had access to loans for herd reconstitution, these being monopolised by those with power and used for purposes other than those planned by the project.

5.15. Fifthly, the choice between credit as against gift must be made. Where herd reconstitution forms part of a wider programme, the development of a credit scheme serves the purpose of establishing a revolving fund potentially available for other uses and may help develop the management and accounting skills required in the development of co-operatives. Some writers have also mentioned that use of credit rather than gifts reduces feelings of dependency among recipients and thus minimises the loss of self-respect for those receiving this kind of aid. It is argued that gifts destroy a people's self-reliance and can undermine traditional systems of distribution within society and ways of coping with drought (Scott and Gromley, 1980). On the other hand, Turton notes that this preference for credit as opposed to gifts usually reflects an ideological belief on the part of the recipient population. He finds that there is a "growing resistance to the concept of relief with no strings attached"; for example most agencies opt for a food-to-work scheme rather than the distribution of free rations (Turton and Turton, 1984, p. 188). However, the gift of food or cash may be the best way of helping a society cope with a temporary inability to feed themselves.

5.16. If loans are to be used, the length of time and terms of repayment must be specified. A very short repayment period obliges the recipient to repay before the animals have had much chance of growing in numbers. Too long a period deprives other potential recipients of the chance of a loan, where a revolving credit fund is in operation. Thus, Marty (1975) recommends a 3-year loan in the case of small stock, given their rapid rates of reproduction while a longer period of 4 to 6 years would be necessary for cattle and other large stock. The *habbanaae* system of the Wodaabe works on the basis of the number of offspring produced rather than a fixed length of time, a cow being loaned for the period required for her to calve 3 times, before being returned to her owner, the borrowing household keeping the 3 calves (Dupire, 1962; White, 1984). The system of *serengoro*, found among the Bambara of central Mali, works in the same way, but is less generous to the borrower, the first offspring being given to the female's owner and the second kept by the borrower when the female is returned to her owner (Fulton and Toulmin, 1982).

5.17. Account must be taken of repayment obligations in the event of livestock losses. Recurrent drought or an epidemic outbreak may make it impossible for recipients to repay and debts should be cancelled under those circumstances. The action to be taken in the event of occasional animal losses is less clear; some schemes have demanded that the loan be repaid regardless of loss, whereas others cancel the debt. The free distribution of livestock to households, in place of a system of livestock loans, has the advantage of having zero costs associated with the collection of repayments. Where administrative skills are scarce and where repayment is likely to run into numerous difficulties, due for example to a high risk of drought losses in future, the option- of giving livestock should be very seriously considered.

5.18. Alternatives to herd reconstitution. One alternative for the government or agencies is to take no action, either leaving the affected population to their own devices or continuing to provide famine relief to the destitute. The provision of food relief at a basic 0.5 kgs of grain per adult per day implies a total of 900–1,000 kgs per annum for a household of 7 people, containing 5 adult equivalents. The cost attributable to providing this grain ration depends on the price of grain, the size of transport costs and who pays the bill. For example, grain provided free to a particular government for distribution as food aid will cost the government little or nothing, depending on who is responsible for its transport and distribution within the country. By comparison, grain which must be bought on the open market will be much more expensive and will cost the government dear in foreign exchange and transport charges. The price of grain used in- this paper is US\$300– 400 per ton, to cover the cost either of buying local grains or of buying world market grain plus transport costs to local markets, which may be as high as US\$150– 200/ton for landlocked states with poor road networks (FAO, 1985d). A year's supply of grain to support the household thus costs US\$300-400, which may be compared with US\$150–200 per household for the cost of distributing a limited number of stock' insufficient to fully support the household' and with US\$1,200 per household for the more ambitious Oxfam-Kenya project, in which the number of animals distributed can provide for most of the household's food requirements. In the latter case, the cost per household represents the consumption requirements estimated at the most basic level for a period of 3 to 4 years.

5.19. A second alternative is for the development of other income generating activities for drought-affected groups. Given the aridity of many of the areas concerned, these have usually revolved around some form of irrigated' agriculture, although a variety of other options have also been suggested, such as resettlement of herders elsewhere or the establishment of industries making use of local resources, such as the Turkana fishing project in northern Kenya. Irrigated agriculture has long been considered an obvious solution to providing a livelihood for those living in semi-arid regions. However, it has met with only a limited degree of success, due to severe technical problems (Goldsmith, 1984), and to very high capital and maintenance costs. For example, the capital costs of irrigated agricultural settlement schemes in northern Kenya are put at between US\$17,000 and US\$60,000 per hectare (Hogg, 1985), with running costs which exceed the expected value of annual output. This implies a capital cost alone of establishing a household in irrigated agriculture of US\$9,000–20,000, a figure far in excess of the re-stocking alternative taken up by Oxfam. The 2 schemes in north-east Mali both include a component for small-scale irrigation of crops, using very simple techniques and costing relatively little. These provide a supplementary source of food to families but are insufficient to support all the family's food needs.

5.20. Resettlement of impoverished herders elsewhere is put forward by many writers as the only long-term solution for the pastoral sector, given rising human populations, high risks of drought and livestock loss and a declining resource base (Perrier, 1985). Movement by the poorest members of pastoral society into agriculture has been taking place in the absence of government intervention over many centuries, as work among the Basseri of south Persia (Barth, 1961), among the Oromo of southern Ethiopia (Legesse, 1973) and north African pastoral groups (Johnson, 1973) has shown. For south-west Ethiopia, Turton documents the spontaneous settlement in farming of one-fifth of the Mursi population following the droughts of the 1970s and contrasts the success of this settlement with "the widespread failure of externally organised agricultural settlement schemes for 'pastoral nomads' in Africa" (Turton and Turton, 1984). They make the useful point that "it may be that the only sensible role for outside authorities in the settlement of 'pastoral nomads' is that of facilitating local initiatives, on the assumption that the only successful settlement schemes will be those... which have been initiated by the settlers themselves".

