Dennis Herlocker

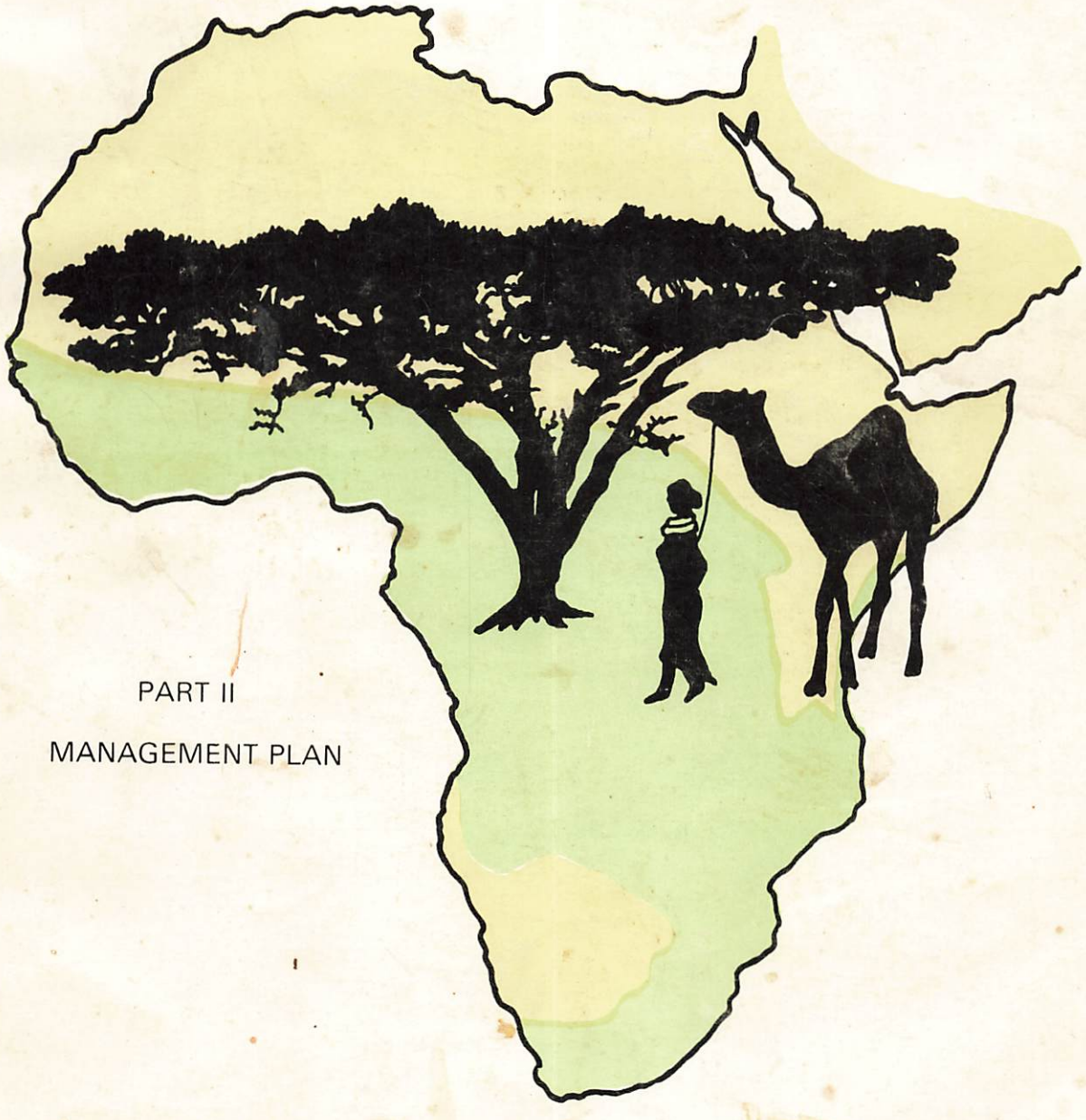
Federal Republic of Germany

Unesco Programme on Man and the Biosphere (MAB)

Republic of Kenya

Integrated Project in Arid Lands (IPAL)

Technical Report Number A - 6



PART II

MANAGEMENT PLAN

Integrated Resource Assessment and Management Plan for Western Marsabit District, Northern Kenya

Published in 1983 by the United Nations
Educational, Scientific and Cultural Organization. Nairobi.

© Unesco 1983

PART II

THE MANAGEMENT PLAN

I

MANAGEMENT POLICY

1. Introduction

Notwithstanding the relevance of the ecological approach to development planning, a common failing, even in ecologically orientated planners, is the scant attention frequently given to the so-called human factor. The existence of a human population anywhere presupposes a complex of ethnic, social and biological influences and interactions. If these are not understood and adequately accommodated in resource-management plans, the consequences can be serious, even disastrous (Lusigi, 1978). The realization of this fact has formed the central thrust of the UNESCO/MAB programme and, indeed, of that of IPAL. Studies on human ecology have formed the central core of IPAL's investigations and the evaluation of the human needs of the Rendille forms the starting point of this management plan.

For the implementation of any resource-management plan to succeed it must adequately take into consideration the socio-economic setting and development programme of the particular country involved. The present plan fully acknowledges the national development projections for the rangelands of Kenya. Recognizing the importance of the range areas of Kenya (which cover over 80 per cent of the total area of the country) and their potential for the production of goods and services needed by mankind, and recognizing also the dangers of erosion and desertification from indiscriminate use, the Government has placed considerable emphasis on the proper development of these lands, based on the following principles:

a. that the people of the range areas must be allowed the opportunity for full social development in terms of the modern world and in accordance with the principles of human rights;

b. that range areas should be developed, conserved, and managed in accordance with the ecological principles of proper land use;

c. that, in so far as other principles allow, the range areas should be developed to yield to the maximum benefit of the national economy.

Kenya's Development Plan for the years 1974-1978 in support of agriculture in general and of smallholders and the rural poor in particular, pointed out the need to pay greater attention to the development of the range areas. Even greater emphasis has been placed on the development of range areas in the National Development Plan of 1979 - 1983. This attention directed to

range areas is in line with the broader goals for the national economy. These are clearly specified in the Development Plan and emphasize the importance of continued economic growth, a greater sharing of the benefits of growth by the poorer segments of society, full control over the country's economy and broader participation by local organizations in governmental planning.

Since Kenya largely depends on primary production from its land resources, the full potential of the land must be developed by every means. But development must take the form most suited to the prevailing circumstances and the purposes to which an area is best adapted. Development of the range areas is as important as the development of any other organic natural resource, and should be undertaken to the maximum extent consistent with conservation.

2. Management Policy Statement

In view of the above considerations, it is therefore the policy of the resource-management plan outlined here to contribute to the improvement of the well-being of the pastoral people in all ways but in particular (assisted by an appropriate education), by the development of an improved land-use system that will reverse the trend of land degradation and sustain land production for the needs of the growing and partially sedentarized pastoral population.

Part of the problem of the development of range areas has been that of gaining acceptance of the chosen development strategies by the local population of the range areas. Many plans have been ill suited to their way of life, and therefore rejected. Planning of development projects in the range areas must be based on an appraisal and evaluation of cultural, political, ecological and socio-economic factors, and resources must be balanced against local human needs in both the short and the long term. Above all, the strategies adopted must be acceptable to the local population.

3. The Pastoral Economy: Constraints and Opportunities

Any developmental and environmental programme which seeks the welfare of the local pastoralists must first of all strengthen the present pastoral economy. Some have suggested that 'The prime emphasis on livestock sector interventions at this time should be to support the subsistence base of pastoral herding rather than to stress commercial activities' (Report submitted to USAID, 1979). Once the pastoral economy has been placed on a firmer and less vulnerable basis, there is no reason why it cannot produce a surplus of livestock and meat for the wider economy as well as enriching the local community. The pastoral

economy can be bolstered by remedying the constraints under which it is at present labouring, and in the process new opportunities will emerge for the pastoralists.

The Rendille of Kargi place their development needs in the following order:

1. water development;
2. improved marketing facilities for livestock;
3. improved medical services;
4. establishment of an adequate veterinary service;
5. improvement of public security;
6. leadership which will get all the people of the tribe working together towards development;
7. drought assistance.

It is critically important that these priorities, as perceived by the people, be taken into account when phasing development interventions. However, some items of obvious importance are absent from the people's list primarily because they have no experience of their value. Such are the need for grazing control, means of storing wealth other than 'on the hoof' (i.e. banking facilities), and the registering of tribal rangelands in order to put them on a firm legal basis.

Adding these to the list, we can divide the constraints to which the pastoral economy is at present subjected into three groups, as follows:

1. constraints on the use of the rangelands:
   - lack of a sufficient number of waterpoints;
   - lack of grazing control;
   - lack of public security;
   - lack of a sufficiently secure land-tenure system;
2. constraints on livestock management and husbandry:
   - inadequate marketing facilities;
   - inadequate veterinary services;
   - inadequate banking facilities;
3. constraints on human welfare:
   - inadequate health services;
   - inadequate measures against drought.

The first two groups of constraints deal mainly and directly with the economic life of the pastoralists. To generate funds to finance the welfare schemes demanded by the third group it is first necessary to develop the pastoral economy. The following sections, 3.1-3.9, deal with the identified constraints in turn.

3.1 Extension of waterpoints

The nomadic community is at present expending exorbitantly high amounts of energy in dry seasons in walking animals long distances, in digging and maintaining wells, and in drawing water for domestic use and for very young animals too weak to walk to water. The two tasks - watering animals and drawing water - should be distinguished, and in fact the distinction is clear in the minds and practice of pastoralists. In addition, they use waterpoints in combination. In the dry seasons they tend to use the more distant waterpoints for watering most of their smallstock and camels, while using others which are nearer to the main camp primarily to draw water and to water limited numbers of stock. Each animal species has its own water requirements, and this in turn regulates the distance at which the animals can graze away from water. In dry seasons, cattle are watered every second day, and so can only use pastures which lie within 15 kilometres of a waterpoint. Smallstock are watered every 4th day and can use pastures within 30 km of water. Camels are watered every 11th to 14th day and can use pastures 60 km or more from water. Usually, water for domestic use is drawn every third day, ideally from waterpoints which are not more than 15 km away. Longer distances create tremendous hardship and are only feasible if the household has 2-4 pack camels.

The Gabra, more than the Rendille, are already opening up new areas of their rangelands by digging permanent and semi-permanent wells at such places as Gadeh, El Boji and Rageh. These wells, firstly, supply water for domestic use and young animals which are kept at home. Secondly, they provide water for limited numbers of cattle and smallstock. Camels are rarely allowed to drink at such wells.

The greatest need in this regard, then, is clearly to have adequate watering points so situated as to reduce unnecessary stress and to increase the productivity of the livestock.

3.2 Grazing control

A detailed classification of rangelands and their condition has already been described in the range resources section of part 1 of this document. A detailed description of livestock movement has also been given. This can also be looked at from the point of view of the intensity of present traditional use.

At present, rangelands in Rendille and Gabra country can be classified in relation to intensity of use into three categories: permanently used rangelands, seasonally used rangelands and occasionally used rangelands.

- Permanently used rangelands are defined as those in constant use and prime examples are the zones surrounding the Korr and Kargi trading centres. Range degradation in these zones has reached critical proportions.
- Seasonally used rangelands are those which are not in constant use but are utilized on a regular but intermittent or seasonal basis. Such ranges surround primary water sources - as at North Horr, Kurawa, Kalacha, Karawe, Maikona and Korole - and secondary water sources, as at Rageh, El Gadeh, El Boji, Balesa Ildere etc. The Rendille have the habit of returning to favourite grazing sites such as Kambini whenever they receive rain, and such sites can also be regarded as seasonally used rangeland. Seasonally used rangelands are intermittently out of use and hence have some opportunity of recovery.
- Occasionally used rangelands are those used irregularly and infrequently, and are usually - but not always - some distance from primary and secondary water sources. These rangelands are usually used by cattle and smallstock in wet seasons. Camels use them for longer periods and more extensively. Prime examples of occasionally used rangelands are the upper reaches of the Asie and Hurri Hills, and certain stretches of the Hedad and Kaisut deserts. There is little danger of overgrazing such areas. Certain sections of occasionally used rangelands are reserved in the mind and practice of the local pastoralists as fall-back ranges intensely used only in periods of drought. Prime examples for smallstock and cattle are the ranges immediately east of Lake Turkana and stretching southwards from Alia Bay. This area is unsuitable for camels because of the presence of the tsetse fly. The eastern side of the Hurri Hills, the ranges lying between Mt. Kulal and Mt. Asie, and part of the Hedad desert and the Dida Galgalo plains are appropriate drought reserves for camels.

It therefore seems inappropriate that one range-use policy should be applied equally and indiscriminately to all parts of the rangelands. The level and intensity of range monitoring and control should vary with the type of range being managed.

There is obviously need to set up exclusion zones in permanently used rangelands in order to give them time to recover from over-use. Again it is essential that seasonally used rangelands be regularly monitored for over-use and range degradation; when and where the evidence suggests it, over-used sections of seasonally used rangeland should be given longer rest periods.

However, generalized and *a priori* judgements on the rate of use of these rangelands are unhelpful; decisions must be based on accurate assessment of the state of the range. With regard to occasionally used rangelands there is little need to improve on their present management (with respect to range care), which is based on the distribution patterns of the rainfall. Gabra pastoralists "follow the rain" in wet seasons when using such rangelands, moving their camps and animals to areas with the most succulent grasses. While the Rendille do not move their camps to all the areas in occasionally used range which receive the heaviest falls, they at least send their *fora* stock to utilize them. The present management of occasionally used rangeland is ecologically rational, allows pastoralists optimum use of the rain that falls, and can be regarded as *ad hoc* rotation.

Finally, it is a necessity that any grazing scheme should provide pastoralists with drought-grazing reserves. Where it is necessary to exclude animals from particular areas for short or long periods of time, alternative grazing should be provided as near as possible, and this may involve the provision of extra waterpoints.

3.3 Public security

A number of factors contribute to insecurity in the IPAL area. It is large, lacks adequate policing, and contains a number of different nomadic pastoral groups - Rendille, Samburu, Gabra, Borana, Turkana and Dassanetch. Traditionally, it was common and accepted practice for certain tribes to raid each others' livestock. It was a matter of honour and prestige to claim the herd of a hostile tribesmen and raiding was recognized as one way of obtaining livestock.

During the colonial period the administration established buffer zones (particularly between the Rendille and the Gabra, the Gabra and Dassanetch and the Samburu and the Turkana) and employed camel-mounted police to protect the pastoralists and to regulate their movement. Breaches of intertribal peace and raiding were severely punished and this established a degree of public security.

In the last twenty years, police have become less mobile and hence less effective. The situation has been further exacerbated by border disputes between Somalia and Kenya. In the 1960s the Gabra and Borana both lost lives and stock to the Somali bandits known as *shifta*. In that decade about 60 Rendille lost their lives and many stock were stolen in one Gabra/Borana raid at Kargi, while about 70 Gabra died in a Dassanetch raid carried out in the early 1970s near North Horr. The fact that some groups, such as the Dassanetch,

Gabra and Borana, straddle the Kenya/Ethiopian border makes it easier for raiders to disappear across the border and avoid detection. Part of the Kenya Government's response has been the introduction of home-guards - pastoralists trained in the use of arms and provided with guns and ammunition. They live and move in their nomadic communities and are not officially remunerated. The home-guard operation complements the work of the police stationed at North Horr and Marsabit, and that also of the Administrative Police posted to the camps of chiefs and assistant chiefs.

Nevertheless, intertribal raiding continues. For example, since December 1981 a number of incidents have occurred between the Gabra and the Rendille involving the theft of animals and in some instances the loss of life.

Since public security is a *sine qua non* for the extensive and efficient use of the rangelands, it is essential that steps be taken to provide the pastoralists with the protection of an adequate police force.

3.4 Land tenure

The rangelands used by the pastoralists are at present held in trust by the Marsabit County Council. Even those who cultivate land on Marsabit Mountain are without title deeds and have to pay low rents to the Council. There are moves, initiated by the prominent people of the district, to induce the Government to register cultivatable land and rangelands on Marsabit Mountain and its slopes, and to issue title deeds. For any future development in agriculture and pastoralism it will certainly be beneficial to have land tenure put on a firmer legal basis. However, the process of bringing this about may have its dangers for the pastoralists. Firstly, pastoralists are in general ignorant of the complexities of land politics and their implications, and are consequently powerless to defend their own genuine interests. Secondly, locally prominent people who dominate the County Council and have influence in Government circles may be tempted to manipulate the situation to gain for themselves rangeland which at present constitutes essential grazing for the pastoralists. If this happens the pastoral economies of the Rendille, Gabra and Borana will suffer irreparable damage.

There is need for the present rangelands of the pastoralists to be safe-guarded from any possible annexation. This can be done by registering their rangelands in the name of the tribe and its elders. It is a matter for legal experts to advise on how exactly this can be carried out.

3.5 Market facilities

The present market structure has already been described in detail in part 1 of this document, in the section on Marketing. However, in analysing the needs of the pastoralists it can only be said bluntly that present market facilities for livestock are inadequate. Prices are low, auctions are infrequent, irregular, or non-existent, and the market is geared to serving the interests of buyers and merchants rather than the needs of the pastoralists. In other part of Kenya it is not uncommon for livestock auctions to be organized by the local county council. In such cases the places and dates of all auctions are fixed at the beginning of the year and detailed lists distributed so that buyers and sellers are given ample notice. In the Rendille and Gabra country no such system exists. Traders usually prefer to buy on an individual basis and frequently the seller is given goods rather than cash for his livestock. The trading community are content with the *status quo*, as it gives them a distinct advantage.

Since merchants and traders form a strong lobby in the Marsabit County Council, it is not perhaps surprising that the council has hitherto shown little interest in organizing auctions. This is of course short-sighted, since the promotion of livestock sales would channel more money into the local economies - which are frequently starved of cash - and this in the long run would bring real benefits to the trading community itself.

The Livestock Marketing Division LMD a Government agency which concentrates on buying bovines of particular sex, age and weight, provides pastoralists with only a minimal service. Its policy of buying in livestock to alleviate the plight of pastoralists during droughts is ineffective since the buying frequently comes too late, when the stock have already lost condition and are worth comparatively little.

Research on cattle and smallstock herd structures indicates a considerable variation in market orientation between pastoral households. Eighty per cent of some household herds are females, suggesting that males are sold or exchanged for females. Other household herds contain 60-65% of females, which indicates little involvement in the market. Pastoralists sell livestock primarily to buy foodstuffs, clothes, footwear, tobacco, ochre and local jewellery. It is normal to sell smallstock - goats more often than sheep - but occasionally cattle are sold to provide for household needs over a long period, or to meet larger demands such as school fees. Frequently the money derived from the sale

of cattle is lodged with a kinsman or friend who is a shopkeeper, and household members go to his shop for commodities when required and are even extended credit facilities. Shopkeepers who gain little from the sale of some commodities strive to obtain high profits from buying and selling livestock themselves.

The most favourable markets exist for cattle and goats. The market for sheep is less favourable, and there is no market at all for camels in the wider national economy. An owner is fortunate to obtain Shs.1,000 for a camel. In the Sudan camels fetch approximately the equivalent in local currency of £400 sterling. However, in north-eastern Kenya, where there are trade links with Somalia, prices for camels are at least twice the Marsabit prices.

The present market structure has far-reaching consequences:

a. Low prices for camels have induced some Gabra and Rendille pastoralists to invest less in camels and more in cattle, for which there is at least some market, however inadequate. This implies an increased pressure on rangelands surrounding the primary and secondary water sources which cattle mainly use, except in wet seasons. The camel, which can use rangelands long distances from permanent water, is infinitely more suitable environmentally.

b. Pastoralists frequently slaughter for food rather than sell animals and buy in food, because of the poor market facilities and low prices available for livestock. The alternative strategy is in many instances more beneficial to the pastoralists - and they admit this - since shop bought food can be spread over a much longer period. Improved terms of trade between the pastoral economy and the wider economy would induce pastoralists to sell more livestock.

c. The unfair market structure which exists at present is one of the main causes maintaining the pastoral economies in a state of underdevelopment. Possibilities of transforming animal wealth into other sources of wealth, which can be used to develop the pastoral economy and to provide improved technical and social services, are blocked.

3.6 Improvement of veterinary services

There is at present a totally inadequate veterinary extension service and consequently animals are lost unnecessarily and their overall productive and reproductive potential is minimized. Livestock ecologists have identified the disease profile of the animals in the study area (see the section 'Livestock Resources' in Part 1). Here only two diseases are mentioned as examples.

Contagious caprine pleuro-pneumonia is rampant. Hundreds of sheep in particular die at the onset of the rains. The other example is the high rate of abortion in camels. Pastoralists in general appear to be willing to pay for the treatment of sick animals, particularly of sick camels and cattle. However, they are reluctant to pay fees for the mass vaccinations of animals, partly because immediate returns on the investment are not visible.

When the prices of livestock improve, the overall willingness to invest in the veterinary care of animals will also improve. It is the task of the Livestock Ecology Programme to outline the technical aspects of a suitable veterinary programme but the human ecologist is in a position to advise on how to deal with the pastoralists, where dips can be located so as to give optimum service, and where clinics ought to be held.

3.7 Banking facilities

In general, pastoralists are reluctant to sell more livestock than is necessary to meet their basic needs. Numerous writers have pointed out that nomadic pastoralists build up herds to a maximum during good years in order to survive through the worse years. This ecologically unsound practice continues unmodified, in part because pastoralists lack easy access to financial institutions and hence are deprived of any means of storing wealth other than "on the hoof". Although a bank has been built at Marsabit Town it will remain remote from the needs of the pastoralists unless it organizes a mobile unit to serve the outlying areas of the district.

The Marsabit Post Office has saving facilities, but the post office is anything from 70 to 400 km away from the majority of pastoralists who live in the plains. Any interest gained would be greatly eroded by travelling and accommodation expenses incurred in reaching the town. There is also another reason why pastoralists are reluctant to open up savings accounts. In times of high inflation rates, money invested in livestock during good years yields higher returns than money lodged in savings accounts. On the other hand, of course, this argument is reversed in drought years.

Nevertheless, and inspite of the absence of banking facilities, certain trends are slowly emerging which indicate that pastoralists are willing both to sell livestock and to open up savings accounts. For example, one Rendille pastoralist, on the advice and at the urging of a brother who is a literate trader, has sold a substantial part of his herd and lodged the money in a savings account. His brother was able to persuade him that it was inadvisable to invest all household

wealth in livestock since the higher profits available from investment in livestock in years of good rain must be balanced against the higher risks and loss of livestock which occur in drought years.

The other trend, which is noticeable particularly amongst commercially minded Gabra pastoralists, is the tendency to buy up young animals to fatten for prompt resale. This tendency should be encouraged as it will assist in effectively increasing offtake.

3.8 Health services

Of the group of identified needs that we have described as welfare services, the provision of adequate health care obviously ranks high. In the proposed project area the following facilities exist at present.

- district hospital at Marsabit Town which serves all pastoral groups
- health centres at Gatab (8 beds) and Laisamis (50 beds)
- dispensaries at Ngurunit, Korr, Loglogo (4 beds) and Kargi.

All these health centres and dispensaries are mission managed and some are visited by a mission doctor once a month. This network provides some basic service for residents of trading centres and for nomads who come for treatment, but the rural nomadic communities, who are frequently located 30 km from a dispensary, are without adequate medical care. The frequency of mobile clinics visiting such communities should be stepped up.

3.9 Drought assistance

The pastoral economy remains vulnerable to periodic droughts. The traditional solution is to send livestock to special areas that are normally reserved for drought years. The territory lying east of Lake Turkana from Alia Bay southwards is one such reserve for cattle and smallstock and in the 1980 drought parts of the Hedad were used as camel pastures. The north west (i.e. rangelands east of Lake Turkana) drought reserve should be consolidated and a new drought reserve opened up on range located east and south-east of Loglogo which is rarely used (see Map 16).

The ideal solution, as practised by some ranchers - South African and German - in Eastern Namibia, is to sell off all stock if a drought threatens to be long and severe.

'But often the only solution is rapid selling, and due to the efficiency of the sales organisation and the means of transport to the abattoir, this can be accomplished on a large scale within days of the farmer's decision to sell. When the rains come again, the farmer may decide to breed up his herd with his own breeding stock, or he may decide to make full use of his grazing by buying in young male stock for fattening. If he lacks the money to carry out his plan immediately, there are several local financial institutions ready to make him a loan. Like his decision to reduce his herd, his decision to expand it may be taken and implemented within days' (Devitt, 1977, p. 196).

This example illustrates what is possible where 'rapid transport, and efficient marketing system, telecommunications and the ready availability of loan capital contribute to the flexibility of the system' (Devitt, 1977, p. 197).

Since Marsabit District lacks such articulation with the wider economy and will do so for some time to come, such solutions are impracticable in the immediate future. The greatest need is, firstly, for pastoralists to be encouraged to sell mature male stock in good years and to lodge the money in savings accounts to be used in drought years. This would provide some form of insurance against drought. Secondly, when drought threatens, auctions should be organized promptly, before the livestock lose condition. This would also provide the pastoralists with ready cash to meet food bills during the drought period.

4. Sedentarization

IPAL acknowledges as an established fact the trend towards sedentarization and reduced mobility of the main camps. Undoubtedly, of course, this trend heightens the need for range monitoring and control in zones surrounding trading centres and waterpoints. But instead of attempting to induce main camps to return to the nomadic way of life - in some respects a romantic conception - the emphasis should be on transferring as many livestock as possible from main camps to *fora* camps. This is already taking place in certain parts of the Rendille country. In August 1982 the main camps at Kholbakha - some 20 km from Marsabit town - contained no cattle and very few small-stock. The only animals that remained in any numbers were milch camels, which were able to graze very close to the main camps and were cared for mainly by young people. The rest of the animals were at *fora*. Turning back the historical clock is in general neither feasible nor desirable.

At present, 'town' pastoralists graze (particularly milch animals) in permanently used rangelands surrounding trading centres. This enables them to provide milk for the household living in the trading centre. The practice is also connected with the availability of labour at the trading centre, where some owners lack labour to maintain herds elsewhere.

As already recommended, the rangelands surrounding trading centres should be closed to animals until they recover their vegetational cover. It must be recognized that this will pose certain problems for the 'town' pastoralist. If he wishes to use the milk of his animals he will have to transport it from his *fora* camp to the trading centre, which could be done easily enough by those who have a sufficient number of pack animals. Others may lack the required number of pack animals, and will have a more serious problem.

Both Rendille and Gabra pastoralists make yoghurt from surplus milk, but in normal circumstances they prefer to drink fresh milk. Research into the comparative nutritional value of milk and yoghurt is necessary. If no great difference exists, 'town' pastoralists should be encouraged to process more of their milk into yoghurt. This would help to offset the transport problem.

There is, in general, a need to increase income opportunities in trading centres in an effort to alleviate poverty and to raise living standards among the sedentarized groups.

5. Education: School Leavers and the Unschooled

Over 95% of the adult Rendille population are illiterate. This creates a formidable barrier to any developmental/environmental programme. The importance of extending present efforts in the field of adult literacy cannot be over-stressed. Development agents initially will have to rely on the elders to implement the management proposals. Hence it will be necessary to hold short courses on water, range and livestock management for elders (particularly those who will be members of range development committees) so as to introduce them to the reasons behind the management proposals.

Numerous primary-school leavers from pastoral households who fail to enter secondary school have difficulty in obtaining paid employment. Many of them are reluctant to return to pastoralism to gain a livelihood. This is in part due to the low esteem in which pastoral nomadism is held in the curricula and

by some teachers and Government officers. It is also partly due to the low incomes obtainable for pastoralism because of poor market facilities and prices for livestock. School leavers expect to start on an income comparable to the minimum wage of a night watchman, approximately Shs.3,600 per annum; the average annual income of pastoral households is about Shs.1,500 - 2,000. But there is yet another reason why some school leavers are slow to commit themselves to pastoralism: many of them are either from poor households or are younger sons and therefore own little livestock to start with.

There is need for IPAL to occupy itself with this human and social problem, because the school leaver together with his unschooled brothers possess the greatest potential for transforming traditional pastoralism along lines which are both environmentally and developmentally sound. It is unreasonable to expect too much innovation from the present generation who are in control. Change will come slowly and mainly - although not exclusively - through the younger generation. IPAL can immediately co-operate with the elders to introduce initial and preliminary changes in range and livestock management. However, for long-term and self sustaining change, direct investment in training the younger generation in skills which are necessary to develop the pastoral economy cannot be avoided. The plans of the Diocese of Marsabit to establish for school-leavers a Training Centre for Pastoralists are timely and most welcome.

6. Structures for Development

Present structures for district development administration have been discussed in Part 1. Particularly since the Government has decided to make districts the foci of project identification and implementation it is essential that the district's development machinery ought to be revitalised, taking due note of the roles Government officers, MPs and other politicians, pastoralists and mountain people, merchants and traders ought to play. The present DDC is too remote from the people. Serious efforts should be made to establish sub-DDCs which meet regularly and on which the pastoral community is well represented. Similarly locational and sublocational development committees ought to include not only Government officials and traders but representatives from the pastoralists. Members of all committees ought to receive some basic training in the arts of planning and implementation. Implementing officers ought to be made more accountable to the committees on the progress of their projects.

At present the DDC lacks the capability of adequately managing on its own projects planned by IPAL. In the early stages of the implementation of IPAL findings the proposed Kenya Arid Lands Research Station (KALRS) will need to work in close cooperation with Government officers and to operate within the district development structures since Government are primarily responsible for the development of the district. This further emphasizes the importance of having efficiently run district offices of the various ministries.

It is recommended that the administration should strongly counteract the tendency to regard appointments to Marsabit District and other outlying areas in the country as punishment posts. Instead, a period of quality service in arid areas should be considered as essential for promotion in the Civil Service. Because Marsabit District is the largest in the country there ought to be correspondingly generous budget allocations for fuel and transport. Steps should be taken to provide improved social amenities for officers living at the district and divisional headquarters - officers' clubs, squash and tennis courts etc. The recent re-opening of the officers' club at Marsabit is to be highly praised.

7. The Collection of Public Funds

It is essential that the local communities should contribute some percentage towards the capital expenditure of all range-development projects. However, the present system of collecting *harambee* funds is open to abuse and should be changed. At present, *harambee* committees, which mainly consist of traders and those living in trading centres, use elders to collect animals from the pastoral households, and receipts are never issued. Some traders are able to buy the *harambee* animals at low prices to resell them for much larger sums of money. This practice should be stopped immediately, since it clearly perverts the spirit and intention of self-help.

It is recommended that in future auctions should be organized to enable the pastoralists to obtain money to contribute to *harambee* or self-help projects in cash. Instead of offering livestock, money should be contributed and receipts obtained, as is of course already the practice in most of the country. The result should be a substantial increase in public trust in *harambee* fund raising.

II

RESOURCE MANAGEMENT OBJECTIVES, PROPOSALS AND PLANS

A. INTRODUCTION

Part 1 of this management plan laid out a detailed description and inventory of the range resources of the Rendille area, resulting from the extensive IPAL surveys and research programmes. Part II contained a detailed analysis of people's needs and of present development constraints and stated the management policy being adopted in this plan. The remaining section will lay down, first, specific management objectives for the various resources and, second, management proposals on how to achieve those objectives.