5.21. An alternative to the settlement of pastoralists, either in irrigated agriculture in semi-arid regions or in dryland farming in higher rainfall zones, lies in the development of income earning activities based on locally available resources, The extent to which viable schemes can be set up depends on the resources available and the cost of exploiting them. The development of resources in pastoral areas has tended to have little or no impact on aiding the herding community to develop alternative sources of income. Indeed, in several cases, resource development has reduced the viability of - the existing pastoral system, as when game parks have been carved out of a herding group's territory. Some projects, such as the Lake Turkana fishery, were established explicitly with the aim of providing those who had lost their livestock with another source of income. However, this does not seem to have provided a promising alternative to pastoralism for the Turkana (Hogg, 1985). Other options that have been considered provide at best a way of supplementing incomes, such as handicraft work, but are not likely to enable many people to support themselves on the proceeds.

5.22. The above discussion of re-stocking projects suggests the following conclusions:

- a. The scale of a herd reconstitution programme must take into account the extent to which households can successfully combine the care of stock with other activities. This will differ from one pastoral zone to another, depending on the other resources available in the region. It will also differ across households, with larger domestic groups being better able to pursue a number of income earning activities. The diversification of household income sources is valuable under risky conditions, such as those found in many semi-arid zones. In areas where the pursuit of multiple activities is possible, re-stocking programmes can spread a small number of stock over a large population. However, where ecological and socio-economic conditions preclude such a diversification of income sources, it would be better to help a limited number of households to re-establish a herd of sufficient size to provide for their subsistence needs while seeking alternative sources of income for the remaining population.
- b. Re-stocking is an obvious policy to pursue where the post-drought distribution of livestock is very uneven and does not make effective use of large areas of pasture.
- c. knowledge of the local community and its effective participation in planning and implementing the credit scheme may have important advantages in the short term by reducing administrative

costs and in the long term by consolidating the role that indigenous social structures can play in channelling resources and ideas.

- d. the choice between livestock loans versus gifts should be made on various grounds and should include the relative cost of administering the collection of repayments and what to do in case of deaths among distributed stock.
- e. the cost of complete herd reconstitution programmes are equivalent at most to the cost of providing a basic grain ration over 3 to 4 years to affected households. They are substantially lower than the costs of major irrigation schemes carried out in semi-arid areas.

Draft power reconstitution

5.23. Major drought-induced losses of work oxen can cause a significant shortfall in crop production in subsequent years. Several schemes have been pursued in the past in Ethiopia and Botswana to give farmers access to draft power with the aim of shortening the post-drought period of rehabilitation. A variety of options exists for governments and agencies interested in mitigating the impact of work oxen losses on subsequent harvests. These were presented and analysed in terms of their effects on different sectors of the economy in Table 5.2. Here the options will be compared in terms of their relative costs and the particular problems associated with the implementation of each. As in the previous case-study on herd reconstitution, the various policy options will also be compared with the alternatives, such as continued provision of famine relief.

5.24. Details of each policy option are shown in Table 5.2. Data on costs are taken from a number of different sources and should be treated with caution, as they indicate rough orders of magnitude rather than precise coatings. Each option will be discussed in brief below.

5.25. *Work oxen credit to farmers.* This involves the issue of loans to farmers in cash or in the form of animals for repayment over a period of years. A number of work oxen credit schemes have been carried out in different countries within general programmes of agricultural development, but - few have had the restoration of drought-induced oxen losses as their explicit objective. The main example of the latter was that pursued by the Ethiopian government over the first 6 months of 1974, during which an estimated 40,000 loans were given out to farmers in drought-affected regions (EPID, 1974). The questions raised by a work oxen credit scheme are the following:

5.26. What are the possibilities for distributing one ox per farmer rather than a full team, farmers either sharing their animals or the scheme being accompanied by the introduction of single ox* cultivation techniques?

*such as the plough equipment developed by ILCA for the Ethiopian highlands which is designed to be pulled by one ox alone (ILCA, 1984).

5.27. What are the number of oxen available for purchase either within the region or in neighbouring rangeland areas and the relative prices in each case, including transport costs? As in the case of herd reconstitution, projects need to consider the position of local impoverished farmers having to sell their last ox to finance food needs. Where the project buys such animals

for redistribution to another, there will be little net benefit from the project's intervention, Alternatively, provision could be made for those farmers truly in distress to sell their ox to the project while remaining eligible for a loan in the subsequent distribution of animals.

5.28. How satisfactory are the grazing resources in the region receiving the oxen? In the absence of natural pastures the cost of providing access to alternative supplies of fodder must be considered, such as keeping the oxen in neighbouring areas where pasture conditions are better or transporting fodder to animals in pasture-deficit areas, the latter probably being more expensive than other options given the high bulk of fodder and its high transport cost to remote areas.

5.29. Whether to give cash loans to farmers with which to purchase oxen or whether to distribute oxen directly? There are many advantages to the farmer being the purchaser of his own ox. He makes the choice among available animals and thus is not forced to take an animal which he feels to be unsuitable for any reason. In addition, farmers will have a good knowledge of local opportunities for the purchase of oxen not so easily available to project staff. The overall effect on oxen prices is also likely to be lower where a large number of individual farmers spread their purchases over a region over weeks or months, in comparison with the large scale operations of governments or external agencies. On the other hand, the government or project may have access to sources of animals at lower prices from more distant areas, which cannot be so easily reached by individual farmers. However, transport costs will be higher when oxen must be brought in from far away. The overall effect of each option on price levels will depend on the relative availability of stock in local and more distant areas and the extent to which there are substantial regional variations in the market price of stock of which large agencies are better able to take advantage. For the oxen loan scheme carried out in Ethiopia in 1974, it was decided to give cash loans to farmers rather than be directly involved in the purchase and distribution of animals. The decision was based on the argument of the increased speed with which cash loans could be given out, in contrast to the more lengthy procedure of purchase, transport and distribution of oxen, and on the perception that purchases by individual farmers would have less effect on the level of oxen prices than if the government were to buy the animals directly.

5.30. However, the granting of loans directly to farmers is not without risks of fraud, as it will be hard to monitor whether or not an ox presented as having been bought was in fact bought, borrowed from a neighbour or was already owned and so on. A given level of fraud is probably acceptable if it keeps down the overall cost and allows a large number of recipients to be reached. In addition, fraud involving the use of funds by needy recipients for purposes other than those intended is of much less importance than fraud involving the diversion of cash to those not truly in need.

5.31. Should oxen be given as loans or as an outright gift and if the former, what should be the terms of loan repayment? The choice between loans and gifts of stock was discussed earlier in the context of herd reconstitution projects. It was seen that there may be circumstances in which the option of giving stock should be seriously considered, such as where the cost of collecting loan repayments is high and where high risks to stock from future drought will create many problems for reimbursement of credit.*

*The possibility of providing insurance cover would help answer these problems, although in few African countries are livestock insurance policies currently available, due both to the general lack of insurance cover for risk and the particular monitoring problems associated with insurance of animals.

5.32. In the case of loans, the project must decide on what terms recipients should repay the credit. If loan repayments are set too high, the farmer may be unable to save sufficient surplus to invest in new draft animals essential to the long-term rehabilitation of the farm's productive capital. The various schemes involving work oxen credit programmes which have been carried out in East and West Africa have had repayment periods of between 3 and 5 years, an upper limit on the length of time given to repay being set by the increasing risk of death among oxen as they reach the age of 9-10 years. For example, the oxen loan programme run by the Agricultural and Industrial Development Bank in Ethiopia requires farmers to repay the loan over a 4-year period, covering both the principal sum borrowed and an annual interest charge of 11%. This scheme is aimed at areas of agricultural surplus in highland Ethiopia and therefore faces fewer problems concerning the ability of farmers to both repay loans and invest in new stock. The overwhelming level of demand by farmers to participate in this-scheme indicates that farmers perceive the repayment term as being relatively easy. By contrast, oxen credit programmes set up by the colonial administration in parts of francophone West Africa in the 1930–50s were not taken up by farmers in the more marginal farming areas because they feared the consequences of being unable to make loan repayments on the dates due' given the high risk of harvest failure. As a result, farmers preferred to build up their oxen holdings slowly, by direct purchases of young male stock, rather than be faced with a high probability of being unable to meet debt repayments in some years (Toulmin, forthcoming).

5.33. Government-run tractor pools: These schemes are based on the government purchasing a fleet of tractors which are then made available to farmers to plough their land for a fee. Benefits from such a scheme will be greatest where the terrain is suited to tractor cultivation, i.e. not too hilly and with few rocks and tree stumps, and where pasture and oxen shortages are so acute that no alternative sources of draft power exist. The costs of such schemes are, however, likely to be substantial, given the high foreign exchange costs of purchasing the tractors, spare parts and fuel which will be needed for their operation. Skilled labour is also necessary for the operation and repair of equipment. Shortages of any of the inputs required for keeping the tractors in working order will increase the cost per hectare of pursuing this option.

5.34 The EPID (1974) programme in Ethiopia of 1974 estimated the costs of setting up a tractor pool at E\$ 20,000 per tractor, in comparison with E\$ 60-70 per hectare using tractors rented from elsewhere. Using these figures, the establishment of a government-run tractor pool would only be cost-effective under the following conditions:

- if each tractor could plough a sufficient number of hectares to reduce the per hectare cost below E\$ 60– 70; in the above case, this would require each tractor to plough a minimum of 280–330 ha.
- if the value of dry season work by the tractor pool, such as the transport of goods, is sufficiently great to compensate for a lower level of ploughing capacity in the farming season.
- if available draft capacity from other sources is so low, whether from oxen or from locally-owned tractors, that the relevant comparison to make is not that of the relative costs of

preparing land by alternative techniques but rather the cost of ploughing using government-owned tractors versus the cost in foregone output of land not being cultivated at all.

5.35. While schemes for providing draft power to farmers after drought have focussed on the use of tractors, there may also be other alternative mechanical options worth considering, such as hand-held cultivators which can be used on small steep plots of land.

5.36. Loans for the hire of local tractor services. In some circumstances, there may be tractors available which can be hired by those farmers with insufficient draft power of their own. For example, in Botswana, even in normal years, farmers regularly hire tractors belonging to others in order to prepare their land. The governments of both Botswana and Ethiopia have in the past granted loans to farmers for hiring tractor power to compensate for drought losses of work oxen. The cost of these has varied from US\$20– 40 per hectare which the farmer is supposed to repay after the harvest, except in the case of crop failure. The government ran such a scheme in Botswana in the late 1960s but found the ensuing harvests were so poor that most debts had to be cancelled. Similarly, the Ethiopian government scheme in 1974 allowed for the hiring of tractors by 7,400 farmers in Harerghe province, but few of these or the work oxen loans made elsewhere, were subsequently repaid, due to the land reform and the general political situation in the post-1974 period. Evidently, the feasibility of a scheme such as this depends on the number of tractors available within a reasonable distance, their spare working capacity and the suitability of farmers' plots to this ploughing technique. There will be costs in the form of fuel, spare parts and skilled labour requirements but these will be borne by the tractor owners rather than the government. The main disadvantage of this scheme is that it does not provide farmers with a renewal of their productive capacity and they will need to find help from this or another draft source in the following years until they have re-built their oxen holdings.