Range management is a well developed discipline dealing with the management of grazing lands, and the techniques it has developed have been applied and shown to work in many parts of the world. There are, however, several considerations that have operated to make the plan proposed here a little different from conventional range-management plans such as have been applied elsewhere. First among these in the unreliable, erratic rainfall of the area and consequent irregular forage production. This means that it is not possible to devise a definite and regularly prescribed grazing rotation.

Many successful range-management schemes have been operated in areas where indigenous populations have been excluded and the range manager has probably been knowledgeable in the broader aspects of the modern economy. Here again the present plan differs, in that we are dealing with the pastoralist people and the success of the plan depends on the attitude they adopt towards the whole plan. We have been constrained by the fact that we must devise strategies that will be acceptable to them and which they will be able to afford to carry out in the long run by themselves.

Thirdly, the deteriorating world economic situation of recent years has probably hit the developing countries harder than the developed world. Kenya is no exception. There is only limited capital outlay available for development, compared with what would normally be available in the more affluent nations. This means that our proposals have had to take into account what can be financed within the available resources in the country. Although it is foreseen that the beginning of the implementation of a development programme will need capital assistance from outside, we recognize the

necessity for it to be sustained locally in the long run. As mentioned earlier, this plan confines itself to the Rendille country of Marsabit District in northern Kenya, which is being treated as one 'development unit'. The specific management objectives are now discussed together with the management plans.

B. MANAGEMENT OF WATER RESOURCES

1. Principal Objectives

a. The first consideration in water development should be the provision of adequate waterpoints for domestic use.

b. The second is the provision of adequate water for livestock well distributed to facilitate even grazing of the range and to reduce stress on livestock caused by walking to distant watering points.

2. Water Development

In part I we noted that the results of studies on the water potential indicate that adequate water resources exist in the Rendille country. The only constraint on its development is cost. Studies have also shown that there is adequate water such that hand-dug wells would adequately cater for the water needs of the area. Priority should therefore be given to the development of hand-dug wells rather than boreholes, whose development costs are exorbitant.

2.1 Well density

The ideal situation with regard to water development in the Rendille area would be to have a waterpoint on every 25 km^2. Livestock would not then have to walk long distances to water and this would also redistribute grazing pressure and alleviate the deterioration of the range. If such a distribution were to be implemented, the Rendille area alone, which is approximately 10,000 km^2, would need 400 wells. At an estimated cost of KShs. 30,000 per well, $US 1,200,000 would be needed for such a development. Under the prevailing economic circumstances, such a development would be unrealistic and impossible to achieve. Even if the area to be served by each well had to be increased to 50 km^2, 200 wells would still be required at a cost of $US 600,000 and this would be almost as difficult to achieve.

In this plan it has been decided to base calculation of the needed well density on the actual available ground water determinations in configuration with the actual water needs of people and livestock as well as on the expected new distribution of livestock if the range management becomes effective.

Map 25 shows the area of an urgent water need at the moment based on the distribution of the present permanent water sources and an effective area served by each well of 761.5 km^2 (15.6 km radius). This is the mean area

taking into account the fact that cattle, smallstock and camels can graze in radii of 10 km, 25 km and 50 km around a well.

Altogether 26 new wells are proposed. For their location see map 25 and the description of the sites on the following pages.

The area without sufficient water supply at the moment has been given priority as well as the insecure areas of the Hedad. All the proposed wells should be hand-dug wells with cement culverts to avoid collapse of the wall. Building with concrete culverts will cost about Shs. 2,500 per metre. On the average one well will cost KShs. 25,000 if the local people contribute their labour. The sinking of boreholes and the mechanical drilling of deeper wells should, however, not be attempted at this stage until the monitoring of the proposed network of wells has produced concrete results. Also the cost of drilling boreholes is prohibitive (100-150 m will cost up to KShs. 600,000).

In addition it is proposed on Mt. Kulal to extend the pipeline from Gatab to Luai (KShs. 200,000) and to rebuild the pipeline at Arabel (KShs. 300,000). At Moruset there is another potential site for pipelines. Further research is necessary here.

Table 153. Proposed new well sites

Resistivity number	Location	Depth of water		Range unit
		Dry season	Wet season	
1	Olturot	10/40	-	12
2	Hedad	6	4	3
9	Korr	3	5	2
10	Kargi	6	4	24
15	Kargi	2	12	2
16	Kargi	3	10	10
18	Balesa Kulal	10	11	12
19	Hedad	20	15	9
20	Hedad	15	11	7
21	Hedad	4	4	5
22	Korole	2	10	1
23	Balesa Kulal	4	4	12
24	Balesa Kulal	3	-	12
25	Balesa Kulal	5.5	3	-
28	Ilim	10	no data available	-
29	Loglogo	10		-
30	Ngurunit	3		20
33	Hedad	3		7
37	Hedad	8		3
39	Hedad	4		-
40	Hedad	10		10
44	Hedad	8		8
45	Hefarein	5		1
46	Korr	2		24
51	Balesa Kulal	3		10
53	Kargi	3		10

Map 25. Water resources in the grazing area

Well, spring, water hole, dam site.....

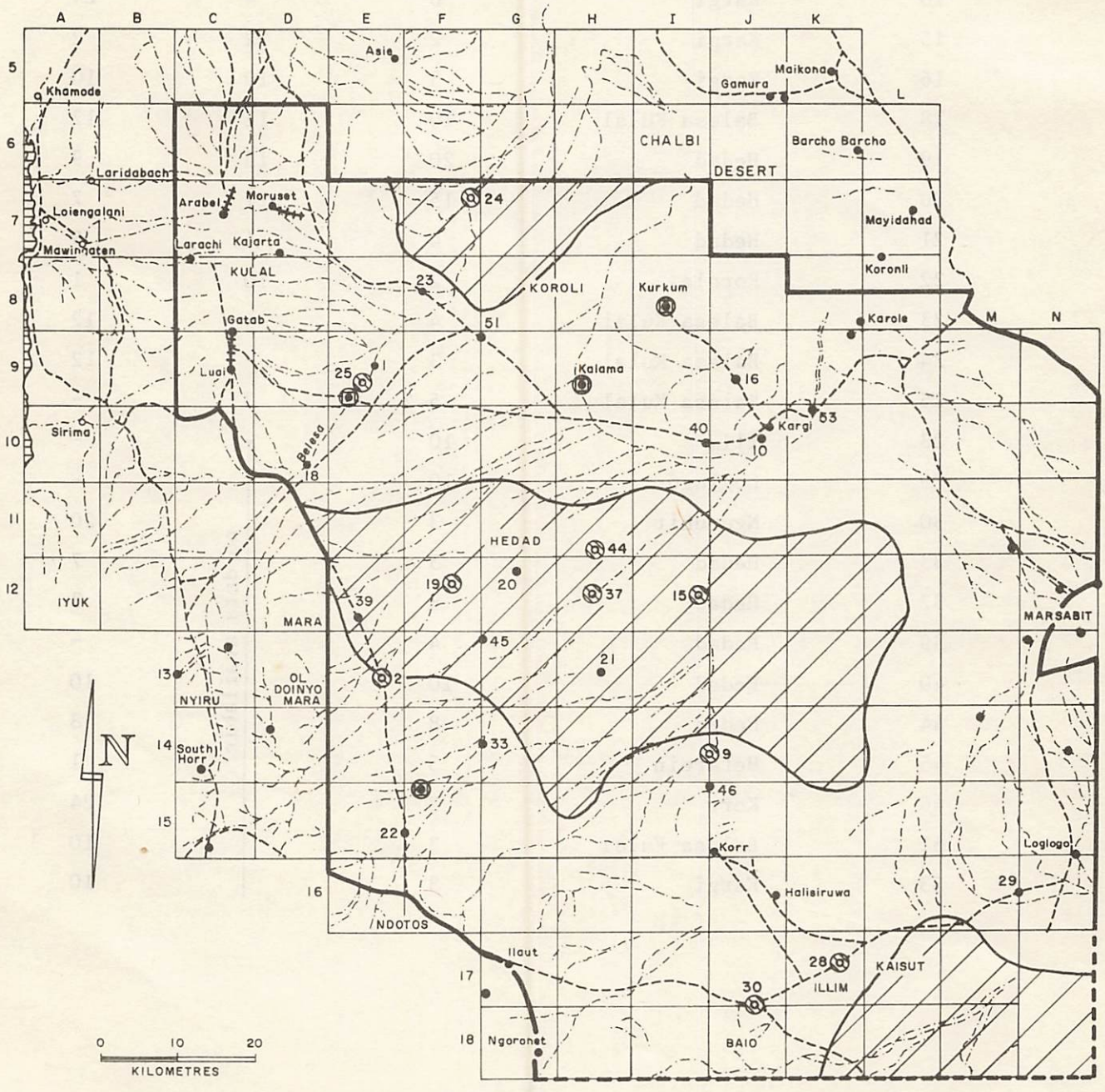
Well, spring, water hole, dam site: limited capacity.....

Well, spring, water hole, dam site: to be developed.....

New proposals of wells (number indicates electrical resistivity measurement) 37

Areas without sufficient water supply at the moment.....

Proposed pipe-lines.....



G.deS.

Table 154. Water needs in the different range units

Area no.	Area	Camel	Cattle	Sheep	Goat	1 km^2	Water need (per year) Total range unit (litres)
1	395.2	6300	8855	3619	5622	61.7	24396
2	494	3935	25601	10366	3535	88.1	43537
3	178.8	325	11745	4803	235	95.8	17108
4	112.9	3216	2139	922	2819	80.9	9096
5a	178.8	2091	13549	556	184	9.3	16380
5b	272.9	1722	22469	11174	1984	136.9	37349
6	160	2153	15418	6381	1962	162	29194
7	240	1226	9986	2843	1121	63.7	15276
8	244.7	5895	7504	3026	5288	88.7	21713
9	672.8	16454	28973	11886	17366	106.5	71679
10	1,025.7	21338	50918	10632	18569	98.1	101457
11	23.5	102	854	350	89	59.1	1390
12	112.7	1318	1730	756	1136	43.8	4940
13	635.2	5333	12979	5972	4822	45.0	28606
14	376.4	2062	32149	13078	1924	130.7	49213
18	668.1	3807	12191	4974	4584	38.3	25556
19	3,011.2	49458	296192	100675	45711	146.8	442046
20	390.5	5701	12541	2965	4845	66.7	26052
21	329.4	120	67327	27557	96	288.7	95100
22	211.7	-	-	-	-	-	
23	258.8	-	-	-	-	-	
24	207	-	-	-	-	-	
25	18.8	-	-	-	-	-	
Total	10,291.1	*	*	*	*	*	1059908

* Average

Camel 3.65 m^3/year/head

Cattle 7.6 m^3/year/head

Sheep, Goat } 1.46 m^3/year/head

DETAILED DESCRIPTION OF PROPOSED WELL SITES

Station 1

Balesa Kulal sheet 42: 52E, 82N. At Olturot. Profile in an east/west direction along airstrip next to UNESCO camp. Altitude 570m a.s.l. Volcanic detritus on surface on plain.

Station 2

Hedad sheet 54: 53E, 54N. 28 km south of Kargi - S. Horr - Gatab - Olturot Road junction. In the Korante plains. Across Lagga Sands in flood plain. Alt. 667m a.s.l.

Station 9

Marsabit sheet 55: 01E, 36N. 15 km north of Korr on Korr - Kargi road. Sandy soil in plain with lava plateau exposures to the east. Alt. 525m a.s.l.

Station 10

Maikona sheet 43: 08E, 77N. At Kargi. Next to borehole C3960. Kunkar limestone in flood plain. Volcanic plateau approximately 1 km south. Alt. 428m a.s.l.

Station 15

Hedad 54: 99E 55N. Along Korr - Kargi road. 20 km south of Kargi - Olturot - Korr road junction. Sands in plain. Alt 478m a.s.l.

Station 16

Maikona sheet 43: 03E, 8 km NW of Kargi on Kargi - Kurkum road. Reddish sands in plain. Alt. 445 (?) m a.s.l.

Station 18

Ng'iro sheet 53: 40E, 71N. Across Balesa Kulal lagga. At Gatab - Ilaut road crossing. Sands in flood plain. Alt. 671m a.s.l.

Station 19

Hedad sheet 54: 62E, 60N. Across Lagga. 10 km NE of Station 2. Sands in flood plain. Alt. 595m a.s.l.

Station 20

Hedad sheet 54: 70E, 35N. In Lagga Hafarin. 19 km below Ilaut - Gatab road crossing sands in flood plain. Alt. 609m a.s.l.

Station 21

Hedad sheet 54: 86E, 36N. Across small lagga. Sands and soils in plain at the top of basaltic lava flow. Alt. 560m a.s.l.

Station 22

Hedad sheet 54: 59E, 25N. In Karante plain. Along Ilaut - Gatab road. 15 km north of Ilaut - S. Horr - Gatab road junction near Oldoinyo Mara. Reddish brown sandy soil in flood plain. Volcanic lava on far east. Basement outcrops in the west. Alt. 760m a.s.l.

Station 23

Balesa Kulal sheet 42: 65E, 94N. In Balesa Kulal Lagga where Balesa Kulal river crosses the Kargi - Guss road. 22 km NW of new Olturot - Kargi - Gus road junction. Sands in river flood plain. Alt. 500m a.s.l.

Station 24

Balesa Kulal sheet 42: In Balesa Kulal Lagga 20 km down Lagga from Kargi - Gus road crossing. Sands in flood plain. Alt. 459m a.s.l.

Station 25

Balesa Kulal sheet 42: 53E, 81N. Near Olturot. In Balesa Kulal Lagga where Balesa Kulal Lagga crosses Kargi - Olturot road. Sands in flood plain. Alt. 569m a.s.l.

Station 28

Laisamis sheet 67: 44E, 03N. Ilim . Along Loglogo - Korr road. Fine sands with basement rock exposures 1 km east of station. Elevation 515m a.s.l.

Station 29

Laisamis sheet 67: 68E, 18N. 15 km west of Loglogo, on Loglogo - Korr road. Sandy soil with volcanic plateaus to the north and east. Alt. 490m a.s.l.

Station 30

Ndoto sheet 66: 24E, 9N. 24 km from Ngurunit on Ngurunit - Korr road. Brownish sandy soil on plain. Alt. 609m a.s.l.

Station 33

Ndoto sheet 66: 90E, 19N. 7 km north of Ilaut - South Horr - Olturot road junction. Across Lagga. Sand in flood plain. Station immediately west of volcanic lava plateau. Alt. 915m a.s.l.

Station 37

Hedad sheet 54: 77E, 42N. Across Lagga. Coarse sands and sandy soils in plain. Alt. 540m a.s.l.

Station 39

Hedad sheet 54: 57E, 47N. Across Lagga. 27 km south of Olturot along Olturot - Ilaut road. Sands in flood plain. Alt. 677m a.s.l.

Station 40

Hedad sheet 54: 95E, 71N. 15 km west of Kargi on Kargi - Olturot road. Reddish brown sands in plain. Alt. 460 (?)m a.s.l.

Station 44

Hedad sheet 54: 69E, 47N. Across Lagga. Coarse sands and sandy soils in plain. Alt. 579m a.s.l.

Station 45

Hedad sheet 54: 67E, 31N. Hafarin area. Station in lagga valley. 500 m west of volcanic hills. Sands. Alt. 665m a.s.l.

Station 46

Marsabit sheet 55: 03E, 25N. 2.5 km from Korr along Korr - Kargi road. Undulating surface. Basement detritus (sands, pebbles and cobbles) overlying basement rocks. Basement exposures. Alt. 580 (?)m a.s.l.

Station 51

Balesa Kulal sheet 42: 70E, 89N. On Kargi - Guss road, 16 km NW of new Olturot - Kargi-Gus road junction. Brownish sands in plain. Alt. 530m a.s.l.

Station 53

Maikona sheet 43: 18E, 84N. 26 km east of Kargi on Kargi - Marsabit road. Volcanic boulders and detritus At the edge of volcanic plateau. Alt. 501 (?)m a.s.l.

Priority of wells

Based on the calculated range carrying capacities the maximum water needs have been calculated for the total area and per km^2. The last one has been used to compile the following priority list. The survey of the water resources took place before the livestock carrying capacities for the various range units were known. That is why for example no sites have been identified in range unit 19 although it has one of the highest water demands. This unit, however, has quite a high water potential but it can only be exploited by boreholes.

Table 155. Priority list of well sites

Site No*	Range unit No.
19	9
40	10
51	10
53	10
16	10
2	3
39	3
21	5a
44	8
15	2
9	2
30	20
20	7
37	7
45	1
22	1
33	1
23	12
24	12

* for details see preceding specific site descriptions.

As usual in hydrology maximum figures have been used. If the whole year is taken into account the actual figures will be less but it is imperative in hydrology that maximum needs are taken care of.

Constraints in the construction of several wells at the same time

One well tapping water from a depth less than 10 m cannot give enough water for all the livestock in a certain area. Normally its capacity will be around 1 m^3/h. Often it can be observed that the local people try to increase the capacity of a specific site by digging more wells in the direct surrounding. This might work in certain places for example, in the lagga at Ilaut where there is a constant chanalized subsurface stream from the wet Ndoto Mountains. This is also possible in the Balesa Kulal but for most streams flowing in the Hedad it is not. One well only can create a depression (cone) in the local upper water table making the other wells around fall dry. There are several methods to determine the most suitable distance from one well to another but each of them involves a lot of capital and technical input. It is therefore proposed that spacing for wells in laggas in the Hedad be 2-5 km if there are no favourite sites like subsurface wells. These store water upstream.

Another point worth noting is that the building of a new well will cause livestock and human concentration around it which will lead to degradation of the environment. If the well is permanent, severe damages are almost unavoidable. The damage increases non-linearly with the amount of available water so that additional wells at the same site would increase this effect. Proper water management will be most likely the most difficult problem in range management in the area. Therefore it is not bad if the wells in crucial areas, where there is a high danger of degradation, dry out at certain times. This will be in accordance with the prevailing natural conditions. In a dry year when there is only little production by the vegetation the well will be dry earlier so that the people are forced to move with their livestock. It has been shown all over the world that the abundance of water favours human sedentarization and thereby accelerates desertification.

To open the flatter southern slopes of Mt. Kulal, the pipeline leading from Mt. Kulal to Gatab will be extended to Luai. Probably this means also the improvement of the catchment areas of Mt. Kulal to bring enough water for domestic and livestock use, e.g. to water approximately 2,500 cattle in this area. The capacity of this pipeline should be 3m^3/h. Another site will be Arabel where the pipeline should be rebuilt.

A further potential site, Moruset, offers possibilities for water development. The rivers can rarely be used to provide water. They flow only during short times when there is rain in this catchment basin. High plains can be directly

associated with higher floods, which are unusable. This is partly why at the moment over 90% of runoff water is not used: it evaporates, disappears below the ground, or flows to other areas where it infiltrates the nearby river-beds. At least this water is not lost completely since it is stored underground and can be tapped by wells, etc.

To decrease the amount of unused and spoiled water we recommend the following systems:

- Diversion of runoff water by small dams to depressions to increase groundwater. These can be used for the growing of fruit trees as an addition to the diet of the local people. (A detailed study of sites etc. is still necessary).
- Where bedrock (lava, basement) is present at a shallow depth, the construction of small surface dams for watering animals. (possible sites exist only in the basement complex areas and the Balesa Kulal, where lava crosses the river).

2.2 Development of existing wells

Many existing wells are not operating to their full capacity due to various malfunctions and breakages. Priority should be given to the fitting of new pumps at these wells. Emphasis should be on simple and functional handpumps which can be easily serviced in the country. The following specific malfunctioning wells should be improved as a matter of priority:

1. Balesa Kulal (near crossing of Olturot road);
2. Hafarin (No. 2); and
3. Kurkum (either increase the recharge of the old well and install a better pump or develop a new well at site 16).

In addition, the dam site at Falam (Kalama) should be repaired to give enough water at least for parts of the dry season and to open up the grazing there.

2.3 Other alternatives for water development

This section is mainly given over to outlining a number of aspects of water development that have not yet been treated in this plan but which are vital to the water-development component of any project.

Firstly, the sites identified during the field work are briefly discussed. There follows a discussion of a number of methods of water conservation which

are appropriate to the IPAL study area in addition to pans, subsurface and sand dams. These are rock catchments, roof-top rain water, harvesting, water harvesting using micro-catchments, and catchment protection work which is an activity closely related to water development. The suitability of these techniques to the IPAL study area in general is briefly assessed. By employing as wide a range of water conservation measures as possible an increasing proportion of the water that is presently lost may be used to good effect and for a wide range of purposes. Thirdly, some aspects of water-development planning and implementation are outlined. These are considered to be essential to the success of the development programme.

a. The sites

Map 26 shows the approximate distribution of the sites identified for alternative water development. The sites are mostly located around the margins of the Hedad. It is not necessarily the case that the sites are in the best locations in terms of spreading the movement of livestock as widely as possible over this area. The core of the Hedad, which is the main waterless region of the study area during the wet season, has still to be properly surveyed for possible water points.

So far only the estimated costs of development of individual sites have been given. The relative costs of pans and dams may be compared if the cost is expressed in terms of Kenya shillings per cubic metre of water stored. Table 56 gives a summary of storage capacities and costs of the various structures proposed. Column 5 shows that although only one pan has been proposed, the estimated unit cost is only KShs. 7/= as compared with the costs of dams, which range from 30/= to 139/= per unit volume of water stored. This suggests that, of the three main types of structures, pans should be the main form of water development used in the rangelands of the IPAL study area. Indeed, the chances that a pan will function successfully appear to be greater than those of a subsurface or sand dam, given the uncertainties concerning vertical and lateral leakage from the sediment reservoirs. Moreover, the cost of pans may be reduced by using donkey or camel-drawn dam scoops and hand labour rather than earthmoving plant, which the above figures assume.

The availability of stone or the transport to import it will also affect the type of structure used. In general, gabion diversion weirs will require larger quantities of stone than subsurface or sand dams. In the Hedad, stone is extremely rare except at the western, southern, and eastern margins. With the exception of the laggas north of Korr, most of the sites identified will require transport to bring in stones and other building materials. The construction costs will of course rise according to the distance to be travelled and the quantity of material required.

Map 26. Distribution of alternative sites for water development

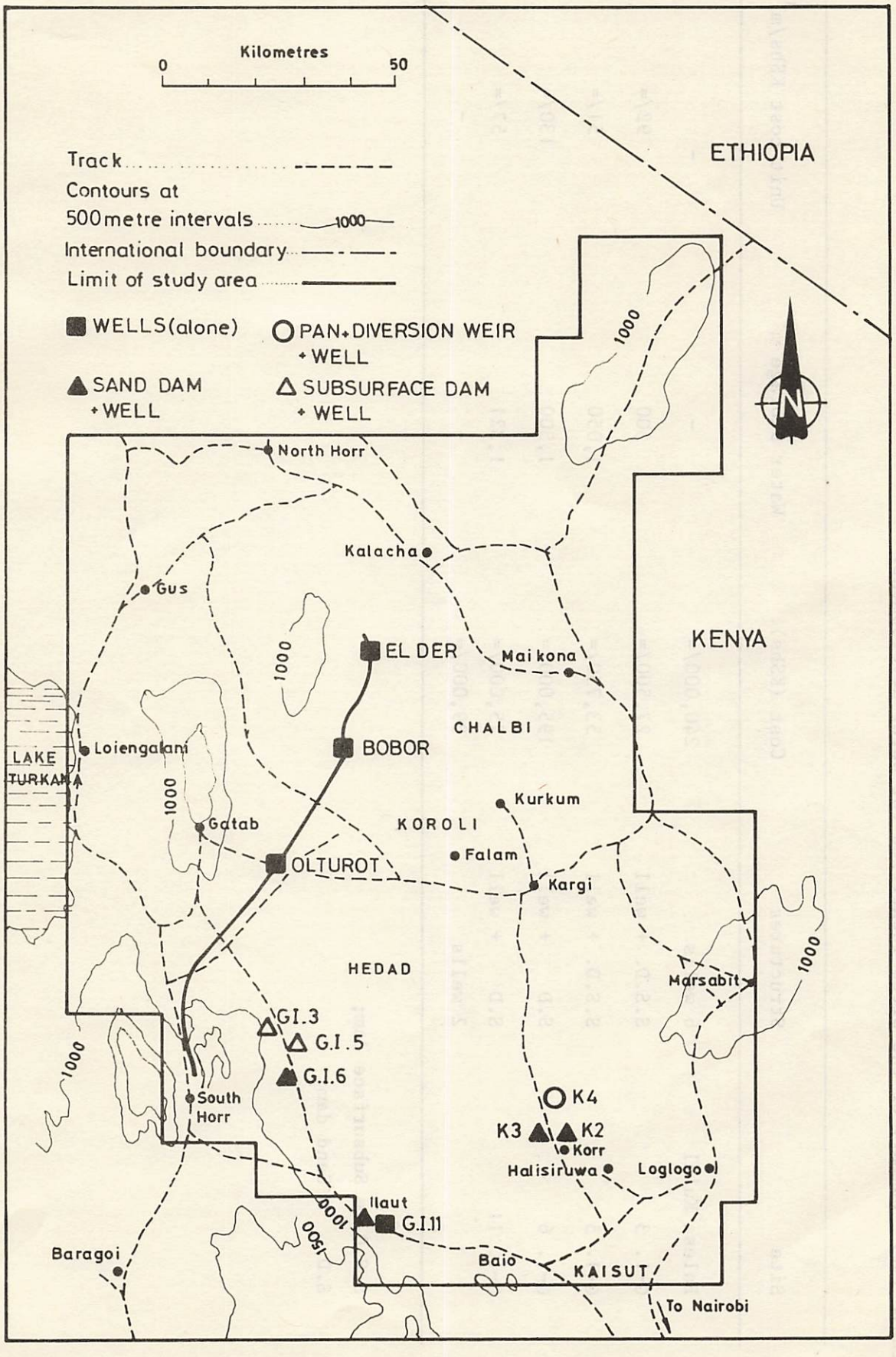


Table 156. Summary of the sites identified for water development.

Site	Structures	Cost (KShs).	Water storage m^3	Unit cost KShs/m^3
Balesa Kulal	6 wells	240,000/=	-	-
G-1. 3	S.S.D. + well	27,500/=	300	92/=
G-1. 5	S.S.D. + well	53,750/=	1,050	51/=
G-1. 6	S.D + well	195,000/=	1,500	130/=
G-1. 11	S.D + well	75,000/=	1,321	57/=
	2 wells	39,000/=	-	-

S.S.D. = Subsurface dam;

S.D. = Sand dam;

The availability of labour for construction and maintenance is another important factor which must be considered. During the period of field work researchers were struck by how few people there were, particularly near the Balesa Kulal and in the area along the Gatab - Ilaut road. Although information on work rates is not available, it must be assumed in the planning process that any type of structure will require at least 300 men days to complete, providing there are no delays in the arrival of building materials and so forth. Special arrangements may be necessary in order to get a reasonable work force. Most of the people's time appears to be taken up with looking after their livestock. Nevertheless, participation of the local population is essential if a sense of ownership and responsibility for the waterpoints is to develop.

b. Other forms of water development and related activities

i. Rock catchments

Where there are hillsides of bare impermeable Basement System rocks, nearly all the rain runs off and is rapidly lost in the sandy pediment surrounding the hills. Small masonry walls 25-30 cm high can be built along hillsides to guide the runoff into either a masonry storage tank or a small storage reservoir. The reservoir may be created by constructing a masonry weir at a suitable site in a natural depression in a rocky valley.

Opportunities for this form of water development exist mainly in the mountainous area around Ilaut and Ngurunit and at isolated rock outcrops such as Baio Mountain (Map 26). In these areas there are huge rock faces which could yield large quantities of good quality water if fully developed.

ii. Roof-top rainwater harvesting

Roof-top rainwater harvesting is feasible and to be encouraged wherever there are buildings with impermeable roofs. Roofs consisting of corrugated iron sheets are found in most of the more permanent settlements in the IPAL study area. Again, nearly all of the rain will run off the roof and may be channelled, using guttering, into a small tank. Providing the tank is kept covered, the water will be of relatively high quality and should be used for domestic purposes. The tank may consist of anything from a fuel drum to a large jar constructed using a wooden lattice framework plastered with mortar. The limited areas of roof-tops in the settlements and the unreliable rainfall will not be

sufficient to provide water for more than a short time after the end of a rainy season. However, at least the domestic water situation will be improved a little. The scattered pattern of building in the settlements will probably mean that this form of development will have to take place on a private basis, but with technical advice provided for the people.

For an area with a mean annual rainfall of 250 mm the following amount of water can be gathered:

(General formula) roof surface (m^2) x annual rainfall = amount of water in l. For example from a roof of effective 50 m^2 (this is a home of 5 x 10 m) and an annual rainfall of 250 mm 12.5 m^3 can be harvested every year. Having a consumption of 10 l daily per person this can provide for more than 3 people for a whole year. With a rainfall of 400 mm this is already 20 m^3 equivalent to 5 people per year. Storage capacity might be a problem.

iii. Water harvesting using micro-catchments

Micro-catchment systems for collecting and using surface runoff before it reaches a stream channel are becoming an increasingly important component in the rehabilitation and development of semi-arid areas. The principle of runoff harvesting involves slowing the velocity of surface runoff and allowing the water time to infiltrate the ground. This is achieved by constructing bunds or ridges of stone or earth at successive, limited vertical intervals so that volumes of runoff generated between them are small and non-destructive.

Various designs exist for micro-catchments. For example, they may be simple ridges running parallel to the contours on steeper slopes, or squares with one corner pointing down the slope (Figure 37). In each case the effect is the same : the runoff is concentrated and allowed to infiltrate and water becomes available for plant growth. Such systems can be used to increase grass cover, to grow trees, and to increase the yield of crops.

Runoff harvesting techniques could be most effective and successful around the permanent settlements where the vegetation has been almost completely removed for a radius of several kilometres. Establishment of runoff harveting systems will be an essential part of an rehabilitation schemes that are initiated around settlements. The techniques and tools required are well within the capacity of the population, provided that an adequate environmental education programme is run.

iv. Catchment protection

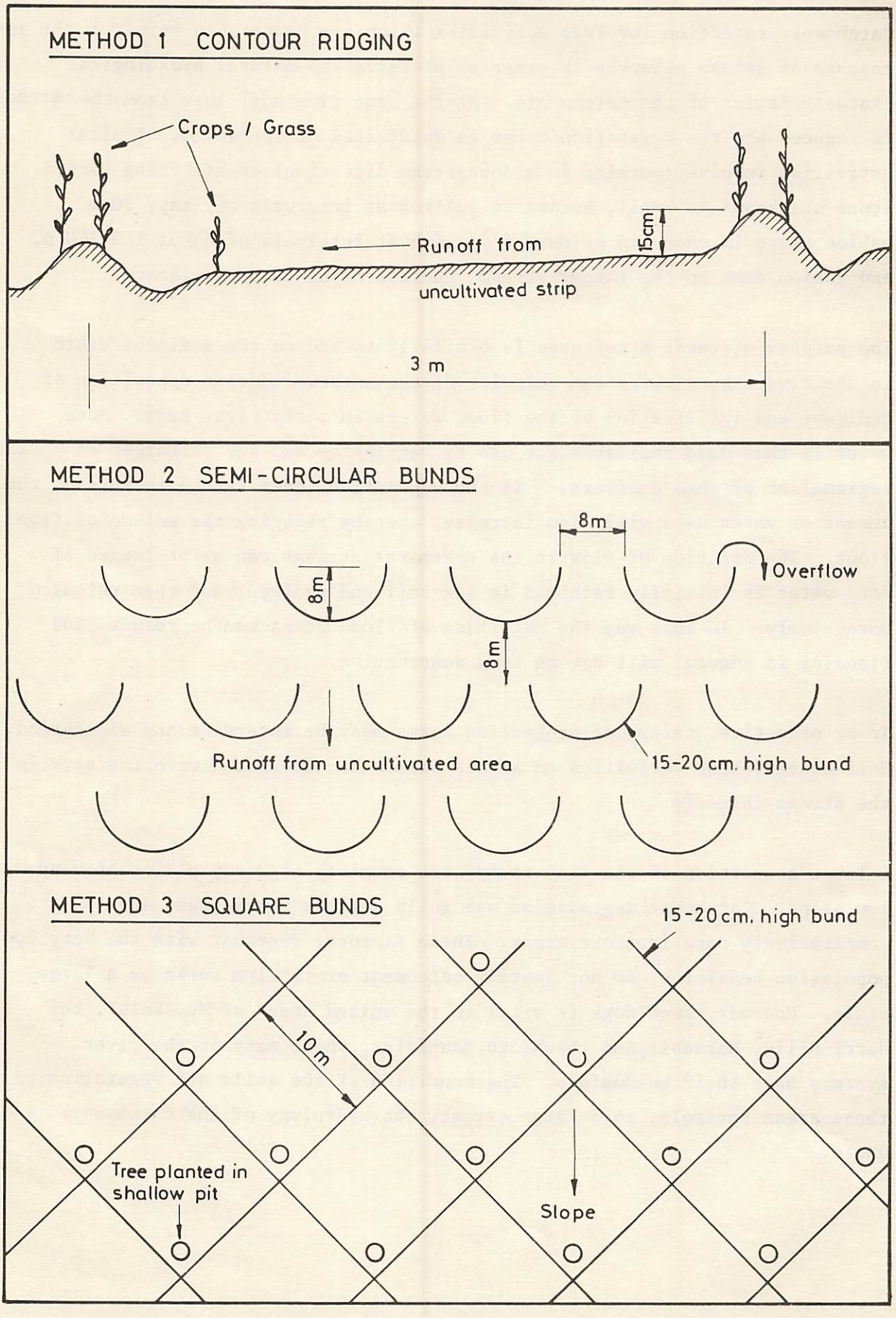
Catchment protection involves activities which are undertaken mainly in the upper reaches of stream networks in order to preserve the natural hydrological characteristics of the catchments. At the same time soil loss from the catchment is reduced and the vegetation cover is maintained or increased. Typical activities involve (working in a downstream direction) constructing heaped stone checkdams in small, headwater gullies at intervals of, say, 30 m, gabion weirs in channels of over 4 m width at intervals of about 100-200 m, and gabion dams on the larger stream channels of up to 30 m width.

The purpose of these structures is basically to reduce the sediment yield in the rivers by slowing the velocity of the water, inducing deposition of sediment and infiltration of the flood waters into the river beds. More water is thus made available for use by vegetation and for recharges of regional or perched aquifers. If the vegetation cover can be increased, the amount of water used will also increase, thereby reducing the volume of flood flows. The duration of flow in the ephemeral streams can be prolonged if more water is initially retained in the soil and sediment and then released more slowly. In this way the magnitude of flood peaks can be reduced and flooding in general will become less destructive.

To be effective, catchment protection works must be intensive and widespread. Soil conservation activities on slopes should be integrated with the work in the stream channels.

A large proportion of the IPAL study area consists of sandy plains of very low slope. Catchment degradation and gully network development are comparatively rare in these areas. These factors, together with the very low population densities, do not justify catchment protection works on a large scale. However, such work is vital in the upland areas of Mt. Kulal, the Hurri Hills, Marsabit and the Ndoto Mountains, where many of the river systems have their headwaters. The condition of the soils and vegetation of these areas controls, to a large extent, the hydrology of the catchments as a whole.

Figure 37. Three runoff harvesting methods (after Smith and Critchley (in Press) and Shanan and Tadmore (1979)



Protection works should begin with badly degraded catchments and the areas around settlements where gully networks are forming particularly near roads. The programme should be integrated with water harvesting and rehabilitation schemes. A fully developed catchment protection programme would help the people understand and conserve their environment better than they do at present, and would improve their dry-season grazing resources.

Improving the climatology network for use in the range management.
Two solutions for controlled grazing in the area are suggested:

i. The IPAL climatology network should function more efficiently. This means that after every month in the dry and every week in the rainy seasons all storage gauges should be read and all data transmitted to Marsabit, so that it is possible to draw isohyetic maps on the same day on a weekly and monthly basis.

ii. As an addition or a separate control, a system of analysing satellite images should be developed. Images are available every 6 days and can be sent from NASA by pouch to Nairobi for analysis of the status of vegetation cover (e.g. the reflection in channel 7 of chlorophyll). It is suggested that efforts be made to have this classification done automatically so that there should be no time delay. If Nairobi had a recording station as planned, then real time scans would be possible. Since the University of Nairobi has an adequate computer capacity, the costs will be low - eventually $500 for the tapes per month and $500 for computer scans.

Both suggestions give decision makers the opportunity to steer the movement of larger groups of animals within a certain radius. It is suggested to range scientists that they consider the possibility of extrapolating from the distribution of rainfall in time an estimate of the fodder production. Probably this would have to be done on the basis of monthly rainfall.

C. MANAGEMENT OF RANGE RESOURCES

1. Principal Objectives

To manipulate grazing use to provide for growth requirements of forage plants, prevent soil deterioration, and allow sustained maximum animal production.

2. Range Condition and Season of Use

Table 157 gives a classification of the range condition in the Rendille country. As will be noticed from this table, all the range types except the perennial grassland type on Marsabit Mountain (see Range Map) are in either fair or poor condition. This situation is rather strange, since some of the sites have not been used for a long time due to the security situation. A better condition would therefore have been expected. In explanation of this condition there are ~~two~~ schools of thought which it is important to mention here, as they have far-reaching management implications.

The first explanation supposes that the whole of the study area must in the past have been subjected to very heavy grazing. This must have resulted in the complete suppression of the desirable herb-layer vegetation, favouring the growth of the less palatable shrub and woody species. It was probably as an adaptation to this condition that the pastoralists changed from cattle to camels. The second school of thought holds that the vegetation we observe at the present moment is a climatic climax produced by the sporadic and low rainfall observed.

Each of these ~~two~~ schools of thought is supported by observations made on exclosures in the study area. The central Kargi exclosure shows a succession of annual grasses, which have colonized the site, while some few perennials are now coming in. On the other hand the Ngurunit exclosure, constructed after a fire which destroyed the unpalatable *Duosperma* bush, showed a quick recovery of *Duosperma*, which immediately dominated the site (within ~~two~~ years). It is difficult to say at present which school of thought holds for the vegetation condition we observe, as the succession experiments are still relatively young. In this management plan we recognize the ~~two~~ possibilities and take them both into account in the plans themselves.

Table 157. Range units, condition rating and current use

	Rating		Current use					
	Range	Woodland	Cattle		Camels		Smallstock	
Season			Wet	Dry	Wet	Dry	Wet	Dry
Unit number								
1	F	P	-	-	/	/	-	-
2	P	P	/	/	/	/	/	/
3	F	F	-	-	-	-	-	-
4	P	F	*Duosperma* common →					
5a	F	P	-	-	-	/	-	-
5b	F/G	F	-	-	-	-	/	-
6	F/P	F	-	-	/	/	-	-
7	F	F/G	-	-	/	-	-	-
8	F	F	/	-	/	-	/	/
9	F	G	*Duosperma* abundant →					
10	F	F	/	/	/	-	/	/
11	F/G	F	-	-	-	-	-	-
12	G	F/G	-	-	/	-	/	-
13	P	VP	No grass		/	/	/	/
14	F	P	-	-	-	-	/	-
18b	F	F/G	/	-	-	/	/	-
19	F/G	F	/	/	/	/	/	/
20b	-	F	/	/	/	/	/	/
21	F	F	/	/	-	-	/	/
22b	E	E	/	/	-	-	/	/
23			-	-	-	-	/	-
24	VP	VP	/	/	/	/	/	/

/ indicates in use; - indicates not used; VP = very poor; P = poor; F = fair; G = good; E= excellent.

Table 158. Carrying capacities of the entire mapped area based on availability of forage

Range unit	Area km^2	Camels	Cattle	Sheep	Goats
1	395.2	1726	1213	2479	3851
2	494.0	1087	3507	7114	2421
3	178.8	89	1609	3290	161
4	112.9	831	293	632	1931
5a	272.9	573	1856	3815	1226
5b	178.8	572	3737	7653	1359
6	160.0	590	2112	4336	1344
7	240.0	533	1368	2016	768
8	244.7	1615	1028	2080	3622
9	672.8	4508	3969	8141	9890
*10	1077.3	6141	7326	7649	13359
*11	202.3	243	1012	2063	526
12	192.9	617	405	887	1331
13	635.2	1461	1778	3748	3303
*14	663.4	995	7762	15789	2322
*15	70.6	56	134	268	127
*16	150.6	346	572	1160	783
*17	47.1	33	71	137	75
*18	1199.8	2520	3000	6119	5639
*19	4512.1	20304	50536	103327	46926
*20	588.1	2352	2588	3058	4999
*21	404.6	40	11329	23184	81
22	315.2		Forests		
23	287.0		Lava plateaus		
24	221.1		Man-made deserts		
25	668.1		Chalbi Desert		
Total	14185.5	47232	107205	203945	106044

* The asterisk shows those units affected by the management plan.

Table 159. Recommended Stocking Rates

Range unit	Area km^2	Camels	Cattle	Sheep	Goats
1	395.2	863	607	1240	1976
2	494.0	544	1754	3557	1211
3	178.8	45	805	1645	81
4	112.9	416	147	316	966
5a	272.9	287	928	1958	613
5b	178.8	286	1869	3827	680
6	160.0	295	1056	2168	672
7	240.0	267	684	1008	384
8	244.7	808	514	1040	1811
9	672.8	2254	1985	4071	4945
*10	1077.3	3071	3663	3825	6680
*11	202.3	122	506	1032	263
12	192.9	309	203	444	666
13	635.2	731	890	1874	1652
*14	663.4	498	3881	7895	1161
*15	70.6	28	67	134	64
*16	150.6	173	286	580	392
*17	47.1	17	36	69	38
*18	1199.8	1260	1500	3060	2820
*19	4512.1	10152	25268	51664	23463
*20	588.1	1176	1295	1529	2500
*21	404.6	20	5665	11592	41
22	315.2	Forests			
23	287.0	Lava plateaus			
24	221.1	Man-made deserts			
25	668.1	Chalbi Deserts			
Total	14185.5	23622	53609	104528	53079

* The asterisk shows those units affected by management plan.

The greater part of the Rendille country being discussed here is made up of annual grassland and annual herb-layer vegetation which contributes to the bulk of the available forage. Annual vegetation is best utilized during active growth in the rainy season. It is therefore proposed here that the annual grasslands be utilized in the rainy season, except for those areas where the terrain is so steep as to constitute an erosion hazard - the steeper slopes of Mt. Marsabit, Kulal, and the Ndotos range (units 1a, 22, and 20 respectively). The perennial shrubs on the Hedad can be used in the dry season.

Rangelands in poor condition (units 24, 2, and 13) should not be used until recovery has been achieved.

Proposed movements and optimal seasons of use are outlined in Map 27 in the livestock section.

3. Carrying Capacity and Stocking Rates

Carrying capacity may be defined as the upper rate of stocking that can be supported in the long run without damage to the habitat. Table 158 gives a summary of carrying capacities calculated for the different range units in the Rendille country. Since stocking rate and animal performance per beast are inversely related (Mentis, 1976), the concept of carrying capacity is not applicable to land on which herbivores are managed for sustained yield. Here, an *optimum* stocking rate, usually below carrying capacity and giving maximum economic returns, is normally chosen. In the Rendille country, determination of the stocking rate will also have to consider the present state of the range condition. Since range condition in most parts is only fair, management must first also cater for the recovery of the land. For these reasons, it is recommended here that a stocking rate only half of the calculated carrying capacity be implemented, and that a constant monitoring of the range condition be carried on to assess the rate of recovery.

4. Range Developments and Improvements

Range improvements must be based on ecological principles, particularly those of competition and succession. A first step in improving range forage resources is providing the desirable forage species with a competitive

advantage for water, sunlight, and soil nutrients. A classification of all the forage species found in the Rendille country according to their desirability to different livestock species is contained in an IPAL technical report. The management strategy therefore should be to encourage the development of the species in the 'desirables' column while discouraging the growth of the undesirable species.

4.1 Deferred grazing

Range improvements can be expensive, and it is suggested that they be undertaken only on a cost - benefit basis. Some, which go beyond the responsibility of the individual and the local authority, should be undertaken by the national Government as part of its efforts to protect its water resources nationally.

Some depleted ranges can be restored by improved management alone. A priority forage improvement programme which should be undertaken immediately is that of deferred grazing. Areas which are badly degraded (units, 24, 2, and 21) should be rested from any form of grazing. The schedule of grazing prescribed in Map 27 should be adhered to strictly, as it makes allowance for the seasonal recovery of various areas. However, since the rainfall in the area is not regular, it is not possible to consider the present prescribed grazing areas as final. Seasonal adjustments should be made, depending on the quantity and effect of the rains in each season. Details of choice of grazing areas are discussed in the livestock section. Deferred grazing should be the only form of forage improvement to be undertaken immediately; the others recommended here should be undertaken only after assessment of the effect of resting various areas.

4.2 Range seeding

Determining whether a range can be restored by natural means or will require artificial seeding is a matter of judgement. However, the decision should be based on the kinds and amounts of plants remaining, the expected rate of natural recovery and the cost of alternative approaches, the climate, the supplementary treatments that may be used to accelerate natural restoration, stable soil conditions, and whether the site is adapted to present artificial seeding techniques. The Rendille country which is depleted still has a

natural recovery potential (see the soils recommendations below) and this should be given a chance first. However, experiments on reseeding should be undertaken on a small scale so that its usefulness in speeding up recovery can be determined for the area.

4.3 Bush Control

Duosperma, which is a relatively an undesirable shrub except during drought conditions, occupies large areas of the Rendille country. Grazing potential could be greatly improved if this bush was eliminated. It is recommended here that control of *Duosperma* be undertaken through controlled burning. Small areas should first be experimented with and then the experience gained applied to the whole area.

5. Soil Protection and Stabilization

From the results of the fertility analyses of the soils, it appears that none of the major mineral elements is lacking. Although the level of nitrogen in the soils is very low, it should be noted that with an average rainfall of 225 mm per year, water is the first limiting factor for the production of the vegetation. After rainfall, the nitrogen content will possibly be the next limiting factor for non-leguminous vegetation. In several places the available potassium content is low but field experiments will have to be carried out to determine whether this is limiting the production of vegetation.

5.1 Soils with no or only slight limitation

If any activities to improve the range are going to be carried out, the range soil mapping units with no or only slight limitations offer the best opportunities for experiment. Methods to be considered include the burning of undesirable species (e.g. *Duosperma*), seeding of desirable perennial grasses, and improvement of the infiltration of rainwater by loosening the topsoil.

The most suitable parts of the survey area are located in the western and central part of the Hedad and in the northern part of the Kaisut 'desert'. The soil mapping units concerned are: FU1 (35 km^2), PsU1 (60 km^2), PsU2 (70 km^2), Ps4 A1 (360 km^2), and PsU A2 (325 km^2) (see Map 5). Unit UF1 (90 km^2) in the Korr and Elgess area has a good potential as well, but not at present because of the overgrazed and degraded state of the land. This area needs protection.

Mapping unit Ls (115 km^2) on Mt. Marsabit and unit M V2p (15 km^2) on Mt. Kulal also have a high potential. Their potentials are even higher than in the plains, due to higher rainfall (590 mm mean annual fall for Ls V2). Unit Pv Vp (55 km^2), located between Mt. Kulal and Mt. Asie, also has only slight limitations for range development. In the most suitable parts of the area livestock can make full use of the vegetation production without danger of degradation of the area. However, monitoring of the soil fertility is recommended.

Total area: 2,025 km^2.

5.2 Area with moderately strong limitations

Moderately severe limitations caused by a relief which renders the soil erodable occur in units PVp (150 km^2), south of Marsabit, and FUA (approximately 350 km^2), in the south-west. Although the potential of the soils is high and rainfall in these areas is higher than in the plains (around 400 mm), only strictly controlled grazing can be practised due to the erosion hazards. Wet-season grazing should be avoided in order to limit trampling of the surface. Unit YV1p (70 km^2) has accessibility problems due to the extremely stony surface. Grazing, however, remains possible, although cattle will have problems. Units Ps U3 (245 km^2) and Ps U4 (approx. 850 km^2), in the eastern Hedad and the Karoli desert, have a slow infiltration rate. Also, salinity and sodicity favour the occurrence of undesirable vegetation (*Acacia reficiens* and A. *mellifera* with mainly *Duosperma* understorey). It is not likely that on these soils perennial grasses will succeed. Grazing will therefore be restricted, due to the limited resources. Exploitation of the woody resources for fuel and construction purposes could offer a good alternative. Units YVC + V2 (380 km^2), south-east of Mt. Kulal, PnSA (30 km^2), south-east of Maikona, and Ps UK (20 km^2), south of Kargi, have a limited production potential for vegetation due to salinity and sodicity or to the shallowness of the soil. These areas should be managed carefully in order to avoid overgrazing the land. Units AA3 (220 km^2) and AAC (150 km^2) may be flooded once or twice yearly, but they support good annual grassland. However, because of the erodability of the topsoil, use should be restricted in order to leave a constant surface cover of vegetation.

Total area: 2,465 km^2.

5.3 Degraded areas

The areas around the settlements of Korr, Kargi and (partly) around Ngurunit, Ilaut, Loglogo, and Gatab, which are heavily degraded at present, need to be improved. The various enclosures in these settlements and observations made in the rainy seasons show that a natural regeneration of the vegetation is quite possible. Surprisingly, the (few) fertility analyses in these areas do not show any lack of mineral elements. Loosening the surface of the soil to increase water infiltration is not recommended because of the danger of wind erosion. It is recommended that these areas should be closed for grazing and wood cutting until a good vegetation cover has established itself.

5.4 Areas not to be used for grazing

These areas are to be excluded from or are inherently unsuitable for management. The parts of the area which should not be used for range management purposes include all the mountain tops, which need complete protection because of their importance as water catchment areas. Also, protection of these as natural forest reserves is very important. The mapping units concerned are the top of the Ndotos, MVC (130 km^2), the top of Mt. Kulal, MV4P (165 km^2), the top of Mt. Asie, MVC (80 km^2), and the top of Mt. Marsabit, MVI (145 km^2). Areas which are inherently unsuitable include the hills in the south-west (HUP, 45 km^2) and in the north-west (HVP, 120 km^2), as well as the hills scattered on the volcanic plateaus (HPP, 55 km^2). The hills are too steep and too rocky, and are often partly bare. After protection from grazing they could become locally important for water catchment. Units LnVI (400 km^2), east of Maikona, and LnV3p (335 km^2) are not suitable because of an extremely bouldery surface combined with salinity and sodicity. The footslopes of the Langipi hills in the north-west are also too stony and bouldery to be used for range management purposes (FV2P, 60 km^2). The soils of the erosional plains are both too rocky and too shallow to be used (Pn/PdSP, 130 km^2). The Chalbi desert is too saline to produce vegetation and is flooded seasonally as well (PIXI, PIXA, 700 km^2). This area however, can serve as a source for salts for livestock. Improvement of the areas which are here described as inherently unsuitable is not possible within the scope of feasible development of the area for range management purposes.

Total area: 2,365 km^2.

5.5 Areas with strong limitations

Strong limitations, caused by an exceedingly stony or bouldery surface in combination with rock outcrops or shallow soils, are found in mapping units LSVC (750 km^2), west and north of Marsabit, Ln V2 (325 km^2), north of Ilaut, LdVP (85 km^2), west of Kargi, and RVC (135 km^2). These areas have accessibility problems and often the soils do not support much vegetation in any case.

It is recommended that these areas should be used as drought reserves. Units MV3P (60 km^2), west of Marsabit, RVA (440 km^2), around Mt. Kulal, FVIP and PV3P, around Mt. Kulal (650 km^2), FVC (300 km^2), around Mt. Asie, UFA (150 km^2), in the Korr and Elgess areas, and DXA (450 km^2), around the Chalbi, all have relief characteristics which may cause erosion. Other factors limiting plant production are present as well. These areas can be used only during short periods by a small number of animals. Unit PsU5 (825 km^2), in the eastern Hedad is highly erodable and production is limited by the salinity and sodicity of the soil. Here too only a low carrying capacity is possible.

Total area: 4,170 km^2

General remark: It is not possible to give the number of range units for the different areas discussed here. A range unit does not necessarily have to be in conformity with a soil unit.

(a) Recommendations for the use of areas with high erosion hazard

Area 1 (range unit 22, 18)

Protection of the upper parts of Mt. Kulal is not only important for soil and forest conservation but also a direct need to protect the water catchment. Damaging the soil plant cover means that the rain water runs off on the surface without any infiltration and disappears finally in the lowlands or is evaporated. Infiltrated water recharges springs and wells on Mt. Kulal which in turn supply the daily basic water needs of the people. It is therefore suggested to completely close the upper slopes of Mt. Kulal from any kind of grazing.

Minimal agriculture with good soil conservation measures is possible in some parts but people should be discouraged from using steeper slopes (>50°) for any purposes. It is difficult to realize this goal in the short term but the people of Gatab should be made to realize that the expansion of the village will increase the dangers of erosion. Strict soil conservation measures are therefore necessary. Existing gullies should be dammed with gabions. Agriculture should be introduced only after a proper survey of the sites. Only gentle slopes which allow for contour ploughing, terraces, etc. are suitable.

Grazing pressure should also be taken away from the areas surrounding the village. By extending the pipeline from Gatab to Luai a reasonable pasture will be opened in this area. Steeper slopes are not suitable for grazing. The costs of this pipeline have been estimated at around KShs. 200,000. The pipeline at Arabel should also be rebuilt to prevent further damage in the northern parts of Mt. Kulal. There is also the possibility of constructing a new water supply by introducing a pipeline at Moruset on the eastern slopes. Detailed surveys are still necessary here.

Area 2 (range units 19, 21)

On the Marsabit plateau agriculture is possible if the general soil conservation measures are observed. People have only to be discouraged from using steeper slopes for this purpose. Shelter belts of trees will decrease aeolian activities but a proper survey is absolutely necessary. From the steppe on Marsabit plateau to the next lower plateau the land is mainly used for grazing. Despite the higher rainfall in comparison with the lowlands, a lower stocking level is necessary here due to the high permeability of the soils of lava origin. These areas also fulfil an important role in water supply. The movement of animals

should therefore be confined to the existing tracks so that further damage is prevented. Protection of the existing plant cover is absolutely necessary to preserve the soils. Fire plays an important role in tick control (see livestock section), but fire can also destroy the vegetation and enhance aeolian and water erosion. Careful use of fire therefore is absolutely necessary.

Area 3/4 (range type 24)

To rehabilitate the surroundings of Kargi and Korr there should be no grazing in a circle of 8 km around Kargi/Korr. Certainly people will have to stay there, because water sources are not available elsewhere. This means that in the dry season the animals will have to come for water in Kargi or pass the town to Karole. With good discipline of the herdsmen, the animals should be kept on present roads. If there is no discipline then fencing will be the only solution, which will consume an enormous amount of money. At the beginning the slopes and the old lava plateaus will present a special problem. There is still fine material under the small stones providing the base for the few plants that grow there. But the piping erosion (subcutane erosion) will continue for quite some time. The empty space left by rotten roots of trees which had been formerly in this area forms tunnels under the surface where water collects, widens them, and then they finally collapse.

Area 5

Here it is recommended to allow grazing only at a low stocking rate e.g. on the lava fields. Efforts should be made to open up the good grazing grounds in the east and also in the west along the Loglogo - Korr road. Loglogo could probably provide an example for a new herding system. In this case the children and women in the families will continue to stay at their proper built homes while the men serve as herdsmen. As long as the food habits of the people are not changed completely 'milk herds' will have to stay around the settlements and watering of animals will continue to be a problem. Here we can only call for discipline like that needed for Korr and Kargi.

Area 6

In order to stabilize the dunes no grazing should be allowed.

Area 7

Grazing should be allowed at low stocking rates.

Area 8

It is possible to divide the Ngurunit basin into areas with almost no use, little use, moderate use and high to very heavily used areas. The latter two should be definitely closed to any grazing. Seen as a whole the Ngurunit area is not overstocked but livestock will have to be better distributed in time and space. The dense cover of *Duosperma* in some area prevents severe erosion. Therefore this dwarf shrub should only be removed when it is certain that no damage will occur afterwards. Experiments in controlled plots are absolutely necessary. Tree cutting should be carried out only under the supervision of a woodland officer. The canopies of the mature trees prevent erosion to quite a high degree. Since Ngurunit belongs to the regions with higher rainfall and also high intensities in the study area, the shade allows grasses to grow which can be used by the livestock. Slopes can only be grazed at a very low stocking rate. It is difficult to decide the time when grazing should take place. From the geomorphological point of view it would be desirable to have a dense grass cover just before the start of the rains. Therefore grazing can take place when the new sprouts are out, so they can hold the soil. This would also decrease the danger of trampling. Despite the high stocking rates the Ngurunit area is not too badly damaged but the dangers are very high if population continues to increase.

Area 9

There is very little current use of this area due to security problems. If security improves this dune belt should be grazed only by camels who would not damage the soil through trampling. Cattle and small stock should be kept out. Also the stocking rates should be quite low. Protection of the vegetation cover is very important. The dunes are stable now but if they become active it will take a long time to stabilize them again.

D. MANAGEMENT OF WOODLANDS AND SHRUBLANDS

1. General Introduction

The necessity of regulating the use of trees, in order to achieve woodland rehabilitation and the maximum sustainable production, requires the formulation of a basic management plan and a set of rules, the establishment of a legalised framework of authority and the staff necessary to implement the rules. Similarly authority is needed to ensure that human and livestock needs for wood and browse fodder are satisfied. This section provides recommendations upon which the implementation of woodland management policy can be based in southern Marsabit District.

2. The Principal Objectives

a. To arrest the current decline in the tree populations and to ensure an optimal sustained production of wood and forage for the long term benefit of the pastoralist people of the region and of the country as a whole.

b. To provide alternative means for the fencing of livestock as a substitute for the thorn-tree night enclosures which are the main cause of tree destruction in the region.

c. To increase the economic productivity of the woodlands through the development of tree product marketing as a contribution to the diversifying of the present livestock-based economy.

3. Principal methods to achieve these objectives

a. Through rotational use and systematic temporary protection from felling, lopping and browsing, ensure that the woodlands and large shrublands are permitted to regenerate and to achieve optimum levels of wood and browse production as sustained yields.

b. Initiate the construction of bamboo fencing units to be used by Rendille families for fencing their livestock at night.

c. Construct dry stone wall permanent night enclosures in suitable sites in rocky areas for the repeated use of Rendille manyattas.

d. Plant *Commiphora* pole cuttings in order to grow live fences for semi-permanent livestock night enclosures in suitable areas of the Hedad shrublands and dwarf shrublands.

e. Initiate the systematic harvesting of dead *Acacia tortilis* and *A. reficiens* trees for firewood and building poles and investigate the possibility of trade in such dead wood.

f. Carry out the systematic tapping and harvesting of gum arabic from indigenous *Acacia senegal* shrublands and initiate the marketing of this product in Kenya and abroad. Investigate the possibility of raising *Acacia senegal* plantations in suitable areas.

4. Regulation of Wood Harvesting

Recognizing that the immediate annual requirement for wood for livestock night enclosures *(bomas)* and firewood for the 12,900 Rendille people in the management area are estimated as:

livestock enclosures: 38,700 tonnes;
firewood: 1,935 tonnes;

the provision of these quantities should be ensured by the Project until effective substitutes are found, but management should also ensure that these quantities are not substantially exceeded.

Wood collection for boma construction should be permitted under certain specific conditions:

a. where alternative night enclosures or construction materials are not made available;

b. that trees are cut only in areas specified by the woodland management officers in accordance with the management plan;

c. that the trees cut are of species and sizes specified by the woodland officers, also in accordance with the management plan.

Wood collection for fuel should be allowed in areas specified by the woodland officers, who would initially follow the guidelines outlined in this management plan and harvest from a limited number of woodland types. Dead wood can be collected without restraint in all areas.

Important principles that should determine wood collection are:

a. Wood should only be collected live where the biomass (dry) exceeds 2.5 tonnes ha^{-1};
b. elsewhere it should be collected from dead and fully mature trees only;
c. the total wood collection should not exceed the annual production in any area. By limiting wood collection to areas of 2.5 tonnes ha^{-1} minimum biomass, the annual collection of 100 kg of wood ha^{-1} (including dead wood) can be ensured.
d. with the exception of dead trees, *Acacia tortilis* should be completely protected in all areas, as constituting a major source of (dead) fuel, fruit for livestock fodder, dropped leaves for sheep fodder, and shade.

In areas where *Acacia tortilis* is traditionally lopped to provide livestock feed in the dry season, limited branch lopping may be permitted under the supervision of the woodland officers. As a guide to the permitted rate of tree lopping, each medium-size tree (crown diameter: 10-15 m) could have one branch of 10 cm diameter lopped every two to three years.

The *Acacia tortilis* woodlands of Ngurunit constitute an area of special management, owing to the unusually high density of trees in the 20-30 year age classes. It would be advantageous to thin these trees systematically, to provide additional space for the remainder and, at the same time, to obtain a supply of building poles of a convenient size. The management officer for the area would be required to supervise the systematic felling of a suitable fraction of these trees, sawing them into usable lengths and storing them for use in buildings and as firewood for distribution by the local Rendille committee. (For these committees, see the section 'Organization of Rendille Range-Development Activities', below). The upper branches could be used initially as livestock enclosure material and later as firewood for the Samburu pastoralists at Ngurunit and Ilaut and the Rendille of the nearby centre of Lependera.

The mature *Acacia tortilis* woodlands along most watercourses in the region and in the Olturot area are in danger of dying out in the next 30 years, as there is insufficient recruitment of young trees.

This is due to the increasing browsing impact of goats and camels in the last 30 years. A special protection strategy is needed to enable *Acacia tortilis* regeneration to take place. It is proposed that alternate 1-km stretches of watercourse bank should be closed to browsing animals for periods of four years each, to provide an opportunity for young trees to grow above goat reach. Such 1-km lengths of bank would be clearly marked by painting marks on tree trunks. After a period of four years (if this proves sufficient) the protected banks would be freed for use again and the formerly open stretches would be protected in their turn for four years. The protection should be effected by woodland guards acting under the authority of the woodland officers and with the support of the Rendille management committees.