5.37. Provision of hand tools. Hand tools are cheap in terms of the cost per unit and of the cost of equipping a farm household. The viability of a switch to hand-prepared land depends on how much land can be cultivated by hand in comparison with a ploughteam and on the possible decline in yield per hectare when land is prepared and weeded by hand rather than by the plough. The extent to which yields will be lower for hand-, as opposed to ploughteam-prepared and weeded land, will be determined by the importance of timely sowing and weeding, by the area of land cultivated per worker, and consequent tightness of land preparation and weeding constraints, and whether the passage of the plough in itself has additional benefits for plant growth and yields due to the creation of an improved top-soil structure.

5.38. In some areas ploughs may make little contribution to raising yields per hectare or per person, for example, where cultivated area per person is low, where soils are fairly light and where the timing of sowing and weeding operations is not of crucial importance to subsequent crop yields. However, under other conditions, where each worker farms a large area and where seed must be planted early to ensure a reasonable yield, preparation of fields with a ploughteam will be the only way in which a large surface can be effectively sown and weeded. For example, under the extensive farming practices of central Mali, where area per worker can be as high as 3–5 ha., ploughteams have a strong positive effect on yields of millet, as they permit this very large surface to be sown and weeded within a cultivation season lasting 6 to 8 weeks (Toulmin, 1983a). Farm households without their own ploughteam must borrow equipment from others,

usually rather late in the season and suffer lower yields as a result, due to sowing much of their grain on unploughed land and to taking longer to finish the weeding of their fields, in both cases increasing the competition faced by millet from heavy weed growth.

5.39. In the case of Ethiopia, average land holdings are much smaller than the extensive areas found in the Sahel, with households farming between 2.1–2.5 ha in the highland region. While this smaller area in the Ethiopian case would lead one to expect a greater possible role for hand cultivation techniques, soils are so heavy that hand preparation of land is in fact very rare, being limited to the steepest hillside plots. Under these soil conditions' farmers resorting to hand cultivation will probably face a significant fall in the area that can be farmed.

5.40. In addition to a decline in area cultivated when land preparation must be done by hand, there are two other costs from the use of hand as opposed to plough cultivation techniques. Firstly, as mentioned above, soil preparation is likely to be less effective using hand tools' leading to less successful seed germination and more competition from weeds, producing lower crop yields per hectare. Secondly, the work involved in hand preparation is very considerable and makes demands on the household workers at a time when energy and food reserves are low.

5.41 As a complement to hand tool cultivation consideration can be given to the provision of fertiliser, aimed at compensating the farmer for a lower area cultivated and low yield per hectare. The advantage of such an approach is that farmers do not have to cultivate such a large area to get a given harvest. Disadvantages include the foreign exchange cost of fertiliser imports and the high costs of transport and distribution to areas of need. The overall profitability of such a project depends on the expected crop response from the application of a certain quantity of fertiliser per hectare. With fertiliser prices of around US\$ 60 per 100 kg and application rates of 100 kg/ha, crop output must rise by at least 150–200 kgs/ha to make this scheme financially profitable. Economic or social profitability will require a lower percentage increase in yields where account is taken of alternative sources of food for farming populations and the value placed on re-establishing viable farming communities.

5.42. *A comparison of costs of alternative policy measures.* The fourth column of Table 5.2 gives estimated areas which can be cultivated for every US\$100 spent on each policy measure. There is remarkable similarity between the alternatives in terms of their costs which, given the imprecision of the data used, would suggest that there is little to choose between the options as far as their financial cost is concerned. In making a choice between the alternatives the relevant issues are those concerning: (a) the availability of oxen, fodder and tractors in the region; (b) the suitability of soils for cultivation by tractor or some other machine; and (c) the shadow price of foreign exchange and skilled labour to the economy.

5.43. In all cases, the cost of action taken to rehabilitate farm production compares very favourably with the cost of providing continued famine relief for the affected population. On the assumption of an annual food need of 900-1,000 kgs per household, costing US\$ 300-400, and the average yield of 400 kgs per hectare, all of the interventions give a benefit cost ratio far in excess of unity in a single year even if account is not taken of the wider benefits associated with the re-establishment of production in rural areas.

Supplementary feeding of livestock to raise productivity.

5.44. The spread of supplementary feeding programmes has been encouraged by governments and project agencies in most parts of Africa not only to aid post-drought recovery of the livestock sector but also as part of a general programme for intensifying livestock production. Supplementing natural pasture with forage crops and agro-industrial by-products is especially important in minimising the adverse impact of a long dry season on the main parameters of herd productivity and in counteracting weight loss among animals used for ploughing in the early rainy season. However, in many cases, there are only limited supplies of locally available supplementary fodder, high transport and distribution costs and high potential foreign exchange earnings from export of certain agro-industrial by-products. Consequently, projects aimed at increasing the domestic use of these materials for raising livestock productivity must consider carefully the optimal areas for their allocation, keeping in mind the opportunity cost of diverting supplies from elsewhere.

5.45. The three policy measures examined here have particular relevance to post-drought rehabilitation policy since they focus on increasing the rate of herd growth and the draft power of work animals in agriculture. Table 5.3 presents details on the three policy measures, giving rough coatings of alternative schemes and the gain associated with each. The final column of the table mentions some of the problem of implementation and the constraints on profitability. The assumptions on which the costs and returns have been estimated are outlined below.

5.46. Raising fertility rates. Calving rates among Sahelian zebu cows kept under traditional conditions lie between 60 and 65% per annum (Wagenaar, 1983). Substantial improvements in these rates have been achieved under research station conditions through the supplementation of females during the dry season, with calving rates rising to 70–75% (Coulomb et al, 1971). Supplementation towards the end of the dry season improves calving performance, both by reducing the chances of miscarriage and stillbirth due to the nutritional stress of the mother and by increasing the speed at which the female returns at the start of the rainy season to sufficient body-weight for ovulation and conception to occur. For the purposes of this example, it is assumed that as a result of distributing supplementary feed to females of breeding age, the calving rate will rise from 60 to 70%. For a herd of 100 animals, containing 40 breeding females, the increase in calving rate implies a rise in the number of calves born per year from 24 to 28. Supplementary feeding of 40 cows thus produces 4 extra calves.

5.47 Taking calf mortality rates of 30% from birth to 12 months and of 10% from 12 to 24 months (the average of figures cited by Wagenaar, 1983), and assuming no change in these from the intervention, of the 4 extra calves born, 2.8 will survive to the age of 12 months and of these, 2.5 will survive to the age of 24 months. The value of a calf aged 24 months is taken as US\$25–30,* so that 2.05 calves of this age are worth US\$62.5–75.0. If a time discount rate of 20% per annum is assumed, the net present value of these calves at the time of supplementation is US\$36.2–43.4. It is arguable, of course, that these market-based figures underrate the true values of calves as potential rehabilitators of farming systems which, if not quickly restored, will require continued and very expensive famine relief to keep their human populations alive. The value of the calves to government may be greater than the market price. Nevertheless, market prices represent a preliminary approximation to true value and one can then apply sensitivity

analysis and see how much higher (or lower) than the market price the true value would need to be before it becomes economic (uneconomic) to adopt this instrument for rehabilitation rather than another.

*equivalent to 12,000-15000 FCFA for 24-month calves in Sahelian markets.

Table 5.2. Draft Power Policy Measures: A Comparison of Alternatives.

Project	Initial cost	Associated cost	Area cultivated per US\$ 100 spent	Issues arising
Work oxen credit to farmers	Loan for oxen purchase of US\$140-180 per ox	Administration, vaccination, insurance fodder	1.00 -1.50 ha.	Oxen locally available? fodder supplies adequate?
Government tractor pool	Purchase of tractor at US\$ 15-20,000	Fuel, spare parts, skilled labour and administration	2.00-2.50 ha.	Soils and terrain suitable
Loans for local tractor hire	Loans to farmers at US\$20-40/ha	Administration Other costs borne by tractor-owner	2.00-3.00 ha.	Tractors available locally? Terrain suited? One year only.
Hand tools	Purchase of tools at US\$5 per unit	Distribution, high cost of labour, fertiliser option	2.00-10.00 ha.	Variability in soils means wide range in area prepared by hand.

Table 5.3. *Alternative uses of scarce domestic fodder supplies.*

Target of policy	Objective	Ration	Gain per kg. of fodder used (US\$)	Problems and issues raised
Breeding females	Raise calving rates from 60 to 70%	2-3 kgs/cow per day for 90 days	less than 0.01	Selection of females most likely to benefit from supplementation
Calves less than 1 year	Increase calf survival rate	0.5 kgs/calf per day for 90 days	0.04-0.05	Selection of calves most vulnerable to death would raise benefits gained
Work oxen in poor condition	Raise farm output by improving performance of oxen	2-3 kgs/ox per day for 90 days	0.15-0.26	Selection of work oxen below critical weight threshold for feeding; availability of extra land for increase in area cultivated

*Assumes only those oxen below critical weight threshold are fed and consequently there is significant improvement in working performance.

N.B. In all cases, there are major problems which arise from the high costs of transport and distribution of animals fodder which will be especially severe for extensive and very mobile systems of livestock production, as found in large parts of the semi arid range areas of sub-Saharan Africa.

5.48. The cost of supplementation depends on the commodity taken, the country concerned, transport costs and on whether the domestic or the export price is taken. An FAO study of domestically available livestock feeds for several Sahelian states quotes prices per kg for groundnut and cotton seed cake, rice and wheat bran ranging from 20–40 FCFA, equivalent to US cents 4–8 (FAO 1985 a,b,c). In contrast to these figures, trade statistics indicate an export value per kg of groundnut and cotton seed cake of US cents 15–17 (FAO, 1982). While the lower price of US cents 4–8 per kg will be taken in the examples here, the high export price of these commodities should be kept in mind, to be discussed later in this chapter. Taking the above cost of supplementary feed and a daily ration per cow of 2–3 kgs over a 90 day period, the overall cost for 40 cows will be US\$288–864.

5.49 It can be seen from the example taken above that the cost of supplementary feed given to all breeding stock will far exceed the benefits gained from extra calf production (estimated at \$40 see para 5.47 above) on the basis of the assumptions used. This makes it crucial for the success of such a policy that only those cows be fed for which there will be a marked effect in terms of improved calving performance. These cows will typically be those which normally calve only once every other rainy season and which take a long time to regain bodyweight and fertility at the start of the rainy season. Returns to supplementation will also be higher where the extra milk produced per cow due to better feeding finds a ready market, for instance where the herd is close to a town.

5.50. Reducing calf mortality rates. Calf mortality Under Sahelian conditions is high, averaging from 20-40% for those from birth to 12 months (Wagenaar, 1983), resulting partly from their

poor level of nutrition, as they must compete for limited milk supplies with the herder, and partly from specific health problems, such as parasites and diarrhoea. Mortality rates are quite variable from one year to the next, depending on the severity of pasture shortages during the dry season.