5. Logistic Support for Woodland Management

As a principle, the Project should assist participating Rendille pastoralists to obtain wood for fuel and, where necessary, for boma fencing material.

Firewood should be transported to settlements from the harvestable woodlands by camel.

Firewood should be cut up and piled in specified areas in the *Acacia tortilis*, *Acacia reficiens* and *Acacia mellifera* woodlands, mainly in management units 9, 10, 12, 18, 20 and 21, where production is high. It is anticipated that dead trees will be sufficient to satisfy fuel requirements.

For *fora* herds and any manyattas as camps situated in management units 9, 10, 12, 18, 20 and 21, live tree cutting should be permitted up to the limits of the annual wood production in the areas concerned. This should apply both to fuel wood and material for thorn bomas.

In all other management units tree cutting would normally be limited to the annual production level (which may be very low), but may be prohibited except for the collection of dead wood. Pastoralists occupying woodland areas where live tree cutting is prohibited should be provided with substitute fencing materials, in the form of either bamboo fencing, dry stone wall enclosures or wire mesh. On the lava areas, permanent enclosures made of rocks will be provided. In the Hedad area, as far as possible, permanent enclosures will be made by planting *Commiphora*

live hedges (see below).

Camel transport of wood to settlements should be confined to the provision of firewood. No thorn fencing material should be transported by camel. In settlements, all fencing should be live hedges or constructed from bamboo units, wire mesh or rocks, depending on the availability of materials.

Camel transport of fuel and fencing material (wire and bamboo) should be under the control of the woodland management officers in co-operation with the camel transport officers. The organization of the transport is described in section F. 5.5 of the management plan. The daily firewood requirement for the Rendille people (at 1,935 tonnes annually) is 5.3 tonnes. To transport this quantity daily will call for 53 camels, each carrying 100 kg of wood. To provide ~~two~~ groups of camels which can work on alternate days, 106 camels will be required. With an extra reserve of animals to provide for unforeseen illness and injury, etc., a further reserve of 20 animals should be available.

6. The Regulation of Livestock Browsing of Trees

Since the main objective of woodland management in Marsabit District should be to ensure adequate regeneration of tree populations through the protection of young trees, browsing requires regulation apart from the particular case of *Acacia tortilis*, already dealt with. Large areas of woodland and shrubland within 20 km of settlements and along the main routes of Rendille livestock movement are in danger of dying out due to lack of recruitment; young trees are being prevented from growing by heavy goat browsing. The results of protecting young trees can be seen in the enclosure plots at Kargi and Ngurunit, where numerous young trees are growing successfully. It is necessary to establish rules which can be applied to any woodland unit needing temporary protection from browsing by goats and camels.

The use of woodland areas for browsing should be on a rotation basis which provides protection for over-browsed areas for periods of 4-5 years to enable young trees to grow beyond the vulnerable stage.

When a balanced age structure has been restored (or where a sufficient number of young trees has grown above 1.5 m high), a woodland should be

used for livestock browsing at a predetermined stocking rate. In tables 160 and 165 initial estimates of suitable camel and goat stocking rates are given for each of the range management units in the management area. It should be borne in mind that these estimates are derived as weighted averages from those obtained for the more numerous range types which have been grouped together into the management blocks or units. Certain important woodland and large shrubland or range types of relatively small area may require management procedures in terms of stocking rates or resting periods that differ from the main range unit in which they are situated. For guidance in the management of such important small woodland areas (particularly the riverine *Acacia tortilis* woodlands) the detailed woodland biomass, production and structure data are available. Provision for special protection of these woodlands for the necessary period for rehabilitation should be made and the protection enforced by the woodland officers.

Estimated stocking rates for each woodland and large shrubland are based upon measured size-class structures and estimated production levels. Three categories of stocking level can be given for woodland types:

a. good structure: general use at predetermined stocking rates dependent upon the production level;
b. fair structure: limited use by goats and camels until regeneration is restored; use by cattle when goats and camels are excluded;
c. poor structure: use only for cattle until regeneration is improved.

A fourth category not included in the above ~~three~~ is the range type (e.g. open annual grassland or dwarf shrubland) which contains trees at very low densities (e.g. 1 ha^{-1} or less) and which cannot be regarded as potentially productive woodland in the near future. Such range types should be managed solely on the basis of the range vegetation production and condition.

The establishment of a rotational system for the resting of woodlands from goat and camel browsing depends upon co-ordination with the rotational system in use for range management. While it is anticipated that livestock rotation will be based upon the main range-management

units, it is proposed that a sub-rotation of use by camels and goats should be set up within the main range units in order to provide the necessary resting periods of several years for individual woodland communities. Thus, at any time at least one of several range types within a main management unit could be used by cattle, which do not browse young trees. Theoretically, these units could also be used by sheep, but since sheep and goats are never herded separately by the Rendille, it is not considered feasible to attempt to herd sheep alone except possibly on an experimental basis under the management of the Project.

The special case of the mature *Acacia tortilis* woodlands along water-courses has been mentioned above. Rotational use of these woodlands would be on a sector-by-sector basis.

7. Criteria for Establishing Stocking Rates

The criteria which have been considered in recommending stocking rates for the different ranges units are discussed in Part 1 (P.) and the application of woodland and large shrubland parameters in assessing the optimum stocking levels in each unit is summarized briefly here.

Since tree and large shrub browse provided nearly 30% of the diets of camels and goats (and 9% of the diet of sheep), browse production from the limited tree and shrub growth is necessarily a regulating factor for camel and goat stocking levels in many of the range units.

The quantity of foliage produced in an average rainfall year by the commonest tree species has been measured. In each woodland community the proportion of palatable to unpalatable foliage is established; in most woodland types in the management area this amounts to approximately half of the total foliage biomass and production. Of the palatable foliage, not more than half should be removed each year in order to avoid excessive limitation of tree growth. In the larger trees this will be achieved without protection, since a proportion of the foliage will be out of the animals' reach until it falls.

This proportion varies with the age and structure of the woodland, but in most cases is approximately half. In woodlands with a large proportion of young trees, the accessible foliage may be considerably more than half, and to ensure successful growth it may be necessary to introduce goats at less than the calculated carrying capacity until these trees have grown taller than goats can reach. An example of a calculation of a woodland carrying capacity is given in the woodland resources section of Part 1. All range-type stocking rates given in Tables 160ff have been estimated taking several factors into account. It is apparent that woodland foliage production and woodland condition are more limiting to carrying capacity for camels and goats than are the production and condition of the dwarf-shrub and herb layers in the same areas. Thus stocking at the livestock densities indicated by the production levels of the range layers would, in some units, result in the over-exploitation of the tree layer, particularly in woodlands where the age-class structure is poor, i.e. where the proportion of young trees in the population is insufficient for recruitment. In all areas where a low goat stocking rate is required, this will also determine the sheep stocking rate, since the ~~two~~ species are herded together in approximately equal numbers. Where goats are to be excluded or held at a low stocking rate in order to increase young-tree growth, camels can be herded at low densities, on the assumption that they will not browse small trees as intensively as goats would, though this would depend on the presence of a moderate density of mature trees for the camels to browse. Cattle stocking rates are independent of tree production, but cattle need tree shade in the middle of the day.

7.1 Special measures for livestock stocking rates during drought

In the early stages of a drought, or during a year when either the long or the short rains fail, the response of the tree populations will be more delayed than that of the herb and dwarf-shrub layers, except in the case of the deciduous tree species, including *Acacia reficiens* and *Acacia mellifera*. Under these conditions the evergreen trees, particularly *Cordia sinensis, Salvadora persica* and *Maerua* and *Cadeba* spp., serve as a reserve of fodder for the browsing animals, which will thus be less affected by the drought than the grazing species. If the drought is prolonged, the trees will be affected and cease producing foliage, and the carrying capacity of all woodland communities, except the large *Acacia tortilis* woodlands, will fall.

Acacia tortilis in its mature age classes is maintained by groundwater and will remain productive during droughts. At such times *A. tortilis* becomes a last reserve of livestock fodder. This reserve can be used partly through normal leaf fall and partly through the lopping of branches to bring the foliage within reach of livestock. Carefully controlled lopping will undoubtedly be justified to save the lives of a number of animals, but should not remove more than 10 per cent of the canopy of any tree.

In severe drought conditions it may be judged necessary to open certain woodlands for livestock even though these woodlands are at the time receiving special protection for regeneration. It should be recognized that prolonged drought will prevent or retard the growth of young trees which are under protection. After drought periods it will be necessary to prolong the protection of woodlands in order to give time for adequate growth before goats can be re-introduced.

To provide a fodder reserve for short-term drought, the fruit of *Acacia tortilis* should be collected and stored for several months as a routine. It should be thoroughly air-dried before storage.

8. Night Enclosures

One of the main causes of desert encroachment around permanent settlements is the modification of the microclimate through the removal of trees for the construction of night enclosures. This is discussed more fully in the immediately following paragraphs. Although the re-introduction of rotational grazing will have the advantage of spreading the effect of tree cutting for the construction of night enclosures, there is still the risk of over-exploitation as the production system intensifies. Three alternative kinds of night enclosures are proposed as follows:

a. Fixed permanent enclosures at strategic places. Throughout the Mediterranean region where winter and summer pastures are used such pens are constructed from stones. Lava boulders are one commodity with which nature has richly endowed the area. Thus at minimal cost dry stone wall pens maybe constructed, in particular at strategic sites on or near the Marsabit lava, where animals may be brought for routine husbandry and veterinary attention. For example at Hogichu, Firimasion, Bagasi, Koroli, Kargi, Kurkum, Kobatal, Falam, Korr, Holisurwa, Gatab, Galmagichan,

Loglogo, Ilaut, Merti, Afarei, and Olturot-Balesa Bobor.

b. Portable night enclosures. Portable night enclosures made from bamboo have been used and transported (by vehicle) for periods of over ~~two~~ years. They give effective protection against predators. However, they are not cheap and they require careful handling. They should be constructed in panel form by the livestock owners themselves as a rural crafts industry in the settlements. In order to promote their use but at the same time stress the need for care, raw bamboo might be delivered at 20% of the actual cost. Suitable transport would be Super Hippo cattle trucks owned by the LMD, which usually travel to the District empty.

The results of the bamboo hurdle experiment indicate that this method is a feasible substitute for thorn-tree night enclosure fences, although it costs about $180 to construct one night boma of sufficient size for 50 cattle or 200 sheep and goats. It is recommended that bamboo fencing should be adopted for the use of Rendille participants in the management scheme to remove the necessity for them to cut trees for thorn bomas. A modified bamboo fence can be carried by camels to new camp sites.

A construction unit should be set up at Kargi as an expansion of the small unit which made the original bamboo hurdles. It is estimated that about 600 bomas will be required for the Rendille livestock. The production unit should employ 40 men to make fencing and it is anticipated that it will take ~~two~~ years to complete the required number of bomas at a cost of $250,000. While the fencing is under construction, probably simultaneously in several settlements, the continued use of thorn fencing will be permitted.

The bamboo raw material will be obtained from the Forest Department on Mount Kenya and the Aberdare Range and transported to Marsabit District on transport being used to carry livestock out of the District for marketing.

c. Live fences of *Commiphora*

Trees of the genus *Commiphora*, which are locally abundant in the Hedad region of the Rendille area, can be grown from pole cuttings in

favourable rainfall years. Excellent live hedges can be planted to form livestock enclosures, as has been demonstrated in Korr settlement by one trader. The planting of *Commiphora* - hedge livestock pens will be the subject of intensive trials as soon as the rainfall permits. Such pens could replace the temporary thorn bomas which are currently the main kind of livestock enclosures and could provide holdings pens in the villages when it is necessary to bring livestock there and could be used in permanent livestock camps elsewhere.

9. Tree Planting

This is dealt with in the section Forestry Development.

E. MANAGEMENT OF LIVESTOCK RESOURCES

1. Principal Objectives

In view of the fact that livestock are currently unable to supply the subsistence needs of the people, due to undernutrition and disease, and are also so unevenly distributed that they are destroying parts of their habitat, the following should be the main objectives of livestock management.

1. To arrest the contribution of livestock to the declining productivity of the range and to restore its fertility.
2. To restore the productivity of livestock to provide for the subsistence needs of the people and thereby end their dependence on external food aid.
3. To develop the livestock resources of the area so that they may contribute significantly to the national economy on a sustained basis and thereby improve the local standard of living.

2. Principal Methods Required to Achieve the Above Objectives

a. The introduction of an improved grazing programme
b. The improvement of animal husbandry and livestock disease control to increase productivity.
c. The development of a viable marketing system for livestock and a unit to utilize animal by-products.
d. The establishment of livestock demonstration and extension units.

It is recognized that, although it may be necessary to introduce new and unconventional ideas to the pastoralist, the programme will operate where possible by emphasizing and building on the beneficial aspects of the current system and eliminating the harmful ones.

3. Detailed Management Procedures

3.1 Introduction of an improved grazing programme

Within the proposed management area it is clear that the existing use of

the range is in need of considerable revision in order to rest over-utilized range and to bring into use pasture which has hitherto been underutilized.

Overutilized range consists of units 2, 13 and 24 stretching from Kargi in the north through Korr to Baio in the South. Part of unit 20 around Ngurunit and Ilaut is also overutilized by livestock. The area around Loglogo is overutilized although the vegetation has not been surveyed. Some parts of Marsabit and Kulal in Units 21a and 21b are overstocked by cattle and smallstock.

Areas which also show heavy use of woody vegetation are units 1, 5a and 14.

In order to rest the overutilized areas, which may require more than 5 years, it is recommended that grazing be discouraged in these units with the exception of livestock temporarily in transit from one area to another and of camels coming to the traditional *soriu* ceremony at Kargi, Korr, Loglogo, Ngurunit and Ilaut two or three times a year.

It is necessary also to protect water catchment areas on Mt. Kulal and Mt. Marsabit from exploitation by livestock. These areas are units 22a and 22b where the vegetation consists of evergreen forest and evergreen to semi-deciduous woodland. It is recommended that no grazing be permitted in these units especially since it is proposed to confer forest reserve status on both the forests.

The main underutilized areas occur in the central and western Hedad, the lower slopes of Mt. Kulal and the lower slopes of Mt. Marsabit i.e. units 3, 4, 6, 7, 8, 9, 18 and 19. It is therefore recommended that the livestock be relocated to the underutilized areas according to a plan involving consecutive phases.

a. Camels

The first of these phases will be to test the possibility of redistributing camels in the form of about ten large *fora* camps containing between 1,500

and 2,000 animals each. The advantages of beginning with camels are that the Rendille already co-operate in the creation of such *foras*. Camels may be quite mobile as they are relatively independent of water. This means that it will not be necessary to embark on water-development in the initial stages, but rather to test whether the necessary security can be created to give the camel owners confidence to use the new area. It is essential to be certain of security before laying out capital on water development which might be wasted in the event of continued insecurity in the area. The redistribution of camels has been determined from the estimated carrying capacities in the following manner.

The existing estimated mean population of 18,643 camels consists of 8,664 camels in the northern part of the range and 9,979 camels in the southern part. The present population is only 51.2% of the estimated carrying capacity for camels. These animals have been allocated propotionately to each range unit depending on its calculated carrying capacity. If the northern population were all to spend one day in a certain unit during a whole year the effective number per annum would be 23.7; similarly the number would be 27.3 for the southern population. The number of days required for each population to spend in the different units is obtained by dividing the proportional allocation by the calculated daily occupancies. Each unit is allocated to one or other population with the exception of units 9, 12, 18 and 19 which are shared. These four units will account for 9,961 camels and will be shared in the ratio of the total population i.e. 4,542 or 45.6% from the northern population and 5,419 or 54.4% from the southern population. This is shown in the following tables.

Table 160. Range units with proposed annual stocking rates of camels

Unit No.	Area	Annual Stocking rate of camels	Days
1	S	883	32
2	S	556	20
3	S	46	2
4	S	451	17
5a	S	293	11
5b	S	293	11
6	S	302	11
7	S	172	6
8	N	827	35
9	S		46
	N	2307	44
10	N	2992	126
11	N	14	1
12	S		4
	N	185	4
13	S	748	27
14	N	289	11
18	N		10
	S	534	11
19	N		133
	S	6935	138
20	S	799	29
21a	S	17	1

S = Southern camel population N = Northern camel population

Table 161. The calendar of movement of camels in the two populations. (Numbers refer to units. Numbers in parentheses are days per unit when less than 1 month.)

Month	J	F	M	A	M	J	J	A	S	O	N	D
Southern population	20(29)	5a(11)	2(10)	19	19	19	2(10)	7(6)	9	18(11)	19	19(17)
	1(16)	4(17)	5b(7)				5b(4)	13(13)		12(4)		13(14)
			3(2)				6(11)	1(16)		9(16)		
Northern population	10(3)	12(4)	8(16)	19	19	19	10	10	10	10	19	19(12)
	11(1)	18(11)	9(44)									
			14(11)									8(19)

b. Cattle

The present population of cattle is only 30.48% of the estimated carrying capacity. Of these 11,060 are in the northern part of the range and 13,492 in the southern part of the range. The daily equivalents are 30.3 and 37.0 respectively.

The cattle population has therefore been allocated proportionately to the different range units as for camels.

Table 162. Range units with possible annual stocking rates of cattle

Unit No.	Area	Annual Stocking rate of cattle	Number of days
1	S	370	10
2	S	1069	29
3	S	490	13
4	S	89	2
5a	S	566	15
5b	S	1139	31
6	S	644	17
7	S	417	11
8	N	313	10
9	S	484	13
	N	726	24
10	N	2126	70
11	N	36	1
12	S	29	1
	N	43	1
13	S	542	15
14	N	1342	44
18	S	204	6
	N	305	10
19	S	4112	111
	N	6167	203
20	S	524	14
21a	S	2811	76

There are several reasons why this system unlike that of camels, cannot be implemented. Although security may be achieved there is no possibility of developing the perched water supplies in order to provide sufficient water for such large numbers of cattle. This is not a problem for camels which regularly water at Korole and can use Lake Turkana at a frequency of once per week. The development of the regional water supply through boreholes is undesirable for cattle because of the frequency of use and the localized grazing and trampling which ensues.

Instead it will be necessary to continue to use some of the areas within reach of permanent water but to attempt to redistribute some of the cattle to ease the burden on overgrazed areas. This may form the second phase of the programme.

The main populations of cattle are presently as follows:

1.	Mt. Kulal	5,000	Units 21b, 18 and 12
2.	Korr-Ngurunit-Ilaut	7,500	Units 13, 20b, 23, 24
3.	Marsabit	12,000	Units 19 and 21a.
	Total:	24,500	

The following stocking rates are proposed.

Table 163. Proposed stocking rates of cattle

Unit No.	Season	No. Cattle	Days	Annual Cattle Equivalent	Remarks
1	Transit	2500	15	103	
2	0	0	0	0	Rest
3	Transit	2500	15	103	
4	0	0	0	0	No water
5a	Transit	2500	15	103	
5b	0	0	0	0	No water
6	0	0	0	0	No water
7	0	0	0	0	No water
8	0	0	0	0	No water
9	Wet	2000	90	493	
	Transit	2500	15	103	
10	Wet	2000	120	657	
11	Wet	1000	30	82	
12	Wet	1000	60	164	
13	Transit	2500	30	205	
	Wet	2500	150	1027	
14	Wet	2000	120	657	
18	Transit	2500	15	103	
	Wet	5000	90	986	
19	Dry	2500	30	205	
	Wet	10000	150	4931	
20	Dry	1000	210	575	
	Wet	2500	150	1027	
21a	Dry	14500	183	7250	
21b	Dry	7500	183	3760	
22	0	0	0	0	Forest
23	Wet	2500	150	1027	
	Dry	1500	210	863	
24	0	0	0	0	Rest
25	0	0	0	0	Chalbi

Table 164. Calendar of occupancy

Month	J	F	M	A	M	J	J	A	S	O	N	D
Kulal	21b	21b	9, 10, 11	18	18	18	21b	21b	21b	21b	9, 10,	12
	J	F	M	A	M	J	J	A	S	O	N	D
Marsabit	21a	21a	14,10	19,14	19,14	19,14	21a	21a	21a	21a	19	19
	J	F	M	A	M	J	J	A	S	O	N	D
Ngurunit	20	20				20	20	20	20	20	20	
	21a	21a	1,3,5a,9,13,18,20,23			21a	21a	21a	21a	13	13	

From this calendar it can be seen that the Kulal population will disperse into units 9, 11 and ~~18~~ in wet seasons, withdrawing to unit 21a in dry seasons. The Marsabit population will disperse into units 10,14 and 19 in wet seasons, withdrawing to unit 21a in dry seasons.

The Ngurunit-Korr-Ilaut population will be dispersed as follows in dry seasons
2,500 to unit 21a via unit 13.
2,500 to unit 21b via units 1,3,5a.
1,000 remaining in Unit 20.
1,500 to unit 23.

In wet seasons 2,500 each will be in units 13, 20 and 23.

Additional security and water will be needed when cattle are in transit between pastures and are grazed in units 10,11,12,14 and 18.

c. Smallstock

Sheep and goats occur in mixed flocks in the average ratio of 1 : 1.5 and it is unlikely that in the near future the ratio will change greatly or that there will be sufficient herdsmen to permit separation of the flocks. For this reason the estimated stocking rate of sheep is taken as 67% of the carrying capacity for goats i.e. 55,337 animals. This gives a total carrying capacity of 137,930 animals. The present stocking rate is 78% of this figure. That for sheep is 77.7% of its revised carrying capacity and that for goats being 78.1% of its carrying capacity.

Table 165. Range units with proposed annual stocking rates of sheep and goats

Unit	Area	Annual Stocking Rates		Number of days per Unit for both Sheep and Goats
		Sheep	Goats	
1	S	2015	3008	35
2	S	1267	1891	22
3	S	84	126	1
4	S	1010	1508	18
5a	S	641	957	11
5b	S	711	1061	12
6	S	703	1050	12
7	S	402	600	7
8	N	1895	2829	31
9	S	5175	7724	41
	N			46
10	N	6655	9933	110
11	N	32	48	1
12	S	407	608	3
	N			4
13	S	1729	2580	30
14	N	689	1029	11
18	S	1643	2452	13
	N			15
19	S	16387	24458	129
	N			148
20	S	1737	2592	30
21a	S	34	51	1
Total		43216	64505	

Present population sizes are as follows: Northern area sheep 22,082 goats 33,123; Southern area sheep 20,937 goats 31,405. Daily equivalents are Northern area sheep 60.5 goats 90.7; Southern area sheep 57.4 goats 86.0.

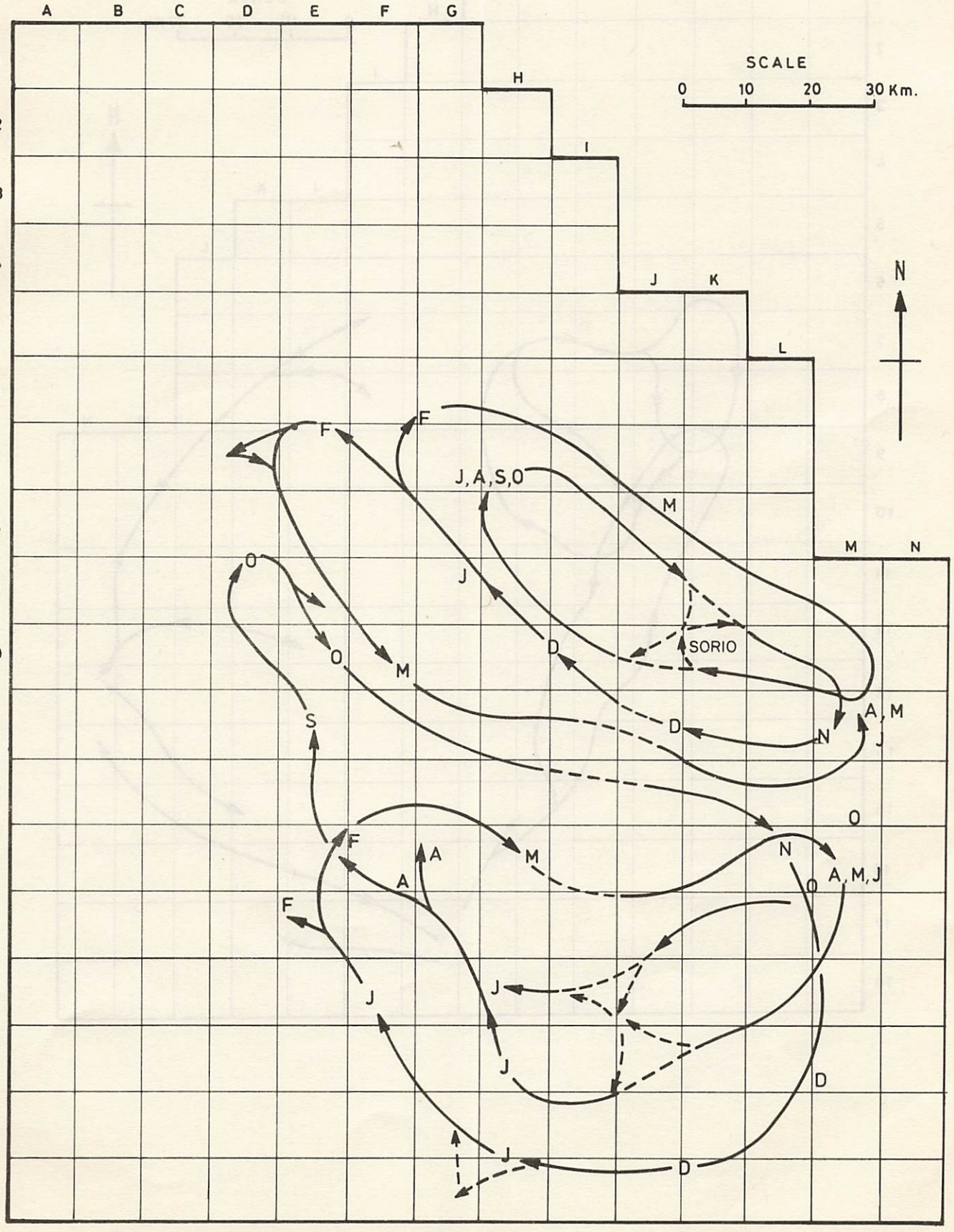
Table 166. The calendar of movement of smallstock in the two populations. (Numbers refer to units. Number in parentheses are days per unit when less than 1 month.)

Month	J	F	M	A	M	J	J	A	S	O	N	D
Southern Population	20(7) 1(24)	1(11) 4(17)	13(15) 20(16)	19	19 21a(1)	19	2(11) 5b(12) 3(1) 7(7)	5a(11) 9(20) 4(1)	12(3) 18(13) 9(13)	9(8) 6(12) 2(11)	19	19(9) 13(15) 20(7)
Northern Population	14(7) 10(24)	10	8	19	19	19	10(29) 11(1)	18(15) 9(16)	9(26) 12(4)	10(29) 9(2)	19	19(27) 14(4)

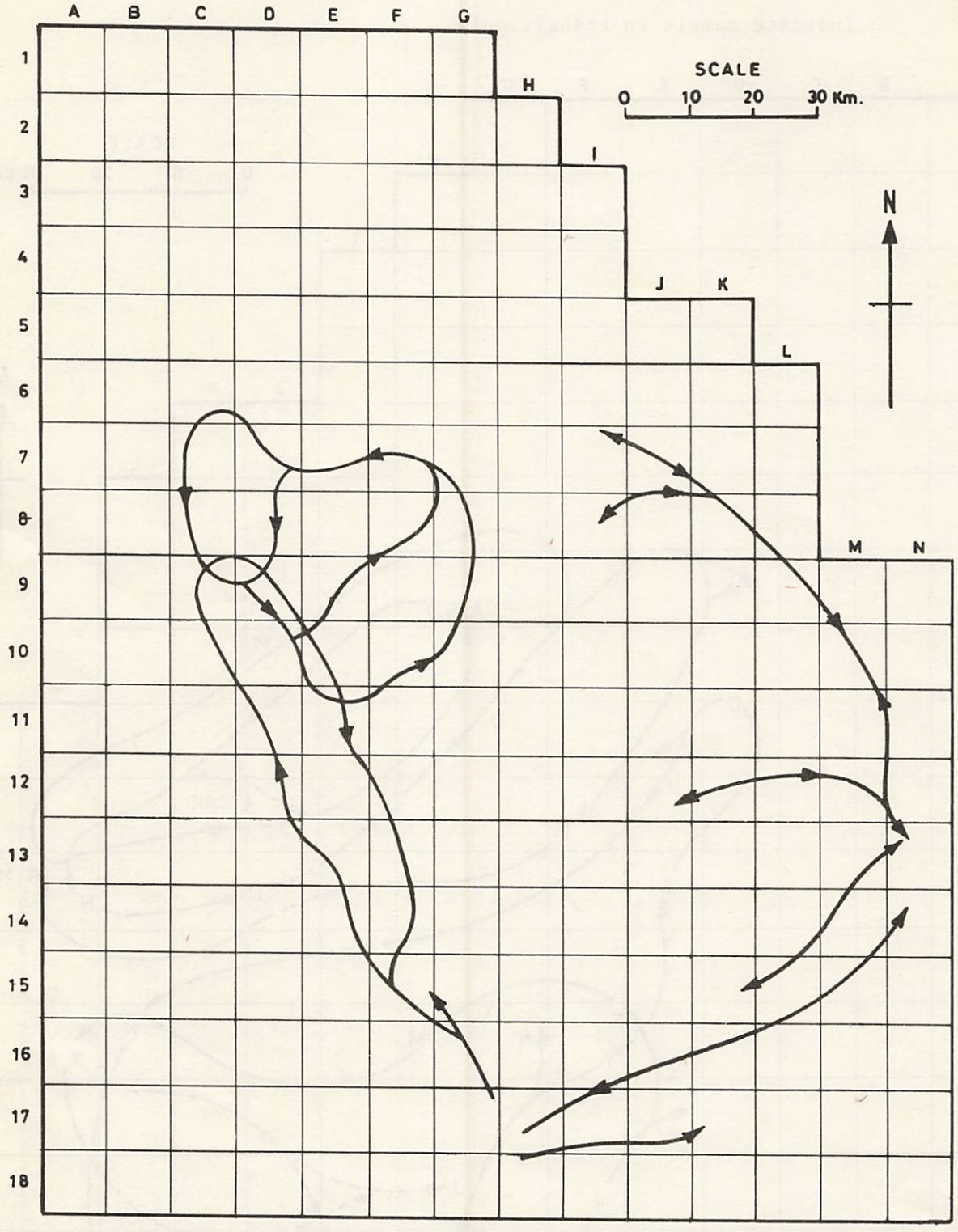
In each population it will be necessary to have about twenty *fora* each numbering approximately 2,500 to 3,000 smallstock. These localized high densities of animals will have both advantages and disadvantages. Among the former they will be easier to protect with security, there will be brief but heavy grazing which will tend to eliminate some of the unpalatable species. They will require less material for the construction of night bomas. Disad vantage include the need to develop sufficient water resources to cope with large concentrations of watering animals in the western Hedad and the greater risk of disease spreading rapidly through the population. However the net benefit will be improvement in range condition, food quantity and quality and ultimately in the health and production of the animals.