5.51. Supplementary feeding of calves has been suggested by a number of researchers as a means to reduce these high rates of mortality and several research programmes have been carried out to assess the merits of alternative supplementation regimes. Mesnil's study (1979) of calf supplementation in the Abala region of central Niger had as its main objective to compensate the young calf for high milk offtake by the herder. Calves of more than 3 months were given a ration of 0.5 kg/day of mixed animal feed (rice flour, groundnut cake, salts and vitamins) and their performance was compared with a control group of non-supplemented calves. The findings of the study were not very significant, as the number of the calves involved in the study was small. Also, herders increased their milk offtake from the mothers of calves receiving supplementation. In addition, the good weather and pasture conditions means that all cattle were under less stress than is often the case by the end of the dry season. Nevertheless, there was an estimated improvement in calf survival rates of 5 percentage points as a result of the supplementation. Mesnil refers to another study in which supplementation had a far more marked effect on raising survival rates (Bres, 1972). This latter study was carried out under much harsher ecological conditions; as a result, non-supplemented calves had a mortality rate as high as 22% in a single month, in contrast to no deaths among supplemented calves.

5.52. The calculations made here will be based on the assumption of a decline in calf mortality rates from 30 to 20% over the first 12 months of life as a result of receiving supplementary feed, this assumed improvement lying between the results of the two studies described by Mesnil (1979). In years of good rainfall, the gain in survival rates from supplementation will be less marked, while in poor years supplementary feeding of calves will produce a major gain in calf survival rates.

5.53. Taking a herd of 100 animals, in which 24 calves are born in the year, the fall in calf mortality over the first 12 months of life reduces the loss of calves to 12 months from 7.2 to 4.8, giving a net gain of 2.4 calves aged 12 months. Assuming no change in the calf mortality rate among calves from 12 to 24 months (taken as 10%), 2.4 calves aged 12 months will leave 2.16 calves aged 24 months. Each of these 24 months calves are valued at US\$25–30, giving a total value of extra calf production of US\$54–65. Using a time discount rate of 20% per annum gives a net present value at time of feeding of US\$45–54.

5.54. The cost of supplementary, feeding is calculated for a ration of 0.5 kgs/day over a 90-day period for the 24 calves, giving a total cost of US\$43–86, if 1 kg costs US cents 4–8. This cost range compares with the estimated value of extra calf production of US\$45–54, suggesting a small margin can be gained on the project when the lower price is taken for the cost of feed. The return to supplementation would increase if account was taken of other benefits to herd productivity arising from the supplementation programme, such as the faster rate of calf growth which should lead to earlier age at sale and earlier age at first calving. The return from supplementation will also rise if only the most vulnerable calves could be selected for feeding.

5.55. Work oxen supplementation. Supplementation of draft oxen aims to moderate dry season weight loss, thereby improving draft performance at the start of the cultivation season. Potential benefits accrue to farmers in the form of an increase in the area that can be cultivated by each oxen pair and increased crop yield from improved timeliness of sowing and weeding operations. The size of the actual benefits gained by the farmer will depend on: the improvement in oxen performance resulting from their supplementation' the availability of extra land that can be brought into cultivation and the significance for crop yields of timely sowing and weeding.

5.56. The improvement in oxen performance is itself dependent on the amount of weight lost by supplemented and non-supplemented animals and the demands made upon them in terms of the intensity of draft required and the length of the working day. There is likely to be some critical threshold below which weight losses substantially impair the work ability of draft animals. Supplementation of animals whose weight has fallen below this threshold will have a significant effect on their ploughing performance. Where the weight lost is less than this amount, however, supplementation may have little or no impact on draft performance. The size and significance of weight losses during the dry season will depend on the fodder availability at different seasons, as this affects the speed with which animals can regain their weight at the start of the rains, the reserves they carry through into the dry season and the amount by which dry season fodder intake falls short of that required to maintain body-weight. However, this critical weight threshold must also be related to this demands made upon the animals. These demands will be greatest where much of the ploughteam's work is done while pasture resources are still scarce, where land preparation is the main task done by draft and where the actual force required for ploughing is high, due to heavy or water-logged soils.

5.57. Improved oxen performance can be translated into high crop output either by an increase in the area cultivated per team or by improving the timeliness and care with which land is prepared, and crops are sown and weeded. The relative size of each of these benefits will be determined by the availability of land with which to increase cultivated area and by the significance of timeliness for final yield, factors which will vary across different regions according to population densities and the pattern and volume of rainfall in relation to plant requirements.

5.58. A number of studies have been done to estimate the fodder requirements of draft oxen of different weights according to the work demanded of them under varying climatic conditions (Goe and McDowell, 1980). A series of supplementation trials carried out in a Sahelian farming village in Mali has shown, under the conditions operating there, that supplementation leads to no statistically significant increase in work oxen performance (Traore and Soumare, 1984). This can be explained by: the availability throughout the dry season of low quality- forage around the village which limits the total weight loss of non-supplemented animals, the light sandy soils of the region and the low demands made on oxen, due to the minimal tillage carried out. In addition, a variety of factors other than nutrition are of importance in affecting oxen performance, such as the qualities of the workers guiding the oxen and holding the plough and the stimulating effect on one oxen team of working alongside another oxen pair. While no result of statistical significance was found between the performance of supplemented oxen and the control group, the former were found to cultivate an area slightly larger than the latter by an amount of 1.15 ha. The value to the farmer of this marginal increase in area depends on the crop

with which it is cultivated. Taking an average yield of 400 kgs/ha., gives an additional output of (1.15 x 400) kgs or 460 kgs, valued at US\$138–184.*

*Grain being valued at US\$300–400 per ton, as explained in the section on herd reconstitution.

5.59. Within the Ethiopian context, supplementation of work oxen is likely to lead to improved tillage and more timely sowing of fields, rather than a significant expansion in area cultivated, given the shortage of unoccupied arable land in most farming regions. However, it is estimated that substantial improvements in yields are possible from better cultivation techniques' such as more timely sowing and better seedbed preparation (Whiteman, 1977). Yield increases from improved techniques are estimated as ranging from 17–18% for wheat and teff to 45% for sorghum (Min. of Ag., 1979), or by an average of 210 kgs/ha. Given a mean holding per work oxen pair of 1.5–2.00 ha., the increment in output due to better oxen nutrition and performance can be estimated at around 300–400 kgs, worth US\$90–160 (taking the price of grain as US\$ 300–400/ton).