The development of this third phase for smallstock is dependent on water resources being available as well as security. For this reason it will be the last of the main livestock grazing developments and should only be implemented once it can be demonstrated that security has been achieved.

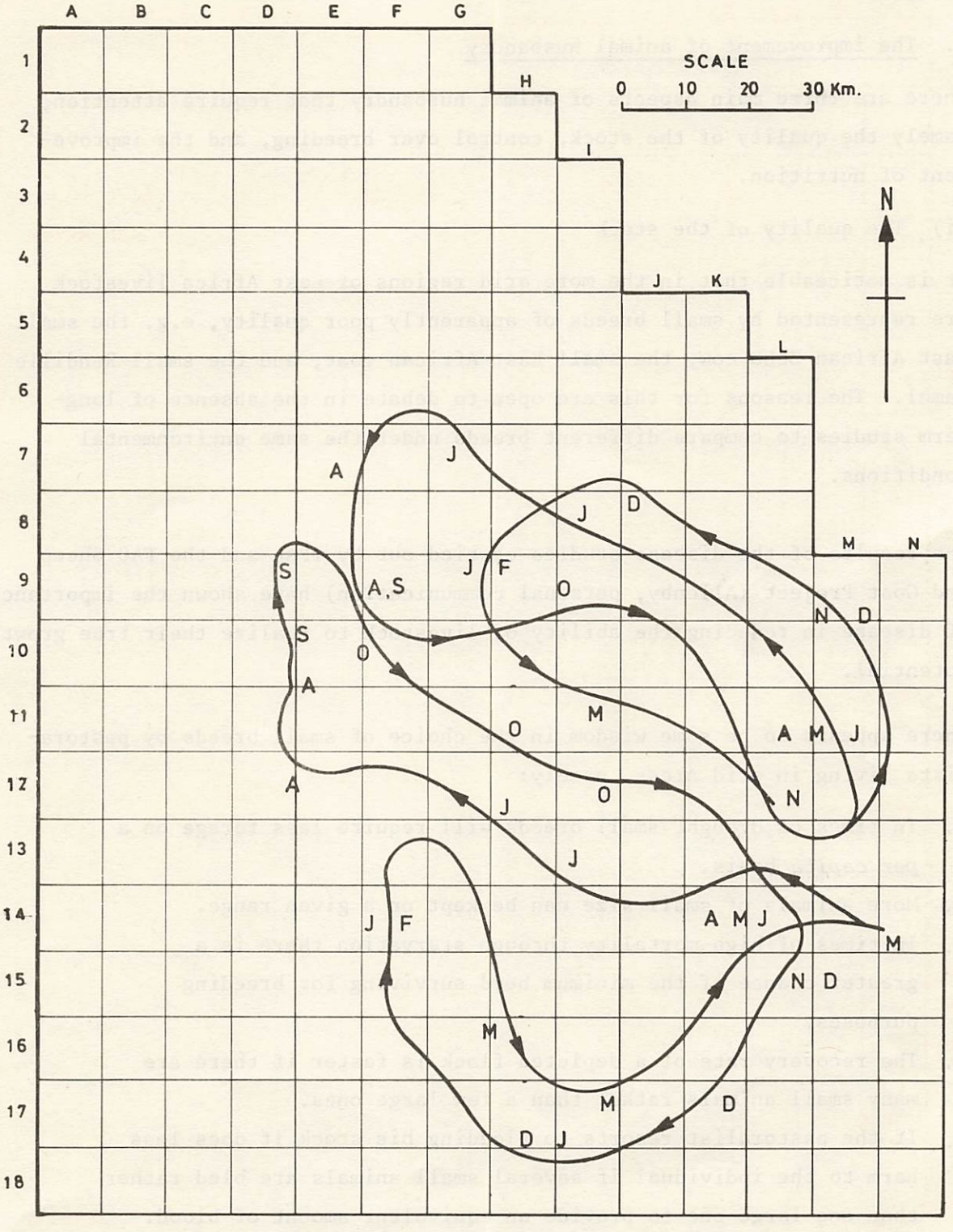
Map 27. Recommended seasonal grazing patterns for Rendille camels. Letters refer to months of the year. *Sorio* refers to short visits to Kargi - Korr for ceremonial purposes. Dashed line indicate camels in transit only



Map 28. Recommended seasonal grazing patterns for Rendille cattle



Map 29. Recommended seasonal grazing patterns for Rendille smallstock
Letters refer to months of the year



3.2 The improvement of animal husbandry and the control of livestock disease.

a. The improvement of animal husbandry

There are three main aspects of animal husbandry that require attention, namely the quality of the stock, control over breeding, and the improvement of nutrition.

(i) The quality of the stock

It is noticeable that in the more arid regions of East Africa livestock are represented by small breeds of apparently poor quality, e.g. the small East African Zebu cow, the small East African goat, and the small Rendille camel. The reasons for this are open to debate in the absence of long-term studies to compare different breeds under the same environmental conditions.

The results of the disease studies carried out by IPAL and the FAO Sheep and Goat Project (Allenby, personal communication) have shown the importance of disease in reducing the ability of livestock to realize their true growth potential.

There appears to be some wisdom in the choice of small breeds by pastoralists living in arid areas, namely:

1. In times of drought small breeds will require less forage on a *per capita* basis.
2. More animals of small size can be kept on a given range.
3. In times of high mortality through starvation there is a greater chance of the minimum herd surviving for breeding purposes.
4. The recovery rate of a depleted flock is faster if there are many small animals rather than a few large ones.
5. If the pastoralist resorts to bleeding his stock it does less harm to the individual if several small animals are bled rather than one large one to provide an equivalent amount of blood.
6. Growth rates of animals on poor pastures may be very slow and it is doubtful whether the larger breeds would reach their full potential.

Nevertheless, larger breeds of livestock under improved range management or on higher-potential areas have substantially larger yields in both meat and milk. Their rates of reproduction may also be higher e.g. through a higher incidence of twinning.

The management scheme contains a few areas of medium to high potential, namely on and around Mts. Kulal and Marsabit and the Ndotos, where rainfall is higher. It may also be assumed that the effect of the grazing programme will be to provide livestock with better pasture, making possible either

a. the stocking of more individuals of the original breeds, or
b. the stocking of fewer individuals of improved breeds.

In recommending the introduction of new breeds these and the following considerations are taken into account.

1. New breeds should be chosen from those already existing in the arid zone which have demonstrated their ability to survive under similar conditions of drought, forage and water availability.
2. New breeds should be more productive under similar conditions of forage availability than the existing livestock.
3. New breeds should be tolerant of indigenous chronic diseases.
4. New breeds should not exacerbate the existing problems of range degradation.

Taking these considerations into account, the following are recommended:

1. Goats: Introduction of a nucleus of Galla stud males.
2. Sheep: No change.
3. Camels: Introduction of a nucleus of Somali stud males.
4. Cattle: In medium-potential areas, as at the foot of the Ndotos and Mt. Kulal, the introduction of improved Boran bulls.

At selected localities on Mt. Marsabit where disease may be carefully controlled and diet supplementation in the dry season is possible, introduction of exotic crossbred bulls. Currently Simmen-thal x Boran, Jersey x Boran and Friesian x Boran show the greatest potential but other breeds should not be ruled out.

Selection from within the existing stock should also be explored as a possibility although it should be noted that it has taken 60 years to develop the high quality Boran beef breed and a similar period might be necessary to develop a dairy Boran breed.

(ii) The control of breeding

At present there appears to be very little control over breeding, with respect to either the males used, the age at first conception, or the season of breeding. This leads to the production of poor quality stock and parturitions during seasons of low forage quantity and quality when the chances of survival of the neonate are minimal.

The following recommendations are made in this respect:

1. that all poor quality males in excess of requirements be castrated and sold;
2. that the scheme keep a reserve supply of stud males for hire should they be needed;
3. that all old males be culled;
4. that all young males be castrated before they reach sexual maturity unless they come from a genetic line of proven high-yield performance;
5. that all breeding males be either kept separate from the females until breeding is required or, in the case of smallstock, be fitted with aprons to prevent insemination (as practised by Maasai shepherds).

The rationale behind the decision whether or not to adopt controlled (i.e. seasonal) breeding depends upon the lifestyle or strategy of the pastoralist. The determining factor should therefore be whether the pastoralist is dependent on milk or not. Traditionally, the pastoralist was dependent on his livestock for milk, but the current trend is away from this towards a mixed diet involving a higher proportion of cereals as a source of carbohydrate. Why this should be encouraged up to a point has been explained previously.

The traditional system therefore attempts to optimize milk yield for subsistence consumption in terms of both quantity and availability throughout dry seasons. Sheep, being poor milk producers, are raised

more for meat. There is no attempt to speed up reproduction by shortening the breeding interval. The modern system recently adopted by some traders involves forfeiting some milk offtake for maximal calf growth rate and maximizing rates of reproduction by reducing the calving interval.

In a simulation study Smith *et al.* (1982) used data from the Ngurunit flocks to determine, among other things, the optimum seasons for kidding of goats with regard to milk yield and kid survival. This is the first strategy if the traditional system is incorporated into the suggested breeding calendar.

Table 167. Suggested breeding calendar

Season	Dry			Wet			Dry			Wet		
Month	J	F	M	A	M	J	J	A	S	O	N	D
Sheep				WI,2			CI,2					PI,2
Goats		P2	WI		CI			W2		C2	PI	
Camels		WI		CI PI					W2		C2 P2	
Cattle		C2	PI		W2	CI				P2	WI	

C = Conceptions P = Parturition W = Weaning

Sheep, being raised for meat, should conceive in the dry season, lamb in December, and be weaned in April at the time of good forage. This will give strong, fast-growing lambs. With goats, which are raised for milk, one-half of the flock should conceive in May and the other half in September. They will kid in October and February and be weaned in March and July. In this way milk will be available for all but two months of the year and the kids will grow under favourable conditions. The kidding and lambing interval would be 12 months.

As with goats, camels will be raised for milk and under this system they should conceive during the April and November rains, which will result in calves one year later. Lactation should continue for 10 months with

weaning in February and September, just before the rains recommence. The calving interval would be 24 months.

Cattle in the higher rainfall areas may be used for milk production. They should conceive in June and calve in March. Weaning should occur in November, with the next conceptions in February, parturitions in October and weaning in May. The cycle should be resumed in June. The calving interval would be 19 months.

The following is the recommended breeding calendar for the second strategy:

Table 168. Second strategy breeding calendar

Season	Dry			Wet		Dry			Wet				
Month	J	F	M	A	M	J	J	A	S	O	N	D	Year
Sheep and Goats					CI					PI		WI	1
	C2					P2		W2	C3				2
		P3		W3	C4					P4		W4	3
Camels				CI									1
				PI					WI	C2			2
										P2			3
			W2										4
Cattle	CI									PI			1
	C2		WI							P2			2

C = Conceptions P = Parturitions W = Weaning

The policy in the above calendar is to reduce the breeding interval by permitting suckling of a larger proportion of the milk thereby achieving rapid growth of the neonate and then weaning early.

For smallstock the kidding and lambing interval would be reduced from 12 to 8 months. Inevitably some parturitions will occur in dry seasons which are suboptimal for the growth of the neonate but this should not be a problem if the neonate is allowed to suckle freely.

For specifically productive camels, calves may be allowed to suckle in the daytime and the calving interval be reduced from 24 to 18 months. Conceptions and parturitions would be in April and October one month after weaning.

For high producing cattle, conceptions should be in January and parturitions in October. Weaning would occur naturally after the next conception at the beginning of the rains in March. The calving interval would be reduced from 18 months to 12 months.

In order to adopt this second strategy on a sustained basis, adequate nutrition which may involve some supplementation is a necessary prerequisite.

Careful monitoring of the ~~two~~ strategies will be necessary.

(iii) The improvement of nutrition

The effective implementation of the grazing programme will lead to an overall improvement of the nutritional status of livestock through an increase in the quantity and quality of available forage as follows:

1. stocking at a rate within the carrying capacity of the range units;
2. stocking the correct species combination for the available forage composition;
3. giving adequate rest periods for growth of vegetation, storage of nutrients, and reproduction;
4. experiment with the cost effectiveness of food supplementation.

Nevertheless, additional measures to improve forage quantity and quality are both possible and are discussed in the range section.

Night grazing

The advantages of grazing livestock at night in addition to the daytime are as follows:

1. There will be a longer grazing time.
2. Livestock may seek shade earlier in the daytime and will expend less energy cooling themselves.
3. This will lead to water conservation and may lengthen the interval between waterings.

4. With a longer interval between waterings it will be possible to extend the foraging range of livestock.

At present these advantages are experienced by wildlife and occasionally by domestic stock. Thus the Gabra do not pen adult animals at night where predation is low, as at Gus; the Turkana will graze their livestock on moonlit nights and donkeys are often left out at night unattended. The advantages to wildlife of night grazing were evident at the end of the prolonged drought in 1976 when three-quarters of all domestic animals had been obliged to leave the study area for highland pastures in Ethiopia and Samburu District, while wildlife were unaffected (Field, 1980).

Disadvantages of night grazing are:

the risk of straying and loss;
the risk of predation and theft;
the need for additional herdsmen.

It is recommended that night grazing using co-operating herdsmen be introduced where predation and theft are a low risk. Monitoring of the performance of herds grazed at night as well as in the daytime with those on a daytime regime should be the duty of IPAL.

Particularly troublesome predators should be controlled. Translocation to reserves is ineffective.

Compensation for losses of livestock to predation should be paid promptly on receipt of the evidence, but claims for losses incurred while stock are in game reserves should not be considered.

Food supplementation

Intensive supplementation

Certain categories of livestock, principally weaners and lactating animals, are particularly vulnerable to shortages in range forage. Owing to problems of harvesting adequate quantities of forage for large numbers of lactating animals as well as weaners, and of the transport of feed to remote localities, it is recommended to harvest naturally occurring concentrated feed.

The most suitable feed for this purpose is provided by the seed pods of *Acacia tortilis*. It is therefore recommended that pods from *Acacia tortilis* be harvested in areas not utilized by livestock and stored until times of shortage when they may be needed. They should then be fed to weaner animals of all livestock categories in controlled quantities. Careful monitoring of the performance of supplemented animals should be the duty of IPAL.

The storage of *Acacia tortilis* pods will require careful supervision, since they may be spoilt by fungi if harvested while still green and by brucid beetles if harvested from the ground after they have ripened and fallen. They will need to be dried thoroughly and routinely to prevent growth of fungi at times of high humidity and possibly also treated to prevent infestation with insect pests.

It is recommended (Kayongo-Male, Mimeo, 1983) that cattle should be supplied with a mineral supplement fortified with respect to phosphorus, magnesium and sodium.

Extensive supplementation

Extensive feed supplementation is recommended for 2 situations:

1. as a grazing insurance for a significant proportion (e.g. three-quarters) of the stock during times of prolonged drought;
2. in the holding and fattening of male animals and castrates destined for market.

There is always a risk, which cannot be predicted from the present state of knowledge of the climate, of the scheme facing a prolonged drought before equilibration of stocking rates is achieved. Under these circumstances livestock owners should be encouraged to utilize an area set aside primarily as an insurance against drought rather than following individual inclinations and travelling long distances to highland pastures outside the scheme, as was the case during the prolonged drought of the early 1970 s.

Such an area with adequate pasture exists to the south-east of Marsabit Mountain owing to insecurity and insufficient water. The area lying within

Marsabit District east of the main Laisamis to Loglogo highway, which is about 4,000 km^2, may be adequate to support three-quarters of the existing population for about 6 months. A similar but smaller area is used to the north-west by the Rendille in times of drought.

Opening of these areas for this purpose will require principally the development of water, but they would then be closed to grazing by law except when the grazing committee makes a unanimous decision to use them. At such times up to 75% of the livestock population should move from their normal grazing areas within the system together with accompanying security, which might be further strengthened from Marsabit.

Animals destined for market should be purchased by the scheme whenever possible, but it is expected that according to tradition larger numbers will be available during dry seasons and drought.

It is proposed that rather than attempt to market these animals immediately, the scheme hold them and fatten them until a suitable market price is offered. This will probably coincide with the following wet season.

Suitable fattening areas exist in the higher-potential parts of the scheme, but these areas should be set aside for agricultural and dairy development. It is recommended therefore that the afore-mentioned south-east drought reserve be used for fattening purposes. This is not a contradiction, since in normal years use of some of the range will be desirable to prevent the pasture from becoming mature, fibrous and unpalatable.

Adequate milk supplies for livestock

The evidence from camels in particular is that the pastoralist is often forced into a situation of inadequate food for his family when he is obliged to deprive suckling animals of the necessary milk for normal growth and disease resistance. It is expected that the occasions when this situation occurs will diminish with the improvement of the nutritional status of livestock.

Nevertheless, pastoralists need to be educated through extension and demonstration of the long-term implications for the family herds if young animals are deprived of an adequate maternal milk supply. A suggested alternative to this would be to encourage pastoralists to sell more castrated animals for cash with which to purchase energy-rich cereals for home consumption, thereby relieving those livestock with a diminishing milk yield from the dual burden of supporting both their offspring and the needs of their owners.

This will be particularly essential for livestock owners who adopt the second breeding strategy outlined above, since this depends on a good maternal milk supply for young animals in order to reduce the calving interval.

b. Livestock disease control

In the absence, so far, of information on the long-term consequences, it is recommended that the disease-control component of the management plan be modest to begin with. As success is achieved with a grazing-management programme there will be increasing justification for expansion of veterinary activities.

The proposals are for:

- an initial phase of veterinary activities, in order of priority, with some suggestions as to the possible direction of a second phase;
- further investigation by IPAL to fill gaps in the data acquired so far.

Veterinary centres

The veterinary activities of the management plan will be conducted and supervised by ~~two~~ veterinary officers based in Korr and Kargi, with necessary staff, housing, office, laboratory, equipment and transport. The responsibilities of such officers should include:

1. diagnosis and monitoring of disease in pastoral livestock;
2. extension and education of the pastoralists in ways in which they can themselves improve the health of their herds;

3. conducting local emergency ring-vaccination campaigns in the event of outbreaks of epidemic diseases;
4. providing a limited veterinary clinical service for the livestock owners;
5. caring for the health of all livestock temporarily under project management; and
6. co-operating with any investigational work being conducted by IPAL.

These Project veterinary officers should be given most of the statutory authority of Government veterinary officers, and have powers to ensure that statutory duties of the state veterinary service are carried out within the Project area (see also 'Disaster Prevention' below). While employed by, and responsible primarily to, the Project, such officers would report also to the grazing committee and to the Director of Livestock Development. Field assistants attached to the veterinary centres would be continuously present with the herds in the grazing areas. They would have monitoring and extension duties, and the responsibility for first reaction to any emergency arising.

In a subsequent phase the number of professional officers could be doubled, with increased mobility to allow services to be more effectively carried into the areas from time to time being used for grazing.

Public relations

Among the 'carrot-and-stick' methods that may be used to persuade pastoral livestock owners to co-operate in a grazing management programme, the provision of veterinary services could be a potent incentive.

It is proposed that co-operating livestock owners be given:

1. free anthrax and blackquarter vaccinations for their cattle, and for other livestock species if a need is indicated, and entero-toxaemia vaccine for smallstock on an elective basis;
2. assistance with spraying livestock against ticks in the vicinity of waterpoints; and
3. free access, or access at much reduced rates, to the veterinary clinical service provided from Korr and Kargi. Access would be

facilitated through a weekly visit by the veterinary officer to approved waterpoints, or to places where livestock camps are constructed.

Veterinary extension and education

The general development and rehabilitation of the project area will depend to a large extent on the education of the pastoral people. It should be an objective of the veterinary component of the management plan to achieve its greatest effect on livestock health through extension and demonstrations to the owners. This effort should be aimed primarily at the owners co-operating in the plan, but others must also be made aware of the lessons to be learned. The extension and demonstration effort will be based on the IPAL-owned flocks and herds in the grazing areas, and these herds will also be at the core of continuous monitoring activities.

While the major improvements in animal health are expected to be achieved through education, it should be stressed that other project activities must ensure in advance that livestock numbers will be kept within the sustained carrying capacity of the land. Veterinary extension policy must at all times be closely integrated with extension work on other subjects, particularly the ecological imperatives that are the basis of the Project's existence. General topics for extension should include, for example:

- the safe and correct usage of acaricides;
- the vaccination of dogs against rabies;
- the prevention of hydatidosis, cysticercosis and human tapeworm disease.

Camels

On the understanding that camels are to be encouraged from the point of view of sound range management, due to their preference for perennial forage, their independence of water supplies, the relatively little damage they cause to the herb layer by trampling, and the long time needed to build up population numbers, priority should be given to the health of this species in the initial years of the management programme.

Detailed recommendations

1. Disaster prevention

A first priority is to reduce the risk, both real and as perceived by the livestock owners, of sudden and serious loss due to epidemic disease.

The major epidemic diseases are rinderpest and bovine pleuropneumonia, which have for many years been subject to very successful national control programmes, but it must be noted that the effectiveness of such programmes has recently been declining in the face of financial constraints on the Government. For example, the annual rinderpest vaccination campaign of 1982 was not completed due to lack of transport operating funds, and annual pleuropneumonia vaccinations have not been done since 1979. The executors of the management plan should have access to supplementary funds and transport to ensure that compulsory annual vaccination campaigns are efficiently carried out in the project area.

In addition to those two bovine diseases it is proposed that a policy of massive free ring-vaccination be adopted in the face of out-breaks of:

1. Caprine pleuropneumonia, in view of the fact that a more effective vaccine has recently become available; and
2. camel pox, if further investigations should prove it to be economically important, and assuming that an effective vaccine could be manufactured.

There would be a case for adding other diseases to the list if they should arise, or in a subsequent phase of the project.

2. Trypanosomiasis

Policy with respect to trypanosomiasis, except in the event of an epidemic due to the appearance of a new serotype, should be to treat confirmed infected animals only. Confirmation could be by buffy-coat or direct smears.

In the present absence from the market of a cheaper effective drug, 'Naganol' (Suramin, Bayer) should be used to treat trypanosomiasis in camels.

Because of its toxicity and the danger of stimulating drug resistance, it would need to be controlled and administered by veterinary officers, but could be provided at 50% of cost to owners participating in grazing-management schemes.

For trypanosomiasis in other livestock the drug for the time being approved by the Government should be made available at its official price.

3. Helminthiasis

Gastro-intestinal roundworms appear to be by far the major health problem of smallstock in the project area, but most especially on the peripheral higher ground, where cattle also become seriously affected.

To save the veterinary centres being too much involved with retail trade, it is recommended that suitable traders should be encouraged to stock effective anthelmintics, e.g. 'Panacur' (fenbendazole 2.5% and 10%, Hoechst), which has been found to be very effective.

The extension programme will advise dosing:

- pregnant sheep and goats 2 weeks before parturition and again at least 4-6 weeks afterwards;
- generally for the flock as a whole - 1 dose at both the beginning and end of the rains. Lambs and kids 1st dose 4-6 weeks after grazing begins if rain has fallen during this period. 2nd dose 3 months after grazing begins;
- cattle (in areas having over 400 mm average rainfall) between the ages of 4 months and 20 months, at the beginning of each wet season, and all ages 2 months later; and
- all camels at the beginning of each wet season, and adult female camels 2 months later.

4. Ticks

In the higher-rainfall areas the blood loss and skin damage caused by cattle ticks are major problems, and it is recommended that 3 cattle dips, to be initially under project management, be built at Karare and Ula Ula

on Marsabit and Luai on Mt. Kulal.

Dips are also needed at two other sites on Marsabit Mountain, at Badasa and in Marsabit North. It is recommended that the project subsidize the cost of these dips, even though they will be outside the management area, in order to equilibrate the tick-control facilities around the mountain.

The other three dips should be constructed with a larger contribution from the project, but dipping fees would thereafter be charged to cover all operating costs, unless the area should be incorporated into a Government compulsory free dipping scheme.

'Tick worry' is also a significant problem among camels, and camel owners should be encouraged through the extension programme to hand-spray, or wash with a hand-cloth, the predilection sites of the ticks, generally weekly. It is especially important that the whole of the body of young camels be regularly and thoroughly treated against ticks in the first six months of life.

As with anthelmintics, it is recommended that selected traders be encouraged to stock spray pumps and acaricides, and be assisted to acquire the necessary retail licences. Organophosphorus-type acaricides are recommended. As stated above, however, additional assistance (not financial) with spraying of livestock will be provided by the Project veterinary officers at those watering points from time to time in use under the grazing-management scheme.

Acaricide treatments of smallstock should be left to the initiative of the stock owners, as they would appear to be only locally and intermittently necessary.

5. Brucellosis

While brucellosis is generally considered to be an important disease the evidence acquired by IPAL does not show it as having great significance in the project area, except possibly in goats and perhaps cattle at Ula Ula. The incidence in livestock has not been related to that in the human population.

Pending further information, it is recommended merely that the Project veterinary service include the epidemiology of the disease in the extension programme, give specific advice where problems occur, and make use of vaccine as may be indicated.

In a subsequent stage there could be grounds for introducing a phased eradication programme, beginning with general vaccination campaigns in parallel with a national eradication programme which may soon be attempted.

6. Pneumonia in Smallstock

Exposure leading to pneumonia has been observed in the course of clinical work to be a severe cause of mortality among infant kids and lambs in wet weather. It also affects older smallstock, calves, and baby camels if other stress such as malnutrition is present. Extension programmes should include advice on keeping such animals protected from wind and rain.

It has also been noted that bacterial diarrhoea occurs more frequently in pens with muddy floors, and often associated with apparently secondary coccidial infections.

c. Further investigations

The investigational and clinical work to date has been fairly comprehensive, but has:

a. not found satisfactory answers to some of the problems;
b. indicated further directions in which investigation is required; and
c. by chance not met with certain diseases that records from other sources show to be significant.

It is most important that a continuing investigational capacity be maintained by IPAL, in co-operation with the veterinary service of the management project, to elucidate the answers to the following problems, many of which have been referred to above:

Camel mange: Traditional methods of controlling this disease depend on the provision of salt water to drink and salt mud to roll in. The veterinary rationale for this therapy is not understood. On the other hand, the more scientific methods tried have not been conspicuously successful, and

experimental camels have not been available for a comparative trial of different therapies. Further investigations should lead to recommendations on control measures.

Trypanosomiasis: Further information is needed on:

- a chronic and debilitating form of trypanosomiasis that has recently been identified in cattle on Marsabit Mountain;
- the significance, if any, of trypanosomiasis in smallstock; and
- the application of possible field technique for diagnosis in camels.

Brucellosis: There are indications for wider surveys to establish the significance and incidence of *Brucella abortus* and *B. melitensis* in all classes of livestock, and to establish the number and severity of resulting human infections.

Pneumonia in smallstock: Problems of pneumonia following exposure to wet and cold suggest a need for trials with alternative types of pen for young kids and lambs. An ideal design would be cheap, wind and water-proof above and on three sides, movable, and easily cleaned. An annex to a human home would give some added benefit from the warmth of a fire.

Sometimes there is high mortality in older sheep at the onset of the rains, and more needs to be known of the causes of such outbreaks before control measures can be recommended.

Others

1. Severe, although not fatal, outbreaks of foot abscesses have been seen in kids and lambs in wet weather. The aetiology and predisposing factors have not been established.

2. A sporadic but highly fatal disease of cattle calves, known locally as *ndiss*, has not been correlated with any known disease in the literature, nor has limited sampling to date succeeded in identifying the causative organism.

3. Medical records have included human cases of bovine-type tuberculosis. A single intradermal test of the IPAL experimental cattle gave a prevalence of reactors of 7.7%, but otherwise little is known of the occurrence of

tuberculosis in the livestock of the study area.

4. Anthrax has been reported sporadically in all species of livestock, and human infections have resulted from eating affected carcasses, but it is unlikely that universal bi-annual vaccination of all animals would be justified.

5. There is a periodic highly fatal epidemic disease of camels that affects large areas of northern Kenya when it appears. The chief external symptom is swelling of the lymph nodes. Existing evidence suggests that this disease is caused by exotic serotypes of trypanosomiasis, but effective control measures have yet been identified. It is most essential that veterinary manpower and facilities be available to investigate this disease when it next appears, and attempts be made to halt it before the camel population is seriously reduced.

3.3 Livestock marketing

d. Livestock by-products

It is proposed that a *small unit* be established under consultant guidance for the more efficient use of animal by-products. This unit will also serve the purpose of training and demonstration.

It is recommended that the unit be *established at Loglogo* for the following reasons:

1. The availability of exploitable water.
2. Good communications with Marsabit, the Kenya Highlands and the management area including the drought reserve.

The Unit should consist of the following:

A small slaughterhouse or abattoir.
A small canning unit.
A tanning shed.
A boilerhouse and autoclave.

The following by-products should be investigated and if they prove profitable full participation of trained pastoralists should be encouraged.

(i) Properly tanned hides using (a) Tannin from the bark of *Acacia seyal* which is abundant and regenerating in the area
(b) Kerosene which has the advantage of requiring very little water (Evans, personal communication; FAO, 1960).

(ii) Cheese and Ghee. These foods enable the storage of milk products from times of abundance for use during periods of shortage. Cheese may be made from camel's milk by mixing with approximately 25-30% cow's milk (Schulthess, personal communication).

(iii) Canning of camel meat and other cull animals for sale as pet food. There is a need for this outlet now that the camel abattoir at Isiolo has fallen into disuse.

(iv) Bone meal. There is a need for mineral supplementation of livestock in particular with respect to cattle whose diets are deficient in phosphorus, magnesium and sodium (Kayongo-Male, 1983). However smallstock also exhibit osteophagia in certain areas. These elements may be obtained from bones and from the salt in the Chalbi desert and possibly Halisiruwa. A cheap mineral lick should be made from these sources which are readily available in the study area.

(v) Fertilizer.
Certain soils in cultivated regions of the study area are deficient in phosphorus and nitrogen (Van Kekem, personal communication). Bones and manure are the cheapest source of these elements and could be processed into a sterile fertilizer.

Implementation

Since the treatment of animal by-products requires certain skills it is recommended that *short term consultants* with practical experience in small scale rural developments be invited to establish the facilities described above and to train pastoralists to run the operation themselves. However, it should be noted that for long term success high technology input should be discouraged.

3.3 Livestock Demonstration and Extension Units

An essential element of the training and monitoring programme will be the live demonstration to the people of the benefits of sound range management, animal husbandry, and animal health.

Considerable interest has already been shown by some Rendille in the experiments being conducted with livestock by IPAL, to the extent of their purchasing male animals from the Project for breeding purposes. It is therefore proposed that two Livestock Demonstration Units (one each in the northern and southern ranges) be established for the purpose of educating the pastoralists in general in these benefits. The units will be operated and supervised by IPAL and will accompany the grazing herds wherever they move. They will consist of a group of animals receiving a certain management input or inputs (treatment herd), compared with a group not receiving input. Examples of specific inputs which should be demonstrated are:

1. a comparison between the performance of improved Galla and small East African goats;
2. seasonal breeding for milk or meat;
3. feed supplementation of weaners with *Acacia tortilis:*
4. disease control of helminths, ticks, etc.

Since it is expected that livestock owners will require specific information on performance, it will be necessary to monitor carefully all aspects of input and production, including the cost-benefit ratio. Careful control of such work will be necessary and this can only be achieved by trained scientific assistants who should preferably be of pastoral origin and fluent in the local languages.

The demonstration herds should consist of all the four main livestock species, but since there would be a very large capital outlay on camels and cattle it will be necessary to limit them to input herds only and to leave it to the livestock owners to judge their performance by comparison with their own stock.

For each unit:

Input 1. 100 goats, 50 each of camels and cattle to demonstrate improved breeds.

2. 60 each of sheep and goats, 30 each of camels and cattle to demonstrate seasonal breeding.
3. 60 each of sheep and goats, 30 each of camels and cattle to demonstrate feed supplement.
4. 60 each of sheep and goats, 30 each of camels and cattle to demonstrate veterinary input.

Thus the two units would require 560 goats, 360 sheep and 280 each of camels and cattle.

4. Drought management

4.1 Introduction

Drought in technical terms is the prolonged absence of moisture which adversely and substantially affects the physiology of plants. As a rough yardstick for the savanna areas of Marsabit District a minimum of 50 mm of rain per month is required to ensure adequate growth of range plants. Drought is a built-in factor in arid ecosystems but its occurrence is unpredictable. Its impact is mediated through the range and livestock management in vogue so that good management practices will lessen the adverse effects of drought, while poor management makes the ecosystem all the more vulnerable.

The impact of drought has a carry-over-effect which lasts for 2 - 3 years after it has passed. Its influence is felt in the following inter-related aspects of the arid ecosystem:

plant life
water availability
animals (domestic and wild)
people and their economy
the national economy.

It is thought unnecessary to examine in technical detail the impact of drought on plant life, water availability and animals since these matters are well documented in the literature. It is for example well known what species of plants are best adjusted to drought conditions. It is felt that these three factors - plants, water and animals - could be best treated in a secondary manner while the primary focus here should be on the effects of drought on the people, their economy and the national economy.

4.2 The Rendille response to drought

The Rendille accept drought as part and parcel of life. Major droughts are recorded in their event calendars. Traditionally the Rendille relied mainly on meat, blood and whatever milk was available during droughts. When their own stock were insufficient to meet subsistence needs in droughts they sought assist nce from the Samburu to the south who on occasions supplied cattle for slaughter. The movement of the Rendille was less restricted then and they had a much larger territory to move in in search of water and forage. At that time the ratio of livestock to people was relatively high and favoured total and direct dependency on pastoralism. Matters changed in the 1940s

when the Rendille began to supplement their diet based on animal products with maize meal. This heralded the beginning of an indirect dependency on livestock. With the drastic drop in the livestock to people ratio caused by the great losses in livestock incurred during the droughts of the 1970s the Rendille can no longer depend totally on their livestock for subsistence. Traditional strategies for coping with drought are no longer viable.

Two problems face them in drought: the survival of the human population and the survival of their livestock. The present practice is to move animals long distances from the main camps. Small stock and cattle are moved north westwards towards Lake Turkana, and southwards into Samburu country where animals are watered along the Milgis and Uaso Nyiro water courses. Milch cattle, sheep and goats are not milked so as to reduce pressure on animals which are already under stress. Kids and lambs are frequently killed to save the mothers. The human population survive off meat (even camels are slaughtered), blood and cereals such as maize and beans. The latter are either bought or received as hand-outs from the churches and government. The ratio of meat to cereals in their diets depend on the availability of cereals. Remittances from labour migrants play an important role in the purchase of shop bought food. In periods of serious drought the Kenya Government sets up national and district famine relief committees to monitor the needs of drought-affected districts and to channel foodstuffs to where the need is greatest.

4.3 Recommendations for coping with drought conditions

Having reviewed the situation amongst the Rendille we would like to concentrate our efforts on outlining recommendations to improve the ability of arid ecosystems to cope in drought conditions. It is emphasized as a first principle that good management of the range and livestock strengthened the local ecosystem and prepared it all the better for drought.
The recommendations are divided into ~~three~~ sets:

a Measures to be taken before drought occurs.

b Measures to be taken during drought.

c Measures to enable the ecosystem to rehabilitate after the drought has passed.

All sets of recommendations considered the various aspects of the arid ecosystems. These include abiotic factors, the range, the livestock and the pastoralists themselves. In addition the recommendations would operate at

three different levels: Government, IPAL and the West Marsabit Integrated Development Project, and the local communities. Due consideration is also given to the financial limits within which the West Marsabit Development Project would operate. There is no point in suggesting measures outside its proposed budget.

a. Before the drought

The following recommendations are made:

1. It is essential to have an inventory of the key physical resources of the Rendille homelands such as soils, vegetation and water profiles. The range should be classified into range units as this would form the basis of any rational use of the range.

2. Drought reserves ought to be established: one in the north-west bordering the eastern shore of Lake Turkana and the other in the south-east, the region east and south-east of Loglogo. In the latter area a borehole is necessary and this would only be used in drought periods. It is acknowledged that the Rendille share the former reserve with the Gabra, and that the Rendille would probably also have to share the second reserve with Boran stock-keepers. Pastoralists would gradually move towards these drought reserves as the drought approached.

3. Haymaking in range units 21, 13 and 18. This hay would be baled and stored in sites close to the drought reserves. It would only be used as supplementary drought feed.

4. Since the mountain areas are vital parts of the grazing system of the Rendille their right to use these pastures should be put on a firm legal basis.

5. The present network of waterpoints should be improved and extended so as to facilitate a more even use of the range.

6. A certain manipulation of the plant cover is thought to be necessary such as the burning of thick bushland. In addition areas particularly subject to erosion ought to be protected by the establishment of anti-erosion shelter belts of trees such as the eucalyptus.

7. Security of the range - without which they can be no real development - could be guaranteed by the deployment of more home guards, making the administrative police more mobile and providing them with more radio telephone sets.

8. An increased off-take of livestock is essential. This could be achieved by upgrading the commercial consciousness of the pastoralists but more importantly by providing them with regular market outlets and good prices.

9. Livestock should be kept healthy at all times by regular drenching and mass vaccinations against epidemics (such as foot and mouth).

10. A large herd of breeding stock should be kept in the more favoured rangelands south towards Nanyuki. These ought to be kept in reserve for restocking after droughts.

11. Food supplies of cereals should be guaranteed. At the national level the National Cereals and Produce Board ought to have a programme to ensure that adequate reserves of food for drought were available in all districts which are vulnerable to drought. Since it is difficult to dry cereals on Marsabit Mountain, and after drying them to keep them dry, it was suggested that experimentation in grain driers on the mountain and the storage of grain in the lowland centres of Loglogo, Laisamis, Korr and Kargi be encouraged.

12. The establishment and maintenance of a good road network joining the savanna centres with each other and Marsabit was essential.

13. More consideration be given in national planning to livestock development in pastoral areas. In the past - phases 1 and 2 - emphasis was on commercial ranching as regards cattle and sheep. Pastoral communities and economies and their needs were totally excluded.

b. During drought

The following proposals are recommended:

1. As a drought threatens there should be an intensive campaign to encourage the pastoralists to sell livestock. Needless to say market facilities ought to be provided.

2. The drought reserves (which ought to be lightly grazed in normal years) should be opened up for use. The stored hay ought to be made available to the pastoralists as supplementary feed for their livestock.

3. The utilization of riverine zones ought to be encouraged, while areas particularly vulnerable to erosion ought to be excluded from use.

4. Water ought to be trucked to animals from the drought reserve borehole so as to reduce stress on the animals and pressure on the range surrounding the borehole.

5. The breeding of animals ought to be prevented during the drought and a campaign to control parasites be intensified. Night grazing could be encouraged with benefit.

6. Food supplies stored at savanna centres ought to be released mainly on a commercial basis although due consideration be given to genuinely destitute households. Packet milk should also be provided on a commercial basis. The present system of providing school children with packet milk has been very successful and is acceptable to the local communities. The possibility of providing fish taken from Lake Turkana ought to be examined.

c. After the drought

1. Areas which were most used during the drought ought to be immediately rested.

2. Drought resistant plants ought to be introduced and inter-seeding encouraged on an experimental basis.

3. Animals from the breeding herd mentioned above ought to be made available to the pastoralists to assist them in re-building their herds after any losses incurred during the drought.

4. Supplementary feeding of livestock ought to be continued for 2 - 3 years after the drought.

The success of the above recommendations depends greatly on having an effective extension service established not only amongst the pastoralists but for Government officials who serve them.

F. HUMAN HEALTH

It is recommended that a health centre be established at Korr, which is central for all the residents of Laisamis Division. In other parts of Kenya it is common for administrative divisions to have their own health centres. To operate efficiently, the health centre should have an ambulance and be in radio contact with all the local dispensaries and Marsabit District Hospital. This would enable the centre to care for urgent cases more quickly. It should also have a mobile unit to serve nomadic communities on a regular basis (Mubia, 1981, p. 18)

There is a need to train adults from the nomadic communities in first-aid to enable them to treat simple and common ailments and to identify cases which need to be dealt with by more qualified personnel. These first-aid assistants should receive on-the-job training at the health centre. Their communities should advise them on their responsibilities and devise ways of raising money to buy equipment, medicine, bandages, etc. Such a system of first-aid assistants operates successfully in Senegal.

It is also recommended that courses on health and nutrition should be established for adults and school children (Mubia, 1981, p. 18).

G. RECOMMENDATIONS FOR THE IMPROVEMENT OF MARKETING AND INFRASTRUCTURE

1. Objectives

The main objectives in the improvement of marketing and infrastructure are:

a. to ensure that pastoralists have access to fair prices for their livestock and livestock products;
b. to ensure that a wide range of goods and services are available for the satisfaction of the present and future needs of the people;
c. to make available new avenues for investment and saving;
d. to improve the pastoralists' standard of living through raised incomes.

It is proposed that these objectives will be achieved by encouraging the diversification of the economy and by improving the efficiency with which different components of the market operate. Emphasis will be placed on helping traders and pastoralists to exchange goods and services in a competitive atmosphere and on a improved road and communications network. This reflects a conviction that the pastoralists in the area receive poor prices and are poorly supplied with essentials principally because they are isolated from the mainstream of Kenya's economy.

2. Livestock Marketing

2.1 Camels

There is currently little trade in camels in the whole of Marsabit District. Only a small demand exists - for less than 100 slaughter camels per 1 year by butchers in the larger centres. It is proposed that the following be done to remedy this situation:

a. Explore the possibility of increasing internal sales by promoting trade in camels from the study area to North Eastern Province, where camel meat has a good market.
b. Try to get into the high-price Middle-East market for live camels, either directly by exporting live animals or indirectly through a neighbouring country. This can best be done by encouraging some large traders from Isiolo and North Eastern Province who are known to be interested and who have the necessary funds.[1] These traders should be given licences and provided with trekking facilities to the coast and,

---

[1] Personal communication from an official of the Kenya LMD.

where necessary, with help in negotiating foreign contracts. It is also necessary to evaluate the possibilities of taking camels from northern Kenya to foreign markets by trek or motorized transport using various alternative routes.

c. Set up a small meat-processing unit for low-quality animals that cannot be marketed through normal channels. For more details see the livestock section.

2.2 Cattle and smallstock

a. Intensify the activities of traders by setting up market-places at all trading centres and designating specific market days. Initially cess collection at these places should not be encouraged, in order to protect the image of these markets as a service to the pastoralists and to traders and not as an ingenious way of taxing the livestock trade. These market places should initially be built and maintained by the Project. In time they can be handed over to the various co-operatives (see below) or to the County Council.

b. Three or ~~four~~ times a year, large and well publicized auctions should be held at centres of livestock concentration. The aim should be to bring together buyers of livestock from down country and traders and pastoralists from the study area. Initially the Project should help in bringing the auctioneers establishing the auction yards, and making transport arrangements for buyers and their animals to and from the auction site and Isiolo. This should include provision of security for both livestock and people. Traders and hawkers should be encouraged to bring their wares to these places and to create a fair-like atmosphere where a variety of goods are offered to pastoralists who sell livestock in the auctions.

c. Initially the Project should help to support prices in these markets by participation in them to ensure that traders do not collude to keep prices low. For this purpose the Project marketing officer should have enough funds to buy up to 100 cattle and 200 to 400 head of smallstock. Such funds could be supplied from the revolving fund proposed in f. below. This would also ensure that at least in the initial stages lack of buyers would not cripple the idea of regular auctions. The LMD and other large buyers should be requested and encouraged to attend the auctions and to provide a market for any animals that the Project might buy.

d. The number of animals offered at each auction and market and the average level of prices should be broadcast on the Rendille radio service on a daily/weekly basis. Average prices of livestock at the major markets of Isiolo, Marsabit and Nairobi should also be included in the broadcast. In the future this should be integrated into a nation-wide price-reporting system like that given on the national radio for horticultural produce. Attempts should also be made to supply price information from Rendille markets to traders from other areas through radio, newspapers, public notices, and any other appropriate media. Maintaining this information flow will ensure that the Rendille are aware of prices in the various markets and can take their animals to the market offering the best prices. On the other hand, traders from outside will be informed of the prices of livestock prevailing in the area. If they come in sufficient numbers the increase in demand should raise the prices to more realistic levels.

e. Encourage the setting up of marketing co-operatives in each trading centre. These should help in selling animals belonging to members at the best possible prices to buyers in the study area or outside. The co-operatives should also try to finish any weakly animals sold to them in the dry season, when most sales are made (for more details see section on co-operatives below).

f. Traders and co-operatives from the area who deal in livestock and who can guarantee the payment of reasonable prices per kg. liveweight (to be determined through negotiation with the Project's Marketing Officer) should be given loans from a revolving fund of Kshs.500,000 established for this purpose by the Project. This is the surest way to encourage the raising of prices for pastoralists without running the risk of having the Project involved in trade. If lending to traders is not acceptable, such funds can be lent exclusively to the co-operative societies to be formed. Care should, however, be taken not to drive the current traders out of business by buying at prices which do not guarantee a reasonable margin after sale.[1]

---

[1] This has happened in the study area already. The LMD came and bought small-stock at Shs. 6/50 in February 1983, which is far above what a local trader can offer. Pastoralists are no longer willing to sell at lower prices, while the LMD does not seem able to keep on buying at this price on a regular basis.

g. Provide trekking routes to Isiolo with rest and watering points at regular intervals. As most of the route is outside Marsabit District, this should be the responsibility of the Ministry of Water Development and the LMD. The provision of such facilities would enable traders, the LMD, co-operatives and the pastoralists to trek their animals down all the year round without fear of losses from death or large decreases in weight.

3. Retail Trade

The problem of poor and irregular supply of essential goods and services should be solved if the following measures are taken by Government and the Project.

a. The KNTC and the Cereals Board should be requested to establish supply depots in Marsabit District. Such depots are extremely important for reducing the distance that retailers have to travel to obtain supplies.

b. Establishment of effective wholesalers at Korr and/or Laisamis for providing supplies of goods to retailers. The Project Marketing Officer should help the District Trade Officer in identifying local traders who are capable of being wholesalers. The aim is to ensure that a retailer can get all his supplies from within Marsabit District. This should reduce the need for individual traders to go as far as Nairobi for supplies. Bulk purchases by wholesalers should also lead to products being brought to Marsabit at lower cost than at present.

c. So far very few traders have obtained loans to improve their businesses. They should be encouraged to seek loans provided for traders by the Project, commercial banks, the District Joint Loans Board, the Industrial and Commercial Development Corporation (ICDC) and Kenya Industrial Estates (KIE). The Project Marketing Officer should help them in preparing applications for these loans and by providing facilities for officers from these lending institutions to come to visit and evaluate traders in the initial stages.

d. At the moment, illiteracy and lack of business training are major handicaps to the smooth running of business in the area. The Project Marketing Officer and the District Trade Officer should be requested to organize regular courses for traders in business practice, law, and accounting, and to make sure that extension officers visit and advise

traders at their places of business. If there is a problem of transport to the trading centres, the Project could help to transport these officers. This should reduce the high rate of business failures and enable local businessmen who now lack the necessary skills to compete favourably with the dominant traders from outside the area.

4. Banking and Financial Institutions

One of the reasons why traders find it difficult to get loans is that there have been no commercial banks in the district; the nearest banks are at Isiolo. The Post Office has an office in Marsabit but the Post Office Savings Bank is not designed to meet the needs of traders and is therefore not used. For the pastoralists, moreover, it is too remote and few know about it, since little promotional effort to encourage savings among them has been made.

The Kenya Commercial Bank has been instructed by Presidential order to establish a branch at Marsabit. It is recommended that this branch should have a mobile unit which should be present at all the major auctions and at any of the livestock markets which develop to a reasonable size. Such a bank could help to:

i. provide deposit facilities for traders and the richer pastoralists;
ii. provide them with loans and business advice;
iii. provide them with a savings service; and
iv. encourage the setting up of more and larger businesses.

However, a bank may not be in a position to serve the ordinary pastoralists and the co-operatives to be formed should each have a banking section. Pastoralists would be encouraged to open savings accounts in this section, which would then arrange to deposit in a consolidated account with the mobile unit of the bank. This is something that has been tried before in co-operatives and despite the high costs involved in dealing with small deposits and withdrawals, it has greatly improved people's willingness to save. Savings in such an account should be promoted as a drought reserve - something to fall back upon in hard times. This should be popular with pastoralists who are very conscious of the need for a drought reserve which, however, they think of at present in terms of animals.

5. Roads and Communications

Lack of good roads and communications has hampered the development of this area by making it inaccessible to Government officers, traders, police and security. It is suggested that to utilize the grazing resources in the area fully, facilitate the development of an efficient marketing system, provide security, and respond quickly to any needs of the people, a good road network is essential.

5.1 All-weather roads (see map 30 below)

It is recommended that the following roads be made passable in all seasons through the making of bridges or slabs and culverts across laggas and by regular maintenance:

i. the Laisamis-Ilaut-South Horr road;
ii. the Marsabit-Kargi-Korr-Ilaut road;
iii. the Korr-Laisamis road.

5.2 New roads

To open up the Hedad and the lava plateaus south-west of Marsabit for grazing the following new roads are recommended:

i. a road joining the Korr-Kargi road with Balesa Kulal, with an extension to Luai;
ii. a road joining Ilaut with Hafarei, Falam, Kurkum and Balesa Borbor;
iii. a road joining the Kargi-Marsabit and the Korr-Loglogo roads.

5.3 Construction of new roads and maintenance of the network

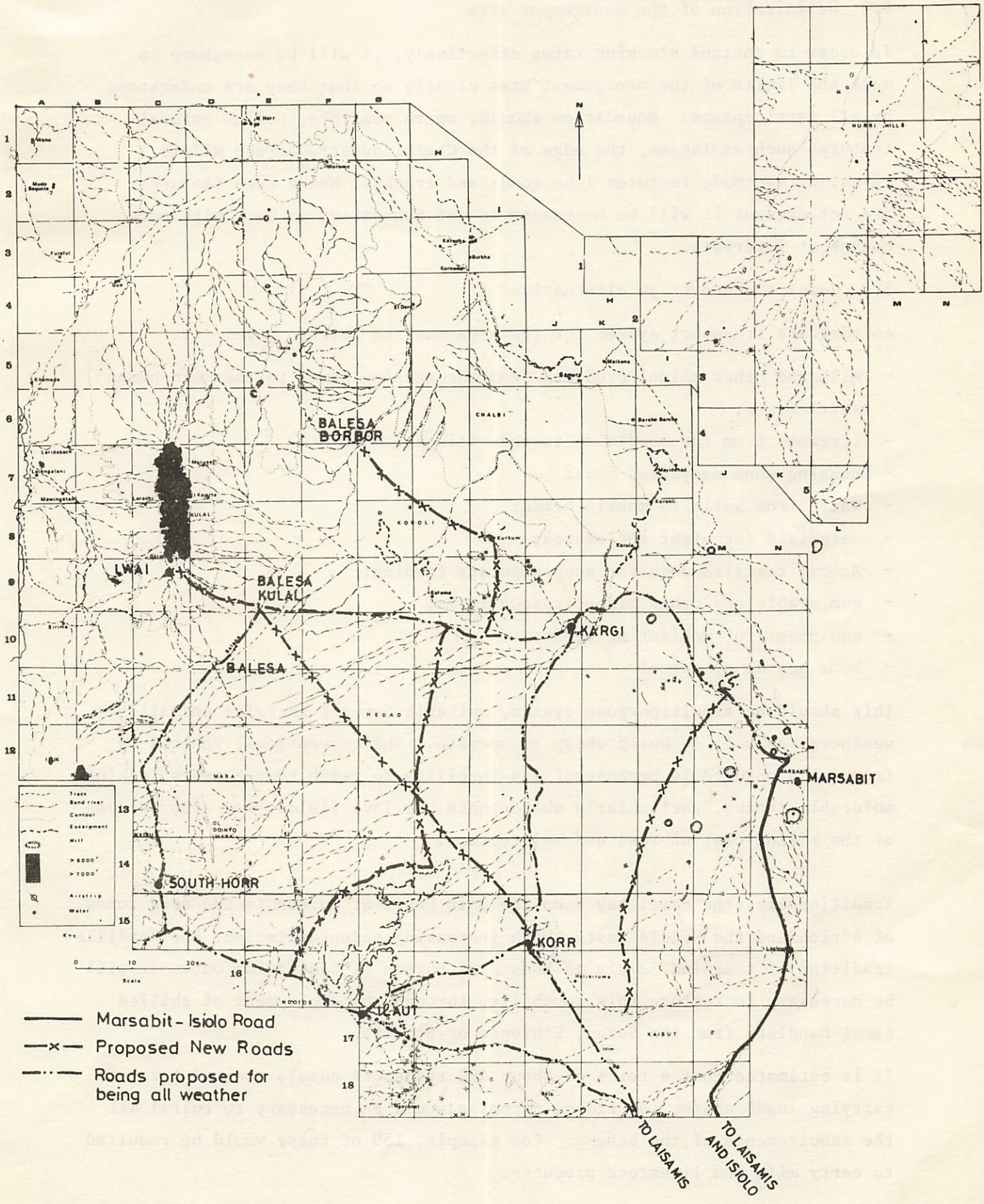
a. It is recommended that as far as possible the new roads should follow contour lines to avoid erosion.

b. Efforts should be made to ensure that all-weather roads are passable throughout the year and that all other roads are maintained in motorable condition, especially after the rains.

c. Where possible, maintenance work should depend on human labour or a combination of human labour for light work and machines for heavy work. This should help to raise employment and increase income from outside the pastoral sector for members of the Project.

d. As the contruction of roads is expensive, these recommendations should be seen as long-term projects to be implemented by the Ministry of Transport and Communication as money becomes available. The project could help with diesel.

Map 19. Proposed road development in the area



5.4 Delimitation of the management area

In order to control stocking rates effectively, it will be necessary to mark the limits of the management area clearly so that they are understood by all participants. Boundaries should, where possible, follow natural features such as laggas, the edge of the Chalbi desert, or the Milgis river, or man-made features like roads and tracks. Where such features are not present it will be necessary to cut boundaries or mark with rock cairns at intervals.

5.5 Camel transport: an alternative

An adequate transport system for the area must be able to move:

- milk and other animal products from the grazing herds to the main human settlements;
- firewood from the woodlands to the villages;
- housing when manyattas move;
- water from wells to mobile camps;
- materials for night enclosures;
- *Acacia tortilis* pods for supplementary feeding;
- gum arabic and other miscellaneous items;
- equipment for monitoring herds;
- home guards on patrol.

This should be a multipurpose system, suitable for all terrains and all weathers, as well as being cheap to operate. The conventional vehicle is frequently unsuitable because of its inability to reach remote areas lacking motorable tracks, particularly where there are lava fields, and also because of the rising cost of fuel and maintenance.

Traditionally, the camel has been the main beast of burden in the arid zones of Africa and the Middle East. With increasing sedentarization, the Rendille tradition of training camels as beasts of burden is fast dying out. It will be necessary to restore this capability through the employment of skilled camel handlers from the Sudan, Ethiopia or Somalia.

It is estimated that a total of about 400 transport camels trained for carrying loads and/or for riding purposes would be necessary to fulfil all the requirements of the scheme. For example, 150 of these would be required to carry milk and livestock products.

They would be used on alternate days when they would transport 80 litres of milk each. It is estimated that a further 100 would be required to transport firewood (see the section on Woodland Management).

In order to establish and maintain a camel transport corps it will be necessary for the locational management committees to request the people to provide the required numbers of camels. The camels will be trained by the scheme but managed by the people themselves. Veterinary care and medicine where necessary should be provided free of charge.

5.6 Air transport

Airstrips are very important in the Project area for the following reasons:

a. in medical emergencies this is often the only hope for a patient in a critical condition, since roads are very poor and distances to hospital are large;

b. in the wet season some places are completely inaccessible by road;

c. in cases of raids by other tribes this is the only fast means of looking for stolen animals and sending armed guards to affected areas;

d. aircraft could be used for reconnaissance flights to gauge the condition of the range in an area to be vacated, to check on the extent of rainfall in an area, and to control grazing movements of livestock. There are several airstrips within easy reach of the management area. These are at Gatab, Luai, Korr, Balesa, Kargi, Marsabit, Ngurunit, Arsim, South Horr, Laisamis, Loglogo, Olturot and Kurkum. In addition to these strips there are some places on the Hedad where the IPAL plane has been landing. Maintenance, however, is not good. It is recommended that these airstrips be regularly levelled. A few more airstrips in the Hedad could be developed at very little cost, since planes can land there even now. At least three such airstrips should be developed.

5.7 Radio telephone

The only telephone and post office available in the study area is at Marsabit District Headquarters.[1] As a result, quick communications between the different centres must rely on travellers' stories, two-way radios and vehicles.

---

[1] It is understood that Gatab will be connected to the telephone system soon.

Radio sets are available at Gatab (mission, IPAL and Police post), Loglogo (mission), Olturot (IPAL), Ngurunit (IPAL, mission), Marsabit (mission, IPAL and Police post) and Laisamis (mission and Police).

It is recommended that use of sets be extended to the mobile herds in the scheme. Each livestock concentration area should have a mobile radio set. At the same time efforts should be made to establish links with mission radios and with the Post Office.

6. The District Administration

It is recommended that the administration should strongly counteract the tendency to regard appointments to Marsabit District and other outlying areas in the country as punishment posts. Instead, a period of quality service in arid areas should be considered as essential for promotion in the Civil Service. Because Marsabit District is the largest district in the country, budget allocations for fuel and transport should be correspondingly generous. Steps should be taken to provide social amenities for officers living at the district and divisional headquarters - officer's club, squash and tennis courts etc. For example, in Garissa (North-Eastern Province) there is an officers' club and officers there have easy access to the swimming pool attached to the boys' orphanage.

The district administration, through the District Development Committee (DDC) is already becoming the focus of development at the district level. This involves a drastic increase in responsibilities and an adjustment phase when productivity is likely to be low. In the early stages of the implementation of this management plan it is therefore essential that an autonomous organization - such as the West Marsabit Integrated Development Project proposed below - should be created.

This body will need to work in close co-operation with Government officers through the DDC. Government officers should have an input from the very beginning to ensure continuity on takeover. This involvement should, however, be gradual, since the implementation of IPAL recommendations will initially require a heavy input of time and expertise and this would disrupt other activities of the DDC.

H. ORGANIZATION OF WESTERN MARSABIT RANGE-DEVELOPMENT ACTIVITIES

1. The Kenya Arid Land Research Station (KALRS)

The implementation of the range development activities proposed here will require well planned and functional organization. It has been agreed that this will be in the form of a research station and a development Project. The Kenya Arid Lands Research Station will be based at the present IPAL headquarters in Marsabit. This station will help to disseminate IPAL's experience in arid lands research in the region through graduate courses and orientation seminars for research scientists. It will also continue long-term research and monitoring of the problems of arid-zone ecosystems and at the same time advise on the implementors of the plans outlined here. The station will be started by the Research Division of the Ministry of Agriculture and Livestock Development, with technical and financial assistance from UNESCO through funds-in-trust with the Federal Republic of Germany.

2. The Western Marsabit Integrated Development Project (WMIDP)

This will be the organ implementing the plans. It will fall under the extension arm of the Ministry of Agriculture and Livestock Development and will be funded by bilateral aid from various sources. It will have its own management unit, but many of the District Officers will be required to devote a specified proportion of their time to the project.

From the very beginning it is realized that introducing development to pastoral groups like those in the plan area is a complicated matter. These people have their own customary ways of doing things and they should not be expected to shift from them and accept new ideas introduced by foreigners unless they themselves are satisfied that these represent an improvement on past practices.

Former efforts to organize grazing schemes where government experts (range staff, veterinarians, administrators, water engineers, etc.) were very sure that they had 'the solution' and even used force to get the pastoralists to heed their advice, have usually met with failure. Some, like the colonial grazing schemes of the 1950s, had to be dropped at Independence because they were so unpopular. Others, like the North-Eastern Province grazing

blocks, are experiencing difficulties because they are too centralized to respond quickly and flexibly enough to the erratic precipitation of rainfall and the incidence of accidental grass fires. They were also not designed to take care of all the species of livestock kept by pastoralists. Their planning seems to have been based mostly on meeting the needs of cattle only. It also appears that the block managers were given too much control over resources whose day-to-day status they are unable to monitor. This has resulted in conflicts when pastoralists are asked to do things which they feel, on the basis of their first-hand information and experience, are not correct. This has eroded the credibility of the proffered 'expert advice'.

Pastoralists have always had institutions for maintaining community co-operation because of:

- the need for protection of a sparsely distributed human and livestock population;
- the need to share grazing, water, labour and information;
- the need for rapid reaction by movement to unpredictable occurrences of rainfall, disease, and security problems.

Most pastoral societies are organized in such a way that there is a hierarchy of community institutions each dealing with different types of decisions. Amongst the Rendille the herdsman is responsible for day-to-day decisions on the particular location within a designated grazing area to graze, how to get there, and for immediate response to accidents or enemy attack. The herd-owner and his herding partners are responsible for decisions on labour allocation, the general area where animals will graze, which animals to send to *fora* camps and which to keep in the community, and how to dispose of any animal. At a higher level the whole camp is responsible for decisions on camp movement and arbitration of disputes, while the tribe makes decisions on the observation of important rituals and religious ceremonies, the resting and opening up of certain areas like the Korole waterholes, and movements involving the whole tribe.

It is emphasized that for a management system to succeed it must have a structure reasonably similar to this for flexibility. Decisions which require to be made immediately should be made as near to the herdsman as possible, while only policy decisions advice and supplies of technical input should

remain highly centralized. Where for some reason decisions have to be made at the centre, pastoralists' representatives must be involved. Care must also be taken to ensure that those who make the decisions have continuous access to relevant information and that feedback from the herders who benefit or lose from such decisions is received continually.

2.1 Organization of the WMIDP

To ensure that pastoralists are involved at the top, that the very important decisions are made at the local level, and that the present Government policy of focusing development at the district level is followed, the following organization is proposed.