5.60. Costs of supplementation are based on an assumed ration of 3 kgs/day over a 90-day period for each ox, the ration consisting of a mixture of groundout and cottonseed cake, rice and wheat bran' priced at US cents 4–8. This gives a total cost per oxen pair for the period of supplementation of US\$21.60–43.20.

5.61 The returns from work oxen supplementation can be calculated from the above figures. These indicate that there are positive benefits from this policy if output increases by an amount worth more than US\$21.60 - 43.20, as a result of the improved performance of the draft team. Significant benefits will be less probable where there is sufficient dry season grazing available so that animals can maintain their body-weight above some critical threshold and where the work demanded of them at the start of the rainy season is not too arduous. Benefits will increase where supplementation is restricted to those animals which have lost a substantial amount of their body-weight and whose subsequent work ability is likely to be much impaired.

5.62. *A Comparison of alternative uses of fodder.* The calculations made above suggest that supplementary feeding has its highest value in the supplementation of work oxen which would otherwise be in poor nutritional state. The returns from alternative measures depend crucially on the assumptions made about likely performance in the absence of supplements and the extent to which performance is improved by the distribution of rations to stock. Thus, for example in the case of calf supplementation, in a year when pasture conditions are good, calf mortality rates will be low and supplementary feeding will have negligible impact on survival rates. Conversely, when pasture and milk supplies are scarce, supplementation of calves will have a much higher return. If those calves most at risk can be identified and selectively fed, the returns from this policy measure will also be much higher.

5.63. Against the comparison of alternative domestic uses of fodder in livestock production must be set the other uses of these resources. These will comprise for example, the foreign exchange earnings on exports of agro-industrial by-products and the value of other commodities which can be derived from the raw materials, such as oil for human consumption from cotton-seed, alcohol from molasses, etc. With export prices of around US cents 15–17/kg for feeds such as groundout

and cottonseed cake (FAO, 1983), the only livestock-related domestic use of higher value is that of work oxen supplementation. Non-selective calf supplementation produces a gain lower than that obtained from exporting these commodities while the non-selective supplementation of breeding cows produces very much lower returns.

5.64. The question of the returns from feeding stock during drought periods, as compared with the post-drought period, has not been looked at explicitly here. It has been the object of some research and discussion (see for example FAO, 1982). It will just be noted here that such a policy raises a number of complex issues to do with the optimal survival rations for stock, selection of animals to be fed, longer term consequences for pasture regeneration, priority to be given to transport of fodder versus human food supplies and so on.

Chapter 6 Conclusions and policy implications

6.01. This paper has discussed a range of policy measures aimed at rehabilitation of livestock and farm, production following drought. From this discussion it can be seen that there are a variety of policies open to decision-makers, each with particular costs and welfare implications. Policies also differ with respect to their spill-over effects on other sectors of the economy, some being precisely targeted, like a subsidy to a certain producer group, while others cause widespread changes to the structure of prices and incentives within the economy. Out of these policy alternatives, decision-makers will face a more restricted choice, determined by the conditions faced in the post-drought period, in terms of the resources available domestically—pastures, livestock, grain, seed etc.—the local administrative capacity and the country's marketing and transport infrastructure. External finance will loosen the tightness of particular constraints, such as when governments can supplement local food supplies with aid in the form of grain and milk powder.

6.02. It would be wise for decision-makers to consider as many policy options as possible, since the conditions faced by different regions and producer groups will vary greatly. For example, where local tractor power is available, government credit or subsidies for tractor hire is an obvious option to pursue, especially where local draft oxen supplies are very limited and prices high. In areas where fodder supplies are scarce and highly vulnerable to drought, alternatives to oxen as sources of draft power should be considered, such as small-scale cultivating machines. While most herd and oxen reconstitution schemes have involved the provision of credit, gifts of livestock should be considered under certain circumstances, where repayment is likely to be subject to high risks and costs of collection.

6.03. An assessment of policy alternatives should include the consequences for the affected communities and the whole economy of making no intervention. Governments may either continue to provide food relief for destitute farmers and herders, or wait for them to reconstitute their systems of production by their own efforts. In either case, there is a cost to taking no action, in terms of forgone output' the resources needed to purchase, transport and distribute food relief, and longer term social costs from the dislocation of local communities from self-sufficient production. Rehabilitation options looked at in this paper represent at most the cost of providing a basic grain ration to the household over 3 to 5 years and many policies, particularly those in the farm sector, produce a much faster return on invested resources invested in rehabilitation. When the social costs to the affected populations are also taken into account, the value to be attached to funding rehabilitation, as opposed to relief measures, is heightened further.

6.04. Policies for rehabilitation of local production systems need to be looked at in relation to short-term relief measures and long-term policies for establishing less drought-vulnerable systems of production. The speedy provision of relief food supplies to producers in greatest distress would reduce the subsequent need for rehabilitation measures. For example, if herders can get access to relief grain supplies, they will be under less pressure to liquidate their livestock capital at very low prices in order to buy food for themselves. Rehabilitation policy should also be formulated in coordination with longer term measures, since the post-drought period can offer a breathing-space within which to initiate changes in patterns of production and resource management. Longer term options are themselves constrained by trends in climate, population

growth and resource productivity. For example, in the case of the Sahel since the end of the 1960s, rainfall has remained well below its long-term level for this century. Consequently, efforts to rehabilitate livestock production must take into account the lower productivity and greater fragility of the pastoral resource base in comparison with conditions typical of the pre-1968 period. Thus, rehabilitation should not necessarily be taken to mean the re-establishment of production systems along the exact lines of those existing in the pre-drought period.