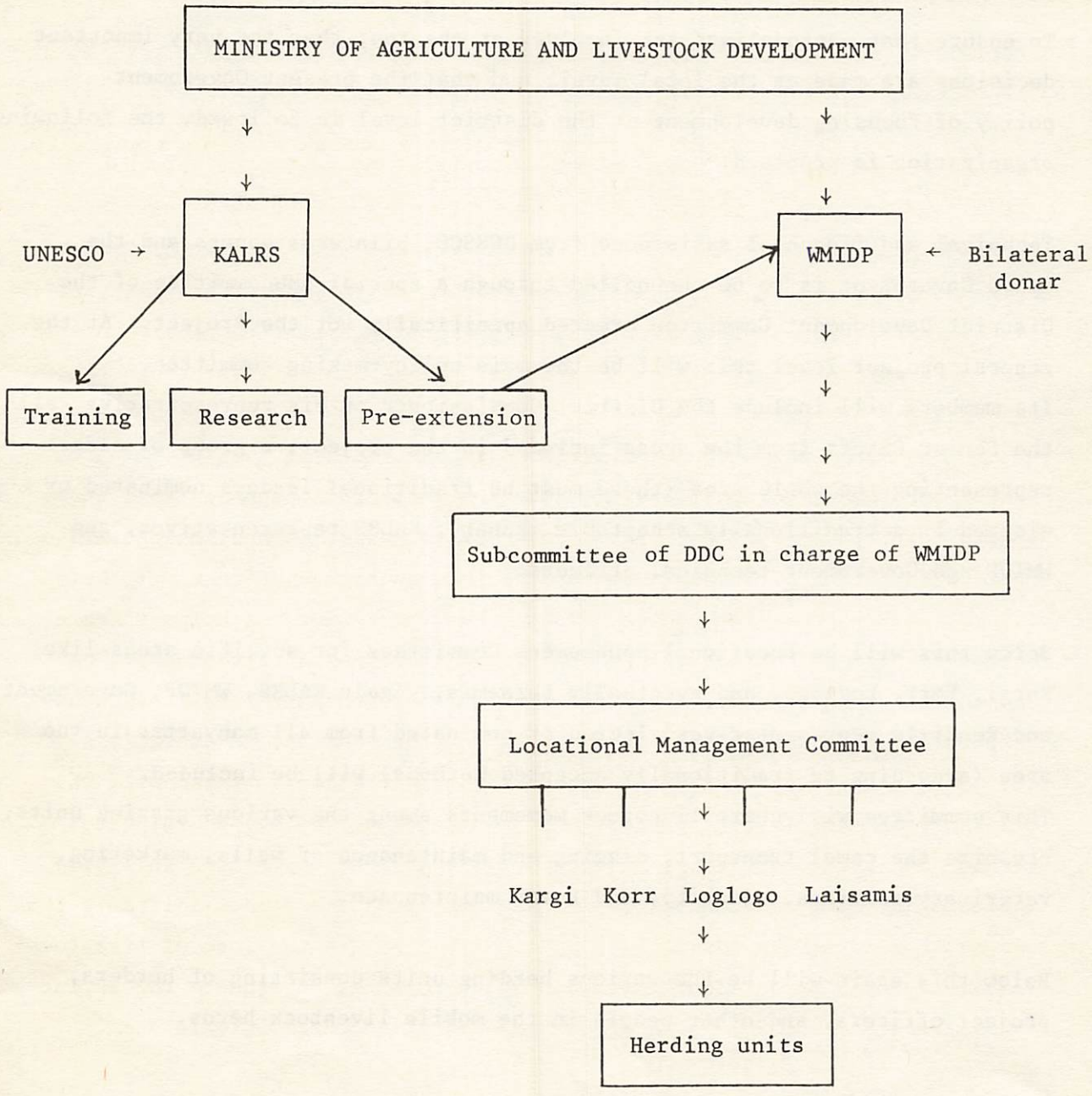
Technical and financial assistance from UNESCO, bilateral donors and the Kenya Government is to be channelled through a special subcommittee of the District Development Committee created specifically for the Project. At the general project level this will be the main policy-making committee. Its members will include the District Commissioner or his representative, all the Senior Chiefs from the areas included in the project, a group of elders representing the whole area (these must be traditional leaders nominated or elected in a traditionally acceptable manner), KALRS representatives, and WMIDP and Government technical officers.

Below this will be Locational Management Committees for specific areas like Kargi, Korr, Loglogo, and eventually Laisamis. Again KALRS, WMIDP, Government and Rendille representatives elected or nominated from all manyattas in the area (according to traditionally accepted methods) will be included. This committee will chart livestock movements among the various grazing units, organize the camel transport, digging and maintenance of wells, marketing, veterinary services, security, and roads maintenance.

Below this again will be the various herding units consisting of herders, project officers, and other people in the mobile livestock herds.

Figure 38

ORGANIZATION OF ACTIVITIES FOLLOWING IPAL



3. Co-operatives

Implementation of these plans is expected to lead to large improvements in livestock productivity. Elsewhere in this plan measures to raise offtake rates and enable the pastoralists to enjoy the benefits of a higher level of commercialization have been set out. One of these was the formation of marketing co-operatives for the sale of livestock and livestock products in competition with existing traders. The aim of these co-operatives is to enable the pastoralists to see for themselves the real value of their products and to help raise prices from their present rather low levels. In collaboration with the commercial bank presently opened in Marsabit and the Co-operative Bank of Kenya, these co-operatives should encourage saving by providing facilities for opening current or savings accounts within easy reach of each member.

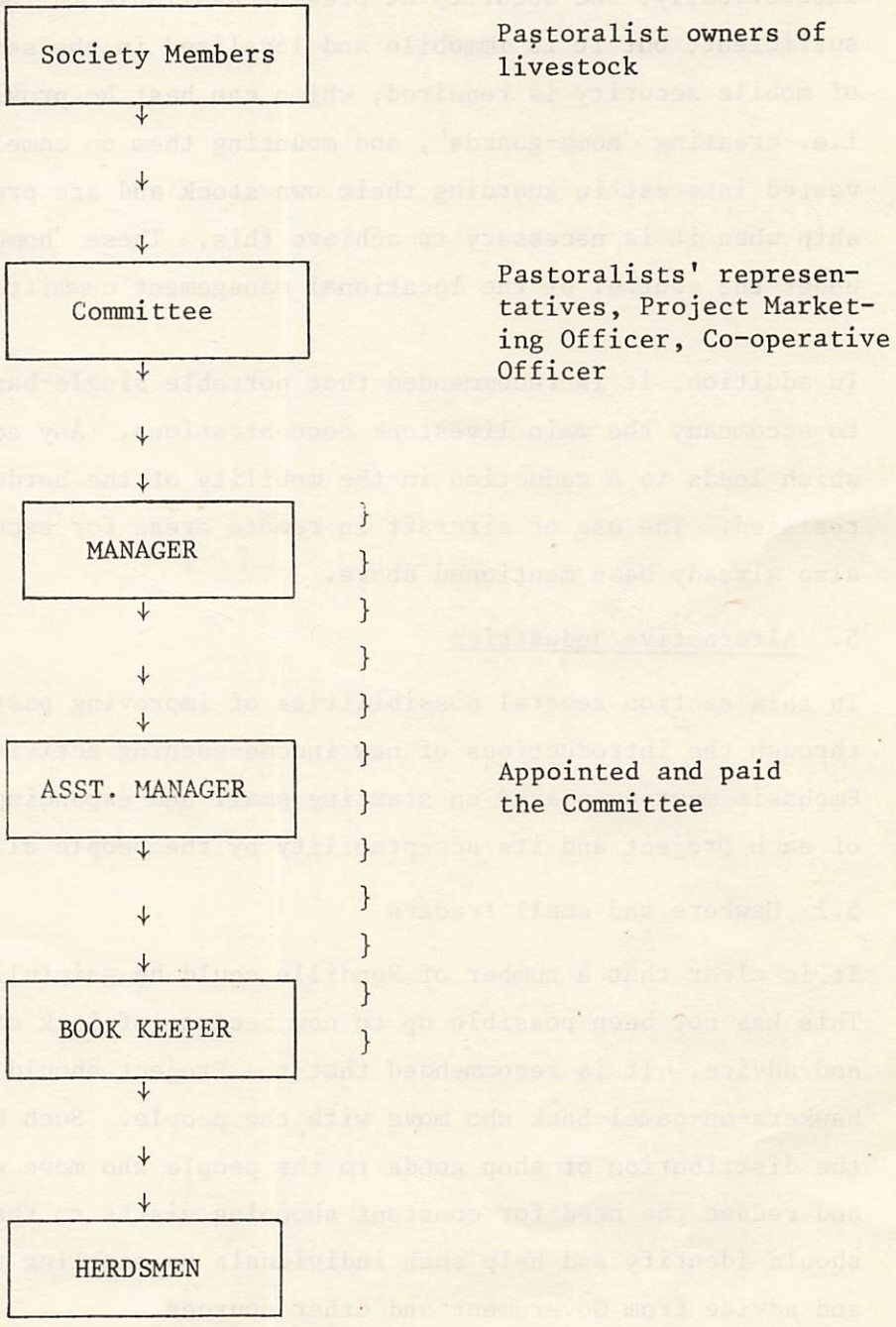
Members should be encouraged to save part of the proceeds of the sales of livestock. These co-operatives would also enable members to receive all forms of Government assistance to rural areas which are channelled through the co-operative movement.

As the co-operative idea is new to the Rendille, it is proposed that they should start in a small way around Kargi, Korr, Laisamis and Loglogo. The Project Marketing Officer and the District Co-operative Officer will help launch them by providing the necessary technical advice and helping train the co-operatives' officers in the buying and selling of livestock. The Project should also provide pay for some of the permanent staff, such as herders and buyers, in the initial stages. Members of the co-operatives will each elect a committee composed of prominent elders. These will then elect a Chairman, Secretary, Treasurer and other officials according to the Co-operatives Act. This management team can then appoint a full-time Manager, his assistant, bookkeepers, herdsmen and recorders. Initially the co-operative will ask for membership contributions in the form of livestock. These will then be sold to raise some of the capital to finance the buying and selling operations. Loans from the Project and from private and Government lending institutions will also be solicited.

To avoid long delays in payment, members should be paid immediately 75% of the expected sale price of the animals delivered to the co-operative. The balance should be paid after the sales and after deduction of costs. The Project could help by lending the society money for these payments in the initial stages and in the organization of subsequent financing by other agencies, such as the Co-operative Bank. It is hoped that in this way the price of livestock will move from the current very low levels which are far below those paid by consumers of meat in towns. During good years it is proposed that these co-operatives should use the drought reserves for fattening the livestock in their possesion in preparation for sales. Supplementation of feed for these animals, using hay and silage made in the higher potential mountain areas of the district or concentrates bought from other parts of Kenya, should be experimented with and used if found to be cost effective. During the period when the livestock are in the co-operatives' hands a high standard of veterinary care should be maintained by the Project veterinary staff. The costs of such care should be deducted from the sale price.

Figure 39

STRUCTURE OF THE PROPOSED CO-OPERATIVE SOCIETIES



4. Security

Evidence from both aerial and household surveys is that lack of security is a primary factor inhibiting the use of certain parts of the range.

Theoretically, the security at present available in the area should be sufficient, but it is immobile and localized in the settlements. A system of mobile security is required, which can best be provided by arming herdsmen, i.e. creating 'home-guards', and mounting them on camels. Herdsmen have a vested interest in guarding their own stock and are prepared to undergo hardship when it is necessary to achieve this. These 'home-guards' should be under the control of the locational management committee.

In addition, it is recommended that portable single-band radios be supplied to accompany the main livestock concentrations. Any addition to security which leads to a reduction in the mobility of the herds should be firmly resisted. The use of aircraft in remote areas for security purposes has also already been mentioned above.

5. Alternative Industries

In this section several possibilities of improving pastoralists' incomes through the introductions of new income-earning activities are presented. Emphasis must be placed on starting small and expanding as the viability of each project and its acceptability by the people allows.

5.1 Hawkers and small traders

It is clear that a number of Rendille could be gainfully employed as hawkers. This has not been possible up to now because of lack of funds, encouragement and advice. It is recommended that the Project should encourage small hawkers-on-camel-back who move with the people. Such hawkers could improve the distribution of shop goods to the people who move with their livestock, and reduce the need for constant shopping visits to the centres. The Project should identify and help such individuals by enabling them to obtain loans and advice from Government and other sources.

5.2 Rural handicrafts

These have not hitherto been tried in the area. As more people become sedentarized and as the new Project takes over some of the herding and reconnaissance functions of elders, there will be more people virtually without work.

It is proposed that a cottage industry for making carvings, leather and traditional mats for tourist and domestic use be encouraged in each settlement. The Catholic mission seems to have been successful in introducing a handicraft industry based on the Nairobi market among the Gabra to the north.

5.3 Firewood collection

Another activity that needs to be encouraged under proper control is the setting up of groups collecting and selling firewood. These will use camels, each of which would be able to bring a 100-kg load every other day. This is already happening on a small scale at Korr, Kargi and Marsabit. It will need some help with the training of camels, encouragement, and much extension work to persuade some pastoralists to take over this job on a commercial basis (see the Woodland section for more details).

5.4 Milk collection

Milk needs to be delivered from the place where the animals are to the trading centres where the people are (see the section on Camel Transport for more details).

5.5 Bee keeping

The Project should encourage and help establish a small honey production industry on the mountains. This should be done by providing modern hives and advice. The Ministry of Agriculture and Livestock Development has already made some efforts in this direction. However, efforts to reach people in the study area have been hampered by lack of funds to take extension personnel to talk to people in suitable areas. Around Ngurunit traditional honey collecting is quite extensive and this could be commercialized and expanded.

5.6 Fishing

Young Rendille who are now jobless and roaming round the settlement centres should be encouraged to go into fishing on Lake Turkana on the western borders. Courses in fishing techniques, net maintenance and so on could be mounted. More Rendille should be encouraged to join the Loiengalani fishing co-operative society, which has now been revived and is doing a good job. It is realised that there are cultural taboos against fishing, but time and increasing need for supplementary sources of income are expected to reduce the effect of these taboos.

5.7 Abattoir

(See the paragraph on Livestock Products and By-products in the Livestock section.)

5.8 Gum arabic

The successful collection by IPAL of marketable quantities of gum arabic from the indigenous *Acacia senegal* indicates that there are good prospects for setting up a small gum arabic industry in Kenya. Systematic tapping of *A. senegal* trees has increased production ~~five~~ times compared with collection from untreated trees. It is believed that sufficient gum can be collected to satisfy the Kenyan market and replace the imported gum arabic coming from the Sudan via Europe. Gum arabic might become the second most important product, after livestock, to bring additional money into Marsabit District.

It is recommended that gum arabic collection be set up by the Project and run for the benefit of the Rendille committees. Initially the business should be under the control of the Project, but could be transferred to local businessmen or co-operatives if it proves viable after several years.

The tapping of *Acacia senegal* trees should always be supervised by the Woodland Management Officers to ensure proper exploitation and to avoid overtapping. It is proposed that an expert on gum arabic be brought from Sudan to advise for one year.

5.9 Cheese and yoghurt making

If the livestock industry prospers there is likely to be an excess supply of milk especially during the wet season. It is recommended that the possibility of improving current methods of making and preserving yoghurt be looked into. Cheese and ghee making could also become a cottage industry in every village, as has happened in the Sudan (see the paragraphs on Livestock Products and By-products in the Livestock section).

5.10 Tourism

The Rendille country, which lies between major tourist attractions like fishing and sailing on Lake Turkana, game viewing in the Mt. Kulal Biosphere Reserve, Solai National Reserve, Sibiloi National Reserve, Marsabit National Reserve, Ndoto Forest Reserve, and the Nyiru Forest Reserve, has a high potential for tourism which should be developed.

Development of the proposed road network will enhance this attraction.

Tourist-based activities like fishing, dancing groups, tourist guides and the making of handicrafts should be promoted by the new Project. A percentage of the income earned from tourist activities, like fees at national park gates, should go directly to development activities within the area e.g. health centres, schools, etc. These activities should provide employment for school leavers.

6. Savings schemes for the Rendille

Since part of the reason why pastoralists keep large herds is to insure against the risks of pastoral life, it is recommended that the grazing scheme encourage the Rendille co-operatives to provide a banking service and a savings scheme in conjunction with a commercial bank or the Co-operative Bank of Kenya.

If pastoralists take up the idea of saving, they will always have money to fall back upon in case of a drought. They will therefore not need to keep the large numbers of animals which they now keep as security against drought periods, because this is a more risky way of insurance than having a bank account, which cannot die or be stolen. The result should be a higher offtake rate.

The possibility of interesting an insurance company in offering insurance policies to Rendille has been discussed, but is thought to be impractical because of the unknown extent of the risk of drought. Keeping animals aside for insurance, perhaps on ranches in the highlands, is also thought to be impractical, since such land could probably be better utilized as a grazing reserve or for agriculture.

It is felt that the main emphasis should be placed on individual savings. Facilities for quick sale of livestock under drought conditions should be provided through rapid mobilization of the LMD, auctions, and all the measures recommended in the section on the marketing of livestock.

I. FORESTRY DEVELOPMENT

Within existing legislation and Government infrastructure, forest reserve status is probably an essential prerequisite for ensuring the protection of forest vegetation in the interests of soil, water and biological conservation. It is recommended that all substantial areas of closed forest, especially on vulnerable sites, should be protected as forest reserves, including Kulal and the upper reaches of Ol'Doinyo Mara. For maximum benefit and convenience, the reserves may include very steep and erodable slopes, even if only lightly wooded, and also patches of included or partially included grassland, as on Kulal. It is not necessary to reserve all small, isolated forest patches.

Since the forests are reserved in the interests of the human population, a substantial amount of utilization of their resources should be permitted so long as it does not significantly diminish the conservation values of the forest. It is appropriate that local residents should be permitted to remove fuel-wood (perhaps only dead wood) and perhaps poles for their private domestic use. This is an important principle. If such domestic extractions are likely to be so large as to damage the forest, it is essential to note that the problem is *not* solved by forbidding such extractions; such measures merely export the environmental degradation to unreserved areas. Large local needs should be provided for by positive measures such as tree-planting.

Decisions about grazing in these and other mountains should not be made only by reference to the Forests Act. Many of the hillsides are traditional grazing grounds; some may be currently over-used while others could safely support more animals. The controlling decisions about the most suitable vegetation cover and the seasons and intensities of livestock use should be made jointly by representatives of the land-users and the forestry livestock, rangeland, and local authorities. When an authority exists with the power and ability to organize and control grazing activities, with full environmental and conservation safeguards, it may no longer be necessary for the woodland and bushland grazing areas to remain as forest reserves, unless there is a particular local justification (such as the requirements of a forestation programme). There is an urgent need for measures to protect the vegetation and soils throughout the arid lands, not just on the wooded catchments.

Sound land-use planning, with properly controlled implementation, is required to take over many of the old objectives of forest reserve status on a larger scale.

It is recommended that many of the wooded hillsides below the closed forests should be opened for regular dry-season grazing by identified groups of pastoralists in controlled, agreed, and variable numbers. It will be necessary to ensure that most livestock leave the dry-season areas during wet seasons in order to ensure that the areas retain their function. Such areas on Kulal (e.g. the areas currently utilized below and around Gatab) should not be declared forest reserves, and such areas on the base of the Ndotos range should not necessarily remain forest reserve indefinitely.

It is recommended that the utilization of the montane forests during periods of extreme drought should be permitted not as a privilege but as an accepted part of the land-use plan, by agreement between all the interested parties. The local and Government authorities will need the power to open the forests for grazing, and also to close them strictly when grazing conditions improve again elsewhere.

The piping of water out of the forests and away from steep slopes from springs and stream heads will be a highly effective way of reducing damage. Such investments, started in the 1940s, should be extended to all suitable springs.

The environmental importance of these and similar forests is so great that the collection of basic information about them deserves special attention. An unobserved contraction of the forests could have serious consequences, and a project such as IPAL should determine the areas, and significant changes with time, of each forest, and should take the opportunity of making continued biological observations, including arrangements for more thorough ground checks and botanical collection. These require a programme of aerial photography and analysis at a much more detailed level than the surrounding rangeland.

It is recommended that new aerial photography should be carried out, perhaps over only a small sample of the IPAL area, combined with a detailed comparison with the old photographs of c. 1958 and c. 1962-63, with ~~two~~ particular aims

1. a quantitative study of changes in the areas of all the main identifiable vegetation types during the 20 years covered by photographs, and
2. the definition of the areas of closed forest now existing, together with the location of the boundaries and forest edges on detailed maps.

In addition, it is recommended that some double-edge-enhanced imagery based on LANDSAT photographs should be commissioned from the Earth Satellite Corporation, preferably for two different seasons (e.g. during the long drought, and after it), covering the whole IPAL area, for purposes of land use planning.

A study of the stocking and productivity of these forests would be of considerable scientific interest, but it would be a major time-consuming and long-term undertaking. Such studies cannot be recommended for the IPAL programme, but they should certainly be included in any MAB studies. Suitable techniques for design, fieldwork, assessment and interpretation of plot-based studies in forests are given by Dawkins and Field (1978) and Synott (1979).

Existing forest boundaries and those which will be declared later should be more strictly enforced.

The status of the Mt. Kulal Biosphere Reserve should be reinforced by the establishment of a forest station at Mt. Kulal. This should help in patrolling and other forestry work.

The Forestry Department at Marsabit should collaborate with forestry officials in Samburu District to see that the Ndotos, the Nyiru and the Ol'Doinyo Mara ranges are well protected.

A belt of fast-growing tree species should be established around Marsabit Mountain. This should fulfil people's future needs for wood and protect the indigenous forest, which is threatened with destruction.

More rural reafforestation is recommended, in villages, at schools, and at other institutions to rehabilitate denuded land and provide human requirements for shade, building materials, and fruits. This should include protecting doum palm groves along the edges of the Chalbi, which are threatened by over-use for building purposes.

These efforts should be reinforced by the establishment for this area of nursery and woodland plot trials by the Forestry Department to test various tree species which have proved useful elsewhere.

To reduce pressure on the forests, especially at Marsaḅit, research into various alternative methods of building houses is called for. This should lay emphasis on mud brick and stone walling.

In the lowlands, alternative and less wood-intensive methods of building cattle bomas should be found. More permanent stone, wooden or permanent hedge structures have been suggested as well as the bamboo hurdles and wire-mesh enclosures discussed earlier in this plan.

J. AGRICULTURAL DEVELOPMENT

The main problem in describing agriculture in Marsabit is lack of consistent statistics. The Government reports available from Marsabit are not very comprehensive and the variation from year to year is so large that one is led to suspect that the hectarages of the various crops presented are little more than guess estimates. They seem to depend as much on who is making the estimates as on actual changes in planting.

A further problem is that farming land has not yet been adjudicated and agriculture is now being practised on forest land in a very unplanned fashion.

Our *first main recommendation* is that all the agricultural land on Marsabit Mountain should be surveyed. This should include the mapping of present farmed areas, the various farm sizes, and potential sites. It should also include a description of present farming practices, soils, and potential for water development. On the basis of this survey, land should be adjudicated to individual families who should get title deeds. Optimal cropping patterns should also be recommended on the basis of the same.

The survey could be conducted by the IPAL land-use specialist in co-operation with the agricultural economist and field assistants.

Our *second main recommendation* is that more use of fungicides, insecticides, and fertilizers should be encouraged. Yields of the main crops are at present very low and could be greatly improved with increased intensification. This calls for more co-ordinated and more effective extension and input-supply services. The Marsabit Farmers' Co-operative Society, which has opened a store in Marsabit, should be encouraged to supply the farm inputs. The Ministry of Agriculture extension service should have a higher proportion of local Burji, Borana and Rendille speaking agents, and have housing provided on the work sites.

The *third main recommendation* in the development of an efficient marketing system for all the crops. This should consist of:

a. the establishment of an enclosed market at Marsabit where farmers can sell their products to townspeople every day;

b. the establishment of a posho mill capable of producing good quality maize meal. This could be owned by the Co-operative or by private people;

c. the maintenance of roads from all farming areas to Marsabit Town in good condition for ease of transportation. Farmers in Badasa, Songa, and Karare could be encouraged to own donkeys or bullock carts for transporting their produce to Marsabit.

The *fourth main recommendation* is that soil-conservation awareness among farmers must be increased. The extension service should promote cultivation practices that are conservation-oriented, and if necessary the administration should enforce the protection of threatened areas. Adjudication of land could be tied up with soil-conservation measures.

Finally, we note that the development of a dairy industry using high-yieding exotic cross breeds cattle seems to be feasible. Farmers should be encouraged to include a dairy enterprise among their activities. This should preferably be based on the use of agricultural waste and the planting of fodder crops for maintenance of contour lines. A large local market exists for milk, both at Marsabit town and in the trading centres of the lowlands. The marketing and distribution of milk would need the organization of a dairying co-operative. This could provide a cooling plant and the necessary transport facilities for collecting and distributing the milk.

Some more pilot work on the viability of small-holder dairying and its veterinary and fodder requirements, especially in drought periods, should be done before implementation, however. The introduction of dairy animals should also be on a small scale at first, expanding in scope as farmers get used to the higher management requirements of exotic breeds.

K. CONSERVATION OF FLORA AND FAUNA

The desert flora and fauna exhibit a number of adaptations to desert survival which serve as useful lessons to the people.

1. Objectives

- to conserve representative examples of the original flora and fauna of the area;
- to conserve rare and endangered desert species;
- to provide additional revenue for the Rendille people.

2. Representative Examples

Examples of the original flora and fauna existing in reserves are:

a. Marsabit National Reserve

This consists of the forested parts of Mt. Marsabit. It is important for forest conservation and water catchment, and is a dry-season area for elephant, rhinoceros (now rare), buffalo, kudu, giraffe, smaller antelope and also a few carnivores. It is not now viable for wildlife, since due to recent changes it no longer covers their home range.

The forest has not been subject to a detailed botanical survey but is known to contain at least five rare tree species (Synnott, 1979). It is extensively used for collecting firewood and building materials and in dry seasons by livestock. The marginal parts are affected by fire.

b. Losai National Reserve

This reserve is located along the southern boundary of the Rendille area. It stretches from Laisamis to Ilaut and along the Marsabit/Samburu District boundary to the Merille Lagga as far as Koiya and thence back to Laisamis.

It includes the large inselberg called Baig, which is capped by relic mist forest, and also isolated outliers of the Ndoto mountains, which may contain the cycad *Encephalartos tegulaneus*.

The Milgis lagga which passes through the area is an important wildlife and livestock concentration region. Wildlife species seen in the reserve are lion, cheetah, elephant, reticulated giraffe, oryx, Grevy's zebra, gerenuk and ostrich. Greater kudu probably occur on the isolated hills. Rhinoceros are suspected to occur but have not been seen recently. The rare stone partridge (*Ptilopachus petrosus*) occurs on these hills.

c. Mt. Kulal Biosphere Reserve

This reserve runs from the northern boundary of the scheme west to encompass the South Island in Lake Turkana and thence eastward, almost reaching the Balesa Kulal.

There is a core area which includes Mt. Kulal above approximately 1,500. The reserve is of particular interest, exhibiting within a very small area ecoclimatological zonation normally found in other parts of the arid zone over a much longer distance. This is due to a very steep rainfall gradient (Edwards et al., 1979). The vegetation of the mountain area is described by Synnott (1979) and Heppar and Jaegar (1982). At least one species of epiphytic orchid (*Polystachya* sp.) is indigenous to the forest and several new species of plant have been collected recently (Heppar and Jaegar, 1982).

The forest is particularly vulnerable at its northern, drier end to livestock utilization and fire hazard. Wildlife in the area includes lion, cheetah, rhinoceros (now rare), reticulated giraffe, oryx, Grevy's zebra, gerenuk, greater kudu, and ostrich. The adjacent Balesa Kulal is an important dry-season concentration area.

3. Recommendations

In order to create an awareness among the Rendille of the value of conservation of their flora and fauna:

3.1 Education

a. Create wildlife clubs in all schools in the area.
b. Include wildlife and environmental conservation in the adult-literacy programme
c Educate Government officers in the value of wildlife and environmental conservation in the area.

3.2 Law enforcement

It is essential that the law with regard to forest and wildlife conservation be enforced and that the officers entrusted with the task be given adequate powers to do so. Infringement of the law should be regarded as a very serious matter by the Government.

3.3 Status of the reserve

The following points are relevant:

a. Existing reserves require advertisement in English, Swahili and Rendille.

b. The Marsabit National Reserve boundaries should be redrawn to comprise the present situation with the old boundaries thereby encompassing the wet season dispersal area of elephant.

c. The Kulal forest reserve should be gazetted as an urgent priority.

3.4 Staff

Where possible Rendille and Samburu should be employed as law-enforcement officers and clerks. They should receive conservation training before beginning work.

The following points are recommended:

- Kulal: 2 x 2 Game Guards to be posted at Luai and Arabel and to commute regularly on patrol to Olturot; 2 x 2 Forest Guards to be posted at Gatab and Arabel
- Marsabit: Existing staff are probably adequate for conservation but require to give attention to discipline and duty in order to carry out effectively the role for which they are employed.
- Losai: 2 Forest Guards and 2 Game Guards should be posted at Ngurunit to patrol the western sector of the reserve, where poaching it common.

L. EDUCATION, TRAINING AND EXTENSION

The importance of the training and education component is a viable management plan for the area will be obvious from the discussion in Part I of this report. Here, specific objectives and recommendations are listed. It has seemed appropriate to include here detailed discussion and a number of examples of particular techniques and approaches that are well adapted for use in the area.

1. Objectives

a. The pastoral Rendille should be involved in their own educational programmes;

b. Extensive mobile extension services should be provided;

c. Extension workers among the pastoral Rendille should make extensive use of teaching aids and media, in order to increase the educational impact of their work;

d. A training centre for pastoralists should be built in Kargi, which would continue with the long-term education of the community.

2. Extension Work

Extension services in the Rendille area should have the following objectives:

a. to maintain direct contact with the Rendille pastoralists;

b. to help the pastoralists to develop an understanding of the management programmes, and thus predispose them to effective co-operation;

c. to teach them the need to conserve and rehabilitate their environment;

d. to gather and evaluate educational programmes.

The extension personnel should be local. Field assistants who have been trained on the job by IPAL in the woodlands, range livestock, hydrology and human ecology programmes, and who themselves come from the Rendille area, should be recruited. They should receive in-service training in adult-education and communication skills, group organization, problem-solving techniques, project activity planning and evaluation.

The extension work should be co-ordinated by the grazing scheme development organization. For example, extension workers whose duties are closely related and require extensive travelling can use the Mobile Educational Unit jointly.

Extension work should be organized on a continuous basis. Using the Mobile Educational Unit, workers should visit each manyatta, showing slides, films and posters and carrying out demonstration exercises and teaching. During such trips they should collect additional educational materials for future programmes and evaluate earlier ones.

The success of the extension programme will depend on the effectiveness and adequate planning of the methods to be used for teaching. It is recommended that the following approaches be considered by extension workers when teaching the Rendille pastoralists.

2.1. The talk-explanation method

This method can best be used when teaching a large crowd of elders and herders. Extension workers using this method should use the Rendille language. We offer here an example of how the method could be used when teaching about foot-and-mouth disease.

Objectives

The pastoralists should:

(i) be able to name some of the contagious livestock diseases;

(ii) be able to tell what traditional approaches they use in controlling the spread of these diseases;

(iii) realize the need to vaccinate their livestock against foot-and-mouth disease;

(iv) be ready to report the disease as soon as it has broken out and respect any quarantine that may be enforced;

(v) understand the cause of the disease.

Suitability of the method

This is one of the most suitable methods for teaching adults, since it provides many of the conditions under which adults learn best. Discussion gives opportunity for an adult participant to make use of his experience in contributing to the learning processes. It requires his action and response. It is usually relevant to his concerns and it gives him a feeling of success when he is able to make a contribution.

2.2 Teaching through demonstration

Some of the management recommendations to be proposed for acceptance will be quite new to local nomadic populations. To convince them that the recommendations made are workable and desirable, demonstrations are necessary. Two types of demonstrations should be exploited: active participatory demonstration and non-active participatory demonstration.

In the IPAL study area, for example, numerous vegetation exclosures have been constructed to demonstrate the recovery of natural vegetation. The recovery processes of vegetation observed in these exclosures were able to convince the Rendille nomads that their land can be rehabilitated if such exclusion centres are set up. This was a non-active participatory demonstration, since the people were not involved in setting up the exclosures. The use of bamboo bomas has been demonstrated by this method. Bamboo bomas used by IPAL livestock and others given to individuals have demonstrated to people using trees for building their enclosures that there is a practical alternative to their traditional practices. Its durability, in particular, has convinced many that bamboo can now be used as an alternative.

Active participatory demonstration, on the other hand, is that which involves both the demonstrator and the participants in the exercise. Learning will be derived from the results of the joint exercise. The results may be immediate or only observable in the long-term, e.g. the results of spraying livestock with acaricide. Teaching through demonstration can be carried out by extension workers or by any other persons knowledgeable about the subject being taught. Suitable topics for the method include:

- the use of veterinary drugs;
- livestock breeding;
- afforestation programmes;
- construction of bamboo and permanent stone-lava bomas;
- construction of wells and dams;
- soil rehabilitation programmes;
- harvesting gum arabic;

- treating and curing leather;
- cooking grain foods;
- handicrafts.

Teaching through demonstration will aim at:

- convincing the participants that recommendations made can work and that the results are repeatable;
- helping them to develop skills required for implementing the recommendations;
- helping them to use the skills so developed for teaching others.

In order to be fully effective, demonstration exercises should be repeated as many times as necessary. Local participants should always be encouraged to take part in them.

Demonstrators must particularly avoid making errors during demonstration and it is essential for them to be thoroughly familiar with all the steps of the demonstration beforehand.

The advantages and disadvantages of a procedure being demonstrated must be adequately explained, and so must any special care that may be required.

2.3 Group teaching

Group teaching will be an essential skill for all extension workers. It is useful for:

- dealing with small groups of people;
- helping people to identify their own educational needs;
- using groups to pass on educational messages to others.

Using this method, small groups of people can be taught by the use of posters, cassette recordings and slide or audio-visual shows.

a. Teaching small groups using slides (as example)

Slide shows can very suitably be carried out in *fora* or in a main manyatta during the evening hours when milking chores are finished.

Objectives

- to help nomads to realize the relationship between vegetation destruction and soil degradation processes;
- to help them to realize that in order to rehabilitate their areas they should first attend to the conservation of vegetation cover.

Evaluation

At the end of the slide show the extension worker could ask people questions on what they have seen and try to elicit a recognition that what has been shown in the slides is what is actually happening in their own areas of the range.

The use of slides is often difficult in such remote areas as the Rendille country. It may therefore be necessary to substitute posters.

Like slides, posters can be effectively shown to small groups of pastoralists either under trees or in the open during the day. The techniques of presentation are essentially the same.

b. Teaching groups of people, using cassette recordings

Cassette recorders have numerous advantages as a teaching tool. They can be used as an information gathering tool, e.g. for taping interviews, songs, drama, and discussions, to be used in future radio or cassette programmes. Second they can be used for transmitting educational messages to groups of people. This will require the careful preparation of lectures or speeches beforehand, to supplement or repeat popular radio programmes. They can also be used to get immediate feedback from group discussions. For example the whole of a discussion in a water and range committee can be put on tape and at the end the tapes played back for further discussion.

2.4 Public meetings as a method of teaching

Two types of public gathering are common in the IPAL study area, the administrative gathering often called a *baraza,* and traditional gatherings. Both kinds of gathering are attended by elders from all the manyattas in the area.

The possible objectives of the administrative *baraza* are:

- to disseminate administrative decisions made by higher authorities to the local people;
- to organize local people for public projects (e.g. the building of hospitals, schools, or waterpoints, the collecting of *harambee* funds);
- to solve security problems;
- to celebrate national or other days (e.g. literacy day, tree-planting days);
- to initiate campaigns (e.g. an adult literacy campaign in a district or location).

The administrative *baraza* has an important role to play in giving people an overview of educational or developmental programmes to be initiated in the near future. That is, it has a generally "informative" function. It also has legal powers to enforce certain programmes, as for example, the imposition of a quarantine for foot-and-mouth disease in areas where an outbreak has been reported. It is not, however, appropriate for teaching purposes because of way it is organized.

Traditional gatherings of the Rendille

The *naapo* gathering has already been described (in Part I). The possible educational role of the *naapo* assembly can be derived from its traditional functions. For example:

The *naapo* assembly could be used for teaching the management of water sources, where the objectives might be to help the Rendille nomads to organize a local water-management committee, and to help them understand the disadvantages of misusing water sources and to realize the need for boiling drinking water.

2.5 Mass Communication

The use of radio as a medium of communication with pastoral nomads has already been demonstrated by IPAL. The IPAL Rendille radio programmes, later rebroadcast in Borana for Borana and Gabra listeners, have gained such popularity in the study area and the rest of the District that there has been a public demand for their continuation. The problems remaining to be overcome are logistic.

Radio programmes that are also to serve as an extension service should have the following objectives:

- to acquaint the nomads with the management programme and help them to establish favourable relations with it;
- to explain the role of the range-development committees; this can be promoted by interviewing committee members to talk about their roles personally 'on the air';
- to provide an opportunity for further learning regarding climate and the pastoral life, soils, vegetation and land use, destructive impacts on tree resources, livestock marketing, livestock diseases and veterinary inputs.

Script writing and recording of the programmes should be undertaken by extension workers with the help of personnel from the Ministry of Information and the Voice of Kenya Rendille Service.

Each programme can then be evaluated in the field by extension workers.

3. Literacy Programme

As had already been shown, the present adult-literacy campaign has had little impact on the nomadic pastoralists of the district (Oba, 1981).

Based on the findings reported, it is recommended that each manyatta should be provided with an adult-literacy teacher. Such teachers need not have a very high level of education. Individuals who have completed primary education of even those who have dropped out of school at primary five or six would be adequate to teach people how to read and write.

It is estimated that 10 % of the Rendille children who attend school drop out before completing primary 7 (the terminal year). The majority of the boys opt for moranhood rather than continue with what they often see as a fruitless education. These children could be utilized full-time to teach others how to read and write. The Range Development Committee (or Co-operative), assisted by the Adult Literacy Office, could give them some monetary incentive to do such a job.

It is further recommended that the Range Development Committee should organize Rendille secondary and primary children to engage in teaching, reading and writing during their school holidays. Each child should be assigned to his own manyatta to teach adults basic literacy and arithmetic.

4. A Training Centre for the Pastoralists

Education for the pastoral Rendille can be most effectively organized through an institutionalized centre that directly involves them in their own educational programmes, with emphasis on the management of their resources.

Such a centre should be situated in Kargi, so as to serve all the areas of the Rendille Range Grazing Scheme, including the Gabra areas to the north in the future.

The centre should be sponsored initially by the organization that will implement the management plan and later taken over by the Ministry of Agriculture and Livestock Development through the Department of Range Development. This should form a long-term priority objective.

The centre should be organized on the same lines as the present Farmers' Training Centres that are found in the agricultural districts of the country, differing only in the subjects covered.

The centre for the pastoralists should have the following objectives:-

(i) to organize short seminars for the Range Development Committees and other pastoralists on resource management;

(ii) to co-ordinate the roles of local Range Development Committees with the extension workers and the Sub-District and District Development Committees;

(iii) to prepare, evaluate, and produce educational materials in the form of films, slides, tapes, radio programmes, posters, charts and reading materials for the extension programmes;

(iv) to prepare training courses for extension workers in leather curing, handicrafts, construction of bamboo bomas, tapping and harvesting of gum arabic, training veterinary personnel who will move with the nomads, first-aid, home economics, and trade.

4.1 Facilities

The training centre should have the following facilities:

(i) a dormitory block with a capacity for 30 people;

(ii) a multi-purpose hall serving as a lecture hall, dining hall and social hall;

(iii) kitchen and store;

(iv) workshop block, divided into a veterinary laboratory, leather workshop, and home-economics room;

(v) tannery block;

(vi) office block;

(vii) staff houses;

(viii) demonstration plots.

4.2 Staff establishment

(i) 1 domestic science demonstrator and an assistant;

(ii) 1 veterinary officer;

(iii) 1 administrator and his assistant;

(iv) 7 junior staff: 2 cooks, 1 attendant, 1 station-hand, 1 leather-curing artisan and 2 drivers;

(v) 2 teachers trained in adult education and communication skills and with skills in making posters, charts, and writing and reading materials.

(vi) 6 extension personnel trained in range education, public health, wildlife education, veterinary work, tannery techniques and craftsmanship.

4.3 Transport

(i) 1 mobile educational unit: a long-wheel-base landrover fitted with audio-visual aids, film projectors, a portable generator, slide projector, screen, public-address system and demonstration equipment, first-aid kit, veterinary clinic drugs and equipment;

(ii) 1 lorry to serve both the Training Centre and the 'Rendille Stores' that should be situated in Korr. The lorry will assist in transporting seminar participants and also in bringing provisions for the centre.

5. Range Development Committee

The direct participation of the Rendille nomads in education and development programmes in the grazing scheme should be seen as absolutely vital. Rendille elders and local leaders should be elected by the pastoralists to form Range Development Committees. The Committee should then be entrusted with supervising the implementation of programmes and grazing movements.

5.1 Objectives of the Range Development Committee

- to assist in the implementation of management programmes;
- to educate pastoralists on resource management, implementation priorities and range use;
- to assist extension workers in their field operations;
- to supervise development programmes and assist security programmes.

In order to be effective in the management roles the Range Development Committee members should be given short but frequent seminars at the Training Centre.

Seminars organized for the Range Development Committee and other pastoralists should aim at:

(i) acquainting groups with the management programmes;

(ii) demonstrating some of the recommendations made;

(iii) providing basic scientific information on factors causing land degradation;

(iv) stressing the need to increase public education on these and other problems.

Courses should be confined to one or two subjects or aspects of subjects which have been drawn up ahead of time by the extension agents and the Training Centre's staff according to the management programme priorities. Courses offered at the Training Centre should include:

- general environmental degradation;
- climate;
- soil degradation and rehabilitation;
- types of vegetation;
- range management;
- destructive impacts on vegetation of man and his livestock;
- conservation;
- water management and grazing regulations;
- livestock marketing;
- food and trade;
- veterinary input and livestock-disease education;
- development projects and implementation;
- home economics.

Each course or subject covered should have its own specific objectives attainable with reasonable success.

6. Formal Education

To increase the participation rate of Rendille children in education, boarding facilities should be expanded in the existing primary schools at Loglogo, Korr, Kargi, and Mt. Kulal, and a primary school opened at Ngurunit. Missionaries, who have played a most important role in education development in the area, should be strongly encouraged to continue with such programmes.

The Government should also consider the possibility of waiving boarding fees, as it had done for other school fees in the District. The utilization level of boarding facilities has been shown to be influenced by the fees paid (See Table 146 in the section on Education in Part I). Clearly, waiving education and boarding fees in these pastoral areas may be used as an incentive to increase participation rates. This has already been shown to work by the mission-sponsored schools.

There is, of course, a further advantage in having boarding facilities utilized. Some nomadic families have been in the habit of leaving households behind in the trading centres, from which their children can attend school. These households keep livestock at the centres for subsistence, and the presence of livestock all the year round in these places has contributed to the deterioration of the areas. Provision of such boarding facilities for all children will make it unnecessary for families to leave some of their livestock behind, and so should reduce the pressure on these degraded centres.

M. CONCLUSION

The accelerated degradation of the arid lands of northern Kenya is largely due to the implementation of unco-ordinated development activities that did not take into account the complex nature of the cause of the problem. The IPAL project has tried to reconcile these downward trends by a comprehensive programme of integrated research on all aspects of the ecosystem. These investigations have been synthesised to produce the resource management guidelines contained here. There is every reason to believe that, even at this seemingly late hour, the implementation of imaginative policies as suggested here would go far to remedy the present critical position. Since Kenya has no minerals or oil, the full potential of the land must be developed by every means. But development must take the form most suited to the prevailing circumstances and the purposes to which an area is best adapted.

Whatever the future of northern Kenya might be, it is conditional upon the degree of support derived from the people locally and the Government as a whole. In implementing this management plan, the most critical factor in the short-term is the timing of development operations. The important points are listed:

- This plan should be implemented as a pilot programme operated in collaboration with the Ministry of Agriculture and Livestock Development, which should co-ordinate all the activities described here although they involve co-operation from other Ministries also.
- No development should begin unless Government officials are confident that regular markets are operating well and will be able to continue operating without lengthy movement restrictions due to imposed quarantine.
- No water investments should take place unless officials are sure that the grazing programme can be implemented in practice.
- The uncontrolled expansion of livestock numbers beyond the recommended stocking rate for the district must not be permitted.
- No activity should be implemented without ensuring that there is adequate provision for the monitoring of its effects on the functioning of the whole system and how it contributes to the rehabilitation of the area.
- All the activities recommended here should be implemented together as they are related in the functioning of the whole system. Sectoral implementation will not improve the situation.

The critical nature of these factors is quite obvious, as is the damage that would occur should they be ignored.

The present stocking rate is generally lower than the recommended one and stock numbers are not expected to exceed the recommended levels. With a marketing system in operation the ideal stocking rates should be reached within a 5-15 year period.

REFERENCES

Beaman, A.W. 1981. The Rendille age-set systems in ethnographic context: adaptation and integration in a nomadic society. Unpublished Ph.D. dissertation. Boston University.

_____. 1983. Women's participation in the pastoral economy: income maximization among the Rendille. *Nomadic Peoples. 12.*

Blackburn, H. and C.R. Field. 1982. Mimeo. The performance of Somali blackhead sheep and Galla goats in Northern Kenya, Ministry of Livestock Development, Kenya.

Borgeson, R.H. 1981. A preliminary analysis of ground water from the Marsabit District, Northern Kenya. IPAL Technical Report B-2, UNESCO, Nairobi.

Bulliet, R. 1975. *The Camel and the Wheel.* Howard University Press, Cambridge, Mass.

Burger, S.W. and R.D. Beaumont. 1970. Sand storage dams for water conservation. Department of Water Affairs, Water for the Future Convention, Water Year 1970, Republic of South Africa.

Carles, A.B. 1980. A study of the recruitment rates in goats and the main factors affecting them. TLMP Draft Final Report.

_____. 1980. Productivity levels of the goat herd at Ngurunit. IPAL Technical Report A-3, UNESCO, Nairobi.

C.S.U. 1972. *Wildland Ecology Handbook.* C.S.U. Ft. Collins, Colorado, U.S.A.

Dahl, G. 1979. Suffering grass-subsistence and society of Waso, Borana. Stockholm Studies in Social Anthropology, 8. Stockholm.

Devitt, P. 1977. 'Coping with drought in Kalahari', in D. Dalby, R.J. Harrison Church and F. Bezzaz (eds.), *Drought in Africa.* International African Institute, London.

Di Castri, F. 1981. MAB: The Man and the Biosphere Programme as an Evolving System. *Ambio,* X : 2-30.

Dolan, Rosemary A. 1980. Migration patterns in the Rendille 1923-1978. IPAL Technical Report A-3, UNESCO, Nairobi.

Eckholm, E.P. 1982. *Down to Earth: Environment and Human Needs.* International Institute for Environment and Development. Pluto Press, London.

Edwards, K.A., C.R. Field and I. Hogg. 1979. A preliminary analysis of climatological data from the Marsabit District of northern Kenya. IPAL Technical Report B-1, UNESCO, Nairobi.

F.A.O. 1960. Rural tanning techniques. Agricultural Development Paper 68, Rome.

F.A.O. 1971. Range development in Marsabit District. AGP SF/Ken 11. Working Paper 9, Nairobi.

Field, A.C. 1978a. ODM-IPAL Sheep and Goats Project, preliminary report on the impact of sheep and goats on the vegetation in the arid zone of northern Kenya. IPAL Technical Report B-2, UNESCO, Nairobi.

_____. 1978b. The food habits of camels in northern Kenya. IPAL Technical Report E-1b, UNESCO, Nairobi.

_____. 1979a. Preliminary report on ecology and management of camels, sheep and goats in northern Kenya. IPAL Technical Report E-1a, UNESCO, Nairobi.

_____. 1979b. Camel growth and milk production in Marsabit District, northern Kenya. IFS Workshop on Camels, Khartoum, Sudan.

_____. 1980. A summary of livestock studies in the Mt. Kulal area. IPAL Technical Report A-3, UNESCO, Nairobi.

_____. 1981a. Minutes of the UNESCO-IPAL International Scientific Seminar, August 1981.

Field, A.C. 1981b. An introduction to the IPAL livestock programme. IPAL Technical Report A-5, UNESCO, Nairobi.

_____. 1981c. The IPAL Cattle Applied Research Programme. IPAL Technical Report A-5, UNESCO, Nairobi.

_____. 1982. The smallstock programme of the UNESCO Integrated Project in Arid Lands. A summary of work carried out between 1976 and 1982. In Proceedings of the Small Ruminant CRSP Workshop, Naivasha, Kenya.

Field, A.C., H.F. Lamprey, S.M. Masheti and G. Norton-Griffiths. 1981. Household, livestock and wildlife numbers and distribution in Marsabit District. 1, population size, densities and habitat selection of fixed environmental variables. IPAL Technical Report A-5, UNESCO, Nairobi.

Government of Kenya. 1976-81. District Agricultural Officers' *Annual Reports*. Government Printer, Nairobi.

_____. 1980. *District Development Plan, 1979-83,* Marsabit District. Government Printer, Nairobi.

_____. 1981. *Kenya Population Census* 1979, Volume 1. Central Bureau of Statistics, Ministry of Economic Planning and Development. Nairobi, Government Printer.

_____. 1983. Report on Loiengalani Fisheries Project, September 1981 - May 1983. Ministry of Tourism and Wildlife, Fisheries Department. Government Printer, Nairobi.

Gulliver, P.H. 1975. 'Nomadic Movements: Causes and Implications', in T. Monod (ed.), *Pastoralism in Tropical Africa,* Oxford University Press, London.

Hepper, F.N., P.M. Jaeger, J.B. Gillett, and M.G. Gilbert. 1982. Annotated checklist of plants of Mount Kulal, Kenya. IPAL Technical Report D-3, UNESCO, Nairobi.

Herlocker D. 1979. Implementing forestry programmes for local community development, South-Western Marsabit District, Kenya. IPAL Technical Report D-2a, UNESCO, Nairobi.

ILCA. 1980. Pastoral development projects. IPAL Technical Report F-1, UNESCO, Nairobi.

Kayongo-Male, H. and C.R. Field 1981. Feed quality and utilization by cattle grazing natural pasture in the range areas of northern Kenya. IPAL Technical Report A-5, UNESCO, Nairobi.

Lamprey H.F. and H. Yussuf. 1981. Pastoralism and desert encroachment in northern Kenya. *Ambio*, X: 131-134.

Lele, U. 1975. *The Design of Rural Development : Lesson from Africa*. The Johns Hopkins University Press, Baltimore and London.

Lewis, H.G. 1977. Report on a short-term consultancy on the grazing ecosystem in the Mt. Kulal region, northern Kenya. IPAL Technical Report B-3, UNESCO, Nairobi.

Lewis, I.M. 1961. *A Pastoral Democracy*. Oxford University Press, London.

Lusigi, W.J. (ed.) 1980. Proceedings of a Scientific Seminar, Nairobi, 24-27 November 1980. IPAL Technical Report A-3, UNESCO, Nairobi.

_____. 1981. Combating desertification and rehabilitating degraded systems in northern Kenya. IPAL Technical Report A-4, UNESCO, Nairobi.

_____. 1983. Proceedings of the IPAL Scientific Seminar. IPAL Technical Report A-5, UNESCO, Nairobi.

Mburugu, E.K. 1983. Factors related to stock ownership and population movements and perception of land pressure and other environmental changes among the Rendille in Marsabit District. IPAL Technical Report F-2, UNESCO, Nairobi.

Meadows, S.J. and J.M. White. 1979. Structure of the cattle herd and determinants of offtake rates in Kajiado District in Kenya. 1962-1977. Mimeo. Nairobi.

Mentis, M.T. 1970. Estimates of natural biomass of large herbivores in Umfolozi Game Reserve area. *Mammalia,* 34:363-393.

Meyn, K. 1970. *Beef Production in East Africa.* I.F.O Munich.

Monod, T. (ed.) 1975. *Pastoralism in Tropical Africa.* Oxford University Press, London.

Moulton, J.E. (ed.) 1968. *Tumours of Domestic Animals* (2nd edn.). University of California Press, Berkeley.

Mubia, E.W. 1981. Preliminary report on a nutrition and health survey of the pastoralists in the IPAL Study Area, Marsabit District. IPAL, Nairobi.

Njiru, G.K. 1982a. The Rendille economy: Some preliminary findings on trading activities. Institute of Development Studies Working Paper 389, Nairobi.

_____. 1982b. Monetary flow through a pastoral economy: Some preliminary observations on income and expenditure patterns of Rendille pastoralists. Mimeographed report presented to IPAL, April 1982.

Oba, G. 1982. Environmental education for nomadic pastoralists: an important input for the management of the arid areas of northern Kenya. Mimeographed report presented to IPAL, Nairobi.

Omara-Opyene, A.L. 1981a. *Cryosurgery and immunotherapy of squamous cell carcinoma in cattle.* (Thesis, University of Nairobi.)

_____. 1982b. A preliminary report on diseases as constraints to production in cattle within the IPAL Study Area. Paper presented to the IPAL Orientation Seminar, November 1983, Nairobi.

Rutagwenda, T. 1981. An attempt to introduce a comprehensive disease control package on specific diseases of camels and evaluation of the control on camel productivity in Ngurunit, Marsabit District, Northern Kenya. IPAL Technical Report A-5, UNESCO, Nairobi.

Said, A.N. 1980. Goat nutrition. IPAL Technical Report A-3, UNESCO, Nairobi.

Said, A.N. and H.J. Schwartz. 1981. Progress report on the nutrition studies on goats and camels and preliminary results of the studies in goat nutrition. IPAL Technical Report A-5, UNESCO, Nairobi.

Salzman, P.C. 1967. Political organization among nomadic peoples. *Proceedings of American Philosophical Society*, 111: 115-131.

Sato, S. 1980. Pastoral movement and the subsistence unit of the Rendille of northern Kenya with special reference to camel ecology . *Africa*, Series 2, Ethnological Studies 6.

Schwartz, H.J. 1979. The role of the camel as a transport animal in the pastoral economy of the Rendille of Marsabit District, Kenya. IFS Workshop on Camels, Khartoum, Sudan.

_____. 1980a. Productivity of domestic stock in S. Western Marsabit District, in *Draft Final Report, TLMP*.

_____. 1980b. An introduction to the livestock ecology programme. IPAL Technical Report A-3, UNESCO, Nairobi.

Shanan, L. and N.H. Tedmore. 1979. *Micro-catchments for Arid Zone Development*. Centre of International Agriculture, Rehovot, Israel.

Simpkin, S.P. 1981. Preliminary report on camel production. IPAL Technical Report A-5, UNESCO, Nairobi.

Smith, P.D. and W.R.S. Critchley. (In press.) The potential of runoff harvesting for crop production and range rehabilitation in semi-arid Baringo. Soil and Water Conservation Workshop, Faculty of Agriculture, Rehovot, Israel.

Sobania, N.W. 1979. Background history of the Mt. Kulal region of Kenya. IPAL Technical Report A-2, UNESCO, Nairobi.

Spencer, P. 1973. *Nomads in Alliance : Symbiosis and Growth Among the Rendille and Samburu of Kenya*. Oxford University Press, London.

Synott, T.J. 1979a. A report on the status, importance and protection of the montane forests. IPAL Technical Report D-2a, UNESCO, Nairobi.

_____. 1979b. A report on prospects, problems and proposals for tree planting. IPAL Technical Report D-2c, UNESCO, Nairobi.

_____. 1976c. A manual of permanent plant procedures for tropical rainfall. Commonwealth Institute of Tropical Forestry, Paper No. 14. Oxford.

Trojonow, M. 1982. Water conservation activities in arid and semi-arid zones of Kenya. Soil and Water Conservation Workshop, Faculty of Agriculture, University of Nairobi, 3-5 March 1982.

U.S.A.I.D. 1979. Report of the Workshop on Pastoralism and African Livestock, Harpers Ferry, West Virginia, September 1979.

U.S.D.A. 1972. *Range Analysis Handbook. Region 2.* U.S.D.A.

Van Kekem, A.J. (in press.) A reconnaissance soil survey of the Kulal area. Report of the Kenya Soil Survey. National Laboratories, Ministry of Agriculture, Nairobi.

Vallentine, J.F. 1971. *Range development and improvements.* Provo. UTAL.

Wilson, A., R.A. Dolan and W.M. Ohahu. 1981. Important camel diseases in selected areas in Kenya. IPAL Technical Report E-6, UNESCO, Nairobi.

Wipplinger, O. 1958. The storage of water and sand. South West Africa Administration, Water Affairs Branch, Windhoek.

Wood, A.D. and E.V. Richardson. 1975. Design of small water storage and erosion control dams. Department of Civil Engineering, Colorado State University, Fort Collins, U.S.A.

Printed by Man Graphics Ltd.
P.O. Box 12714 Nairobi

A LIST OF IPAL PUBLICATIONS

Adu Bobie, G.J. (1983). The Role of Rendille Women. *IPAL Technical Report F—2,* Unesco, Nairobi.

Allen, I.A. (1983). Report of a Consultancy in Education and Training. *IPAL Technical Report F—1,* Unesco, Nairobi.

Ayiemba, E.H.O. (1983). Human Ecology: A Study of Environmental Perception and Modes of Survival among the Samburu in Kenya. *IPAL Technical Report F—2,* Unesco, Nairobi.

Baur, P.J. (1983). Report on a Short Term Consultancy on Water Development in some part of Marsabit District, Northern Kenya. *IPAL Technical Report B—2,* Unesco, Nairobi.

Borgeson, R.H. (1983). A Preliminary Analysis of Ground-Water Data from the Marsabit District of Northern Kenya. *IPAL Technical Report B—2,* Unesco, Nairobi.

Edwards, K.A., C.R. Field and I.G.G. Hogg (1979). A Preliminary Analysis of Climatological Data from the Marsabit District of Northern Kenya. *IPAL Technical Report B—1,* Unesco, Kenya.

Field, A.C. (1978). ODM — IPAL Sheep and Goats Project Preliminary Report on the Impact of Sheep and Goats on the Vegetation in the Arid Zone of Northern Kenya. *IPAL Technical Report E—2,* Unesco, Nairobi.

Field, C.R. (1979). Preliminary Report on Ecology and Management of Camels, Sheep and Goats in Northern Kenya. *IPAL Technical Report E—1a,* Unesco, Nairobi.

Gernot, B. (1983). An Analysis of Climatological Data from the Marsabit District of Northern Kenya. *IPAL Technical Report B-3,* Unesco, Nairobi.

Hepper, F.N., P.M.L. Jaeger, J.B. Gillett and M.G. Gilbert (1981). Annotated Check-list of the Plants of Mount Kulal, Kenya. *IPAL Technical Report D—3,* Unesco, Nairobi.

Herlocker, D.J. (1979). Vegetation of Southwestern Marsabit District, Kenya. *IPAL Technical Report D—1,* Unesco, Nairobi.

Kokwaro, J.O. and D.J. Herlocker (1982). A Check-list of Botanical, Samburu and Rendille Names of Plants of the "IPAL" Study Area, Marsabit District, Kenya. *IPAL Technical Report D—4,* Unesco, Nairobi.

Kruuk, H. (1980). The Effects of Large Carnivores on Livestock and Animal Husbandry in Marsabit District, Kenya. *IPAL Technical Report E—4,* Unesco, Nairobi.

Lewis, J.G. (1977). Report of a Short-term Consultancy on the Grazing Ecosystem in the Mt. Kulal Region, Northern Kenya. *IPAL Technical Report E—3,* Unesco, Nairobi.

Lusigi, W.J. (1980). ED. Proceedings of a Scientific Seminar Nairobi 24—27 November 1980. *IPAL Technical Report A—3,* Unesco, Nairobi.

Lusigi, W.J. (1981). Combatting Desertification and Rehabilitation Degraded Production Systems in Northern Kenya. *IPAL Technical Report A—4,* Unesco, Nairobi.

Lusigi, W.J. (1983). ED. Proceedings of the IPAL Scientific Seminar Nairobi, 1—2 December 1981. *IPAL Technical Report A—5,* Unesco, Nairobi.

Martin, G.H.G., J.J. Opiyo and P. Simpkin (1981). Small Mammals of the Arid Savanna and Two Montane Sites in Northern Kenya. *IPAL Technical Report E—5,* Unesco, Nairobi.

Mburugu, E.K. (1983). Factors Related to Stock Ownership and Population Movements; and Perception of Land Pressure and Other Environmental Changes among the Rendille in Marsabit District. *IPAL Technical Report F—2,* Unesco, Nairobi.

Ndombi, J.M. (1983). Report of Feasibility Studies for Ground-Water Development in the UNESCO/IPAL Study Area, Marsabit, Northern Kenya. *IPAL Technical Report B—2,* Unesco, Nairobi.

Okelo, R.O. (1981). Some acridids of Arid and Semi-Arid Southwestern Marsabit District, Northern Kenya. *IPAL Technical Report E—5,* Unesco, Nairobi.

Ongweny, S.G. (1983). A Preliminary Account of Erosion, Sediment Transport and Surface-Water Resources of Parts of Marsabit District. *IPAL Technical Report B—2,* Unesco, Nairobi.

Sobania, N.W. (1979). Background History of the Mt. Kulal Region of Kenya. *IPAL Technical Report A—2,* Unesco, Nairobi.

Synott, T.J. (1979). A Report on the Status, Importance and Protection of the Montane Forests. *IPAL Technical Report D—2a,* Unesco, Nairobi.

Wilson, A.J., Rosemary Dolan and W. Mukani Olahu (1981). Important Camel Diseases in Selected Areas in Kenya. *IPAL Technical Report E—6,* Unesco, Nairobi.