6.05 The areas for action open to national governments and foreign donors overlap, but are obviously not identical. However, while price, taxation and trade policy measures are the preserve of national administrations, external financial aid can be of value in reducing the conflicting objectives faced by governments in the post-drought period. An example of this can be seen in the compensatory finance paid by the European Development Fund to several Sahelian governments after the 1973 drought to reduce the adverse impact on national budgets of lifting direct livestock taxes. The temporary abolition of this tax probably had a significant effect on all owners of stock, producing widespread benefits for a relatively low outlay.

6.06. Non governmental organisations (NGOs) have played a valuable role in developing small-scale projects suited to the particular conditions and problems of drought-affected communities, This is especially the case for the Sahel, where a number of innovative herd reconstitution schemes have been set up since 1973. The experience of these schemes provides other agencies with possible models for intervention. However, the relative success of much NGO work may depend precisely on its small-scale operation. Large-scale herd credit programmes will face greater problems from a shortage of animals available for redistribution and consequently higher prices.

6.07. Decision-makers in both government and development agencies are faced with a shortage of resources and a wide range of potential uses for funds. Following a period of drought, the conflict between alternative uses of resources is likely to be particularly acute' given the shortfall in meat, grain and foreign exchange earnings. In deciding on the priorities to be given to each objective, a number of factors need to be taken into account, as is seen in the following examples.

6.08. Domestic vs. export markets: While political considerations might encourage the diversion of meat and fodder supplies to domestic consumers and producers, account must also be taken of the possible loss of export markets to alternative suppliers. The Ivory Coast, for example now gets a substantial proportion of its meat supplies from non-African sources, having formerly depended almost entirely on imports of Sahelian livestock. This switch in the source of meat imports took place after the 1968–73 drought, when supplies of meat from the Sahel were scarce and highly priced. Meat exporting countries like Mali are now in a much weaker position in the Ivory Coast market since they face strong price competition from other meat exporters' such as Argentina.

6.09. Male cattle for meat vs. draft purposes: Where oxen are an important input into farm production, some competition is likely to exist between the use of male cattle for meat, by their fattening and early slaughter, and their being used for draft purposes. The relative strength of demand from each sector will depend on the incomes and purchasing power of domestic and

foreign consumers of meat and of the investment funds available to farmers. Where drought losses of work oxen have been high, farmers' ability to reconstitute their oxen holdings will be made more difficult where they face strong price competition from consumers of meat. In such cases, governments may need to intervene to achieve the desired balance between satisfying immediate demands for meat with the requirements for rehabilitating the productive capital of the farm sector.

6.10. Resources to aid the farm vs. the livestock sector: In a number of areas decision-makers are likely to be faced by policy choices which either favour the rehabilitation of farm production or benefit livestock producers. For example, governments can choose to subsidise the distribution of animal feeds to certain groups of producers, such as owners of draft oxen or herding communities. It can be argued that re-establishing grain production should receive prior claim on resources, given the importance of grain in the diet of all consumers and of the poorest groups in particular. Re-establishing grain production is also likely to benefit livestock producers to the extent that increased grain supplies and lower grain prices will reduce pressure on herders' income and reduce the number of animals needed to constitute a viable livestock holding. On the other hand, it can also be argued that livestock production is the only way of effectively using the resources of certain semi-arid areas. Grazing animals may be the only way of exploiting the sparse natural vegetation, converting these resources into valuable products for the rest of the economy as well as providing support to a proportion of the human population. Pastures which are not grazed constitute a waste of resources, a loss which can be reckoned in foregone milk and meat output. The overall balance in the distribution of resources to aid rehabilitation in farming as opposed to pastoral areas should consider these arguments.

Appendix

Data on livestock losses during drought

Country/Region (source)	Period	Species	Loss (%)
West Africa/Sahelian region (B. Sitta, Le Courier no. 65, 1981)	1968–73	cattle	12–45%
		sheep & goats	15–30%
Burkina Faso (FAO Production Yearbook, 1976)	1972–74	cattle	33%
		sheep	31%
		goats	23%
		horses	20%
		donkeys	42%
Chad (FAO/Chad, 1984)	1984–85	cattle	32%
Mali (FAO, 1985b)	1968–73	cattle	35%
Telataye, Gao NE Mali (Marty, 1975)	1967–75	cattle	93%
		sheep & goats	78%
		horses	69%
		donkeys	35%
		camels	41%
Mauritania (FAO Situation Report no. 7, 1985)	1983–85	cattle	40–90%
Niger/Pastoral zone (Bernus et al, 1983)	1973	cattle	63%
		sheep	47%
		goats	33%
		camels	38%
Niger/Agadez Department (Bernus et al., 1983)	1968–74	cattle	88%
		sheep	80%
		goats	70%
		camels	45%
	1972–74	cattle	82%
		sheep	50%

Ethiopia/NE Rangelands (LMB, 1974)		goats	28%
		camels	36%
Kenya/Maasailand (Campbell, 1978)	1976	cattle	20–33%
Kenya/Isiolo District (Hogg, 1985) Note: effects of drought and banditry	1963–70	cattle	7%
		sheep & goats	>90%
		camels	>95%
Kenya/N. Turkana (Hogg, 1985)	1979–80	cattle	>90%
		sheep & goats	80%
		camels	40%
Sudan/E. Region (FAO/OSRO 1985)	1984	cattle	23%
		sheep	12%
		goats	5%
		camels	7%

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List of abbreviations

AFSC	American Friends Service Committee
BMC	Botswana Meat Commission
EEC	European Economic Community
EPID	Extension Project Implementation Department
FAO	Food and Agriculture Organization
FM	Malian Franc
GDP	Gross Domestic Product
IAR	Institute of Agricultural Research
LMB	Livestock and Meat Board
NGO	Non-Governmental Organization